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

Quy Nguyen-Phuoc, Duy; An Ngoc Nguyen, Nguyen; Nguyen, Minh Hieu; Ngoc Thi Nguyen, Ly; Oviedo-Trespalacios, Oscar

DOI
10.1016/j.tra.2022.11.002

Publication date
2022

Document Version
Final published version

Published in
Transportation Research Part A: Policy and Practice

Citation (APA)
Quy Nguyen-Phuoc, D., An Ngoc Nguyen, N., Nguyen, M. H., Ngoc Thi Nguyen, L., & Oviedo-Trespalacios, O. (2022). Factors influencing road safety compliance among food delivery riders: An extension of the job demands-resources (JD-R) model. *Transportation Research Part A: Policy and Practice*, *166*, 541-556. https://doi.org/10.1016/j.tra.2022.11.002

Transportation Research Part A 166 (2022) 541–556

Contents lists available at ScienceDirect

Transportation Research Part A

journal homepage: www.elsevier.com/locate/tra

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

Duy Quy Nguyen-Phuoc [a,*], Nguyen An Ngoc Nguyen [b], Minh Hieu Nguyen [c], Ly Ngoc Thi Nguyen [d], Oscar Oviedo-Trespalacios [e,f]

[a] Faculty of Road and Bridge Engineering, University of Science and Technology – The University of Danang, 54 Nguyen Luong Bang Street, Lien Chieu District, Danang City, Viet Nam
[b] Institute of International Management, National Cheng Kung University, No.1, University Road, Tainan City 701, Taiwan
[c] Faculty of Transport - Economics, University of Transport and Communications, No. 3 Cau Giay Street, Dong Da District, Hanoi, Viet Nam
[d] The University of Danang – University of Economics, 71 Ngu Hanh Son, Danang, Viet Nam
[e] Delft University of Technology, Faculty of Technology, Policy and Management, Section of Safety and Security Science, Jaffalaan 5, 2628 BX Delft, The Netherlands
[f] Queensland University of Technology (QUT), Centre for Accident Research and Road Safety – Queensland (CARRS-Q), Faculty of Health, 130 Victoria Park Road, Kelvin Grove, QLD 4059, Australia

ARTICLE INFO

Keywords:
Human factors
Job design
Ergonomics
Job strain
Vulnerable road users
Responsible risk management
Gig economy

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,

* Corresponding author.
E-mail addresses: npqduy@dut.udn.vn (D. Quy Nguyen-Phuoc), ra6097688@ncku.edu.tw, nguyennna@due.udn.vn (N. An Ngoc Nguyen), hieunm@utc.edu.vn (M.H. Nguyen), lyntn@due.udn.vn (L. Ngoc Thi Nguyen), oscar.oviedotrespalacios@qut.edu.au (O. Oviedo-Trespalacios).

https://doi.org/10.1016/j.tra.2022.11.002

Available online 25 November 2022

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 vehicke. Workers tend to adopt unsafe practices if the perceived benefits of risk-taking action outrank 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 Ruysseveldt 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 towardss 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.

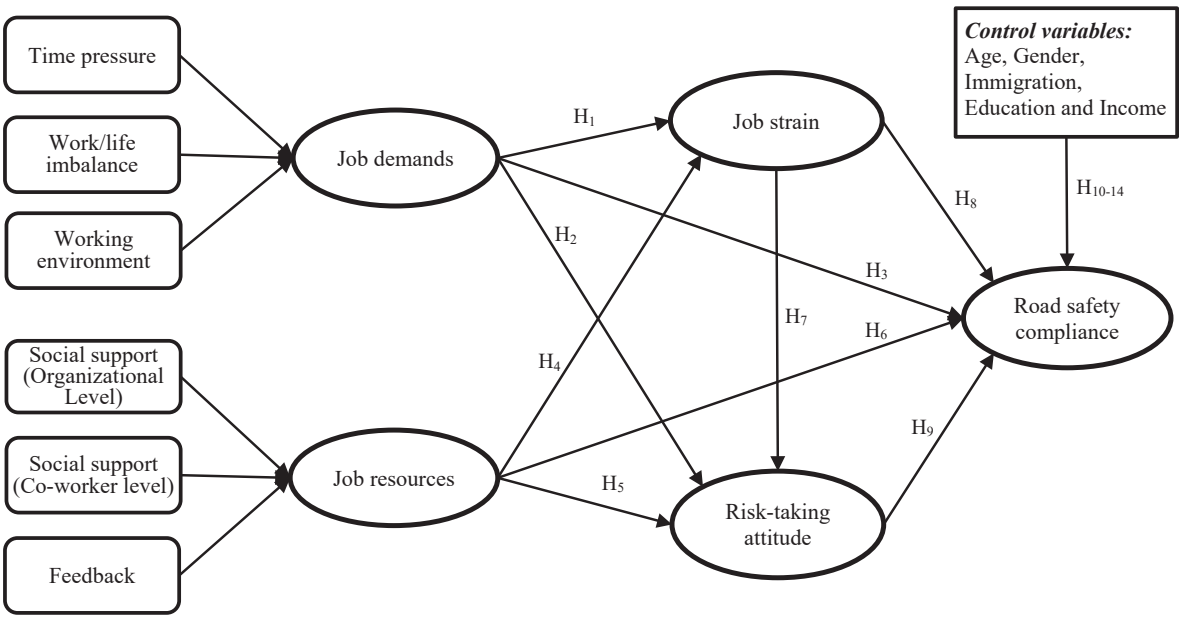

Fig. 1. Proposed conceptual model.

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-Trespalacios 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-Trespalacios 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-Trespalacios 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
Job demands (JDE)	***Time pressure (TIP)***	TIP1	I am always in a hurry to fulfil the assignment on time	(Demerouti et al., 2001)
		TIP2	I often think about the penalty for late delivery	(Zheng et al., 2019)
		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	
	Work/life imbalance (WLI)	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	
	Working environment (WEN)	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*	
Job resources (JRE)	***Social support (Organizational Level) (SSO)***	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.	
	Social support (Coworker level) (SSW)	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.	
	Feedback (FDB)	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	
Job strain (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.	
Risk-taking attitude (RTA)		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	
Road safety compliance (RSC)		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.

	n	%		*n*	%
Gender			*Level of education*		
Male	487	88.5	High school	95	17.3
Female	63	11.5	College	206	37.5
Age			University	178	32.4
Mean (Standard Deviation)	25.66 (5.54)		Above university	31	5.6
Married status			Other	40	7.3
Single	403	73.3	*Monthly income (million VND)*		
Married	147	26.7	Mean (Standard Deviation)	8.62 (4.52)	
Job type					
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
Job demands' Dimension 1: Time pressure (TIP)					0.889	0.931	0.819
	TIP1	4.820	1.555	0.876			
	TIP2	4.825	1.541	0.927			
	TIP3	4.915	1.494	0.910			
	TIP4	5.424	1.404	–			
Job demands' Dimension 2: Work/life imbalance (WLI)					0.895	0.927	0.760
	WLI1	4.262	1.567	0.847			
	WLI2	4.189	1.627	0.880			
	WLI3	4.260	1.636	0.906			
	WLI4	4.275	1.699	0.853			
Job demands' Dimension 3: Working environment (WEN)					0.795	0.880	0.711
	WEN1	5.358	1.374	0.892			
	WEN2	5.198	1.474	0.849			
	WEN3	5.171	1.374	0.786			
Job resources' Dimension 1: Social support (Organizational Level) (SSO)					0.905	0.954	0.913
	SSO1	4.111	1.599	0.950			
	SSO2	4.116	1.596	0.961			
Job resources' Dimension 2: Social support (Coworker level) (SSW)					0.829	0.898	0.746
	SSW1	5.051	1.295	0.852			
	SSW2	5.015	1.346	0.910			
	SSW3	5.002	1.368	0.827			
Job resources' Dimension 3: Feedback (FDB)					0.853	0.931	0.872
	FDB1	5.089	1.438	0.934			
	FDB2	5.091	1.464	0.933			
Job strain (JST)					0.877	0.915	0.730
	JST1	4.071	1.481	0.833			
	JST2	3.831	1.458	0.895			
	JST3	3.967	1.529	0.834			
	JST4	3.751	1.585	0.854			
Risk-taking attitude (ATT)					0.890	0.923	0.751
	RTA1	4.280	1.829	0.883			
	RTA2	4.535	1.646	0.877			
	RTA3	4.507	1.620	0.862			
	RTA4	4.780	1.531	0.844			
Road safety compliance (RSC)					0.743	0.844	0.647
	RSC1	4.609	1.448	0.902			
	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	**0.751**	**0.867**								
FDB	**0.872**	0.232	**0.934**							
JST	**0.730**	0.071	−0.086	**0.854**						
SRB	**0.647**	−0.204	0.119	−0.141	**0.804**					
SSW	**0.746**	0.241	0.353	−0.123	0.030	**0.864**				
SSO	**0.913**	0.035	0.009	−0.015	−0.001	0.179	**0.955**			
TIP	**0.819**	0.267	0.109	0.154	−0.022	0.133	0.074	**0.905**		
WLI	**0.760**	0.083	−0.125	0.304	−0.059	−0.107	0.128	0.255	**0.872**	
WEN	**0.711**	0.281	0.282	0.190	−0.001	0.251	0.094	0.337	0.219	**0.843**

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*	*t*	*p*
Job demands					
Time pressure (TIP)	1.174^{***}	0.408	0.124	3.278	0.001
Work/life imbalance (WLI)	1.093^{***}	0.426	0.162	2.635	0.008
Working environment (WEN)	1.152^{***}	0.555	0.107	5.175	<0.001
Job resources					
Social support (Organizational Level) (SSO)	1.036^{ns}	−0.005	0.126	0.040	0.968
Social support (Coworker level) (SSW)	1.184^{***}	0.601	0.126	4.789	<0.001
Feedback (FDB)	1.146^{***}	0.615	0.125	4.927	<0.001

Notes: *VIF* = Variance Inflation Factor; *SD* = Standard Deviation; ^{ns} non-significant, $^{***}p < 0.01$.

Table 7
Results of direct effects among constructs.

Path Relation (Hypothesis)	Path Coefficient (β)	*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	0.052ns	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	0.027ns	0.044	0.607	0.544	**Rejected**
JST -> RSC	−0.125**	0.050	2.497	0.013	Supported
Control Variables					
Age -> RSC	0.151***	0.053	2.860	0.004	Supported
Gender -> RSC	0.067*	0.040	1.679	0.093	Supported
Immigrate -> RSC	−0.071ns	0.047	1.523	0.128	**Rejected**
Education level -> RSC	0.035ns	0.046	0.750	0.453	**Rejected**
Income -> RSC	−0.129**	0.049	2.614	0.009	Supported

Notes: ns 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 (Table 7). As for risk-taking attitude, job demands and job resources were the most influential determinants of this construct ($\beta_{JDE \rightarrow ATT} = 0.247$, $t = 4.747$, $p < 0.01$ 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

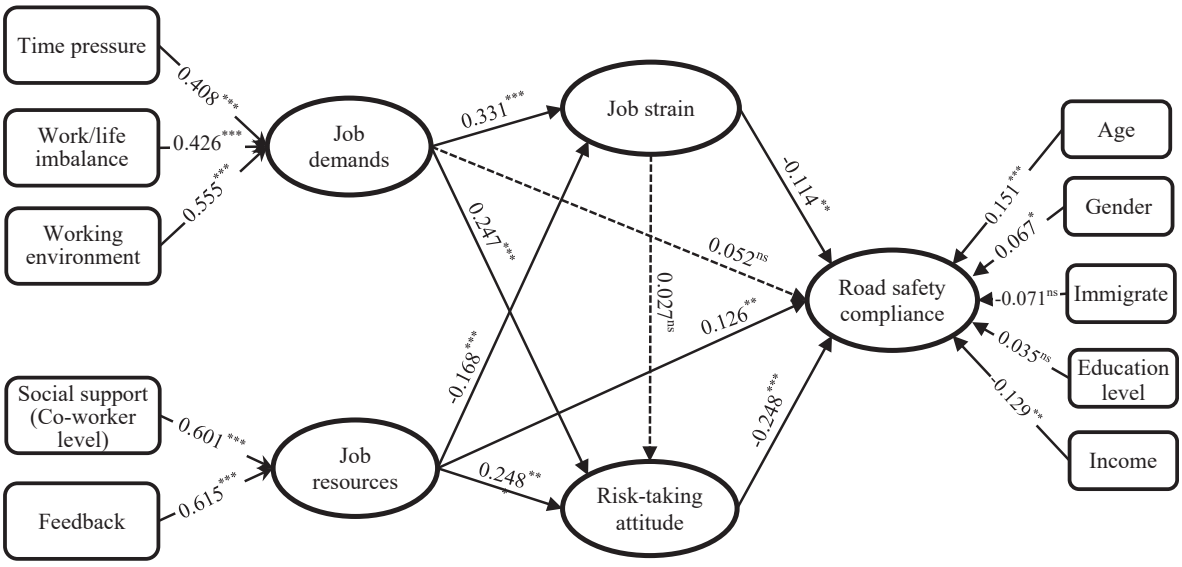

Fig. 2. Results of PLS-SEM.

Table 8
Results of indirect effects between each construct.

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

Notes: ^{ns} non-significant, ***$p < 0.01$, **$p < 0.05$, *$p < 0.1$.

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 (β = -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) (β = -0.061, t = 3.187, $p < 0.01$ and β = -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 β = -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.

Acknowledgement

This research is funded by the Science and Technology Development of the University of Danang under project number B2021-DN02-01.

References

Åberg, L., 1993. Drinking and driving: Intentions, attitudes, and social norms of Swedish male drivers. Accident Analysis & Prevention 25, 289–296.
Ajzen, I., 1991. The theory of planned behavior. Organizational behavior and human decision processes 50, 179–211.
Ajzen, I., Fishbein, M., 1975. A Bayesian analysis of attribution processes. Psychological bulletin 82, 261.
Ajzen, I. 1985. From intentions to actions: A theory of planned behavior. *Action control.* Springer.
Anastasopoulos, P.C., Mannering, F., 2016. The effect of speed limits on drivers' choice of speed: A random parameters seemingly unrelated equations approach. Analytic Methods in Accident Research 10, 1–11.
Andrei, D.M., Griffin, M.A., Grech, M., Neal, A., 2020. How demands and resources impact chronic fatigue in the maritime industry. The mediating effect of acute fatigue, sleep quality and recovery. Safety Science 121, 362–372.
Bakker, A.B., Costa, P.L., 2014. Chronic job burnout and daily functioning: A theoretical analysis. Burnout Research 1, 112–119.
Bakker, A.B., Demerouti, E., 2007. The Job Demands-Resources model: state of the art. Journal of Managerial Psychology 22, 309–328.
Bakker, A.B., Demerouti, E., Verbeke, W., 2004. Using the job demands-resources model to predict burnout and performance. Human Resource Management: Published in Cooperation with the School of Business Administration, The University of Michigan and in alliance with the Society of Human Resources Management 43, 83–104.
Bakker, A.B., Demerouti, E., Euwema, M.C., 2005. Job Resources Buffer the Impact of Job Demands on Burnout. Journal of Occupational Health Psychology 10, 170–180.
Balasubramanian, V., Jagannath, M., 2014. Detecting motorcycle rider local physical fatigue and discomfort using surface electromyography and seat interface pressure. Transportation Research Part F: Traffic Psychology and Behaviour 22, 150–158.
Berthelsen, H., Hakanen, J.J., Westerlund, H., 2018. Copenhagen psychosocial questionnaire-a validation study using the job demand-resources model. PloS one 13, e0196450.
Bronkhorst, B., 2015. Behaving safely under pressure: The effects of job demands, resources, and safety climate on employee physical and psychosocial safety behavior. Journal of Safety Research 55, 63–72.
Brough, P., Timms, C., Siu, O.-L., Kalliath, T., O'Driscoll, M.P., Sit, C.H.P., Lo, D., Lu, C.-Q., 2013. Validation of the Job Demands-Resources model in cross-national samples: Cross-sectional and longitudinal predictions of psychological strain and work engagement. Human Relations 66, 1311–1335.
Byun, J.H., Jeong, B.Y., Park, M.H., 2017. Characteristics of motorcycle crashes of food delivery workers. Journal of the Ergonomics Society of Korea 36, 157–168.
Byun, J.H., Park, M.H., Jeong, B.Y., 2020. Effects of age and violations on occupational accidents among motorcyclists performing food delivery. Work 65, 53–61.
Chang, H.-L., Yeh, T.-H., 2007. Motorcyclist accident involvement by age, gender, and risky behaviors in Taipei. Taiwan. *Transportation Research Part F: Traffic Psychology and Behaviour* 10, 109–122.
Chen, C.F., Chen, S.C., 2014. Investigating the effects of job demands and job resources on cabin crew safety behaviors. Tourism Management 41, 45–52.
Chen, H.-K., Yan, D.-W., 2019. Interrelationships between influential factors and behavioral intention with regard to autonomous vehicles. International Journal of Sustainable Transportation 13, 511–527.
Cheung, C.M., Zhang, R.P., Cui, Q., Hsu, S.-C., 2021. The antecedents of safety leadership: The job demands-resources model. Safety Science 133, 104979.
Chu, F., Guo, M., Liu, S., Chen, S., 2020. Work-family conflict, personality, and safety behaviors among high-speed railway drivers. Journal of Transportation Safety & Security 12, 1147–1163.
Cini, L., Maccarrone, V., Tassinari, A., 2021. With or without U (nions)? Understanding the diversity of gig workers' organizing practices in Italy and the UK. European Journal of Industrial Relations 09596801211052531.
Clarke, S., 2013. Safety leadership: A meta-analytic review of transformational and transactional leadership styles as antecedents of safety behaviours. Journal of occupational and organizational psychology 86, 22–49.
Cœugnet, S., Naveteur, J., Antoine, P., Anceaux, F., 2013. Time pressure and driving: Work, emotions and risks. Transportation Research Part F: Traffic Psychology and Behaviour 20, 39–51.
Constantinou, E., Panayiotou, G., Konstantinou, N., Loutsiou-Ladd, A., Kapardis, A., 2011. Risky and aggressive driving in young adults: Personality matters. Accident Analysis & Prevention 43, 1323–1331.
Costantini, A., Ceschi, A., Oviedo-Trespalacios, O., 2022. Eyes on the road, hands upon the wheel? Reciprocal dynamics between smartphone use while driving and job crafting. Transportation Research Part F: Traffic Psychology and Behaviour 89, 129–142. In this issue.
Creaser, J.I., Ward, N.J., Rakauskas, M.E., Shankwitz, C., Boer, E.R., 2009. Effects of alcohol impairment on motorcycle riding skills. Accident Analysis and Prevention 41, 906–913.
Crizzle, A.M., McLean, M., Malkin, J., 2020. Risk Factors for Depressive Symptoms in Long-Haul Truck Drivers. International Journal of Environmental Research and Public Health 17.
Curry, A.E., Pfeiffer, M.R., Elliott, M.R., 2017. Compliance With and Enforcement of Graduated Driver Licensing Restrictions. American Journal of Preventive Medicine 52, 47–54.
da Silva, D. W., Andrade, S. M. d., Soares, D. F. P. d. P., Mathias, T. A. d. F., Matsuo, T. & de Souza, R. K. T. 2012. Factors associated with road accidents among Brazilian motorcycle couriers. *The Scientific World Journal,* 2012.
China Daily 2018. Summary of Interesting Data in Meituan.
de Palma, A., Picard, N., 2005. Route choice decision under travel time uncertainty. Transportation Research Part A: Policy and Practice 39, 295–324.
Demerouti, E., Bakker, A.B., Nachreiner, F., Schaufeli, W.B., 2000. A model of burnout and life satisfaction amongst nurses. Journal of advanced nursing 32, 454–464.
Demerouti, E., Bakker, A.B., Nachreiner, F., Schaufeli, W.B., 2001. The job demands-resources model of burnout. Journal of Applied psychology 86, 499.
Demerouti, E., Le Blanc, P.M., Bakker, A.B., Schaufeli, W.B., Hox, J., 2009. Present but sick: a three-wave study on job demands, presenteeism and burnout. Career Development. International.
Di Meco, A., Bennett, J.M., Batchelor, J., Chekaluk, E., Andrews, E., Habib, J., 2021. The role of cognition for identifying unsafe young drivers. Safety Science 138, 105099.
Dijkhuizen, J., Gorgievski, M., van Veldhoven, M., Schalk, R., 2016. Feeling successful as an entrepreneur: a job demands—resources approach. International entrepreneurship and management journal 12, 555–573.
Dollard, M.F., Tuckey, M.R., Dormann, C., 2012. Psychosocial safety climate moderates the job demand–resource interaction in predicting workgroup distress. Accident Analysis & Prevention 45, 694–704.
Duarte, P., Amaro, S., 2018. Methods for modelling reflective-formative second order constructs in PLS. Journal of Hospitality and Tourism Technology 9, 295–313.

Eagly, A. H. & Chaiken, S. 1993. *The psychology of attitudes*, Harcourt brace Jovanovich college publishers.
Endriulaitienė, A., Šeibokaitė, L., Žardeckaitė-Matulaitienė, K., Markšaitytė, R., Slavinskienė, J., 2018. Attitudes towards risky driving and Dark Triad personality traits in a group of learner drivers. Transportation Research Part F: Traffic Psychology and Behaviour 56, 362–370.
Fornell, C., Bookstein, F.L., 1982. Two structural equation models: LISREL and PLS applied to consumer exit-voice theory. Journal of Marketing Research 19, 440–452.
Fornell, C., Larcker, D.F., 1981. Evaluating structural equation models with unobservable variables and measurement error. Journal of Marketing Research 18, 39–50.
Friswell, R., Williamson, A., 2008. Exploratory study of fatigue in light and short haul transport drivers in NSW, Australia. Accident Analysis and Prevention 40, 410–417.
Galiere, S., 2020. When food-delivery platform workers consent to algorithmic management: a Foucauldian perspective. New Technology, Work and Employment 35, 357–370.
Gao, X., Shi, X., Guo, H., Liu, Y., 2020. To buy or not buy food online: The impact of the COVID-19 epidemic on the adoption of e-commerce in China. PloS one 15, e0237900.
Goldenhar, L.M., Williams, L.J., Swanson, N.G., 2003. Modelling relationships between job stressors and injury and near-miss outcomes for construction labourers. Work and Stress 17, 218–240.
Goods, C., Veen, A., Barratt, T., 2019. "Is your gig any good?" Analysing job quality in the Australian platform-based food-delivery sector. Journal of Industrial Relations 61, 502–527.
Guého, L., Granié, M.-A., Abric, J.-C., 2014. French validation of a new version of the Driver Behavior Questionnaire (DBQ) for drivers of all ages and level of experiences. Accident Analysis & Prevention 63, 41–48.
Hair, J. F., Hult, G. T. M., Ringle, C. M. & Sarstedt, M. 2017. *A primer on partial least squares structural equation modeling (PLS-SEM)*, Sage Publications, Inc.
Hair, J.F., Ringle, C.M., Sarstedt, M., 2011. PLS-SEM: Indeed a silver bullet. Journal of Marketing Theory and Practice 19, 139–152.
Haghani, Milad, Behnood, Ali, Oviedo-Trespalacios, Oscar, Bliemer, Michiel C.J., 2021. Structural anatomy and temporal trends of road accident research: Full-scope analyses of the field. Journal of Safety Research 79, 173–198.
Hair Jr, J.F., Matthews, L.M., Matthews, R.L., Sarstedt, M., 2017b. PLS-SEM or CB-SEM: updated guidelines on which method to use. International Journal of Multivariate Data Analysis 1, 107–123.
Hakanen, J.J., Schaufeli, W.B., Ahola, K., 2008. The Job Demands-Resources model: A three-year cross-lagged study of burnout, depression, commitment, and work engagement. Work & Stress 22, 224–241.
Hall, G.B., Dollard, M.F., Winefield, A.H., Dormann, C., Bakker, A.B., 2013. Psychosocial safety climate buffers effects of job demands on depression and positive organizational behaviors. Anxiety Stress and Coping 26, 355–377.
Hansez, I., Chmiel, N., 2010. Safety behavior: Job demands, job resources, and perceived management commitment to safety. Journal of Occupational Health Psychology 15, 267–278.
Harris, P.B., Houston, J.M., Vazquez, J.A., Smither, J.A., Harms, A., Dahlke, J.A., Sachau, D.A., 2014. The Prosocial and Aggressive Driving Inventory (PADI): A self-report measure of safe and unsafe driving behaviors. Accident Analysis & Prevention 72, 1–8.
Hartley, L.R., El Hassani, J., 1994. Stress, violations and accidents. Applied Ergonomics 25, 221–230.
Hayman, J., 2005. Psychometric assessment of an instrument designed to measure work life balance. Research and practice in human resource management 13, 85–91.
Henseler, J., Ringle, C. M. & Sinkovics, R. R. 2009. The use of partial least squares path modeling in international marketing. *In:* Sinkovics, R. R. & Ghauri, P. N. (eds.) *New challenges to international marketing.* Bingley: Emerald Group Publishing Limited.
Henseler, J., Ringle, C.M., Sarstedt, M., 2015. A new criterion for assessing discriminant validity in variance-based structural equation modeling. Journal of the Academy of Marketing Science 43, 115–135.
Henseler, J., Hubona, G., Ray, P.A., 2016. Using PLS path modeling in new technology research: updated guidelines. Industrial Management & Data Systems 116, 2–22.
Hensher, D.A., Greene, W.H., Li, Z., 2011. Embedding risk attitude and decision weights in non-linear logit to accommodate time variability in the value of expected travel time savings. Transportation Research Part B: Methodological 45, 954–972.
Hofmann, D.A., Morgeson, F.P., 1999. Safety-related behavior as a social exchange: The role of perceived organizational support and leader–member exchange. Journal of applied psychology 84, 286.
Hu, L. t. & Bentler, P. M. 1999. Cutoff criteria for fit indexes in covariance structure analysis: Conventional criteria versus new alternatives. *Structural Equation Modeling: A Multidisciplinary Journal,* 6, 1-55.
Husain, N.A., Mohamad, J., Idris, M.A., 2019. Daily emotional demands on traffic crashes among taxi drivers: Fatigue and safety motivation as mediators. IATSS Research 43, 268–276.
Huynh, D. 2019. Making Megacities in Asia: Comparing National Economic Development Trajectories, Springer Nature.
Iversen, H., 2004. Risk-taking attitudes and risky driving behaviour. Transportation Research Part F: Traffic Psychology and Behaviour 7, 135–150.
Jung, M., Lim, S., Chi, S., 2020. Impact of Work Environment and Occupational Stress on Safety Behavior of Individual Construction Workers. International Journal of Environmental Research and Public Health 17.
Karasek, R., Brisson, C., Kawakami, N., Houtman, I., Bongers, P., Amick, B., 1998. The Job Content Questionnaire (JCQ): an instrument for internationally comparative assessments of psychosocial job characteristics. Journal of Occupational Health Psychology 3, 322.
Kline, R. B. 2011. *Principles and practice of structural equation modeling,* New York, Guilford Press.
Khan, Gohar F., Sarstedt, Marko, Shiau, Wen-Lung, Hair, Joseph F., Ringle, Christian M., Fritze, Martin P., 2019. Methodological research on partial least squares structural equation modeling (PLS-SEM): An analysis based on social network approaches. Internet Research 29 (3), 407–429.
Kvalheim, S.A., Dahl, O., 2016. Safety compliance and safety climate: A repeated cross-sectional study in the oil and gas industry. Journal of Safety Research 59, 33–41.
Laurent, J., Chmiel, N., Hansez, I., 2018. Jobs and safety: A social exchange perspective in explaining safety citizenship behaviors and safety violations. Safety Science 110, 291–299.
Lawton, R., 1998. Not working to rule: Understanding procedural violations at work. Safety Science 28, 77–95.
Leiter, M. P. & Arnold, B. B. 2014. The contemporary context of job burnout. *Burnout at work.* Psychology Press.
Leiter, M. P. & Bakker, A. B. 2014. The contemporary context of job burnout. *Burnout at work.* Psychology Press.
Li, F., Jiang, L., Yao, X., Li, Y., 2013. Job demands, job resources and safety outcomes: The roles of emotional exhaustion and safety compliance. Accident Analysis & Prevention 51, 243–251.
Li, C., Mirosa, M., Bremer, P., 2020. Review of online food delivery platforms and their impacts on sustainability. Sustainability 12, 5528.
Li, Z., Tirachini, A., Hensher, D.A., 2012. Embedding risk attitudes in a scheduling model: application to the study of commuting departure time. Transportation Science 46, 170–188.
Li, F., Wang, G.X., Li, Y.J., Zhou, R.G., 2017. Job demands and driving anger: The roles of emotional exhaustion and work engagement. Accident Analysis and Prevention 98, 198–205.
Li, M.K., Yu, J.J., Ma, L., Zhang, W., 2019. Modeling and mitigating fatigue-related accident risk of taxi drivers. Accident Analysis & Prevention 123, 79–87.
Liang, Q., Leung, M.-Y., Ahmed, K., 2021. How adoption of coping behaviors determines construction workers' safety: A quantitative and qualitative investigation. Safety Science 133, 105035.
Llamazares, J., Useche, S.A., Montoro, L., Alonso, F., 2021. Commuting accidents of Spanish professional drivers: when occupational risk exceeds the workplace. International journal of occupational safety and ergonomics 27, 754–762.
Lohmöller, J.-B., 2013. Latent variable path modeling with partial least squares. Springer Science & Business Media.

Lucidi, F., Mallia, L., Lazuras, L., Violani, C., 2014. Personality and attitudes as predictors of risky driving among older drivers. Accident Analysis & Prevention 72, 318–324.
Ma, M., Yan, X., Huang, H., Abdel-Aty, M., 2010. Safety of public transportation occupational drivers: Risk perception, attitudes, and driving behavior. Transportation Research Record 2145, 72–79.
Machin, M.A., Sankey, K.S., 2008. Relationships between young drivers' personality characteristics, risk perceptions, and driving behaviour. Accident Analysis & Prevention 40, 541–547.
Mallia, L., Lazuras, L., Violani, C., Lucidi, F., 2015. Crash risk and aberrant driving behaviors among bus drivers: The role of personality and attitudes towards traffic safety. Accident Analysis & Prevention 79, 145–151.
Martinussen, L.M., Sømhovd, M.J., Møller, M., Siebler, F., 2015. A Go/No-go approach to uncovering implicit attitudes towards safe and risky driving. Transportation Research Part F: Traffic Psychology and Behaviour 30, 74–83.
Meijman, T. F. & Mulder, G. 1998. Psychological aspects of workload. *A Handbook of Work and Organizational Psychology.* Psychology Press.
Meng, F., Li, S., Cao, L., Li, M., Peng, Q., Wang, C., Zhang, W., 2015. Driving Fatigue in Professional Drivers: A Survey of Truck and Taxi Drivers. Traffic Injury Prevention 16, 474–483.
Mullen, J., 2004. Investigating factors that influence individual safety behavior at work. Journal of Safety Research 35, 275–285.
Nahrgang, J.D., Morgeson, F.P., Hofmann, D.A., 2011. Safety at work: a meta-analytic investigation of the link between job demands, job resources, burnout, engagement, and safety outcomes. Journal of Applied Psychology 96, 71.
Ndagire, M., Kiwanuka, S., Paichadze, N., Kobusingye, O., 2019. Road safety compliance among motorcyclists in Kawempe Division, Kampala, Uganda: a cross-sectional study. International Journal of Injury Control and Safety Promotion 26, 315–321.
Neal, A., Griffin, M.A., Hart, P.M., 2000. The impact of organizational climate on safety climate and individual behavior. Safety Science 34, 99–109.
Neal, A., Griffin, M.A., 2006. A study of the lagged relationships among safety climate, safety motivation, safety behavior, and accidents at the individual and group levels. Journal of Applied Psychology 91, 946.
Newnam, S., Mamo, W.G., Tulu, G.S., 2014. Exploring differences in driving behaviour across age and years of education of taxi drivers in Addis Ababa, Ethiopia. Safety Science 68, 1–5.
Nguyen, M.H., Armoogum, J., Nguyen Thi, B., 2021. Factors affecting the growth of e-shopping over the covid-19 era in Hanoi. Vietnam. *Sustainability* 13, 9205.
Nguyen-Phuoc, D.Q., Nguyen, A.H., De Gruyter, C., Su, D.N., Nguyen, V.H., 2019a. Exploring the prevalence and factors associated with self-reported traffic crashes among app-based motorcycle taxis in Vietnam. Transport Policy 81, 68–74.
Nguyen-Phuoc, D.Q., Phuong Tran, A.T., De Gruyter, C., Kim, I., Ngoc, S.u., D., 2019b. Turn signal use among car drivers and motorcyclists at intersections: a case study of Da Nang. Vietnam. *Accident Analysis and Prevention* 128, 25–31.
Nguyen-Phuoc, D.Q., De Gruyter, C., Nguyen, H.A., Nguyen, T., Su, D.N., 2020a. Risky behaviours associated with traffic crashes among app-based motorcycle taxi drivers in Vietnam. Transportation Research Part F: Traffic Psychology and Behaviour 70, 249–259.
Nguyen-Phuoc, D.Q., De Gruyter, C., Oviedo-Trespalacios, O., Ngoc, S.D., Tran, A.T.P., 2020b. Turn signal use among motorcyclists and car drivers: The role of environmental characteristics, perceived risk, beliefs and lifestyle behaviours. Accident Analysis & Prevention 144, 105611.
Nguyen-Phuoc, D.Q., Oviedo-Trespalacios, O., Nguyen, T., Su, D.N., 2020c. The effects of unhealthy lifestyle behaviours on risky riding behaviours–A study on app-based motorcycle taxi riders in Vietnam. Journal of Transport & Health 16, 100666.
Nguyen-Phuoc, D.Q., Oviedo-Trespalacios, O., Su, D.N., De Gruyter, C., Nguyen, T., 2020d. Mobile phone use among car drivers and motorcycle riders: The effect of problematic mobile phone use, attitudes, beliefs and perceived risk. Accident Analysis & Prevention 143, 105592.
Nguyen-Phuoc, D.Q., Su, D.N., Tran, P.T.K., Le, D.-T.-T., Johnson, L.W., 2020e. Factors influencing customer's loyalty towards ride-hailing taxi services–A case study of Vietnam. Transportation Research Part A: Policy and Practice 134, 96–112.
Nielsen, M.B., Mearns, K., Matthiesen, S.B., Eid, J., 2011. Using the Job Demands-Resources model to investigate risk perception, safety climate and job satisfaction in safety critical organizations. Scandinavian Journal of Psychology 52, 465–475.
Nunnally, J. C. & Bernstein, I. H. 1994. *Psychometric theory,* New York, McGraw-Hill.
Nykänen, M., Sund, R., Vuori, J., 2018. Enhancing safety competencies of young adults: A randomized field trial (RCT). Journal of Safety Research 67, 45–56.
Olumide, A.O., Owoaje, E.T., 2015. Young Age as a Predictor of Poor Road Safety Practices of Commercial Motorcyclists in Oyo State, Nigeria. Traffic Inj Prev 16, 691–697.
Oviedo-Trespalacios, O., 2018. Getting away with texting: Behavioural adaptation of drivers engaging in visual-manual tasks while driving. Transportation Research Part A: Policy and Practice 116, 112–121.
Oviedo-Trespalacios, O., Afghari, A.P., Haque, M.M., 2020. A hierarchical Bayesian multivariate ordered model of distracted drivers' decision to initiate risk-compensating behaviour. Analytic Methods in Accident Research 26, 100121.
Oviedo-Trespalacios, O., Çelik, A.K., Marti-Belda, A., Włodarczyk, A., Demant, D., Nguyen-Phuoc, D.Q., Rubie, E., Oktay, E., Argandar, G.D., Rod, J., 2021. Alcohol-impaired walking in 16 countries: a theory-based investigation. Accident Analysis & Prevention 159, 106212.
Oviedo-Trespalacios, O., Phillips, J.G., 2021. Sexual activity while driving: A content analysis of media reports. Transportation Research Part F: Traffic Psychology and Behaviour 80, 141–149.
Oviedo-Trespalacios, O., Rubie, E., Haworth, N., 2022. Risky business: Comparing the riding behaviours of food delivery and private bicycle riders. Accident Analysis & Prevention 177, 106820. In this issue.
Oviedo-Trespalacios, O., Scott-Parker, B., 2017. Transcultural validation and reliability of the Spanish version of the behaviour of young novice drivers scale (BYNDS) in a Colombian young driver population. Transportation Research Part F: Traffic Psychology Behaviour 49, 188–204.
Oviedo-Trespalacios, O., Scott-Parker, B., 2018. Young drivers and their cars: Safe and sound or the perfect storm? Accident Analysis Prevention 110, 18–28.
Papakostopoulos, V., Nathanael, D., 2021. The Complex Interrelationship of Work-Related Factors Underlying Risky Driving Behavior of Food Delivery Riders in Athens, Greece. Safety and Health at Work 12, 147–153.
Parker, D., Manstead, A. S., Stradling, S. G., Reason, J. T. & et, a. 1992. Intention to commit driving violations: An application of the theory of planned behavior. *Journal of Applied Psychology,* 77, 94-101.
Pawar, N.M., Khanuja, R.K., Choudhary, P., Velaga, N.R., 2020. Modelling braking behaviour and accident probability of drivers under increasing time pressure conditions. Accident Analysis & Prevention 136, 105401.
Pojani, D., Stead, D., 2015. Sustainable urban transport in the developing world: Beyond megacities. Sustainability 7, 7784–7805.
Popan, C. 2021. Algorithmic Governance in the Gig Economy: Entrepreneurialism and solidarity among food delivery workers. *Cycling Societies.* Routledge.
Poulter, D.R., Chapman, P., Bibby, P.A., Clarke, D.D., Crundall, D., 2008. An application of the theory of planned behaviour to truck driving behaviour and compliance with regulations. Accid Anal Prev 40, 2058–2064.
Qin, H., Wei, Y., Zhang, Q., Ma, L., 2021. An observational study on the risk behaviors of electric bicycle riders performing meal delivery at urban intersections in China. Transportation Research Part F: Traffic Psychology and Behaviour 79, 107–117.
Statista Reports 2018. eServices Report 2018 – Online Food Delivery. Hamburg, Germany.
Rosenbloom, T., Wolf, Y., 2002. Sensation seeking and detection of risky road signals: a developmental perspective. Accident Analysis & Prevention 34, 569–580.
Rowden, P., Matthews, G., Watson, B., Biggs, H., 2011. The relative impact of work-related stress, life stress and driving environment stress on driving outcomes. Accident Analysis & Prevention 43, 1332–1340.
Rowe, R., Andrews, E., Harris, P.R., Armitage, C.J., McKenna, F.P., Norman, P., 2016. Identifying beliefs underlying pre-drivers' intentions to take risks: An application of the Theory of Planned Behaviour. Accid Anal Prev 89, 49–56.
Rusli, R., Oviedo-Trespalacios, O., Abd Salam, S.A., 2020. Risky riding behaviours among motorcyclists in Malaysia: A roadside survey. Transportation Research Part F: Traffic Psychology and Behaviour 74, 446–457.
Salanova, M., Schaufeli, W.B., 2008. A cross-national study of work engagement as a mediator between job resources and proactive behaviour. The International Journal of Human Resource Management 19, 116–131.

Sandhåland, H., Oltedal, H.A., Hystad, S.W., Eid, J., 2017. Effects of leadership style and psychological job demands on situation awareness and the willingness to take a risk: A survey of selected offshore vessels. Safety Science 93, 178–186.
Santos, W. J. d., Cêlho, V. M. d. S., Santos, G. B. & Ceballos, A. G. d. C. d. 2019. Work overload and risk behaviors in motorcyclists. *Revista brasileira de enfermagem,* 72**,** 1479-1484.
Schaufeli, W.B., Bakker, A.B., 2004. Job demands, job resources, and their relationship with burnout and engagement: A multi-sample study. Journal of Organizational Behavior: The International Journal of Industrial, Occupational and Organizational Psychology and Behavior 25, 293–315.
Schaufeli, W.B., Taris, T.W., 2014. A critical review of the job demands-resources model: Implications for improving work and health. Bridging occupational, organizational and public health 43–68.
Schaufeli, W.B., Taris, T.W., Van Rhenen, W., 2008. Workaholism, burnout, and work engagement: three of a kind or three different kinds of employee well-being? Applied psychology 57, 173–203.
Shan, D., Neis, B., 2020. Employment-related mobility, regulatory weakness and potential fatigue-related safety concerns in short-sea seafaring on Canada's Great Lakes and St. Lawrence Seaway: Canadian seafarers' experiences. Safety Science 121, 165–176.
Shi, J., Xiao, Y., Tao, L., Atchley, P., 2018. Factors causing aberrant driving behaviors: A model of problem drivers in China. Journal of Transportation Safety & Security 10, 288–302.
Singh, A. 2021. Top 10 successful online food delivery apps in the world. Net Solutions.
Southgate, P. & Mirrlees-Black, C. 1991. *Traffic policing in changing times*, HM Stationery Office.
Strahan, C., Watson, B., Lennonb, A., 2008. Can organisational safety climate and occupational stress predict work-related driver fatigue? Transportation Research Part F: Traffic Psychology and Behaviour 11, 418–426.
Su, D.N., Nguyen-Phuoc, D.Q., Johnson, L.W., 2019. Effects of perceived safety, involvement and perceived service quality on loyalty intention among ride-sourcing passengers. Transportation 1–25.
Tagod, Manal, et al., 2021. Coercive pressure as a moderator of organizational structure and risk management: Empirical evidence from Malaysian construction industry. Journal of Safety Research 77, 139–150.
Tong, R., Yang, X., Li, H., Li, J., 2019. Dual process management of coal miners' unsafe behaviour in the Chinese context: Evidence from a meta-analysis and inspired by the JD-R model. Resources Policy 62, 205–217.
Tran, N.T., Bachani, A.M., Pham, V.C., Lunnen, J.C., Jo, Y., Passmore, J., Nguyen, P.N., Hyder, A.A., 2012. Drinking and driving in Vietnam: public knowledge, attitudes, and practices. Traffic Injury Prevention 13, 37–43.
Truong, L.T., Nguyen, H.T.T., Tay, R., 2020. A random parameter logistic model of fatigue-related motorcycle crash involvement in Hanoi. Vietnam. *Accident Analysis & Prevention* 144, 105627.
Tseng, C.-M., Yeh, M.-S., Tseng, L.-Y., Liu, H.-H., Lee, M.-C., 2016. A comprehensive analysis of factors leading to speeding offenses among large-truck drivers. Transportation Research Part F: Traffic Psychology and Behaviour 38, 171–181.
Turner, N., Stride, C.B., Carter, A.J., McCaughey, D., Carroll, A.E., 2012. Job Demands–Control–Support model and employee safety performance. Accident Analysis & Prevention 45, 811–817.
Ulleberg, P., 2001. Personality subtypes of young drivers. Relationship to risk-taking preferences, accident involvement, and response to a traffic safety campaign. Transportation Research Part F: Traffic Psychology and Behaviour 4, 279–297.
Ulleberg, P., Rundmo, T., 2003. Personality, attitudes and risk perception as predictors of risky driving behaviour among young drivers. Safety Science 41, 427–443.
Urie, Y., Velaga, N.R., Maji, A., 2016. Cross-sectional study of road accidents and related law enforcement efficiency for 10 countries: A gap coherence analysis. Traffic Injury Prevention 17, 686–691.
Useche, S.A., Ortiz, V.G., Cendales, B.E., 2017. Stress-related psychosocial factors at work, fatigue, and risky driving behavior in bus rapid transport (BRT) drivers. Accid Anal Prev 104, 106–114.
Useche, S.A., Montoro, L., Alonso, F., Pastor, J.C., 2019. Psychosocial Work Factors, Job Stress and Strain at the Wheel: Validation of the Copenhagen Psychosocial Questionnaire (COPSOQ) in Professional Drivers. Frontiers in Psychology 10.
Vahedi, J., Shariat Mohaymany, A., Tabibi, Z., Mehdizadeh, M., 2018. Aberrant Driving Behaviour, Risk Involvement, and Their Related Factors Among Taxi Drivers. International Journal of Environmental Research and Public Health 15.
Van Den Tooren, M., De Jonge, J., 2008. Managing job stress in nursing: what kind of resources do we need? Journal of advanced nursing 63, 75–84.
Van Ruysseveldt, J., Verboon, P., Smulders, P., 2011. Job resources and emotional exhaustion: The mediating role of learning opportunities. Work & Stress 25, 205–223.
VietnamCredit 2020. Overview of Vietnam's food delivery market. Hanoi, Vietnam.
VietnamPlus 2021. Vietnam's average monthly income in 2020 down 1 percent. Vietnam.
Wang, Y., Li, L., Prato, C.G., 2019. The relation between working conditions, aberrant driving behaviour and crash propensity among taxi drivers in China. Accident Analysis & Prevention 126, 17–24.
Wei, W., Guo, M., Ye, L., Liao, G., Yang, Z., 2016. Work-family conflict and safety participation of high-speed railway drivers: Job satisfaction as a mediator. Accident Analysis & Prevention 95, 97–103.
Westaby, J.D., Lowe, J.K., 2005. Risk-taking orientation and injury among youth workers: examining the social influence of supervisors, coworkers, and parents. Journal of Applied Psychology 90, 1027.
Yagil, D., 1998. Gender and age-related differences in attitudes toward traffic laws and traffic violations. Transportation Research Part F: Traffic Psychology and Behaviour 1, 123–135.
Yagil, D., Luria, G., 2010. Friends in need: the protective effect of social relationships under low-safety climate. Group & Organization Management 35, 727–750.
Yang, L., Feng, Z., Zhao, X., Jiang, K., Huang, Z., 2020. Analysis of the factors affecting drivers' queue-jumping behaviors in China. Transportation Research Part F: Traffic Psychology and Behaviour 72, 96–109.
Yang, J., Hu, Y., Du, W., Powis, B., Ozanne-Smith, J., Liao, Y., Li, N., Wu, M., 2014. Unsafe riding practice among electric bikers in Suzhou, China: an observational study. BMJ Open 4, e003902.
Yelgin, C., Ergun, N., 2021. The effects of job demands and job resources on the safety behavior of cabin crew members: a qualitative study. International Journal of Occupational Safety and Ergonomics 1–11.
Yelgin, Ç., Ergün, N., 2021. The effects of job demands and job resources on the safety behavior of cabin crew members: a qualitative study. International Journal of Occupational Safety and Ergonomics 1–11.
Zaal, D. 1994. Traffic law enforcement: A review of the literature. Clayton, Victoria: Monash University Accident Research Centre.
Zhang, Z., Guo, Y., Fu, R., Yuan, W., Yang, G., 2020b. Do situational or cognitive factors contribute more to risky driving? A simulated driving study. Cognition, Technology & Work 22, 759–767.
Zhang, Y., Huang, Y., Wang, Y., Casey, T.W., 2020a. Who uses a mobile phone while driving for food delivery? The role of personality, risk perception, and driving self-efficacy. Journal of Safety Research 73, 69–80.
Zheng, Y., Ma, Y., Guo, L., Cheng, J., Zhang, Y., 2019. Crash Involvement and Risky Riding Behaviors among Delivery Riders in China: The Role of Working Conditions. Transportation Research Record 2673, 1011–1022.
Zhong, S.Q., Zhou, L.Z., Ma, S.F., Jia, N., 2012. Effects of different factors on drivers' guidance compliance behaviors under road condition information shown on VMS. Transportation Research Part a-Policy and Practice 46, 1490–1505.
Zohar, D., 2000. A group-level model of safety climate: testing the effect of group climate on microaccidents in manufacturing jobs. Journal of applied psychology 85, 587.