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Risky riding behaviour among young, motorized two-wheeler riders in India: A quantitative analysis of the psychosocial determinants

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ABSTRACT

Road crash injuries have emerged as a significant public health issue in many low-and middle-income countries in recent years. Annually, more than 1.35 million people lose their lives due to road crashes, making it one of the leading causes of death worldwide. In India, road crash injuries have increasingly become a major concern for motorized two-wheeler riders. It is important to understand risky riding behaviours to develop accurate and evidence-based risk reduction programmes that fit the target population well. The current study aimed to identify the psychosocial determinants of refraining from risky riding behaviour in young, motorized two-wheeler riders. A quantitative survey based on the theory of planned behaviour (TPB) complemented with questions measuring routine behaviours was conducted among 238 young riders aged 18–25 riding motorized two-wheelers in Manipal, a locality of Udupi district in Karnataka province of Southwestern India. The study tool assessed four risky riding behaviours: (1) speeding, (2) helmet non-use, (3) performing stunts, and (4) using mobile phones while riding. The results of the study indicated that the intention to refrain from risky riding behaviours can be explained by important psychosocial determinants of human behaviour, including attitude, social norms, and perceived behavioural control and their underlying belief systems with regard to perceived benefits and costs, perceptions of other's behaviours and approval, and expressions of personal control that inform these psychosocial determinants. In addition, the extent to which participants automatically behaved in risky riding practices in the past did not prove to be a strong predictor of future intentions to refrain from risky riding. It is concluded that the study resulted in an in-depth understanding of the psychosocial determinants of risky riding behaviour. Policymakers and programme developers are encouraged to use the findings in defining programme goals for future educational interventions to promote safe two-wheeler riding.

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1. Introduction

Road crashes have emerged as the latest significant public health challenge in several low and middle-income countries (LMICs) in Asia and Africa. In total, LMICs contribute to 92 % of the road traffic injuries (RTIs) associated with mortality. The economic cost involved in road traffic trauma injuries varies between 1 % and 2 % of the total national product in LMICs, causing 1.19 million deaths in 2021 which corresponds to a rate of 15 road traffic deaths per 100,000 population (WHO, 2023). In India, road crashes kill almost 150,000 people annually, which accounts for almost 11 % of the crash-related deaths in the world. It is noteworthy to mention that the total number of deaths related to RTIs is expected to cross the 250,000 mark by 2025 in India (Singh, 2017). Globally, around one-fourth of all road crashes are among motorized two-wheelers (MTWs) riders. Globally, four-wheeler vehicle occupants represent 30 % of fatalities; followed by pedestrians who make up 23 % of fatalities; and powered two- and three-wheeler users who make up 21 % of fatalities. Furthermore, in the Southeast Asian and the Western Pacific regions, most deaths are among riders of motorized two- and three-wheelers, who represent 43 % and 36 % of all deaths, respectively (WHO, 2023).

With the exponential increase in MTWs usage in the last twenty years, road crashes involving motorists have emerged as India's latest public health concern (MoRTH; Annual report, 2022). In LMICs, MTWs are actively used for commutation and day-to-day activities. MTWs' riders contribute to the major share of this burden as they are less protected than the driver or passengers of a car as their bodies are exposed directly to an obstacle or another vehicle (Gopalakrishnan, 2012). Figures indicate that the issue is very prevalent in the younger population. Indeed, road crashes are one of the leading causes of premature deaths among the youth population in developing countries like India (Konlan et al., 2020; Wong et al., 2010). Motorists between 18–25 years of age are more vulnerable to road crashes as compared to any other road users, accounting for 50 % of the total crash-related deaths (MoRTH; Annual report, 2022; WHO, 2023). Furthermore, they account for 19.8 % of India's total road crash victims in 2022 (MoRTH; Annual report, 2022).

Robbins and Chapman (2019) reported that young people are more prone to crashes due to two factors: experience and age. Firstly, crash risk is higher for young drivers due to a lack of experience, for instance, in comprehending, assessing, and responding to hazards. Also, experience issues could be at play for inexperienced MTW riders. Secondly, age-related, risky driving amongst young drivers has been theoretically explained by neurocognitive evidence that suggests an imbalance between the development of the social-affective brain and the cognitive control system during the transition period from child to adult (Ross et al., 2016). That is, the socio-emotional reward system of the brain shows early adolescent remodelling while the cognitive control system (e.g., inhibitory control, working memory, mental flexibility and planning) matures more gradually among people who are in their 20s. This maturational gap between both brain systems makes it challenging for youngsters to self-regulate impulsive responses, which is even more visible in males than in females. These different trajectories in male and female brains thus also suggest that male road users, compared with female road users, prioritize the benefits of risk-taking over the costs associated with it (Robbins & Chapman, 2019; Rolison & Moutari, 2020; Rahman et al., 2021).

Considering the causes of road crashes in India, overspeeding is the leading cause of road crashes, contributing to 72.3 % of the total crashes (MoRTH; Annual report, 2022). Several previous studies have observed speeding as the main cause of fatal crashes (e.g., Gururaj, 2014; Ruikar, 2013). Speeding can be either excessive (riding beyond the lawful limit) or inappropriate (riding within limits, but too fast for the traffic condition) and it poses a significant risk for fatal crashes (Begg & Langley, 2001). Speeding is influenced by several psychological factors such as beliefs and perceptions associated with speeding and different motives, including impression management, risk-taking, and sensation-seeking (Mannering, 2009). Mobile phone usage while riding is another common behaviour observed among young riders. In a study conducted in Mysore, India by Setty et al. (2020) it was observed that 50 % of the observed riders use mobile phones while riding. A multi-city nationwide survey conducted to understand the utilization patterns, its effects, as well as the perception of mobile phone usage among road users across India, mentioned that 94 % of the respondents believed that the use of a mobile phone while riding is risky, 47 % of them receive calls while riding and 60 % do not stop riding before answering calls (Save LIFE Foundation, 2017).

In addition, it has been observed that predominantly due to humid climatic conditions, helmet usage is lower in several parts of coastal India (Hassan et al., 2017; Setty et al., 2020). Stunt performance on two-wheelers can often result in severe fatal road crashes (Watson et al., 2007). Some of the very few studies on stunt behaviour have stated that performing stunts is much riskier compared to other unsafe riding practices seen among two-wheelers. Those riders can be addressed as risk calculators as there can be possibilities that they might have either witnessed or themselves have past experiences of a road crash because of performing stunts. Furthermore, they were more persuaded by this belief, as they might have articulated road crash experiences as a potent reminder for them not to indulge in such activities (Bazargan-Hejazi et al., 2013).

To effectively design risk prevention programmes, it is essential to comprehensively understand the risk behaviour. Understanding the psychological factors that explain risk behaviour provides essential leads for designing educational programmes to promote safer riding behaviour in the priority population (Chen & Chen, 2011; Bartholomew Eldredge et al., 2016). Different theoretical frameworks in the social and health psychology field describe the determinants of human behaviour, among which is the Theory of Planned Behaviour or its most recent formulation the Reasoned Action Approach (Fishbein & Ajzen, 2010). Currently, there is a paucity of studies applying psychological and behavioural theories to investigate risky riding behaviour among motorists, particularly in LMICs like India. The current study aimed to understand the psychosocial precursors that motivate MTWs riders' speeding behaviour, helmet non-use, performing stunts, and use of mobile phones while riding by applying the TPB.

Table 1
Socio-demographic and crash details.

Variable	n (%)
Age	
18 to 20 years	66 (27.80
21 to 23 years	121 (50.80)
24 to 25 years	51 (21.40)
Gender	
Male	157 (66.00)
Female	81 (34.00)
Education	
Pre-university college	75 (31.50)
Undergraduate	106 (44.50)
Intern	16 (6.70)
Postgraduate	41 (17.20)
Type of motor vehicle	
Moped < 50 cc	5 (2.10)
Light motorcycle 50 – 125 cc	45 (18.90)
Motorcycle > 125 cc	59 (24.80)
Scooters (Activa, TVS, Vespa, Bajaj)	129 (54.20)
Riding alone/pillion	
Ride alone	200 (84.00)
Ride with a pillion rider	38 (16.00)
Years of riding	
< 1 year	41 (17.20)
1 to 5 years	176 (73.90)
6 to 7 years	21 (8.80)
Riding hours	
1 to 5 h	168 (70.60)
6 to 10 h	41 (17.20)
>10 h	29 (12.20)
Crash	
Yes, once	46 (19.30)
Yes, two times	24 (10.10)
Yes, three or more times	5 (2.10)
Never	163 (68.50)
Fines	
Yes	58 (24.40)
No	180 (75.60)
Near crash experience in the past one month	
Yes, once	20 (8.40)
Yes, two times	4 (1.70)
Yes, three or more times	8 (3.40)
No	206 (86.60)

1.1. Theory of planned behaviour (TPB) and its application to risk-taking behaviour

According to TPB, human behaviour is governed by behavioural intentions. Humans are expected to carry out their intentions whenever the opportunity arises, provided there are no environmental constraints that hinder them from executing their intentions and they have the necessary skills to carry out the intended behaviours (Fishbein & Ajzen, 2010). This behavioural intention branches out from three underlying factors: attitude, subjective norm, and Perceived behavioural control (PBC). Noteworthy to mention, that the three factors (i.e., attitudes, subjective norms, and PBC) are formed from three kinds of belief considerations. Attitude toward the behaviour is a person's overall evaluation of the behaviour (Francis et al., 2004). Attitudes are produced from behavioural beliefs (i.e., beliefs about the outcomes of their behaviours weighted by the corresponding outcome evaluation), including either positive or negative evaluations of these outcomes (Zhou et al., 2012; Papadimitriou et al., 2019). Subjective norms are a person's estimate of the social pressure to perform or not perform the target behaviour (Francis et al., 2004; Rowe et al., 2016). Subjective norms are produced from normative beliefs (i.e., beliefs about whether referents that are in some way essential to the person, think that one should perform his/her target behaviour weighted by the motivation to comply with that referent). PBC is the extent to which a person feels able to enact the behaviour (Francis et al., 2004). PBC result from control beliefs (i.e., beliefs about control factors facilitated by the perceived power of those factors). PBC has direct and mediated effects (by behavioural intention) on behaviour and refers to the person's perception of their ability to successfully engage and control that behaviour (Ajzen, 1991; Rowe et al., 2016).

The TPB has been widely applied in studying risky riding behaviours. For instance, several studies have applied the TPB to explain speeding behaviour (e.g., Conner et al., 2005; Paris & Van den Broucke, 2008). A study conducted in Taiwan investigated the speeding behaviour of riders of heavy bikes using the TPB (Chen & Chen, 2011). Perceived enjoyment and concentration seem to positively impact young riders' speeding behaviour. Furthermore, it affirmed individual factors, such as personality traits and experience, to reflect contrasts in speeding behaviour in past research (Chen & Chen, 2011). Furthermore, a study done in Vietnam (Van Le et al., 2023) to examine the influence of personality trait on risky riding behaviour using the extended theory of planned behaviour indicated

Table 2
Measures speeding behaviour.

Concepts	Items	Scoring**	Mean	SD
Perceived benefits α = 0.743	Following the speed limit makes me feel in control of my motorbike	1 = Fully disagree 5 = Fully agree	2.57	1.15
	Following the speed limit decreases crash risk	1 = Fully disagree 5 = Fully agree	3.72	1.15
	Following the speed limit allows me to better react to unforeseen traffic situations	1 = Fully disagree 5 = Fully agree	4.06	1.17
Perceived barriers α = 0.637	Following the speed limit makes me lose time*	1 = Fully agree 5 = Fully disagree	2.85	1.09
	Following the speed limit causes inconvenience for other riders on the road*	1 = Fully agree 5 = Fully disagree	3.43	1.15
	Following the speed limit restricts my freedom*	1 = Fully agree 5 = Fully disagree	3.30	1.14
	Following the speed limit makes it difficult to follow the surrounding traffic*	1 = Fully agree 5 = Fully disagree	3.25	1.14
Normative beliefs α = 0.734	Most riders I see on the road follow the speed limit	1 = Fully disagree 5 = Fully agree	2.82	1.17
	Most of my friends and known contacts think that speed limits should be followed	1 = Fully disagree 5 = Fully agree	3.68	1.13
	People who follow the speed limits are negatively evaluated by society*	1 = Fully agree 5 = Fully disagree	3.11	1.11
	Most people consider riders who follow the speed limit as gentle and decent	1 = Fully disagree 5 = Fully agree	3.74	1.08
	Most people consider riders who follow the speed limits as an example to be followed by other riders	1 = Fully disagree 5 = Fully agree	3.75	1.15
Control beliefs α = 0.686	For me, following the speed limit is dependent on how others behave*	1 = Fully agree 5 = Fully disagree	2.93	1.22
	Even if other riders are exceeding it, I can follow the speed limit	1 = Fully disagree 5 = Fully agree	3.58	1.18
	For me, always following the speed limit depends more on the circumstances than on myself*	1 = Fully agree 5 = Fully disagree	2.48	1.12
Attitude α = 0.606	Me following the speed limit every time I ride in the coming two weeks is …	1 = Very bad 5 = Very good	3.99	0.98
	Me following the speed limit every time I ride in the coming two weeks is …	1 = Very unpleasant 5 = Very pleasant	3.68	1.14
	Me following the speed limit every time I ride in the coming two weeks is …	1 = Very unwise 5 = Very wise	3.91	1.03
Subjective norm α = 0.789	Most people who are important to me … – Approve of me following the speed limit every time I ride	1 = Very unlikely 5 = Very likely	3.70	1.23
	Most people who are important to me … – Follow the speed limit themselves every time I ride	1 = Very unlikely 5 = Very likely	3.63	1.12
	Most people who are important to me……. – think I should follow the speed limit every time I ride	1 = Fully disagree 5 = Fully agree	3.92	1.18
Perceived behavioural control α = 0.787	I am confident that I can follow the speed limit every time I ride my bike	1 = Fully disagree 5 = Fully agree	3.80	1.19
	Me following the speed limit every time I ride is completely up to me	1 = Very unlikely 5 = Very likely	3.78	1.17
	If I wanted to, I could follow the speed limit every time I ride	1 = Very unlikely 5 = Very likely	3.91	1.15

(*continued on next page*)

Table 2 (*continued*)

Concepts	Items	Scoring**	Mean	SD
Intention α = 0.846	How likely is it that you will follow the speed limit every time you ride in the coming two weeks?	1 = Very unlikely 5 = Very likely	3.68	1.16
	I plan to follow the speed limit in the coming two weeks.	1 = Very unlikely 5 = Very likely	3.85	1.16
Habit α = 0.892	Speeding is something……. – I do automatically	1 = Very unlikely 5 = Very likely	2.33	1.21
	Speeding is something……. – I do without having to consciously remember	1 = Very unlikely 5 = Very likely	2.39	1.25
	Speeding is something……. – I do without thinking	1 = Very unlikely 5 = Very likely	2.41	1.29
	Speeding is something……. – I start doing before I realize I am doing it	1 = Very unlikely 5 = Very likely	2.35	1.19

* **Item is reverse coded for data reduction and data analysis.**
** **Scoring indicates the scoring after recoding.**

that personality traits directly but also indirectly influence risky riding behaviours through the mediating TPB constructs (Van Le et al., 2023; Chen 2009).

For helmet utilization, TBP was used in a study conducted in Cambodia among young riders. The results concluded that helmet usage is dependent on specific elements, such as riding short distances or when hair is styled to go out (Brijs et al., 2014). A study conducted by Shruthi et al. (2019) among the healthcare providers using TPB in Bangalore, India to investigate helmet usage practices revealed that although most respondents were aware of the advantage of using a helmet, 65 % of them reported using it regularly. PBC and intentions were significant indicators for helmet usage. Furthermore, knowledge of the advantages of helmet use and usage are positively correlated (Shruthi et al., 2019). TPB has also been used to examine psychological factors that affect decision-making or intention to use mobile phones while driving. For instance, Zhou et al. (2012) in China used TPB in predicting car drivers' answering intentions and compensatory decisions while driving and attitudes, subjective norms, perceived behavioural risk and control and prior answering behaviour emerged as common predictors. In recent times, in a study conducted by Nguyen et al. (2020) in Vietnam among small-displacement motorcycles using the TPB, it was reported that the intention to use a mobile phone while riding is associated with a negative attitude and PBC of the riders towards mobile phone use while riding.

2. Research aim

Informed by the TPB (Ajzen, 1991; Fishbein & Ajzen, 2010), this study aims to understand the psychosocial precursors that predict young MTWs riders' intention to use a helmet and refrain from speeding behaviour, mobile phone usage, and performing stunts while riding.

3. Methodology

3.1. Survey questions

The survey for exploring psychological determinants of refraining from risky riding behaviour among young MTWs riders' was conducted online using the software programme Qualtrics. At the time of data collection, the COVID-19 pandemic started and governmental restrictions applied regarding keeping social distance and staying at home. The survey contained questions identifying the demographic details, riding history, crash history, and psychosocial variables related to risky riding behaviours. The demographic questions were on gender, age, education, time spent on riding the two-wheelers, type of two-wheeler, licence issued, crash and conviction details, and past riding behaviour. Next, the study tool consisted of questions measuring attitude, social norms, PBC, self-reported behaviour, and intentions concerning the four identified risk behaviours (speeding, helmet non-use, performing stunts, and using mobile phones while riding).

3.2. Procedure and participants

Participants in the age range of 18 to 25 years residing in the university town of Manipal were recruited for this study. Manipal is situated on the Southwest coast of India, bordering the Arabian Sea in the state of Karnataka. Manipal is home to the Manipal Academy of Higher Education (MAHE), and it hosts approximately 30,000 students from across India and 60 countries all over the world. The study was approved by the institutional ethical committee of Kasturba Medical College at Manipal Academy of Higher Education, India (reference: KMC IEC-09/2018) and ethics committee, Hasselt University, Belgium (REC/SMEC/VRAI/189/128). The principal

Table 3
Measure helmet usage.

Concepts	Items	Scoring**	Mean	SD
Perceived benefits α = 0.761	Wearing a helmet protects me from dust and rain	1 = Fully disagree 5 = Fully agree	3.98	1.10
	Wearing a helmet protects me from getting into trouble with the police	1 = Fully disagree 5 = Fully agree	4.15	1.15
	Wearing a helmet decreases my risk of suffering a fatal crash	1 = Fully disagree 5 = Fully agree	4.13	1.15
Perceived barriers α = 0.670	Wearing a helmet obstructs my view while riding*	1 = Fully agree 5 = Fully disagree	2.98	1.17
	Wearing a helmet makes me feel heavy	1 = Fully disagree 5 = Fully agree	3.32	1.15
Normative beliefs α = 0.688	Most riders I see on the road wear a helmet while riding their bike	1 = Fully disagree 5 = Fully agree	3.24	1.12
	My friends think that I should never be riding without wearing a helmet	1 = Fully disagree 5 = Fully agree	3.80	1.21
	My parents think that I should never ride without wearing a helmet	1 = Fully disagree 5 = Fully agree	4.16	1.22
	People who wear a helmet while riding are negatively evaluated by society*	1 = Fully agree 5 = Fully disagree	3.21	1.18
	Most people consider riders who wear a helmet while riding as an example to be followed by other riders	1 = Fully disagree 5 = Fully agree	3.97	1.11
Control beliefs α = 0.875	For me, it is hard to wear a helmet when only riding a short distance*	5 = Fully disagree 1 = Fully agree	3.30	1.14
	For me, it is hard to wear a helmet when I am going out for a party/social function*	1 = Fully agree 5 = Fully disagree	2.70	1.18
	For me, it is hard to wear a helmet when it is hot and humid*	1 = Fully agree 5 = Fully disagree	2.69	1.25
	For me, it is hard to wear a helmet when I am in a hurry*	5 = Fully disagree 1 = Fully agree	3.29	1.20
Attitude α = 0.671	Me wearing a helmet every time I ride in the coming two weeks is …	1 = Very bad 5 = Very good	4.01	0.91
	Me wearing a helmet every time I ride in the coming two weeks is …	1 = Very unpleasant 5 = Very pleasant	3.88	1.19
	Me wearing a helmet every time I ride in the coming two weeks is …	1 = Very unwise 5 = Very wise	3.95	1.18
Subjective norm α = 0.842	Most people who are important to me … – think I should wear a helmet every time I ride	1 = Fully disagree 5 = Fully agree	4.03	1.17
	Most people who are important to me … – approve of me wearing a helmet every time I ride	1 = Very unlikely 5 = Very likely	3.99	1.18
	Most people who are important to me … – wear a helmet themselves every time I ride	1 = Very unlikely 5 = Very likely	3.82	1.12
Perceived behaviour control α = 0.855	I am confident that I can wear a helmet every time I ride my bike	1 = Fully disagree 5 = Fully agree	3.94	1.16
	Me wearing a helmet every time I ride is completely up to me	1 = Very unlikely 5 = Very likely	3.89	1.23
	If I wanted to, I could wear a helmet every time I ride	1 = Very unlikely 5 = Very likely	4.08	1.15

(*continued on next page*)

Table 3 (*continued*)

Concepts	Items	Scoring**	Mean	SD
Intention α = 0.871	How likely is it that you will wear a helmet every time you ride in the coming two weeks?	1 = Very unlikely 5 = Very likely	3.88	1.18
	I plan to wear a helmet every time I ride in the coming two weeks	1 = Very unlikely 5 = Very likely	4.07	1.07
Habit α = 0.829	Not wearing a helmet while riding……. – I do automatically	1 = Very unlikely 5 = Very likely	2.23	1.21
	Not wearing a helmet while riding……. – I do without having to consciously remember	1 = Very unlikely 5 = Very likely	2.24	1.21
	Not wearing a helmet while riding……. – I do without thinking	1 = Very unlikely 5 = Very likely	2.29	1.24
	Not wearing a helmet while riding……. – I start doing it before I realize I am doing it	1 = Very unlikely 5 = Very likely	2.26	1.23

* **Item is reverse coded for data reduction and data analysis**.
** **Scoring indicates the scoring after recoding**.

researcher identified the eligible participants and obtained their details by contacting some of the local colleges, MTWs repair shops, and youth clubs, based on the inclusion criteria, which was that they should be 18–25 years have been using MTWs. The participants were not provided with any incentive. A total response of 344 was recorded. The online survey link generated via Qualtrics was circulated among the identified eligible participants through WhatsApp or email. The principal researcher first provided a brief overview of the study to the participants, and consent was taken from them before starting the survey. Before the final survey, a pilot study was carried out among ten eligible participants to check the suitability of the study tool and asses it's content validity. To this end, the participants clearly understood the survey questionnaire. Out of 344 responses, 106 were incomplete and dropped after data cleaning, resulting in 238 fully completed responses that were used for data analysis. Out of the 238 completely recorded responses, 157 were males (66 %) and 81 were females (34 %). For age, 121 (50.80 %) participants were in the age range of 21 to 23 years, 66 (27.80 %) of them were in the range of 18 to 20 years and 51 (21.40 %) were in the 24 to 25 years range.

3.3. Psychosocial measures

Tables 2–5 provide an overview of the direct measures of attitude, subjective norm and PBC and measures of the beliefs informing these constructs referred to as perceived benefits, perceived barriers, normative beliefs, and control beliefs respectively. The tables include example items, a measure of the internal consistency of the scale measuring the constructs (Cronbach's alpha), and the sample's mean score and standard deviation. The internal consistency among the domains in each of the four risky riding behaviours ranged from moderate to good (see Tables 2, 3, 4, and 5).

3.4. Data analysis

The recorded data in Qualtrics was exported to SPSS IBM version 24 for analysis. Mean and standard deviations were used to summarize the continuous variables. Categorical variables were summarized using frequency and percentage. Cronbach's alpha was used to determine the internal consistency of the items measuring the psychosocial variables regarding the four risky riding behaviours, namely speeding, helmet non-use, performing stunts, and using mobile phones while riding. Pearson's correlation coefficient determined the correlation between the scores of four risky riding behaviours, and among the study variables (determinants) for each risk behaviour. Finally, stepwise multiple linear regression analyses were conducted to assess the amount of explained variance in each of the four intention measures and determine unique significant associations of the psychosocial measures with intention for the four risky riding behaviours.

4. Results

4.1. Socio-demographic and crash details

Table 1 presents the socio-demographic and crash details of the participants. A higher number of the participants were of the age group 21 to 23 years, 121 (50.80 %) and 157 (66 %) of the participants were male. The majority, 106 (44.50 %) participants were undergraduate students. As far as the type of vehicle is concerned, most of the respondents, 129 (54.20 %) were found to use scooters, followed by motorcycles > 125 cc 59 (24.80 %). Around 84 % of the respondents reported riding alone. The large majority of the participants (73.90 %) reported one to five years of riding experience. Most respondents (70.60 %) reported one to five hours of riding per week. A fifth of the participants (19.30 %) experienced a crash once, whereas about 12.20 % of the participants experienced a crash

Table 4
Measures performing stunts.

Concepts	Items	Scoring**	Mean	SD
Perceived benefits α = 0.862	By performing stunts, I show that I am a good rider*	1 = Fully agree 5 = Fully disagree	2.82	1.29
	By performing stunts, I impress the opposite gender*	1 = Fully agree 5 = Fully disagree	3.03	1.35
Perceived barriers α = 0.665	Performing stunts increases my risk of fatal crashes	1 = Fully disagree 5 = Fully agree	4.11	1.26
	Performing stunts makes me feel brave*	1 = Fully agree 5 = Fully disagree	3.30	1.24
	Performing stunts may get me in trouble with the police	1 = Fully disagree 5 = Fully agree	4.12	1.65
Normative beliefs α = 0.793	Most riders I see on the road perform stunts every now and then while riding their bike*	1 = Fully agree 5 = Fully disagree	3.00	1.13
	My friends think that I should never perform stunts	1 = Fully disagree 5 = Fully agree	3.93	1.17
	My parents think that I should never perform stunts on my bike	1 = Fully disagree 5 = Fully agree	4.18	1.13
	Performing stunts while riding is negatively evaluated by society*	1 = Fully agree 5 = Fully disagree	3.58	1.12
	Most people consider riders who do not perform stunts while riding as an example to be followed by other riders	1 = Fully disagree 5 = Fully agree	3.82	1.16
Control beliefs α = 0.686	For me, it is hard to resist performing stunts when I am in a jolly mood*	1 = Fully agree 5 = Fully disagree	3.54	1.82
	For me, it is easy to resist performing stunts when there are police on the road	1 = Fully disagree 5 = Fully agree	3.65	1.32
	For me, it is hard to resist performing stunts when I am on the road and see others performing stunts*	1 = Fully agree 5 = Fully disagree	3.19	1.25
Attitude α = 0.605	Me performing stunts every time I ride in the coming two weeks is…*	1 = Very good 5 = Very bad	3.82	1.29
	Me performing stunts every time I ride in the coming two weeks is …*	1 = Very pleasant 5 = Very unpleasant	3.89	1.23
	Me performing stunts every time I ride in the coming two weeks is …*	1 = Very wise 5 = Very unwise	3.78	1.30
Subjective norm α = 0.642	Most people who are important to me … – think I should never perform stunts on my bike	1 = Fully disagree 5 = Fully agree	3.99	1.28
	Most people who are important to me … – approve of me performing stunts*	1 = Very likely 5 = Very unlikely	2.06	1.06
	Most people who are important to me … – resist performing stunts while riding the bike	1 = Very unlikely 5 = Very likely	3.75	1.24
Perceived behaviour control α = 0.829	I am confident that I can resist myself to perform stunts every time I ride my bike	1 = Fully disagree 5 = Fully agree	3.63	1.36
	Me not performing stunts every time I ride is completely up to me	1 = Very unlikely 5 = Very likely	3.95	1.24
	If I wanted to, I could ride my bike without performing stunts	1 = Very unlikely 5 = Very likely	3.82	1.38
Intention α = 0.863	How likely is it that you will restrict yourself from performing stunts every time you ride in the coming two weeks?	1 = Very unlikely 5 = Very likely	3.81	1.28
	I plan to restrict myself from performing stunts every time I ride in the coming two weeks.	1 = Very unlikely 5 = Very likely	3.98	1.22

(*continued on next page*)

Table 4 (*continued*)

Concepts	Items	Scoring**	Mean	SD
Habit α = 0.907	Performing stunts while riding … – I do automatically	1 = Very unlikely 5 = Very likely	1.78	0.97
	Performing stunts while riding … – I do this without having to consciously remember	1 = Very unlikely 5 = Very likely	1.85	1.05
	Performing stunts while riding … – I do without thinking	1 = Very unlikely 5 = Very likely	1.86	1.03
	Performing stunts while riding … – I start doing them before I realize I am doing it	1 = Very unlikely 5 = Very likely	1.89	1.07

* **Item is reverse coded for data reduction and data analysis**.
** **Scoring indicates the scoring after recoding**.

two or more times. A quarter of the participants (24.40 %) reported ever being fined for violation of traffic rules. Only a small number of participants reported a near-crash experience; the majority (86.60 %) reported no crash experience.

4.2. Correlation between the psychosocial determinants and intention per risky riding behaviour

The intention to refrain from speeding was significantly associated with subjective norms, PBC, perceived benefits, normative and control beliefs. The strongest correlation was found with PBC (r = 0.691). The intention to use a helmet was positively correlated with subjective norms, perceived behavioural control, perceived benefit, normative beliefs. The intention to avoid mobile phone usage while riding was significantly associated with attitude, subjective norm, PBC, perceived barriers, normative and control beliefs. Lastly, the intention to refrain from performing stunts was positively associated with attitude, subjective norm, PBC, perceived barriers, normative beliefs, control beliefs, and negatively with habit (Table 6).

4.3. Prediction of behavioural intentions

Forward stepwise multiple linear regression analysis was performed for each of the four risky riding behaviours with behavioural intention towards safer riding behaviour as dependent variable and perceived barriers, perceived benefits, normative beliefs, control beliefs, attitude, subjective norm, PBC, gender, education, type of motor vehicle , number of years of riding, riding hours per week, previous crash experience and fines as independent variables. Positive relations suggest that higher scores in the predictor variables are associated with higher intentions to refrain from the risky behaviour. Dummy variables were created for categorical (demographic and riding behaviour indices reported in Table 2), considering one of the categories as a reference.

Table 7 provides the stepwise multiple linear regression analysis for the intention to refrain from speeding. It can be observed that PBC, subjective norms, normative beliefs and benefits are significant predictors (R^2 = 60.2 %). All four significant predictors were positively related to the intention to refrain from speeding.

Table 8 provides the results of helmet non-use. Subjective norms, benefits, barriers, and fines were found to be significant predictors, explaining more than 60 % of the variance in intention to use a helmet (R^2 = 65.8 %). Subjective norms and benefits were positively related, whereas; barriers and fines were negatively related.

Table 9 includes the result of the intention to stop performing stunts. In this case, PBC, barriers, benefits, control beliefs and habits were significant predictors, explaining almost 70 % of the variance in intention (R^2 = 69.2 %). Habits was negatively related to the dependent variable, while the other three variables showed a positive relationship with intention.

Table 10 provides the results of mobile phone usage. Here, PBC, normative beliefs, attitude, perceived barriers, and subjective norms were significantly related to the intention to avoid mobile phone usage while riding, also explaining almost 70 % of the variance in intention (R^2 = 69.7 %).

5. Discussion

Road traffic injuries have increasingly become a major concern for MTWs riders in India. The paper aimed to understand the psychosocial determinants of risky riding behaviour among young, MTWs riders. The widely used theory of planned behaviour (Fishbein & Ajzen, 2010) for explaining human behavior and identifying target variables for educational interventions (Bartholomew Eldredge et al., 2016) was applied to explain the intention to refrain from risky riding behaviors related to speeding, helmet non-use, performing stunts, and mobile phone usage while riding. The results of the study indicated that the motivation to adapt more safe riding practices can be explained by important psychosocial determinants of human behaviour, including attitude, social norms, and perceived behavioural control and their underlying belief systems (perceived benefits and costs, perceptions of other's behaviours and approval, and expressions of personal control). Noteworthy to mention, the extent to which participants automatically behaved in risky riding practices in the past did not prove to be a strong predictor of future intentions to refrain from risky riding.

Our results align with other studies that explained risky riding practices conducted in the Global South (Nguyen et al., 2020;

Table 5
Measures mobile phone usage.

Concepts	Items	Scoring**	Mean	SD
Perceived benefits α = 0.662	For me, it is important to attend calls/reply to messages on my mobile phone while riding*	1 = Fully agree 5 = Fully disagree	2.91	1.26
	Using my mobile phone while riding gives me a feeling that I can do multitasking*	1 = Fully agree 5 = Fully disagree	2.97	1.25
Perceived barriers α = 0.667	Using my mobile phone while riding increases my risk of crashes	1 = Fully disagree 5 = Fully agree	4.05	1.73
	Using my mobile phone while riding distracts me	1 = Fully disagree 5 = Fully agree	3.71	1.15
	Using my mobile phone while riding may get me in trouble with the police	1 = Fully disagree 5 = Fully agree	4.14	1.11
	For me, it is safe to use my mobile phone when there is less traffic on the road*	1 = Fully agree 5 = Fully disagree	2.92	1.21
Normative beliefs α = 0.866	My friends think that I should never be using my mobile phone while riding	1 = Fully disagree 5 = Fully agree	3.84	1.24
	My parents think that I should never be using my mobile phone while riding	1 = Fully disagree 5 = Fully agree	4.20	1.15
	Most people think negatively about those riders who use mobile phones while riding	1 = Fully disagree 5 = Fully agree	3.61	1.13
	Most people consider riders who do not use their mobile phones while riding as an example to be followed by others	1 = Fully disagree 5 = Fully agree	3.95	1.12
Control beliefs α = 0.596	For me, it is hard to resist taking pictures on my mobile phone while riding and posting it on social media*	1 = Fully agree 5 = Fully disagree	3.30	1.24
	For me, it is easy to resist using my mobile phone while riding when there are police on the road	1 = Fully disagree 5 = Fully agree	2.17	1.23
	For me, it is hard to resist using my mobile phone while riding when I am getting a call/ message*	1 = Fully agree 5 = Fully disagree	3.19	1.26
Attitude α = 0.611	Me using my mobile phone every time I ride in the coming two weeks is …*	1 = Very good 5 = Very bad	3.64	1.26
	Me using my mobile phone every time I ride in the coming two weeks is …	1 = Very pleasant 5 = Very unpleasant	3.59	1.26
	Me using my mobile phone every time I ride in the coming two weeks is …*	1 = Very wise 5 = Very unwise	3.70	1.26
Subjective norm α = 0.604	Most people who are important to me … – think I should never use my mobile phone while riding	1 = Fully disagree 5 = Fully agree	3.85	1.28
	Most people who are important to me … – approve of me using my mobile phone every time I ride*	1 = Very likely 5 = Very unlikely	3.83	1.11
	Most people who are important to me … – use a mobile phone themselves every time they ride*	1 = Very likely 5 = Very unlikely	3.39	1.19
Perceived behaviour control α = 0.855	I am confident that I can avoid using my mobile phone every time I ride my bike.	1 = Fully disagree 5 = Fully agree	3.86	1.19
	Me not using my mobile phone every time I ride is completely up to me	1 = Very unlikely 5 = Very likely	3.78	1.29
	If I wanted to, I could avoid using my mobile phone every time I ride	1 = Very unlikely 5 = Very likely	4.0	1.18
Intention α = 0.801	How likely is it that you will avoid using your mobile phone every time you ride in the coming two weeks?	1 = Very unlikely 5 = Very likely	3.74	1.24
	I plan to avoid using my mobile phone every time I ride in the coming two weeks	1 = Very unlikely 5 = Very likely	3.96	1.15

(*continued on next page*)

Table 5 (*continued*)

Concepts	Items	Scoring**	Mean	SD
Habit α = 0.841	Using a mobile phone while riding… – I do automatically	1 = Very unlikely 5 = Very likely	2.16	1.18
	Using a mobile phone while riding… – I do without having to consciously remember	1 = Very unlikely 5 = Very likely	2.23	1.20
	Using a mobile phone while riding… – I do without thinking	1 = Very unlikely 5 = Very likely	2.19	1.21
	Using a mobile phone while riding… – I start doing it before I realize I am doing it	1 = Very unlikely 5 = Very likely	2.18	1.22

* **Item is reverse coded for data reduction and data analysis.**
** **Scoring indicates the scoring after recoding.**

Sharma et al., 2014; Truong, Nguyen, & De Gruyter, 2019) as well as in the Global North (Paris & Van den Broucke, 2008). Beliefs about one's own capabilities, the benefits of safe riding practices and perceptions about the beliefs of important others – that is, beliefs that inform the more general evaluations defined by the theoretical concepts perceived behavioral control, attitude and subjective norm – consistently showed positive associations with future intentions to adopt more safe riding practices. Moreover, by applying the theory of planned behavior we were able to explain large proportions of explained variance in the different intention measures.

The participants in the current study express a positive intention to adopt more safe riding practices by avoiding speeding, mobile phone use, and performing stunts, and do not ride without a helmet. However, to what extent these intentions will be translated into behaviour remains to be seen. For instance, in a focused group discussion performed by the same authors in the same study setting, it was revealed that the young riders will use mobile phones while riding as they expect important calls from their friends/colleagues regarding classes or assignments (Sumit et al., 2022). Also, the study setting has a humid climate and humidity has been shown to act as a barrier to inconsistent usage of helmets (Sreedharan et al., 2010; Hassan et al., 2017; Setty et al., 2020). This is contrary to the findings of a study in Vietnam where riders agreed to the harmful consequences of mobile usage while riding as suggested by the social references (Nguyen et al., 2020). This also corroborates with findings of some of the studies conducted in the Indian setting, where the participants consider using a mobile phone while riding as less dangerous than any other risky riding behaviour (Setty et al, 2020).

The study setting happens to be one of the most cosmopolitan towns in India with 30,000 students from across India and 60 countries all over the world. It can be well argued that our study setting is a melting point for various several cultures. Noteworthy to mention, culture is related to riding behaviour as well. In a study conducted by (Nordfjærn, Şimşekoğlu, & Rundmo, 2014), among 2148 participants from Norway, Russia and India, Sub-Saharan Africa, and Near East countries, it was revealed that Norwegians reported overall safer attitudes towards traffic safety and driver behaviour than the participants from the other countries. Africans reported the highest risk perception as the countries also differed substantially in road traffic culture. Cultural factors were stronger predictors of participants behaviour than of risk perception. Furthermore, a study conducted by Haghdoust et al. (2022) mentioned

Table 6
Correlation of safe riding intentions with their psychosocial determinants.

	Speeding (Pearson r, p-value)	Helmet usage (Pearson r, p-value)	Performing stunts behaviour (measured with intention)P-value	Mobile phone usage (measured with intention)P-value
Attitude	0.120 0.065	0.088 0.178	0.515** 0<.001	0.635** 0<.001
Subjective norm	0.682** 0<.001	0.743** 0<.001	0.677** 0<.001	0.493** 0<.001
PBC	0.691** 0<.001	0.714** 0<.001	0.788** 0<.001	0.767** 0<.001
Perceived benefits	0.640** 0<.001	0.736** 0<.001	0.004 0.951	−0.054 0.406
Perceived barriers	−0.123 0.059	0.084 0.197	0.688** 0<.001	0.695** 0<.001
Normative beliefs	0.600** 0<.001	0.582** 0<.001	0.643** 0<.001	0.740** 0<.001
Control beliefs	0.483 <0.001	0.004 0.952	0.233** 0<.001	−0.238** 0<.001
Habit	−0.041 0.526	−0.085 0.191	−0.257** 0<.001	−0.073 0.260

*Significant at 5% level of significance.
** Significant at 1% level of significance.

Table 7
Intention to refrain from speeding.

	B	SE B	β	t	P	sr^2
Step 1						
PBC	0.508	0.035	0.691	14.702	0<.001	0.478
$R^2 = 0.478$						
R^2 change = 0.478						
F change = 216.159 ($p < 0.001$)						
Step 2						
PBC	0.313	0.042	0.425	7.377	0<.001	0.100
Subjective norm	0.291	0.042	0.399	6.911	0<.001	0.088
$R^2 = 0.566$						
R^2 change = 0.088						
F change = 47.762 ($p < 0.001$)						
Step 3						
PBC	0.252	0.044	0.344	5.705	0<.001	0.057
Subjective norm	0.247	0.043	0.338	5.797	0<.001	0.059
Normative belief	0.112	0.030	0.204	3.758	0<.001	0.025
$R^2 = 0.591$						
R^2 change = 0.025						
F change = 14.119 ($p < 0.001$)						
Step 4						
PBC	0.213	0.046	0.29	4.605	0<.001	0.036
Subjective norm	0.216	0.044	0.297	4.949	0<.001	0.042
Normative belief	0.09	0.031	0.163	2.917	0.004	0.015
Perceived benefits	0.112	0.044	0.157	2.553	0.011	0.011
$R^2 = 0.602$						
R^2 change = 0.11						
F change = 6.517 ($p = 0.011$)						

that socio-cultural factors have been examined within the framework of social-demographic characteristics and risky driving behaviours. Nevertheless, investigating the impact of cultural factors within the realm of road traffic crashes warrants further exploration.

6. Practical implications

The current study aimed to understand the psychosocial precursors that predict young MTWs riders' intention towards safer riding behaviours. In the four studied behaviours, we were able to explain large proportions of variance in the measures of intention, ranging between 60 up to 70 %, by associating intention with psychosocial predictors of human behavior as identified by the Theory of Planned Behavior (Ajzen, 1991) within the reasoned action approach (Fishbein & Ajzen, 2010). Future interventions can thus target these psychosocial determinants to increase motivation to adopt more safe riding practices, which can best be done in the form of educational interventions using behaviour change methods that link with the identified psychosocial determinants (Kok et al., 2016). For example, the use of public awareness campaigns and persuasive messages to communicate safety norms and inform young riders' about the benefits of safe riding to install more positive attitudes, whereas more individual, skill-based approaches can be implemented in training and licensing programmes to strengthen personal capacities to refrain from risky driving even if environmental influences (e.g., peer influence, being late for class, lack of police enforcement) would trigger more risky riding. These approaches thus aim to strengthen perceptions of behavioural control, which proved to be the strongest determinant of riders' intention to use a helmet and refrain from speeding, performing stunts, and using mobile phones while riding in the current study.

6.1. Limitations

Several potential limitations in the study were noted. Firstly, the study faces critics of social desirability bias as the responses of the participants might incline to the societal expectation of the riding behaviour to be observed in MTWs riding. Secondly, the study findings cannot be generalized to other settings and age groups as its focus was very specific both in terms of place (i.e., Manipal) and age (i.e., young riders). Thirdly, the survey was carried out in a predominantly urban setting and thereby, the perception of the rural participants was excluded. Lastly, at the time of data collection, the COVID-19 pandemic started, and the data was collected online, which is a relatively new concept in the local scenario and the total number of participants in the survey was less due to limited internet access and the inability to respond to online questionnaires.

7. Conclusion

In the present study, the psychosocial determinants of risky riding behaviours (i.e., (1) speeding, (2) helmet non-use, (3) performing stunts, and (4) using mobile phones while riding among young, MTWs were investigated using a quantitative survey based on the theory of planned behaviour complemented with habit related questions measuring routine behaviours. To the best of our

Table 8
Results for prediction of helmet behavioural intentions.

	B	SE B	β	t	P	sr^2
Step 1						
Subjective norm	0.521	0.031	0.743	17.029	0<.001	0.552
$R^2 = 0.551$						
R^2 change = 0.551						
F change = 289.990 ($p < 0.001$)						
Step 2						
Subjective norm	0.310	0.04	0.442	7.832	0<.001	0.095
Perceived benefits	0.298	0.04	0.419	7.422	0<.001	0.085
$R^2 = 0.637$						
R^2 change = 0.085						
F change = 55.085 ($p < 0.001$)						
Step 3						
Subjective norm	0.326	0.039	0.465	8.336	0<.001	0.103
Benefit	0.323	0.04	0.454	8.054	0<.001	0.096
Barrier	−0.144	0.044	−0.137	−3.256	0.001	0.016
$R^2 = 0.652$						
R^2 change = 0.016						
F change = 10.603 ($p = 0.001$)						
Step 4						
Subjective norm	0.319	0.039	0.455	8.176	0<.001	0.097
Perceived benefits	0.314	0.040	0.442	7.840	0<.001	0.09
Perceived barriers	−0.132	0.044	−0.125	−2.978	0.003	0.013
Fines	−0.393	0.195	−0.080	−2.015	0.045	0.006
$R^2 = 0.658$						
R^2 change = 0.006						
F change = 4.062 ($p = 0.045$)						

Table 9
Results for prediction of stunts behavioural intentions.

	B	SE B	β	t	P	sr^2
Step 1						
PBC	0.552	0.028	0.788	19.658	0<.001	0.621
$R^2 = 0.621$						
R^2 change = 0.621						
F change = 386.424 ($p < 0.001$)						
Step 2						
PBC	0.414	0.035	0.591	11.874	0<.001	0.374
Perceived barriers	0.316	0.059	0.302	5.397	0<.001	0.042
$R^2 = 0.663$						
R^2 change = 0.042						
F change = 29.124 ($p < 0.001$)						
Step 3						
PBC	0.398	0.039	0.568	10.267	0<.001	0.147
Barriers	0.320	0.058	0.306	5.534	0<.001	0.043
Benefits	0.067	0.025	0.100	2.669	0.008	0.010
$R^2 = 0.673$						
R^2 change = 0.010						
F change = 7.122 ($p = 0.008$)						
Step 4						
PBC	0.379	0.039	0.542	9.695	0<.001	0.129
Perceived barriers	0.323	0.057	0.309	5.632	0<.001	0.044
Perceived benefits	0.101	0.029	0.149	3.513	0.001	0.017
Control beliefs	0.088	0.037	0.105	2.384	0.018	0.008
$R^2 = 0.680$						
R^2 change = 0.008						
F change = 5.685 ($p = 0.018$)						
Step 5						
PBC	0.378	0.039	0.540	9.817	0<.001	0.128
Perceived barriers	0.311	0.057	0.297	5.499	0<.001	0.040
Perceived benefits	0.108	0.028	0.160	3.817	0<.001	0.019
Control beliefs	0.110	0.037	0.131	2.972	0.003	0.012
Habits	−0.060	0.020	−0.109	−2.924	0.004	0.011
$R^2 = 0.692$						
R^2 change = 0.011						
F change = 8.553 ($p = 0.004$)						

Table 10
Results for prediction of mobile usage behavioural intentions.

	B	SE B	β	t	P	sr^2
Step 1						
PBC	0.521	0.028	0.767	18.372	0<.001	0.588
$R^2 = 0.589$						
R^2 change = 0.589						
F change = 337.540 ($p < 0.001$)						
Step 2						
PBC	0.330	0.038	0.486	8.676	0<.001	0.110
Normative belief	0.214	0.031	0.385	6.875	0<.001	0.069
$R^2 = 0.657$						
R^2 change = 0.069						
F change = 47.267 ($p < 0.001$)						
Step 3						
PBC	0.293	0.038	0.431	7.616	0<.001	0.081
Normative belief	0.173	0.032	0.312	5.351	0<.001	0.040
Attitude	0.18	0.05	0.179	3.604	0<.001	0.018
$R^2 = 0.675$						
R^2 change = 0.018						
F change = 12.991 ($p = 0.008$)						
Step 4						
PBC	0.276	0.038	0.406	7.166	0<.001	0.069
Normative beliefs	0.125	0.037	0.224	3.407	0.001	0.016
Attitude	0.155	0.05	0.154	3.085	0.002	0.013
Perceived barriers	0.104	0.038	0.16	2.712	0.007	0.010
$R^2 = 0.685$						
R^2 change = 0.010						
F change = 7.353 ($p = 0.007$)						
Step 5						
PBC	0.294	0.038	0.432	7.653	0<.001	0.077
Normative beliefs	0.109	0.037	0.195	2.974	0.003	0.012
Attitude	0.175	0.05	0.175	3.518	0.001	0.016
Perceived barriers	0.132	0.039	0.203	3.387	0.001	0.015
Subjective norm	0.114	0.038	0.135	2.998	0.003	0.011
$R^2 = 0.697$						
R^2 change = 0.011						
F change = 8.552 ($p = 0.004$)						

knowledge, no study in India has comprehensively investigated more than one risky riding behaviour altogether. The obtained results have both theoretical and practical implications. The current study is a valuable contribution to the existing literature regarding the understanding of risky riding behaviour among young riders. The results of the study resulted in an in-depth understanding of the psychosocial determinants of risky riding behaviour and are useful for designing interventions to change young motorists' mind towards risky riding behaviour. Policymakers and practitioners should be encouraged to consider the identified psychosocial determinants to initiate behavioural change programmes in co-creation with young riders, government authorities, university officials, and the regional transport office. Last but not least, it is important to mention that an in-depth understanding of the psychosocial determinants of risky riding behaviour can initiate informed and targeted interventions.

CRediT authorship contribution statement

Kumar Sumit: Writing – review & editing, Writing – original draft, Investigation, Formal analysis, Conceptualization. **Robert AC Ruiter:** Writing – review & editing, Validation, Supervision, Methodology, Formal analysis, Conceptualization. **Veerle Ross:** Writing – review & editing, Validation, Supervision, Methodology, Conceptualization. **Geert Wets:** Supervision, Funding acquisition, Conceptualization. **Kris Brijs:** Writing – review & editing, Supervision, Methodology, Funding acquisition, Conceptualization.

Declaration of Competing Interest

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

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Data availability

The data that has been used is confidential.

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