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An extension of the job demands-resources (JD-R) model**

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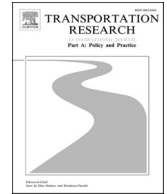
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# Transportation Research Part A

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## Factors influencing road safety compliance among food delivery riders: An extension of the job demands-resources (JD-R) model

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### ABSTRACT

On-demand food delivery involves transport services based on gig-economy models. Food delivery services rely on motorcycles in many jurisdictions, resulting in safety risks. Motorcycles are generally two-wheeled and therefore inherently unstable. They also lack rider restraint or roll cage to minimise the consequences of a collision. Given the risks of motorcycle food delivery, there is a need to understand how job design may influence safety behaviour on the roads and regulate this economic activity to minimise potential harmful health consequences on the riders. This study investigated the impact of job demands and resources on food delivery riders' compliance with road safety regulations. The job demands-resources (JD-R) model was used as the theoretical framework for this research. Data were collected using a cross-sectional design involving 550 motorcycle delivery riders in two megacities in Vietnam. A structural equation analysis indicated that job demands (e.g., time pressure, work/life imbalance, working environment) and job resources (e.g., social support, feedback) influence, directly and indirectly, job strain, risk-taking attitude, and road safety compliance. Control variables such as age, gender, and income also influenced road safety compliance. This study has critical implications for the food delivery industry that can help achieve sustainable development goals in the global south.

### 1. Introduction

Food delivery is the last step of an online-to-offline transport service. The customer generally initiates the service using an app- or website-based platform to select food/groceries to be delivered. The order is then prepared, packed and delivered within a period that is often transparent to the customer. Delivery riding jobs are attracting numerous new riders in urban settings worldwide. For example,

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Meituan, one of the largest domestic third-party delivery platforms in China- the leading market for online food purchasing- employed over 0.5 million riders by 2017. This figure keeps rising (China Daily, 2018). According to Statista Reports (2018), the annual growth rate of the online food delivery sector is 9.5 %, and the value of this sector will reach 145.3 billion USD in 2023. Online food delivery brands are increasingly common worldwide, e.g., Zomato is in nearly 25 countries, UberEats in over 1,000 major cities worldwide, Deliveroo in over 200 cities, and Just Eat covers over 82,000 restaurants (Singh, 2021). Additionally, well-known restaurant chains (e.g., Domino's Pizza, KFC, and McDonald's) and smaller/local ones have dedicated delivery teams to transport their products using similar app-based schemes (Li et al., 2020). During the COVID-19 pandemic, food delivery services grew in popularity compared to in-person food services due to lockdowns and social distancing practices (Gao et al., 2020, Nguyen et al., 2021). Food delivery is undoubtedly becoming a prominent service in the road traffic environment, highlighting the need to manage the road safety risks of this economic activity.

The remarkable growth of food delivery services has resulted in serious concerns due to significant accounts of crashes and risky behaviours among delivery riders. Regarding crashes, a study conducted in Nanjing (China) reported that in the first half of 2019, 3,357 crashes involving food delivery riders resulted in 2,584 injuries and three fatalities (Li et al., 2020). In early 2017, a study in Shanghai (China) reported that, on average, a delivery rider is fatally injured every 2.5 days due to road crashes (Zheng et al., 2019). Regarding risky behaviours, delivery riders are often reported to have poor adherence to road rules. Empirical evidence from Beijing and Suzhou (China) showed that the ratios of risky driving behaviours at intersections for delivery riders are significantly higher than those for private riders (Qin et al., 2021, Yang et al., 2014). Food delivery riding is a risky economic activity in urgent need of research on the factors influencing its safety outcomes. This information can support advocacy for safer work conditions and evidence-based policy development.

The poor safety outcomes of delivery riders are often accompanied by poor working conditions and well-being (Byun et al., 2017, Qin et al., 2021, Zheng et al., 2019). For instance, a study based in Shanghai and Nanjing (China) with 824 delivery riders found that riders have long working days of 9.1 h on average. Only 22 % reported taking at least one rest day, while over 35 % worked over 10 h daily, resulting in high fatigue and stress levels (Zheng et al., 2019). In Athens (Greece), approximately 64 % of delivery riders reported not having crash insurance, and about 74 % declared that their employers do not take notice of protective behaviours such as helmet wearing (Papakostopoulos and Nathanael, 2021). In South Korea, an analysis of the national compensation records found that riders making in-house delivery for small restaurants are likelier to use a poorly maintained motorcycle and lack adequate protective equipment (Byun et al., 2020). In Australia, a qualitative study reported that delivery riders often earned below the national minimum wage for casual employment and denounced frequent safety-critical situations on the road such as crashes and near-misses (Goods et al., 2019). Thus, it is also crucial to consider that delivery riders are at the crossroad of poor working conditions and the risks associated with being a vulnerable road user.

Previous studies have focused on factors determining specific risky driving behaviours of food delivery riders (e.g., using a mobile phone when riding, red-light running, non-use of a helmet, and running on motor lanes) (Zhang et al., 2020a, Papakostopoulos and Nathanael, 2021, Qin et al., 2021) and the characteristics of the crashes (Byun et al., 2017, da Silva et al., 2012). Recent research has studied the impact of the delivery process and working conditions on risky behaviours on the road. For example, Galiere (2020) has reported that the pressure to reduce downtime assigned by the platforms can be associated with risky behaviours such as red-light running or selecting dangerous travel speeds. Llamazares et al. (2021) also pointed out that specific factors linked to the job design (e.g., time pressure and fatigue) contributed to commuting crashes among professional drivers. Generally, there is an agreement that work experiences can impact workers' on-road behaviour even after the workday has finished (Costantini et al., 2022). Notwithstanding, no study has systematically researched how work-related factors are associated with adherence to road safety regulations among delivery riders. Another shortcoming of the existing studies is the lack of a comprehensive work-specific theory to guide the analyses. Most prior authors have applied ad-hoc methods to account for the working conditions when investigating riders' behaviours (Papakostopoulos and Nathanael, 2021, Qin et al., 2021), i.e., using variables such as riders' age, riding experience or work experience. Consequently, the interrelationships between unobserved (latent) factors such as work experiences and their effects on riding behaviours are largely unknown.

To fill this gap, the present investigation explores the determinants of road safety compliance among food delivery riders in two megacities of the global south. Specifically, Partial Least Squares Structural Equation Modeling (PLS-SEM) is used to test hypotheses representing an extension of the job demands-resources (JD-R) model considering the effects of socio-demographic characteristics as control variables. The study context is Hanoi and Hochiminh City, which are the two largest cities in Vietnam (Huynh, 2019, Pojani and Stead, 2015). Both cities have witnessed rapid growth in the food delivery market with prominent platforms such as Now's, GrabFood, Goviet, and Beamin. GrabFood, the most popular platform, serves around 68 % of orders in Hanoi and Hochiminh City and 300,000 orders per day (VietnamCredit, 2020). The JD-R model, proposed by Demerouti et al. (2001), has become one of the most significant stress and motivation models used in work and organizational psychology research when holistic approaches to job design are needed (Berthelsen et al., 2018, Schaufeli and Taris, 2014). To the best of our knowledge, there has been no research on delivery riders' on-road behaviours employing the JD-R model. This study will examine the interrelationship among original JD-R constructs (i.e., job demand, job resource, job strain), risk-taking attitude and road safety compliance. The results contribute to a better understanding of factors affecting the delivery riders' adherence to safety regulations. We also want to highlight that a critical contribution of this paper is that it offers comprehensive information on delivery riders' safety from an under-explored region. The literature on delivery riders' driving behaviours has been dominated by research conducted in high- and middle-income countries such as South Korea, China, and Greece. Studies from low-middle income countries, where the traffic flow is dominated by motorcycles, are less common (Byun et al., 2020, Zheng et al., 2019).

## 2. Theoretical background

### 2.1. Job demands-resources (JD-R) model

According to the JD-R model, working conditions are a function of two factors (Demerouti et al., 2001): job demands and resources. The ‘Job demands’ aspect is defined as the “physical, social, or organizational aspects of the job that require sustained physical or mental effort and are therefore associated with certain physiological and psychological costs (e.g., exhaustion)” (Demerouti et al., 2001). When job demands are poorly designed to the point that employees cannot meet such demands, employees can experience burnout, stress, or harmful behaviours in the workplace (Meijman and Mulder, 1998). The ‘job resources’ aspect is conceptualized as the physical, psychological, social, or organizational characteristics of the job that can (1) assist in attaining occupational goals; (2) decrease job demands and (3) promote self-development (Demerouti et al., 2001). These resources help employees to meet their job demands and protect other resources (Bakker and Demerouti, 2007).

The JD-R model argues that demands and resources interact with the well-being and motivation of the employees (Bakker and Demerouti, 2007). As explained in the previous paragraph, uncontrolled job demands have the potential to result in the exhaustion of physical and cognitive resources resulting in burnout, whilst job resources are a protective factor linked with increased work engagement and outstanding performance (Demerouti et al., 2000, Bakker and Demerouti, 2007). As a result, the JD-R model can explain workers’ psychological states from positive and negative perspectives associated with work engagement and work-related strain, respectively (Schaufeli and Taris, 2014). Engaged employees “have a sense of energetic and effective connection with their work activities, and they see themselves as able to deal well with the demands of their job” (Schaufeli et al., 2008). In contrast, job strain, the erosion of engagement, refers to work-originated long-term exhaustion that gradually diminishes employee interest in their work (Schaufeli and Bakker, 2004, Leiter and Arnold, 2014). Workers in transport sectors typically encounter many stressors that undermine mental health and, in turn, have a detrimental impact on safety outcomes (Meng et al., 2015, Li et al., 2019, Wang et al., 2019). For example, motorcyclists have to be directly exposed to weather conditions while manipulating their vehicles continuously (Truong et al., 2020), so the incidence of fatigue is significantly higher among motorcycle riders than among drivers of other transport modes (Balasubramanian and Jagannath, 2014). We can also talk about how motorcycle riders have less protection in case of a crash and are directly exposed to air pollution.

Although not in the case of food delivery, the JD-R theory has been successfully applied to other transport services (Nahrgang et al., 2011). For example, by surveying transport employees, Demerouti et al. (2001) identified physical environment and shift-work schedule as the two most significant dimensions of job demands. Other studies considered time pressure/work overload and work-life conflict as the primary job demands encountered by employees (Hansez and Chmiel, 2010, Andrei et al., 2020, Bronkhorst, 2015). Chen and Chen (2014) concluded that workload and emotional demands were determinants of job demands among aircrews. Furthermore, existing studies have empirically tested the effect of some specific aspects of job demands on safety behaviour. Wei et al. (2016), Chu et al. (2020) explored the relationship between work-home conflict and high-speed railway drivers’ willingness to show proactive safety behaviours. Similarly, Husain et al. (2019) identified that emotional demands are the primary factor making taxi drivers neglect safety compliance. Arguably food delivery riders experience similar circumstances; they are assigned a limited time for each order and penalized for delayed deliveries (Zheng et al., 2019). Also, the work can require riders to ride in extreme weather, bad road conditions, and long working hours. All these factors can increase stress and prevent riders from spending quality time with their family and personal interests, leading to a degradation of their quality of life. Following previous research, the present study considered time pressure, work-life imbalance, and working environment as the key indicators of food delivery riders’ job demands. Until recently, previous research by Zheng et al. (2019) has suggested a direct relationship between time pressure and job demands. This study provides a more comprehensive examination of job demands in the context of food delivery riders and their influence on riders’ risky behaviours. Arguably, the delivery demands on top of the road-specific demands of being a motorcycle rider intersect to create the job demands of food delivery riders.

Regarding job resources, various job attributes play intrinsic and extrinsic motivational roles for employees. The convenience of food delivery applications allows food delivery riders to receive feedback easily and quickly from customers. Indeed, feedback was found to be the main factor representing job resources of workers in transport operations (Demerouti et al., 2001), which has also been confirmed in general human resources research (Dijkhuizen et al., 2016, Salanova and Schaufeli, 2008). Concerning communication between supervisors and employees, constructive feedback also helps employees to do their work more effectively (Bakker et al., 2005). Based on this, we hypothesize that performance feedback may advance food delivery riders’ understanding of customers’ demands and generate motivation to improve their performance in the next deliveries. Moreover, job resources in safety-critical occupations were associated with social support (i.e., organization, supervisors, and coworkers) (Hansez and Chmiel, 2010, Andrei et al., 2020, Bronkhorst, 2015), which creates a safe climate in the workplace. Safety climate is not only reflected through organizational policies, investments, practices, and procedures (Zohar, 2000) but also in worker-to-worker communication concerning the value of psychosocial health and workplace safety (Dollard et al., 2012, Hall et al., 2013, Nielsen et al., 2011). Correspondingly, this study considered coworker support as a protective factor of risky riding behaviour. To conclude, feedback, organizational support, and coworker support were used to evaluate food delivery riders’ job resources.

### 2.2. Risk-taking attitudes

Attitudes term refers to “tendencies to evaluate an entity with some degree of favour or disfavour, ordinarily expressed in cognitive, affective and behavioural responses” (Eagly & Chaiken, 1993). Accordingly, this study conceptualises risk-taking attitudes as a rider’

preference for participating in risky riding activities when in control of a vehicle. Workers tend to adopt unsafe practices if the perceived benefits of risk-taking action outweigh the potential costs (e.g., the possibility of injury) (Mullen, 2004). Notably, food delivery riders may rush to complete as many orders as possible since it improves their wages, even if this decision increases the risk of crashing (Goods et al., 2019).

In the transport literature, the theory of reasoned action (Ajzen and Fishbein, 1975) and the theory of planned behaviour (TPB) (Ajzen, 1991, Ajzen, 1985) are the most widely-used models to investigate the impact of attitudes on dangerous on road actions such as speeding, following too closely, jumping traffic lights, and aggressive overtaking (e.g., Åberg, 1993, Parker et al., 1992). Attitudes were often found to be the most influential factor among the three TPB examined variables (i.e., subjective norms, perceived behavioural control, and attitudes) in predicting drivers' behavioural intentions in the TPB model (Chen and Yan, 2019, Rowe et al., 2016, Poulter et al., 2008).

At the practical level, the impact of risk-taking attitudes on travel behaviour studies has been proven by numerous studies (de Palma and Picard, 2005, Hensher et al., 2011, Li et al., 2012) and risky behaviours among a wide range of road users such as pedestrians, car drivers, motorcycle riders (Oviedo-Trespalacios et al., 2021, Nguyen-Phuoc et al., 2020d, Oviedo-Trespalacios et al., 2020). In previous studies, risk-taking attitudes in driving were described by several indicators such as attitude toward rule violations and speeding, and attitude towards the careless driving of others (Iversen, 2004, Endriulaitienė et al., 2018). Generally, people reporting favourable attitudes towards risk-taking are more likely to engage in risky behaviours.

### 2.3. Road safety compliance

Safety compliance is defined as adhering to safety regulations and procedures (Neal et al., 2000, Clarke, 2013). Safety regulations and procedures are the traffic rules in the road traffic environment. In previous research, road safety compliance among commercial riders has been judged in terms of helmet usage, *retro*-reflector jacket usage, valid riding license, mobile phone use while riding, alcohol-impaired riding, and carrying one passenger per time (Ndagire et al., 2019, Olumide and Owoaje, 2015, Nguyen-Phuoc et al., 2020c). According to a study about delivery riders in China, the most common violations were identified as mobile phone usage, lane deviation, speeding, riding against the direction of traffic, and red lights running (Zheng et al., 2019). Although penalties (e.g., written or verbal warning, fines, or arrest) are imposed by governments to improve riders' compliance with road rules (Southgate and Mirrlees-Black, 1991, Zaal, 1994, Rusli et al., 2020, Oviedo-Trespalacios, 2018), the impact of these measures has shown limited effectiveness in Vietnam (Nguyen-Phuoc et al., 2020d, Nguyen-Phuoc et al., 2020b). The role of food delivery companies in risky riding prevention has been lacklustre, even though they directly influence these behaviours. Therefore, there is a need to understand what factors influence road safety compliance among food delivery riders beyond current legal aspects.

## 3. Hypothesis development

### 3.1. Job demands

One of the essential assumptions in the JD-R model is that workers can experience strain when job demands are unmanageable and when job resources are insufficient (Bakker et al., 2004). Job strain is an undesirable outcome, as it can lead to chronic exhaustion and psychological detachment from work (Bakker and Costa, 2014). In the transport context, previous research has examined the role of job demands and their consequences in terms of employees' fatigue. For instance, Crizzle et al. (2020) discovered that diminishing occupational demand could lower the frequency of depressive symptoms among long-haul truck drivers. This result was in line with research on seafarers (Shan and Neis, 2020), and taxi drivers (Husain et al., 2019, Friswell and Williamson, 2008, Useche et al., 2019). Additionally, personnel has increased risk-taking attitudes when facing multiple job demands such as work overload (Sandhåland et al., 2017, Santos et al., 2019), time pressure (Cœugnet et al., 2013), or physical demands (Demerouti et al., 2009). It has been well established that time pressure increases drivers' willingness to engage in risky behaviours, e.g., abrupt and aggressive application of brakes and speeding (Pawar et al., 2020, Zhang et al., 2020b, Zheng et al., 2019). With regards to the influence of job demands on safety compliance, Lawton (1998) determined that time pressure and high workload were two major demands that led to railway workers' non-compliance with safety regulations. Apart from transport services (Chu et al., 2020, Chen and Chen, 2014), the association between job demands and safety compliance has also been affirmed in other industries such as gas and oil production (Kvalheim and Dahl, 2016, Li et al., 2013) and construction (Goldenhar et al., 2003, Jung et al., 2020). Hence, the job demands-related hypotheses are stated in the context of food delivery services as below:

H1: Job demands have a direct and positive impact on job strain.

H2: Job demands have a direct and positive impact on risk-taking attitudes.

H3: Job demands have a direct and negative impact on road safety compliance.

### 3.2. Job resources

By following the JD-R model, the present investigation presumes that food delivery riders' job resources can ease job strain on participants. Previous research has verified that social support and safety climate can reduce work-related driving fatigue (Strahan et al., 2008, Nahrgang et al., 2011). The occupational psychology literature has shown that emotional exhaustion could be reduced when employees possess certain job resources such as physical and emotional resources (Van Den Tooren and De Jonge, 2008), social support (Brough et al., 2013) and feedback and task variety (Hakanen et al., 2008, Van Ruyseveldt et al., 2011).

Although the relationship between job resources and risk-taking attitudes has not yet been investigated for professional drivers, one can argue that peer support and peer norms are contributing factors. Emerging research has shown that delivery riders have a sense of community, as evidenced by their growing organizing practices and solidarity actions (Cini et al., 2021, Popan, 2021). More generally, previous research has found that attitudes toward risk-taking can be altered in the workplace by safety knowledge sharing among coworkers and supervisors (Nykänen et al., 2018, Westaby and Lowe, 2005). Social support increases the sense of belonging (Bakker and Demerouti, 2007), and a sympathetic atmosphere signifies an organization’s appreciation and commitment to its employees (Hofmann and Morgeson, 1999). This, in turn, encourages workers’ safety compliance in the working environment (Yagil and Luria, 2010, Goldenhar et al., 2003, Clarke, 2013). In an airline setting, Chen and Chen (2014) confirmed that flight attendants’ perceptions of more significant job resources would result in them exhibiting safety behaviours. Thus, the following hypotheses are formulated:

- H4: Job resources have a direct and negative impact on job strain.
- H5: Job resources have a direct and negative impact on risk-taking attitude.
- H6: Job resources have a direct and positive impact on road safety compliance.

### 3.3. Job strain

Job strain represents “the long-term exhaustion from, and diminished interest in, the work we do” (Leiter and Bakker, 2014). Husain et al. (2019) argued that taxi drivers who suffered from acute fatigue tended to ignore safe driving practices to fulfil the priority tasks (i.e., complete more trips). Useche et al. (2017) also claimed that job strain was significantly correlated with the preference for risky driving among bus drivers. Furthermore, Li et al. (2017) empirically demonstrated the impact of emotional exhaustion on driving anger related to illegal driving and hostile gestures. Indeed, individuals exposed to increased strain tend to comply with safety mandates (Liang et al., 2021, Hansez and Chmiel, 2010, Laurent et al., 2018). The relationship between job strain and road safety compliance has been confirmed in studies involving truck drivers (Hartley and El Hassani, 1994, Rowden et al., 2011). Hence, this study justifies two following hypotheses in the food delivery domain:

- H7: Job strain has a direct and positive impact on risk-taking attitude.
- H8: Job strain has a direct and negative impact on road safety compliance.

### 3.4. Risk-taking attitudes

Prior research has provided significant evidence on the negative relationship between risk-taking attitudes and safe behaviours among young novice drivers (Ulleberg and Rundmo, 2003) and older and experienced drivers (Lucidi et al., 2014, Yang et al., 2020). A recent study by Shi et al. (2018) confirmed the relationship between attitudes and driving behaviours in a sample of Chinese bicycle riders. It highlighted that riders with favourable attitudes towards safety were likelier to obey the traffic rules when riding a bicycle. In the context of public transport, non-compliance with safety rules has also been linked with drivers’ attitudes towards speeding and other road violations (Ma et al., 2010, Mallia et al., 2015). Based on the trend above, the following hypothesis is formulated:

- H9: Risk-taking attitude has a direct and negative impact on road safety compliance.

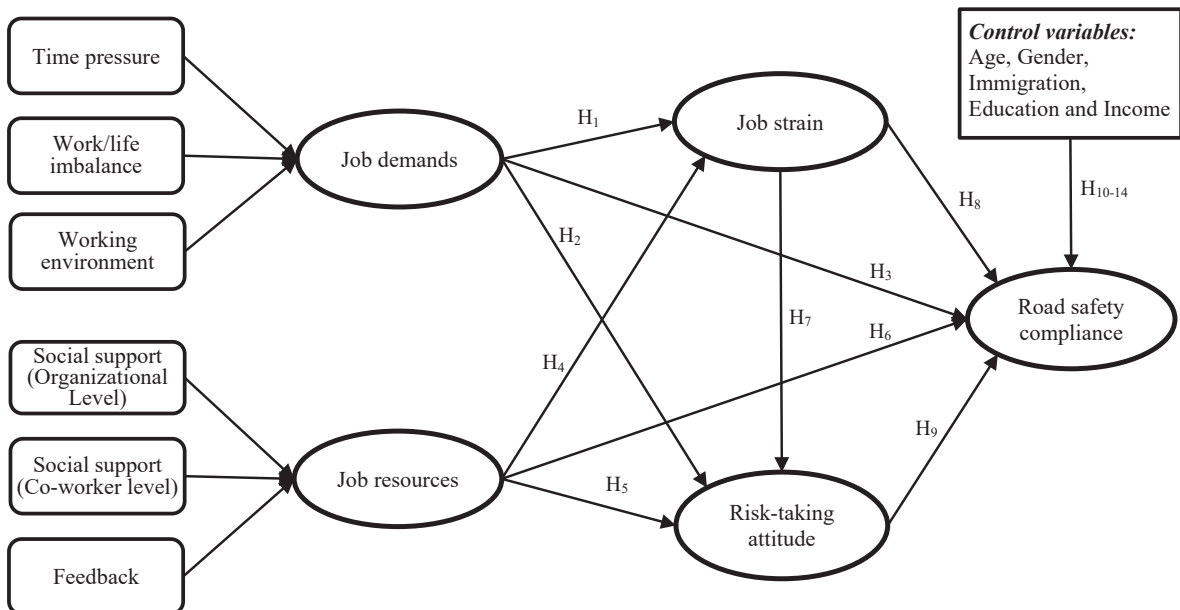


Fig. 1. Proposed conceptual model.

### 3.5. Control variables

The present investigation considers food delivery riders’ demographic characteristics (i.e., gender, age, education, income, and immigration) as control variables and explores their influences on road safety compliance. While young and lowly educated drivers have a high possibility of infringing road safety rules (Constantinou et al., 2011, Machin and Sankey, 2008, Di Meco et al., 2021, Oviedo-Trespalcacios and Scott-Parker, 2018), older and more educated drivers are reported to engage in fewer violations, specifically speeding offences (Vahedi et al., 2018, Newnam et al., 2014, Tseng et al., 2016). Additionally, female drivers were found to display a higher willingness to comply with traffic laws compared to male ones (Yagil, 1998), which has been replicated in other studies about gender differences in terms of road safety compliance (Rosenbloom and Wolf, 2002, Ulleberg, 2001, Martinussen et al., 2015, Harris et al., 2014, Guého et al., 2014, Oviedo-Trespalcacios and Phillips, 2021). Many cases of safety law infractions were also witnessed among low-income drivers (Anastasopoulos and Mannering, 2016, Curry et al., 2017, Urie et al., 2016, Zhong et al., 2012, Oviedo-Trespalcacios and Scott-Parker, 2017) and migrant workers (migration from rural areas to cities) (Nguyen-Phuoc et al., 2019a).

The evidence above indicates that age, gender, immigration, education, and income are directly related to drivers’ road safety compliance. Adapting this relationship to food delivery riders, this study suggests hypotheses 10 to 14.

Fig. 1 represents the theoretical research framework of the study.

## 4. Methodology

### 4.1. Survey

To examine the theoretical framework proposed, a standard questionnaire was designed with three sections. The first was an

**Table 1**  
Measurement items.

Constructs	Dimensions	Measurement items	Supporting literature		
<b>Job demands</b> (JDE)	<b>Time pressure (TIP)</b>	TIP1	I am always in a hurry to fulfil the assignment on time	(Demerouti et al., 2001) (Zheng et al., 2019)	
		TIP2	I often think about the penalty for late delivery		
		TIP3	I often worry about late delivery while working because of the time limit for each order		
		TIP4	I try to complete the number of orders as many as possible to increase my wage		
	<b>Work/life imbalance (WLI)</b>	WLI1	Personal life suffers because of work	(Hayman, 2005)	
		WLI2	Job makes personal life difficult		
		WLI3	Neglect personal needs because of work		
		WLI4	Put personal life on hold for work		
	<b>Working environment (WEN)</b>	WEN1	Delivery riders have to ride motorcycles in adverse road conditions (e.g., poor road surfaces), which increases the risk of accident	(Demerouti et al., 2001)	
		WEN2	Delivery riders work in all weathers even in bad weather conditions		
		WEN3	Delivery riders work in a pressured working environment as they are required to deliver to the right place, sometimes in the dark within a set time frame*		
	<b>Job resources</b> (JRE)	<b>Social support (Organizational Level) (SSO)</b>	SSO1	The delivery firms are willing to invest money and effort to improve safety for riders.	(Cheung et al., 2021, Karasek et al., 1998)
			SSO2	The delivery firms seem to care about my safety.	
<b>Social support (Coworker level) (SSW)</b>		SSW1	Delivery riders who I know expect me to behave safely.	(Cheung et al., 2021, Karasek et al., 1998)	
		SSW2	Delivery riders who I know emphasize working safety and make sure to do the same.		
		SSW3	Delivery riders who I know remind me to follow safety regulations.		
<b>Feedback (FDB)</b>		FDB1	I get enough feedback about the quality of my performance	(Demerouti et al., 2001)	
		FDB2	I always receive feedback about my performance from the customers		
<b>Job strain</b> (JST)	JST1	I feel burned out from my work.	(Li et al., 2013)		
	JST2	I feel emotionally drained from my work.			
	JST3	I feel fatigued when I get up in the morning and have to face another day on the job.			
	JST4	I feel frustrated by my job.			
<b>Risk-taking attitude (RTA)</b>	RTA1	If you are a good driver it is acceptable to engage in risky driving behaviours sometimes	(Iversen, 2004)		
	RTA2	Taking chances and breaking a few rules does not necessarily make bad drivers			
	RTA3	Traffic rules are often too complicated to be carried out in practice			
	RTA4	Traffic rules do not need to be respected in bad conditions of road and weather			
<b>Road safety compliance (RSC)</b>	RSC1	I do not engage in any risky riding behaviours when working as a delivery rider	(Neal and Griffin, 2006)		
	RSC2	I ride carefully to avoid traffic accidents when working as a delivery rider			
	RSC3	I ensure the highest levels of safety when I carry out my job.			



introduction to the research and some background information about the survey (e.g., time and place) recorded by the research assistants. The core content of the survey included a series of attitudinal statements formulated from the relevant previous studies to measure constructs (Table 1). Precisely, time pressure was measured via four items adapted from Demerouti et al. (2001) and (Zheng et al., 2019). Based on Hayman (2005), four items were adopted to measure work/life imbalance. The working environment measurement was conducted through three statements introduced by Demerouti et al. (2001). Social support at the organizational and coworker levels were evaluated through two and three items modified from Cheung et al. (2021). Two items used in Demerouti et al. (2001) were adapted to measure feedback. The measurement of job strain was attained by using four statements deployed in (Li et al., 2013), while the work of Iversen (2004) provided the basis for formulating four items to measure risk-taking attitude. Finally, three items to evaluate road safety compliance among delivery riders were adopted by Neal and Griffin (2006). A seven-point Likert scale was employed to collect riders' opinions about the items. The last part of the questionnaire requested the socio-demographics of riders, including gender, age, educational level, immigration status, and income.

The questionnaire was initially prepared in English before being translated into Vietnamese. The English version was shared with transport and human factors experts, whose feedback was then used to improve the questionnaire. Subsequently, the improved questionnaire was used to conduct pilot surveys with thirty couriers in both Hanoi and Hochiminh City. Only some minor comments on wording choices were returned to the research team. After these issues were addressed, the final version of the questionnaire was adopted and used for data collection.

#### 4.2. Data collection

A self-administered survey technique was used in this study. Surveyors were students of several universities in Hanoi and Hochiminh City who had been appropriately trained. To recruit respondents, the surveyors accessed public areas where delivery riders frequently gathered when waiting for orders, such as lakes, department stores, parks, and restaurants. Invitations were directly given to riders. Those who accepted to participate in the survey were given pens to fill out the forms. To achieve high-quality data, the surveyor and the participant in each survey were paid 1 USD for the former and 1.5 USD for the latter. The survey was undertaken on weekdays and weekends but avoided the peak time windows of delivery (11:00–13:00 and 17:30–19:30) to reduce the rate of incomplete responses. The survey was conducted for one month, from 10 April 2021 to 9 May 2021. Of 600 forms collected in the two cities, 28 were eliminated due to incomplete data and unreliable responses with the same values given to all statements. The field-based data was then transferred to a computer from the paper forms (572 replies). After removing outlier values, the final sample encompassed 550 usable responses, including 269 in Hanoi and 281 in Hochiminh city.

#### 4.3. Data analysis

To test hypotheses among constructs in an extension of a theory, covariance structural equation modelling (CB-SEM) has been used heavily in the past (Anderson and Gerbing, 1988). PLS-SEM has been increasingly utilized as an effective alternative to CB-SEM in various fields (Su et al., 2019, Nguyen-Phuoc et al., 2020e), and safety research is not an exception (Nguyen-Phuoc et al., 2020b; Tagod et al., 2021). PLS-SEM can work effectively on a small sample with no requirement for the normal distribution of data (Khan et al., 2019). Moreover, PLS-SEM is highly recommended for research considering many constructs and aiming to understand the increasing complexity caused by extensions of well-established theories (Hair et al., 2017a). While CB-SEM should be applied to assess how well-established theories fit reality, PLS-SEM is used for exploratory analysis and testing of developmental theories (Fornell and Bookstein, 1982, Hair et al., 2017b). This study develops a theoretical framework based on the JD-R model to explore how road safety compliance is formed among food delivery riders. Two new constructs: risk-taking attitude and road safety compliance, were added to the JD-R model. Additionally, job demands and resources are higher-order constructs that make the proposed model more complex. Therefore, PLS-SEM was selected for this study to test the theoretical framework presented in Section 2.

**Table 2**  
Survey respondent characteristics.

	<i>n</i>	%		<i>n</i>	%
<i>Gender</i>			<i>Level of education</i>		
Male	487	88.5	High school	95	17.3
Female	63	11.5	College	206	37.5
<i>Age</i>			University	178	32.4
Mean (Standard Deviation)	25.66 (5.54)		Above university	31	5.6
<i>Married status</i>			Other	40	7.3
Single	403	73.3	<i>Monthly income (million VND)</i>		
Married	147	26.7	Mean (Standard Deviation)	8.62 (4.52)	
<i>Job type</i>					
Part-time	297	54.0			
Full-time	253	46.0			

Note: 1 USD = 23,000 VND.

## 5. Results

### 5.1. Descriptive statistics

The sample profile is depicted in Table 2. Male delivery riders accounted for most of the sample (88.5 %). Among the respondents, over 70 % were single, and their mean age was 25.66 years old ( $SD = 5.54$ ). There was a slightly higher proportion of part-time delivery riders (54 %) than full-time ones (46 %). Regarding the level of education, approximately 70 % of the respondents had a college or university degree. The delivery riders who participated in this study also reported that they earned around 8.62 million VND per month, which is above Vietnam's average monthly income (4.20 million VND) (VietnamPlus, 2021).

### 5.2. Measurement model

#### 5.2.1. First-order measurement model evaluation

The PLS-SEM analysis yielded Cronbach's alpha (CA) and composite reliability (CR) values of each examined construct as inputs to assess the reliability of the measurement model (Hair et al., 2017a). Results in Table 3 show that the figures for these two indices of all variables were higher than the recommended threshold of 0.7, confirming satisfactory internal consistency reliability (Nunnally and Bernstein, 1994). Regarding indicator reliability, except that TIP4 was removed from the scale of time pressure construct due to its loading being under the cut-off value of 0.7, the assessment resulted in the retention of all indicators in the measurement models, with the outer loadings ranging from 0.786 to 0.961 (Henseler et al., 2009). The indicator RSC3 with the factor loading of 0.686 also was retained as the removal of this parameter from the scale of road safety compliance did not significantly affect the reliability and validity of the construct (Hair et al., 2017). Additionally, the average variance extracted (AVE) values of all proposed constructs presented in Table 3 were well above the critical threshold of 0.5 (Fornell and Larcker, 1981), signifying the high convergent validity of the outer models.

**Table 3**

First-order model evaluation.

Constructs	Items	M	SD	Loadings	CA	CR	AVE
<b>Job demands' Dimension 1: Time pressure (TIP)</b>	TIP1	4.820	1.555	0.876	0.889	0.931	0.819
	TIP2	4.825	1.541	0.927			
	TIP3	4.915	1.494	0.910			
	TIP4	5.424	1.404	–			
<b>Job demands' Dimension 2: Work/life imbalance (WLI)</b>	WLI1	4.262	1.567	0.847	0.895	0.927	0.760
	WLI2	4.189	1.627	0.880			
	WLI3	4.260	1.636	0.906			
	WLI4	4.275	1.699	0.853			
<b>Job demands' Dimension 3: Working environment (WEN)</b>	WEN1	5.358	1.374	0.892	0.795	0.880	0.711
	WEN2	5.198	1.474	0.849			
	WEN3	5.171	1.374	0.786			
<b>Job resources' Dimension 1: Social support (Organizational Level) (SSO)</b>	SSO1	4.111	1.599	0.950	0.905	0.954	0.913
	SSO2	4.116	1.596	0.961			
<b>Job resources' Dimension 2: Social support (Coworker level) (SSW)</b>	SSW1	5.051	1.295	0.852	0.829	0.898	0.746
	SSW2	5.015	1.346	0.910			
	SSW3	5.002	1.368	0.827			
<b>Job resources' Dimension 3: Feedback (FDB)</b>	FDB1	5.089	1.438	0.934	0.853	0.931	0.872
	FDB2	5.091	1.464	0.933			
<b>Job strain (JST)</b>	JST1	4.071	1.481	0.833	0.877	0.915	0.730
	JST2	3.831	1.458	0.895			
	JST3	3.967	1.529	0.834			
	JST4	3.751	1.585	0.854			
<b>Risk-taking attitude (ATT)</b>	RTA1	4.280	1.829	0.883	0.890	0.923	0.751
	RTA2	4.535	1.646	0.877			
	RTA3	4.507	1.620	0.862			
	RTA4	4.780	1.531	0.844			
<b>Road safety compliance (RSC)</b>	RSC1	4.609	1.448	0.902	0.743	0.844	0.647
	RSC2	5.205	1.414	0.810			
	RSC3	5.291	1.424	0.686			

Note: *M* = Mean; *SD* = Standard Deviation; *CA* = Cronbach's Alpha; *CR* = Composite Reliability; *AVE* = Average Variance Extracted.

**Table 4**  
Fornell-Larcker criterion of the first-order factor model.

Construct	AVE	ATT	FDB	JST	SRB	SSW	SSO	TIP	WLI	WEN
ATT	<b>0.751</b>	<b>0.867</b>								
FDB	<b>0.872</b>	0.232	<b>0.934</b>							
JST	<b>0.730</b>	0.071	−0.086	<b>0.854</b>						
SRB	<b>0.647</b>	−0.204	0.119	−0.141	<b>0.804</b>					
SSW	<b>0.746</b>	0.241	0.353	−0.123	0.030	<b>0.864</b>				
SSO	<b>0.913</b>	0.035	0.009	−0.015	−0.001	0.179	<b>0.955</b>			
TIP	<b>0.819</b>	0.267	0.109	0.154	−0.022	0.133	0.074	<b>0.905</b>		
WLI	<b>0.760</b>	0.083	−0.125	0.304	−0.059	−0.107	0.128	0.255	<b>0.872</b>	
WEN	<b>0.711</b>	0.281	0.282	0.190	−0.001	0.251	0.094	0.337	0.219	<b>0.843</b>

**Table 5**  
Heterotrait-Monotrait Ratio (HTMT) of the first-order factor model.

Construct	ATT	FDB	JST	SRB	SSW	SSO	TIP	WLI	WEN
ATT									
FDB	0.272								
JST	0.113	0.099							
SRB	0.207	0.165	0.181						
SSW	0.285	0.421	0.139	0.059					
SSO	0.051	0.014	0.047	0.049	0.204				
TIP	0.294	0.126	0.175	0.087	0.158	0.084			
WLI	0.101	0.143	0.339	0.079	0.125	0.146	0.285		
WEN	0.327	0.341	0.229	0.090	0.308	0.115	0.397	0.259	

To evaluate discriminant validity, this study used both traditional Fornell-Larcker criterion (Fornell and Larcker, 1981) and recently supported Heterotrait-Monotrait Ratio (HTMT) (Henseler et al., 2015). Accordingly, the square root of each construct’s AVE scores, which are displayed as the bold diagonal elements in Table 4, was higher than all correlation coefficients representing the relationships between it and other latent variables in the model (Fornell and Larcker, 1981). As for HTMT values shown in Table 5, all of them were much lower than Kline’s recommended value of 0.85 by Kline (2011). The results of these two tests were combined, and satisfactory discriminant validity was established (Henseler et al., 2015).

5.2.2. Second-order measurement model evaluation

The analysis detected job demands and job resources as formative second-order constructs and processed the evaluation of the higher-order measurement model by considering the outer weights of the first-order constructs and their variance inflation factor (VIF) in Table 6 (Duarte and Amaro, 2018). As for the second-order construct of job demands, all of the three dimensions, namely time pressure (TIP), work-life imbalance (WLI) and working environment (WEN), had the outer weights higher than the suggested value of 0.1 (Lohmöller, 2013) and satisfactory *t*-values at corresponding significance levels based on 5,000 bootstraps, providing empirical support for the contribution of the three components to the formation of the higher-order construct (Hair et al., 2017). Regarding VIF values of these first-order constructs, the figures ranged from 1.903 to 0.174 – well under the common cut-off of 5.0, indicating that multicollinearity did not exist among them (Hair et al., 2011). Likewise, the two indicators of the second-order construct of job resources – social support at coworker level (SSW) and feedback (FDB) – were retained as their scores for outer loadings, *t*-values, and VIF satisfied the criteria as mentioned above (Table 6). However, the analysis eliminated the indicator of social support at the organizational level (SSO) due to its negative weight (-0.005, lower than 0.1 as Lohmöller (2013) suggested) and insignificant *t*-value (*t* = 0.040, *p* = 0.968) (Hair et al., 2017). The statistically significant parameters were processed to the next estimates of the structural model.

**Table 6**  
Assessment of the second-order measurement model.

Second-order / First-order constructs	VIF	Outer Weights	SD	<i>t</i>	<i>p</i>
<b>Job demands</b>					
Time pressure (TIP)	1.174 <sup>***</sup>	0.408	0.124	3.278	0.001
Work/life imbalance (WLI)	1.093 <sup>***</sup>	0.426	0.162	2.635	0.008
Working environment (WEN)	1.152 <sup>***</sup>	0.555	0.107	5.175	<0.001
<b>Job resources</b>					
Social support (Organizational Level) (SSO)	1.036 <sup>ns</sup>	−0.005	0.126	0.040	0.968
Social support (Coworker level) (SSW)	1.184 <sup>***</sup>	0.601	0.126	4.789	<0.001
Feedback (FDB)	1.146 <sup>***</sup>	0.615	0.125	4.927	<0.001

Notes: VIF = Variance Inflation Factor; SD = Standard Deviation; <sup>ns</sup> non-significant, <sup>\*\*\*</sup>*p* < 0.01.

**Table 7**  
Results of direct effects among constructs.

Path Relation (Hypothesis)	Path Coefficient ( $\beta$ )	SD	t	p	Result
ATT -> RSC	-0.248***	0.052	4.768	<0.001	Supported
JDE -> ATT	0.247***	0.052	4.747	<0.001	Supported
JDE -> JST	0.331***	0.053	6.283	<0.001	Supported
JDE -> RSC	0.052 <sup>ns</sup>	0.064	0.809	0.419	Rejected
JRE -> ATT	0.248***	0.044	5.580	<0.001	Supported
JRE -> JST	-0.186***	0.043	4.365	<0.001	Supported
JRE -> RSC	0.126**	0.054	2.318	0.020	Supported
JST -> ATT	0.027 <sup>ns</sup>	0.044	0.607	0.544	Rejected
JST -> RSC	-0.125**	0.050	2.497	0.013	Supported
<b>Control Variables</b>					
Age -> RSC	0.151***	0.053	2.860	0.004	Supported
Gender -> RSC	0.067*	0.040	1.679	0.093	Supported
Immigrate -> RSC	-0.071 <sup>ns</sup>	0.047	1.523	0.128	Rejected
Education level -> RSC	0.035 <sup>ns</sup>	0.046	0.750	0.453	Rejected
Income -> RSC	-0.129**	0.049	2.614	0.009	Supported

Notes: <sup>ns</sup> non-significant, \*\*\* $p < 0.01$ , \*\* $p < 0.05$ , \* $p < 0.1$ .

### 5.3. Structural model

#### 5.3.1. Model fit

This study used standard root mean square (SRMR) resulting from a bootstrap-based procedure to assess the approximate model fit of the proposed model (Henseler et al., 2016). The figure for SRMR shown in Table 7 was 0.062, which is less than the recommended cut-off value of 0.08 (Hu and Bentler, 1999), implying that the examined model fit the data well.

#### 5.3.2. Evaluation of direct relationships

A bootstrapping routine with 550 cases and 5,000 resamples was implemented to evaluate the hypothesised relationships of the structural model. This test yielded seven statistically supported hypotheses among nine proposed relationships between examined constructs (Fig. 2), with their corresponding empirical  $t$ -values higher than the critical value of 1.96 at an error probability of 5 % (Table 7) (Hair et al., 2017). Particularly, attitude towards risk-taking while riding and riders' job strain negatively affected their compliance with road safety ( $\beta_{ATT \rightarrow RSC} = -0.248, t = 4.768, p < 0.01$  and  $\beta_{JST \rightarrow RSC} = -0.125, t = 2.497, p < 0.05$ , respectively). By contrast, there was a positive effect of job resources on road safety compliance of food delivery riders with  $\beta = 0.126$  and  $t$ -value = 2.318 at  $p < 0.05$  while job demands failed to directly predict how riders comply with road safety as the figures for this hypothesis were insignificant ( $\beta_{JDE \rightarrow ATT} = 0.247, t = 4.747, p < 0.01$  and  $\beta_{JRE \rightarrow ATT} = 0.248, t = 5.580, p < 0.01$ , respectively), whereas the linkage between job strain and attitude towards risky driving behaviours was not empirically supported. Regarding path relationships to job strain, the result revealed opposite effects that its two predictors produced. The higher the job demanded, the more job strain riders

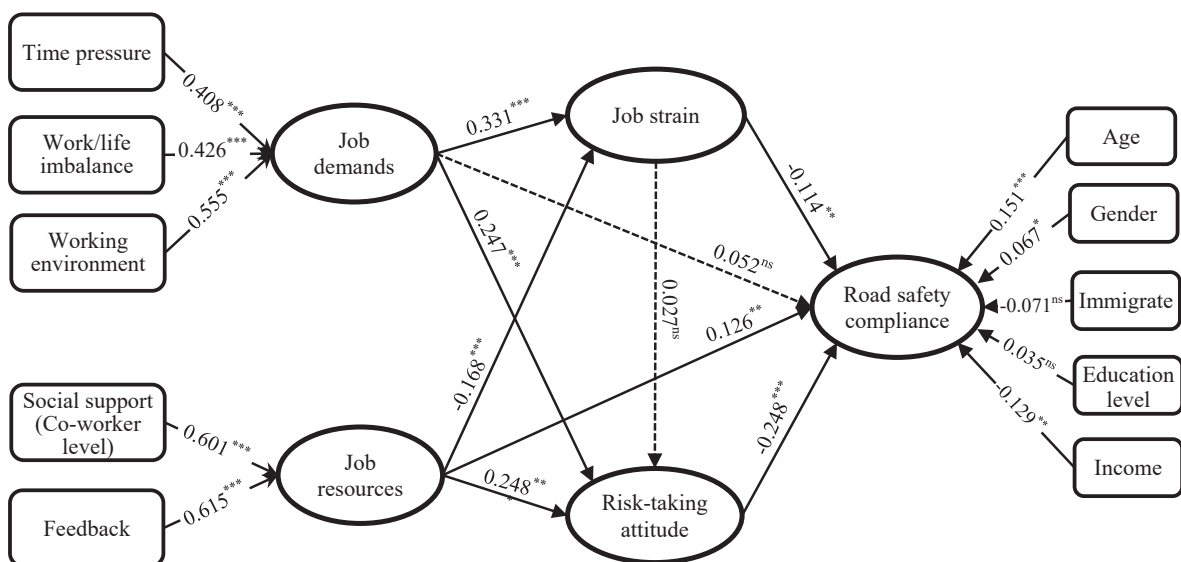


Fig. 2. Results of PLS-SEM.

**Table 8**  
Results of indirect effects between each construct.

Specific Indirect Effects	Path Coefficient	SD	t	p
JDE -> JST -> ATT	0.009 <sup>ns</sup>	0.015	0.586	0.558
JRE -> JST -> ATT	-0.005 <sup>ns</sup>	0.009	0.582	0.561
JDE -> ATT -> RSC	-0.061 <sup>***</sup>	0.019	3.187	0.001
JRE -> ATT -> RSC	-0.062 <sup>***</sup>	0.018	3.517	<0.001
JDE -> JST -> ATT -> RSC	-0.002 <sup>ns</sup>	0.004	0.574	0.566
JST -> ATT -> RSC	-0.007 <sup>ns</sup>	0.011	0.594	0.552
JRE -> JST -> ATT -> RSC	0.001 <sup>ns</sup>	0.002	0.568	0.570
JDE -> JST -> RSC	-0.040 <sup>**</sup>	0.019	2.236	0.025
JRE -> JST -> RSC	0.023 <sup>**</sup>	0.011	2.073	0.038

Notes: <sup>ns</sup> non-significant, <sup>\*\*\*</sup> $p < 0.01$ , <sup>\*\*</sup> $p < 0.05$ , <sup>\*</sup> $p < 0.1$ .

got; conversely, resources they received from doing their job negatively influenced job strain.

Concerning the effects of control variables on the dependent construct, the analysis supported the associations between age, gender and income on road safety compliance. Among them age and gender influentially predicted food delivery persons' conformity to safety rules in a positive manner ( $\beta = 0.151$ ,  $t = 2.860$ ,  $p < 0.01$ ) and ( $\beta = 0.067$ ,  $t = 1.679$ ,  $p < 0.1$ ) whereas income negatively impacted their road safety compliance ( $\beta = -0.129$ ,  $t = 2.614$ ,  $p < 0.05$ ).

Together with the analysis of direct relationships above, this study also tested the mediating effects of the proposed constructs. Four out of nine examined indirect paths were empirically supported. The results in Table 8 showed that the direct causal link between job demands (JDE) to safety compliance (RSC) was fully mediated by risk-taking attitude (ATT) and job strain (JST) ( $\beta = -0.061$ ,  $t = 3.187$ ,  $p < 0.01$  and  $\beta = -0.040$ ,  $t = 2.236$ ,  $p < 0.05$ , respectively) as no significant direct linkage between these two variables was found. On the other hand, the mediations of riders' attitudes towards conducting risky behaviours (ATT) and their job strain (JST) in the relationships between job resources (JRE) and safety compliance (RSC) were partially established despite in opposite directions. Interestingly, increase in job resources (JRE) indirectly reduced riders' compliance with safety (RSC) by affecting their risk-taking attitude (ATT) with  $\beta = -0.062$  ( $t = 3.517$ ,  $p < 0.01$ ) while partly contributed to the increase of safety compliance (RSC) by decreasing job strain with  $\beta = 0.023$  ( $t = 2.073$ ,  $p < 0.05$ ). Other indirect linkages of the structural model were rejected due to insignificant results.

### 5.3.3. Predictive capability evaluation

The predictive relevance ( $Q^2$ ) is typically used to evaluate the structural model's predictive power (Hair et al., 2017). The assessment of predictive relevance was conducted by running a blindfolding procedure, which requires  $Q^2$  score for each dependent factor being larger than 0 to achieve a certain level of predictive capability (Henseler et al., 2009, Hair et al., 2017). Accordingly, the figures for  $Q^2$  values of all of the three constructs met this requirement ( $Q^2_{RTA} = 0.10$ ,  $Q^2_{JST} = 0.08$ ,  $Q^2_{RSC} = 0.05$ ) (Hair et al., 2017).

## 6. Discussion

### 6.1. Theoretical implications

The present investigation is the first theory-led empirical study conducted to understand the influence of job demands and resources on road safety compliance among food delivery riders in the Global South. Additionally, this is the first application of the JD-R model to understand the behaviour of delivery riders. Four main theoretical contributions can be discussed:

Firstly, this paper confirms that food delivery riders are exposed to risks not just specific to their experiences as vulnerable road users but also the nature of the job design. This means that the demands that non-commercial motorcycle riders experience when on the road are not directly comparable to those experienced by food delivery riders. Indeed, non-commercial motorcycle riders most likely experienceless demands because they do not need to negotiate job-specific demands. The present study considered this during the theoretical development of the research by adding specific characteristics of the food delivery job into the theoretically expected variables conceptualised by the JD-R model, i.e., job demands and resources. Specifically, the current research contributes to the literature on the safety behaviours of delivery riders by proposing a framework that explains road safety compliance based on the JD-R. The results presented in this research paper address the link between organisational factors and road safety more broadly.

Secondly, the present study also identified the mediating effects of job strain and risk-taking attitude in the relationships between job demands and resources and safety compliance. The existing literature has mainly focused on direct links between job demands and job resources and road safety behaviours (Turner et al., 2012, Bronkhorst, 2015), ignoring the effect that attitudes have on the link between job strain and riders' behaviour. Notably, in this study, the job demands factor was not a direct predictor of safety compliance; however, significant indirect paths through job strain and risk-taking attitude were identified. Previous research also supports these findings, as job demands were proved to affect the job strain of professional drivers (Useche et al., 2019) and emotional and psychological stress were proved to have a negative effect on safety compliance (Liang et al., 2021). No prior research attempt has integrated these two factors as mediators in a comprehensive JD-R model to investigate road safety compliance among food delivery riders.

Thirdly, we also identified that job demands and job resources are higher-order formative constructs. Previous research did not

clarify the dimensions that form these two variables nor treat them as both negative and positive aspects in one integrated study. More specifically, all three attributes of job demands (i.e., time pressure, work-life imbalance and working environment) have been validated to influence safety behaviours either separately in different studies (Papakostopoulos and Nathanael, 2021, Yelgin and Ergün, 2021, Liang et al., 2021) or in an interrelated manner (Zheng et al., 2019, Bronkhorst, 2015). On a more general basis, the present research provides support for the results of previous studies using the JD-R. As the JD-R constructs appear to predict job strain as theoretically expected but also have a direct and indirect influence on risky behaviour (Tong et al., 2019). Previous research has indicated that job resources positively affect safety performance while job demands have a negative influence on the safety behaviours of cabin crew members (Yelgin and Ergun, 2021) and healthcare-related workers (Bronkhorst, 2015).

Finally, the impact of control variables on road safety compliance among food delivery riders was examined. The findings highlighted that male and younger riders should be the main target of safety interventions as they are at a higher risk. This was in line with the findings from previous studies, which found that young and male motorcyclists had a higher tendency to violate traffic regulations and to neglect potential risks (Chang and Yeh, 2007, Tran et al., 2012, Creaser et al., 2009, Nguyen-Phuoc et al., 2020c, Rusli et al., 2020). This could be due to psychosocial and developmental factors that make young people more likely to engage in more risky activities while on the road (Oviedo-Trespalacios and Scott-Parker, 2018, Nguyen-Phuoc et al., 2019b). Additionally, income was associated with road safety compliance. Better-paid riders were more likely to engage in risky riding behaviours. In fact, to increase their income, food delivery riders must complete as many orders as they can on time, particularly during peak hours. As such, they tend to engage in time-cutting risky behaviours (e.g., speeding, or red-light running) to reduce the time spent on an order. The finding was not found in the context of app-based taxi motorcycle riders in Vietnam (Nguyen-Phuoc et al., 2019a, Nguyen-Phuoc et al., 2020a) but it has been reported in high income countries such as Australia (Oviedo-Trespalacios et al., 2022).

## 6.2. Practical implications

The main finding from the present study is that the industry stakeholders of food delivery services need to implement urgent measures aimed at reducing job demands of riders to prevent job strain and increase road safety compliance. Additionally, industry stakeholders need to recognise that there are many traffic-specific factors outside of the control of the delivery riders, which should not result in penalties for them. Specifically, delays resulting from congestion or unexpected disruptions on the roads are frequent in countries with poorly developed infrastructure such as Vietnam. These delays can result in riders trying to avoid delay-related penalties (e.g., loss of income or poor ratings) for late deliveries by engaging in time-cutting risky behaviours such as speeding or red-light running that are detrimental to their safety. A good strategy to improve food delivery service equity is not penalizing riders and sharing the burden of delays among stakeholders. Additionally, delivery companies need to take a more proactive approach by prioritising safety over financial revenue. For example, they can prioritise safer routes over faster routes in their platforms. However, this initiative requires those companies who value fast delivery over the safety-related behaviours of their riders to redefine their safety culture (Papakostopoulos and Nathanael, 2021).

The present research also shows the need for creating spaces to foster a sense of community and peer support among delivery riders. Companies should create spaces for delivery riders to connect with their peers and prioritise community-led safety initiatives to improve the job resources of riders. In many high-income countries, specific labour associations representing delivery riders have been created to support and advocate for delivery riders, e.g., Association for Delivery Drivers in the United States, Nationwide Delivery Riders Association (NDRA) in Korea, and the National Delivery Champions Association (NDCA) in Singapore. Such organisations should be officially established in the global south to provide resources more effectively to the delivery riders.

The role of the industry should also be reviewed by governmental agencies. Specifically, governments should consider a bolder approach and stricter legal framework for the operation of these companies, as their job design approaches can have a direct impact on the effectiveness of road safety initiatives. In this study, lack of adequate job resources and poor job design increases favourable attitudes towards risk. This clearly demonstrated that the way these industries are regulated directly impacts road safety performance. The goals of economic prosperity should not further perpetuate road safety issues. There is also a need to educate the delivery riding workforce on these issues. Delivery riders need to understand how the systems influence their behaviour and the importance of social resources to improve their safety outcomes. This will help them to understand their rights and engage in advocacy activities seeking less exploitative practices in the industry.

## 7. Limitations and future research

Several limitations are identified. Firstly, this study only focused on motorcycle delivery riders in a developing country. Future research should be carried out on car delivery drivers in developed countries to understand similarities but also identify specific issues. Secondly, only a limited number of dimensions of job demands and job resources were examined in this study. Other dimensions (e.g., workload, emotional, autonomy) can be added to explore their impacts on the formation of job demands and job resources construct. Finally, the impact of personal demands as well as personal resources on road safety compliance among delivery riders has not been explored in this study. Future research can develop a more holistic model by integrating situational factors but also a more detailed account of the influence of customers on the safety behaviour of delivery riders. Future research should also strive to improve the quality of the evidence by stopping relying so much on self-reported methods and embracing more naturalistic approaches (Haghani et al., 2021).

## 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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