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A Focus Group Study to Explore Risky Ridership among Young Motorcyclists in Manipal, India

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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. In India, motorized two-wheelers comprise 70% of the vehicle population and are considered the most vulnerable road users. Road crash injury is common among the young-aged population leading to premature deaths. It is essential to understand risky riding behaviors to develop accurate, evidence-based risk reduction programmes that fit the target population's characteristics and the intervention setting. The current study aims to improve the understanding of the typical characteristics of motorcycle crashes among young riders in India, primarily focusing on the prevalence and role of risky riding behaviors. Five focus group discussions with eight to ten participants in each group (N = 35) were conducted in Manipal, in the Karnataka state of Southwestern India. A thematic analysis was completed using MAXQDA software to identify, analyze, and report on themes within the data. Speeding, riding under the influence of alcohol, and the poor maintenance of motorcycles were indicated as leading causes of crashes. Furthermore, using mobile phones while riding, violations of the traffic rules, and helmet non-use were identified as other risky behaviors among young riders. Future research can be taken up in other settings for the target population. Generational awareness with the involvement of young riders, government authorities, university officials, and the Regional Transport Office can be initiated. Engaging young riders, government authorities, university officials, and the Regional Transport Office through behavioral interventions such as persuasive communication techniques, an active experimental approach (such as the use of a simulator), and regulating the licensing procedure can reduce the number of road crashes.

Keywords: focus group discussions; Manipal; motorcycle; risky riding; road crashes; young riders

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Citation: Sumit, K.; Brijs, K.; Ross, V.; Wets, G.; Ruiter, R.A.C. A Focus Group Study to Explore Risky Ridership among Young Motorcyclists in Manipal, India. *Safety* **2022**, *8*, 40. https://doi.org/10.3390/safety8020040

Academic Editor: Raphael Grzebieta

Received: 28 February 2022
Accepted: 24 May 2022
Published: 1 June 2022

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1. Introduction

Roads are the primary source of connectivity for any country, which secures socio-economic and logistical planning [1]. Motorization has improved the lives of millions of people worldwide. However, the advantages have been accompanied by a substantial cost [2]. The higher density of road networks has given rise to global public health concerns, such as air pollution and increased morbidity and mortality through road traffic crashes. Road crashes have emerged as the latest Public Health challenge in Asia and Africa's low and middle-income countries (LMICs). LMICs contribute to 92% of the road traffic injuries (RTIs) associated with mortality. The economic cost involved in RTIs with a traumatic outcome varies between 1% and 2% of the total national product in LMICs, causing 1.35 million deaths and 50 million injuries every year worldwide [3,4]. Road crashes in India kill almost 150,000 people annually, accounting for nearly 11% of the crash-related deaths in the world. It is expected that the total number of deaths related to RTIs will cross the 250,000 mark by 2025 [5].

Motorcycles are one of the conventional and affordable means of transportation in LMICs. Motorcycle-related injury is common and causes premature deaths with high costs for society, especially when it concerns the young population in the productive age group [1,6]. With an estimated 37 million motorcycles, India is home to one of the world's largest numbers of motorcycle users. With the exponential increase in motorcycle use in the last twenty years, road crashes involving motorcyclists have emerged as India's latest Public Health challenge [7]. Globally, one-fourth of all road crashes are among motorcyclists. What is even more concerning, however, is that in the South-East 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 [3]. It is noteworthy to mention that death rates due to road crashes among motorcyclists exceed the global average in India. Motorcyclists accounted for 30.9% of India's total fatal road crashes in 2017 [8].

In India, motorists between 18 and 25 years-of-age are more susceptible to road crashes than any other road user category, contributing to 50% of the total crash-related deaths [7,8], and accounting for 41.4% of India's total road crash victims [7]. Several studies in India have reported the vulnerability of young riders to road crashes [8,9]. Reasons for this increased vulnerability in young riders resemble those for young car drivers. In a study by Robbins et al. [10], it was 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 [10,11]. Similarly, experience issues could be at play for inexperienced motorcycle riders. Secondly, age-related, risky driving among 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 childhood to adulthood [12]. The brain's socio-emotional reward system shows early adolescent remodelling, while the cognitive control system (e.g., inhibitory control, working memory, mental flexibility, and planning) matures more gradually well into peoples' 20s. This maturational gap between both brain systems makes it difficult for youngsters to self-regulate impulsive responses, which is even more profound in males than in females. A possible explanation for this sex difference is that male road users, compared with female road users, prioritize the benefits of risk-taking over the costs associated with it [10,12]. Applied to risky motorcycle riding, young adult riders are more vulnerable for risk-taking in response to highly social–affective situations, such as the presence of a peer passenger or riding a highly powered motorcycles [13].

This current study reports on a focus group study among young riders that aimed to understand the typical characteristics of motorcycle crashes. The next section is a literature review, firstly summarizing studies where a self-report instrument (i.e., the Motorcycle Rider Behavior Questionnaire (MRBQ) has been used to associate risky ridership with several safety-indicators (e.g., crash involvement, number of violations and traffic fines). This is followed by an overview of motorcyclist crash causation with respect to three main contributory factors: human factors, vehicle factors, and environmental factors.

2. Literature Review

2.1. Risky Riding and Motorcyclist Safety: The MRBQ

According to Elliott et al. [14], it is important to understand how rider behavior is related to crash risk to develop effective road safety interventions. Taking the typology behind the Driver Behavior Questionnaire (DBQ) [14,15] as a conceptual starting point, Elliott et al. [14] proposed a new self-reported tool for measuring motorcyclists' behavior named the Motorcycle Rider Behavior Questionnaire (MRBQ). The MRBQ is a five-factor tool differentiating between traffic errors (e.g., failing to notice or anticipate that another vehicle might pull out in front of you and have difficulty stopping), control errors (e.g., running wide when going round a corner), speed violations (e.g., exceeding the speed limit on rural roads), stunts (e.g., engaging in racing with other riders or drivers), and the use of protective equipment (e.g., using motorcycle gloves). The authors found that the

MRBQ was able to predict crash risk for motorcyclists. More in detail, based on a sample of 8666 UK motorcyclists, they established that traffic errors were the main predictors of crash risk, and that for crashes in which respondents accepted some degree of blame, control errors and speed violations were also significant predictors [14]. Since then, the MRBQ has been used in several cultural and geographical settings (e.g., Bui et al. [16] in Vietnam; Motevalian et al. [17] in Iran; Oluwadiya. [18] in Nigeria; Özkan et al. [19] in Turkey; Sakashita et al. [20]; Stephens et al. [21] in Australia; Sumit et al. [22] in India; Topolšek and Dragan [23] in Slovenia; Uttra et al. [24] in Thailand).

Even though across these different studies, the MRBQ was a significant correlate of safety-related indicators such as crash involvement, the more specific MRBQ-factors significantly correlating with safety-related indicators investigated varied, and the psychometric properties of the MRBQ were inconsistent. For example, Oluwadiya [18] studied commercial motorcyclists in Nigeria and found major differences between the British motorcyclists' factor structure and their Nigerian counterparts. Insufficient internal consistency and predictive validity were reported in the study by Sakashita et al. [20] in Victoria, Australia. Moreover, the study by Nguyen et al. [25] mentioned: "*from a conceptual point of view, the MRBQ is sometimes capturing behaviors that are less suited to the particular context under study, while vice versa, the MRBQ is sometimes missing behaviors that are particularly relevant to a specific geographic or cultural region*" (Nguyen et al. [25] p. 3), which was acknowledged in other studies, such as the ones by Özkan et al. [19], Uttra et al. [24] and by Sumit et al. [22]. For instance, Sumit et al. [22] added items to the original MRBQ related to mobile phone use while riding because this behavior frequently occurs in the Indian context. In terms of factor structure and predictive validity, the authors found that the five-factor structure extracted in previous studies replicated quite well in an Indian sample of 300 young motorcycle riders (age 18–25 years), and that performance of stunts and commission of violations were the two MRBQ-factors that were positively associated with self-reported near-crash experiences. In addition, the performance of stunts, commission of violations, and use of a motorcycle of 125–200 cc were associated with an increased number of traffic fines. Furthermore, Uttra et al. [24] presented 26 indicators that composed the motorcycle rider behavior of Thai people. These were separated into four factors, namely traffic error, control error, stunts, and safety equipment. Unlike previous studies, the support for a relationship between the MRBQ and self-reported crash involvement was less significant.

In summary, aside from some exploratory work (e.g., Hassan et al. [26]; Setty et al. [27]; Sharma et al. [28]; Shruthi et al. [29]; Sumit et al. [22]), not much is currently known about the occurrence of risky motorcyclist riding behaviors in India. Also, the focus of these studies was almost exclusively on speeding or mobile phone use, while previous work conducted in the same or neighboring regions (i.e., South-East Asia and the Pacific) found evidence for the occurrence of multiple additional forms of risky riding, such as wrong lane use, illegal U-turns, intentional right-of-way violations, turn signal neglect, red-light-running, riding in pair or a group, and alcohol-impaired riding (e.g., Nguyen et al. [25]). It remains unclear whether these manifestations of risky riding also apply to the Indian context. Furthermore, more advanced insight into the underlying psychological mechanisms that guide risky ridership among Indian motorcyclists is lacking, nor is it known what typical risk-prone circumstances trigger risky riding behaviors in India.

As for the socio-cognitive determinants of risky riding, some work is available for mobile phone use (e.g., Nguyen et al. [30]; Nguyen-Phuoc et al. [31]; Truong et al. [32]), speeding (e.g., Chorlton et al. [33]; Elliott [34]), the use of personal protective equipment and safety helmets (e.g., Ali et al. [35]; Bachani et al. [36]; Brijs et al. [37]; Norris and Meyers [38]), and a (non-) compliance to the traffic code and rules (e.g., Susilo et al. [39]), but none of these studies apply to the Indian context, and most of this work is based on cross-sectional surveys where the Theory of Planned Behavior was used as the supportive theoretical framework while additional determinants may play a role as well (see, for instance, the studies by Özkan et al. [19] and by Nguyen et al. [30]). Qualitative research techniques would be a perfect complement to such structured survey studies to uncover

and learn more about the deeper-situated motives behind risky riding behavior. Unfortunately, such qualitative studies on risky motorcycle riding are rather scarce. To the best of our knowledge, besides the work by Bazargan-Hejazi et al. [40], Huth et al. [41], and Nguyen et al. [25], no qualitative research on risky motorcycle riding is available. Undoubtedly, there is a clear need for qualitative research, particularly when a more in-depth understanding of what drives risky riding is still missing.

2.2. Motorcyclist Crash Causation

Overall, the occurrence of road traffic crashes can be primarily attributed to three contributory factors: (1) human factors, (2) vehicle factors, (3) environmental factors. Out of these, human factors are the dominant causative factor [42]. Several previous studies have demonstrated that the major cause of crash is related to the human factor (e.g., Lin and Kraus [43]; Özkan et al. [19]). Furthermore, in a study conducted by Yousif et al. [44], it was revealed that more than half of road crashes are due to human factors. It is also essential to understand the role of environmental infrastructural factors, such as road condition, road design, and traffic volume, which are some of the predominant environmental factors causing road crashes [2,26,29]. Finally, certain vehicle-related factors such as poorly maintained lighting systems and worn-out tires can be attributed to road crashes [2,42].

With respect to environmental factors, weather conditions have been identified as an important risk-increasing environmental factor. Weather affects road surface conditions and the motorist's visibility, thereby increasing the chances of mishaps. Adverse weather conditions such as heavy rain, thick fog, and hailstorms make riding riskier as visibility reduces and road surfaces slippery [3,5,8,9]. Contrary to that, the annual report published by the Ministry of Road Transport and Highways, Government of India, (MoRTH; Annual report, 2019), signals that almost $\frac{3}{4}$th of crashes among motorcyclists occur under sunny/clear weather. Nevertheless, the same report mentioned that crashes under adverse weather conditions such as rain, fog, and hail/sleet accounted for 17.3% of the total road crashes in India. Furthermore, in an a-depth Chinese crash data study conducted by Wang et al. [45], it was reported that poor visibility is one of the major contributors to road traffic crashes. Also, in a study by Aupetit et al. [46] to identify the risky situations of novice motorcyclists on real roads, 13 incident scenarios were identified among novice motorcyclists, among which loss of control due to wind or a slippery road.

A second environmental factor relates to roads being in unacceptable conditions in many parts of India [1,8]. Roads are not always built with a proper long-term vision in terms of country planning and urban development, so they often cannot accommodate the quickly rising number of vehicles [1]. Undoubtedly, bad roads are also a significant crash risk among motorcyclists [3,5,7,47]. Konlan et al. [47] for example, reported that bad roads account for 23.3% of road crashes among motorcyclists. Furthermore, motorcyclists are prone to road crashes due to poor geometric and cross-sectional road design. As a two-wheeled vehicle, a motorcycle is more dependent than other vehicles on a solid, high-friction road surface to maintain control. In addition, the critical surface area where the tire meets the roadway is smaller on a motorcycle than on any other highway vehicle, and those points of contact are essential for the motorcyclist's stability, maneuvering, and braking. Poorly designed intersections and curves, pavement defects, and dangerous bridge joints increase the crash risk among motorcyclists [5,7,48].

As for vehicle-related factors, most studies have identified poorly maintained brakes, lighting and worn-out tires as risk factors for road crashes among motorcyclists [1,2,49]. Additionally, missing, or loose parts such as bolts, cotter pins, or nuts can cause a motorcycle to wobble, making steering difficult and increasing the chance of a crash. Turn signals are another important part of motorcycle maintenance that is often neglected. When turn signals are not working, other drivers will not know the motorcyclists' intentions while turning, increasing crash risk [50–52].

As for human factors, speeding is probably the commonest behavioral factor reported across different studies among motorcyclists [2,28,53,54]. Some studies, such as the ones

conducted by Chen and Chen [53] in Taiwan and Paris and Van den Broucke [54] in Belgium, have explained speeding with the help of the Theory of Planned Behavior. For instance, in their study, Paris and Van den Broucke [54] reported that self-reported speeding was predicted by intention and perceived behavioral control. They also demonstrated the validity of the Theory of Planned Behavior to predict self-reported speeding behavior. Chen and Chen [53] reported that perceived enjoyment and concentration seem to positively impact riders' speeding behavior. Furthermore, they affirmed individual factors, such as personality traits and experience, to reflect differences in speeding behavior. A study conducted in Bangalore, India by Sharma et al. [28] to determine the inclination to speed and its correlates indicated that the propensity towards speeding was more commonly observed among young male riders. Furthermore, it distinguished different elements correlating with the speeding inclination among young riders, such as state of passion, sensation seeking, risk-taking, and rule-breaking.

Another common human factor observed among riders is mobile phone usage while riding. An observation study conducted in Mysore, India by Setty et al. [27] found that 50% of the observed riders use mobile phones while riding. No difference was observed in the proportion of mobile phone usage during the daytime or across various days of the week. A multi-city nationwide survey was conducted to understand the utilization patterns, its effects, and the perception of mobile phone usage among road users across India. Although 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 [55].

Riding under the influence of alcohol has also been identified as one of the major causes of crashes among young riders in India. This has been reflected by MoRTH; Annual report (2019) and with several previously conducted studies [2,56]. For instance, Gopalakrishnan [2] mentioned that in LMICs like India, between 33% and 69% of fatally injured drivers and between 8% and 29% of non-fatally injured drivers were under the influence of alcohol before their crash. Noteworthy to mention, fatal crashes are more prevalent on weekends among young riders due to riding under the influence of alcohol [3]. Wrong lane use is one another commonly observed traffic violation in India. For instance, it was reported in MoRTH; Annual report (2019), that driving on the wrong side accounted for 6% of fatal road crashes. Furthermore, red-light running has been observed as a common problem among young motorcyclists in India [57]. Empirical evidence with other Southeast Asian countries has also indicated the commonly observed practice of red-light running among young motorcyclists. For example, Abdul Manan et al. [58] observed that the average rate of red-light running violations was between 3.6% and 22% based on a field survey at 27 intersections in Malaysia. Finally, tailgating is also one of the commonly observed risky riding behaviors among young Indian riders [1,6]. Moreover, in the Southeast Asian context, Bui et al. [16] in their Motorcycle Rider Behavior Questionnaire (MRBQ) study, obtained a mean value of 2.67 on tailgating items among 2254 motorcyclists in Vietnam, which meant that they committed this behavior on an occasional basis. Apart from the above-mentioned human factors, other human factors can also impede driving and can cause crashes. For instance, in a systematic review conducted in LMICs by Piyasena et al. [59] a positive association between vision impairment and traffic crashes in LMICs was reported.

3. Objectives

The overall aim of the current study is to improve the understanding of typical characteristics of motorcycle crashes among young riders in Manipal, India, primarily focusing on the prevalence and role of risky riding behaviors. Two more specific objectives are proposed. Firstly, to assess the dangers associated with risky riding behaviors and associated underlying motives among young riders in Manipal. Secondly, to identify road infrastructural and environmental factors associated with increased motorcyclist crash risk and their suggestions for improving rider safety. The findings from the current study will provide valuable leads for designing risk reduction programs targeting young Indian motorcycle riders to motivate them to follow safe riding practices.

This study contributes to the current literature in three different ways. Firstly, there is the geographical setting. To the best of our knowledge, this is the first study into the underlying motives of risky ridership among Indian motorcyclists. Even though there are studies available addressing the Indian context, these studies mainly focus on crash risk or the prevalence of risky rider behaviors, not on the underlying determinants of risky ridership. Secondly, this study adds to previous qualitative studies on motorcyclist safety. We found only three studies where in-depth interviews and/or focus groups were the method used to collect data. In two out of these three studies, the focus of data collection differed from our study. The study by Huth et al. [41], for instance, was primarily interested in uncovering the risks motorcyclists associate with operating a motorcycle. The study by Bazargan-Hejazi et al. [40] was focused primarily on how motorcyclists cope with the dissonance between personal demonstration of risky motorcycle riding behaviors on the one hand, and the personally held beliefs related to the dangers associated with those risky rider behaviors on the other hand. Different from those two studies, our study put more emphasis on the underlying motives of risky motorcycle riding. Left aside the study by Nguyen et al. [25], qualitative work focussing on the determinants of risky motorcycle riding behavior is non-existent. That study, however, was not conducted in India, but in Vietnam. Thirdly, different from previous work, our study captured the opinions of motorcyclists in terms of what they themselves believed to be effective or ineffective safety promoting countermeasures. In our opinion, it is valuable to know how motorcyclists evaluate countermeasures that are targeted to improve their safety. Practitioners as well as policy makers could learn valuable lessons from that.

4. Methodology

4.1. Semi-Structured Focus Group Discussion

Focus group discussion (FGDs) is a widely used method in qualitative research. A small group of participants is consulted to understand their perspectives, practice, attitude, and behavior on a specific topic or an issue. FGDs have been defined as a "carefully planned discussion designed to obtain perceptions on a defined area of interest in a permissive, non-threatening environment" [60]. The interaction within the group and guidance provided by the moderator stimulates comprehensive discussions to get an in-depth understanding of the underlying attitudes and behaviors towards a highlighted topic. FGDs can serve four different purposes (1) to describe and understand an issue; (2) for planning to achieve a set of goals; (3) to tweak the execution of the investigation; and (4) to analyze and plan out policy decisions on what was revealed during an investigation [61]. Considering the proposed research question in our study, the purposes of the FGD in this particular study is to understand the issue under investigation and to achieve a set of goals for future intervention development.

In total, five FGDs were conducted (i.e., one with both males and females together and two each for males and females separately) with 8–10 participants in each of them. Heterogeneity in FGDs can serve to uncover deeper insights into what is being studied. In the current study, one of the five FGDs was heterogeneous based on the participant's gender to get varied, in-depth information on typical characteristics of motorcycle crashes among young riders and supplement the findings of the homogenous FGDs. This is in line with recommendations from Grønkjær et al. [62]. Apart from the participants, there were two more people in all FGDs: the moderator and one person for taking notes and recording the session. The first author of this article acted as the moderator. He underwent some in-house training procedures to get familiarized with moderating FGDs, in which he was acquainted with key steps to organize, conduct and moderate FGDs. An in-depth interview guide was prepared for the FGDs encompassing the primary areas of interest that were deduced from the current trends of riding practices among the young-aged population that will provide insights into the thought process of the young riders and how they perceive the practice of risky conduct while riding their motorcycles. The discussion guide intended to prompt thoughts and personal opinions and guide the conversation among participants

to identify factors associated with risky riding behaviors. More in detail, the interview guide was designed to elicit discussion among the participants about their views on the leading causes of road crashes, existing environmental hazards, and suggestions from them on how to improve rider safety. All the FGDs started with an opening question, and then sub-questions were optionally asked to guide the participants closer towards the research objectives. The discussions were facilitated in such a manner that new topics could freely emerge [60].

4.2. Participants

The participants included were in the age range of 18 to 25 years, and residing in the university town of Manipal. Manipal is situated at 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 young students from all across India and 60 countries all over the world.

The principal researcher visited college canteens, common youth hangouts points, motorcycle repair shops, youth clubs to identify eligible participants based on the inclusion criteria. The purpose of the study was explained to eligible participants and 35 agreed to participate in the FGDs. The participants were not provided with any incentive. To further investigate the issue of sample size, previous studies were consulted, where it was indicated that the ideal number of participants for qualitative research should be around 20 to 30 (e.g., Creswell et al. [63]; Morse [64]; Patton, [65]). Morse [64], for instance, proposed that a sample size of 30 participants is a good working number for qualitative studies based on interviewing techniques. During the focus group discussions, it was carefully monitored whether all participants received the opportunity to formulate ideas (instead of the group discussions being monopolized by the more responsive participants, and some people rather staying in the background), and whether no new themes, sub-themes or codes emerged, and participants indicated themselves they could not think of anything new to add to what was already said before suggesting that data saturation within each group discussion was reached [66].

Table 1 shows further details of the age and gender break-up of the study participants.

Table 1. Participant characteristics.

Age	**% (n)**	**Mean**	**Standard Deviation**
18–20	20 (7)		
21–23	45.6 (16)	22.2	2.12
24–25	34.4 (12)		
Gender	**% (n)**		
Male	51.4 (18)		
Female	48.6 (17)		
Years of riding	**% (n)**		
<1 year	22.86 (8)		
1 to 3 years	48.57 (17)		
3 to 5 years	28.57 (10)		
Riding hours in a week	**% (n)**		
1 to 5 h	57.14 (20)		
6 to 10 h	25.71 (9)		
>10 h	17.15 (6)		
Type of motorcycle	**% (n)**		
100 cc to 125 cc	77.14 (27)		
125 cc to 200 cc	20 (7)		
>500 cc	2.86 (1)		

4.3. Procedure

The study was approved by the institutional ethical committee of Kasturba Medical College at Manipal Academy of Higher Education (reference: KMC IEC-09/2018). Written informed consent was obtained from the participants at the beginning of the FGDs. The purpose of the study was explained to all the participants. Participants were told their names would not be mentioned to maintain confidentiality and anonymity. In total, five FGDs were conducted, and on average, lasted for 80–90 min. Participants were sensitized about the outcomes of the study. The moderator explained the objectives before each FGD, and participants were informed that the result of the FGDs would be used to generate evidence for understanding risky riding behaviors and for the improvement of rider safety in the city. Group members were encouraged to communicate with one another, exchange ideas and share experiences, and to maintain a cordial atmosphere in the group. Participants were reminded at a regular interval not to hesitate to put their opinion across. A specific flow was followed during the discussion to encapsulate the research themes from the FGDs groups. Furthermore, one of the team members was delegated for taking notes and facilitating the recording of the session. It was clearly observed that the number of focus group discussions conducted was sufficient in the sense that saturation point was reached and no new ideas emerging anymore. The discussions were audio-recorded.

4.4. Thematic Analysis

The FGDs were conducted in English and Kannada. The data collected was processed according to the protocol proposed by Braun & Clarke [67], (Figure 1). Familiarization with data included listening to the recordings and processing the notes taken during the discussions. Transcripts were thoroughly read to gain familiarity with the data content and to detect meaningful topics across the transcripts. Proper grammar and spell-check of the transcripts were done before subjecting the transcript to the MAXQDA software for thematic analysis. More in detail, thematic analysis is based on the identification of patterns through careful reading of the data and a thematic structuring into categories (e.g., Fuller et al. [68]; Rice & Ezzy [69]). In thematic analysis, patterns are identified in a bottom-up procedure. The method is data-driven and goes beyond semantic content, focussing on the latent level information, i.e., underlying ideas and concepts. The method is based on researcher judgement rather than on quantifiable measures (Braun & Clarke [67]). Themes consist of patterned responses related to the research questions and are not subject to a prevalence threshold.

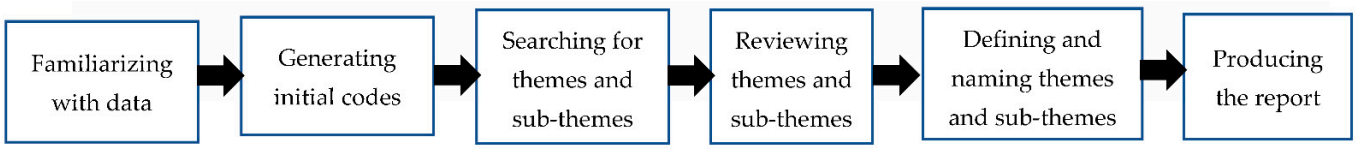

Figure 1. Stepwise data analysis protocol. Source-Braun & Clarke (2006).

As for the MAXQDA software, firstly, a thorough reading of the entire data was performed. Then the interesting and essential features of the data were coded related to the study's objectives. Color coding was given to the verbatims, which gave a similar kind of information, and also to the text providing information other than the study objectives were highlighted. The software has an option of code memo where the meaning of code and the context can be written, which helps determine which category the code belongs to. Once the entire document was coded, it was exported to a Word document. Then, to categorize the codes, the coder compared the codes to decide which categorization is more appropriate for the group of similar context codes. The number of repetitions of the codes in the Word document determines the significance of the information, leading to answering the research question. Subsequently, categories were created with the few codes that have specific qualities in common. Finally, categories and coding matrix were analyzed and summarized into groups and four main themes were derived from it [70]. Noteworthy

to mention, the principal researcher himself (first author) was the coder and he got first familiarized with the thematic analysis protocol proposed by Braun & Clarke [67] and also, he got acquainted himself with the MAXQDA software in order to do the coding.

5. Results

Table 2 gives an overview of the different themes derived from the FGDs, highlighting the most important sub-themes and related codes. Also, for each of these codes, the number of associated quotes is indicated.

Table 2. Themes, codes and quotes.

Category	Codes	Associated Quotes
Theme 1: Risky behaviors considered as safety critical		
1. Reasons for speeding	Thrill-seeking	12
	Late for college	4
	Empty roads	2
	Show-offs	8
	Age factor	9
	Influenced by movies	3
	Competition/racing	6
	Overtakes	7
	Peer pressure	6
2. Ignorance in servicing motorcycles	Using 2nd hand bikes	2
	Save pocket money	3
	Using rented bikes	2
3. Drink and drive culture	Loss of coordination	5
	Loss of judgment	5
Theme 2: Risky behaviors observed among young riders		
1. Use of gadgets while riding	Cell phone addiction	11
	Listening to music	4
	Checking itinerary	6
	Making pictures & videos	5
	Time saving	5
2. Helmet non-use	Spoiled hairstyle	8
	Humid climate	5
	Helmet theft	7
	Streamlined vision	3
	Discomfort	3
	Pillion riders don't use a helmet	4
3. Under-aged riding	Lack of parental supervision	3
	No valid licence	1
	Lack of proper training	2
	Access to motorcycles without a licence	7
Theme 3: Environmental factors for crashes		
1. Climatic and road conditions	Heavy rain	5
	Vertical curvature	3
	Potholes	3
	Irregular horizontal alignments	3
2. Absence of basic safety infrastructure	No streetlights	6
	No signboards	4
	No speed breaks	3
	No cameras	6
	No barricades	5

Table 2. *Cont.*

Category	Codes	Associated Quotes
Theme 3: Environmental factors for crashes		
3. System accountability	Inadequate training & examination	4
	Limited accessibility to RTO *	2
	Long-standing queues in RTO *	2
	Corruption	1
	Licensing fraud	3
	Increase in private vehicles	6
Theme 4: Suggestions for crash reduction		
1. Education & awareness activities	Alcohol limitation in pubs	3
	Promote public transport	6
	Stakeholder synergy	4
	Promote physically active travelling	6
	Promote cycling	2
2. Equipment & technologies	Put traffic barricades	3
	Speed breaker	3
	Traffic signals	5
	Signboards	4
	Advancement in technology	3
	Improve road conditions	6
	Install cameras	5
	Cover potholes	2
3. Strict enforcement	Heavy penalties	7
	Increase checking on weekends	9
	Frequent random checks	4

* RTO-Regional Transport office.

The thematic analysis revealed four themes with multiple categories (Figure 2). The first theme explored the risky behaviors considered as safety-critical causing road crashes among young riders. The second theme was about risky riding behaviors observed among young riders, comprising the use of mobile phones while riding and non-usage of a helmet. The third theme covered details related to risks arising from environmental conditions and road infrastructure. The last theme comprised suggestions for the reduction of crashes and the improvement of road safety.

5.1. Theme 1: Risky Behaviors Considered as Safety-Critical

Participants reported that speeding, poorly maintained motorcycles, and riding under the influence of alcohol are the main factors for road crashes among young riders.

5.1.1. Speeding

Participants felt that speeding and racing propensities while riding motorcycles was commonly seen among young riders. Young riders were said to be enthusiastic about the thrill of chasing exercises while being ignorant of the adverse consequences of speeding. Further discussion revealed that additional reasons for speeding were being in a hurry (e.g., getting late to reach a destination such as a college), and competition among friends:

> *"The speed thrills, so the young riders like to indulge in speeding. It is like a racing thing for them. In that state of mind, they think that they can speed and are not much bothered about road conditions, and they just do not care about the effects of road crashes."* (P3, Male)

Figure 2. Overview of themes, sub-themes, and codes.

Furthermore, participants reported that empty roads and sports bikes provoke them to indulge in show-offs, dangerous overtaking, and the performance of stunts. Moreover, participants identified seeking attention from their peers, flaunting their expensive bikes, and demonstrating judgement and control while riding as supplementary motives for speeding:

> *"I think one of the reasons for speeding is to show off to others the power of their bikes. I know that boys tend to buy bikes based on their speed and capacity of it. So just because they own a good bike, they indulge in speeding."* (P1, Female)

Speeding, however, was not exclusively associated with thrill-seeking and adventurousness. For instance, it was mentioned that when stressed or undergoing mishaps in their personal life, young riders often choose to go for a long ride as a kind of coping mechanism to appease themselves with the situation. The increased danger resulting from that, is riders being less concentrated on the road, and thus less attentive for sudden hazards requiring immediate corrective action. Finally, escape from traffic police checkpoints was mentioned as a reason to speed. More specifically, young riders not possessing the essential documents for their vehicle or without a proper license tend to raise the speed to get rid of the checking procedures:

> *"A person can also ride a bike because of some sort of external distress. Moreover, that is the time like they want to escape the problem that they are facing. And because of which, they generally take their bikes for a long ride. Furthermore, this could account for road crashes among them, as they are not very much concentrating on the road because they are thinking about their problem and at the same time riding the vehicle."* (P16, Male)

> *"I have seen many people, when there is checking by police, then they suddenly increase their speed and they try to run away from that site, especially in Manipal. Once, I have witnessed it at syndicate circle, my friend was riding without a helmet, and the moment he saw the police check post, he increased the speed and ran away from there."* (P4, Female)

5.1.2. Alcohol Impairment

The majority of the participants reported that riding under the influence of alcohol is the primary reason for crashes among the youth population in Manipal. Participants felt that alcohol impairment reduces a person's thinking and reasoning abilities, leading to erroneous judgments and even loss of neuro-muscular coordination. Consumption of alcohol and subsequent decisions to ride back home after weekend parties was said to have become almost a culture among youths in Manipal:

> *"There is a pub culture in Manipal. Many people go to these places and get intoxicated. The thing is that cognitive abilities are badly affected after drinking. The rider cannot control the vehicle, which can cause road crash. Furthermore, I believe that this is the major cause of crashes in Manipal."* (P28, Male)

> *"The major reason is drunk and drive. Because whenever we take alcohol, it completely affects muscular coordination of our body."* (P9, Male)

5.1.3. Poorly Maintained Motorcycles

Most participants drew attention towards the use of second-hand motorcycles by the young-aged population in Manipal. Youngsters come from different parts of India and abroad to Manipal to study. As such, they reside only temporarily in Manipal, which is why they prefer to purchase a second-hand bike. After completion of their studies, these bikes are resold to newly incoming arrivals. Currently, there is no official authority regulating and monitoring the sale and safety of such second-hand motorcycles. Poorly maintained motorcycles were considered to be jeopardizing the safety of young riders in Manipal:

> *"The young students prefer to buy second-hand bikes instead of buying a new proper vehicle because they are cheaper. So, there is no regulating body to keep a check on it. Now they do not maintain the second-hand bikes, and it is prone to crashes."* (P6, Male)

> *"Vehicle condition is one of the reasons for road crashes. Most of the students in Manipal are from other states of India and abroad. So, they prefer second-hand bikes during their course of stay. They will sell their bikes and will go from here. Now the new students prefer buying these second-hand vehicles which are not in good condition. This causes a problem later. So, I believe the vehicle condition is important for safe riding."* (P34, Female)

According to some of the participants, saving pocket money is one of the primary reasons for not getting a vehicle properly serviced. Students prefer to keep their limited pocket money for other expenses rather than spending it on regular motorbike servicing. Additionally, a lot of youngsters are ignorant about the importance of getting their motorcycles regularly inspected. Those who service their vehicle only get the minimum essentials checked (e.g., brakes and engine oil), while the rest is skipped. Spoilt headlights, taillights and even indicators are usually not replaced, which by itself already is a road safety violation. Interestingly, some participants also mentioned that many rental firms provide motorcycles that are not adequately serviced with poorly maintained brakes:

> *"Look, pocket money is limited for young students, and that is the reason they do not go for timely service of their bikes. They have to pay the house rent, mess bill, and many other expenses. Thereby very little is left for the maintenance of the bikes. So, they will mainly sometimes go for a brake check or changing of the engine oil. Moreover, I have seen my friends having a bike without a taillight and indicator. Now it becomes difficult for the riders behind to make out where exactly he is turning. In many instances, he has almost experienced very close crash situations."* (P13, Female)

> *"Also, many students here rent a bike for the day-to-day commutation. The rented bikes are not adequately serviced and maintained. I had rented a bike, and it did not have a proper brake system, and whenever I used to come down, it was challenging for me to control the bike."* (P4, Female)

5.2. Theme 2: Risky Behaviors Observed among Young Riders

5.2.1. Use of Mobile Phone while Riding

Participants discussed the use of mobile phones while riding among the youths. Young riders were said to attend phone calls with only one hand available to balance the motorbike. Timesaving was believed to be an important underlying motive. In addition, listening to high-volume music while riding with the earplugs in for enjoyment was another reason for using the mobile phone while riding. Furthermore, youngsters were said to browse google maps for visiting specific addresses. These behaviors were perceived as dangerous since they create a distraction and decrease riders' situation awareness. Finally, some of the participants mentioned the use of a mobile phone to take pictures and make videos while riding as a common trend among the young-aged riders:

> *"So, they probably feel that the phone call is important, and it has to be attended without wasting time. They feel that both riding the bike and talking on the phone can be done at the same time. They do not have the patience to stop and then take the call. We see young riders listening to music in high volume and riding because they do not want to drive alone, they need some company, and music gives them that company on a long ride."* (P7, Male)

> *"They use mobile phones to access google maps while they are driving in an unfamiliar area. Sometimes they also listen to music while riding. They cannot hear the honking from the other vehicles. So, most of the attention is on the phone and not on the roads. This eventually leads to crashes."* (P13, Female)

> *"Many times, it happens that while riding a bike, the person sitting behind tends to make a video of them going till their destination using a mobile phone camera, which results in the driver's distraction as he/she tends to look into the video quite often. This distraction leads to crashes."* (P33, Male)

5.2.2. Helmet Non-Use

Most participants felt that non-use of helmets was related to the fact that it spoils hairstyle. Discomfort due to extreme humidity was another motive for not using a safety helmet. Few participants also mentioned that sometimes young riders simply tend to forget wearing a helmet, for instance, when being in a hurry. Furthermore, helmet weight and obstructed field of view were mentioned as possible reasons for not using it:

> *"Young riders do not prefer wearing helmets because they think that it is not cool. Alternatively, also it just damages their hairstyles. Also, wearing a helmet produces a lot of heat, mainly in the summer season. It causes discomfort."* (P11, Female)

> *"I can say sometimes they are in a hurry, and they forget to take their helmet sometimes because of the weather. It is too humid."* (P29, Female)

> *"I also think helmets cause much physical disturbance, and it is heavy on the head, and it is very suffocating. That is why the preference is low."* (P3, Male)

> *"Young riders do not choose to wear a helmet because of the streamlined vision they get after wearing the helmet. They consider they cannot see the whole 280-degree vision, which might cause some problems to see if anyone is coming from behind."* (P7, Male)

Interestingly, participants also mentioned helmet theft as another reason for riding without a helmet. More specifically, carrying a helmet without secure methods to store the helmet once reaching the destination was considered as an important barrier for wearing helmets. It is common practice among young riders to hang their helmet on the rear-view mirror while parking, often resulting in the helmet being robbed. Some participants also reported that, since most young riders only reside for a limited period of time as a student in Manipal, there is almost no motivation to buy a helmet. Additionally, most rental companies offer motorcycles without the inclusion of a helmet. Many youngsters simply do not see a point in investing in it and believe they can safely manage the riding task

without wearing a safety helmet. The non-use of safety helmets among pillion passengers was also raised as an important safety issue:

> *"If you have a moped or a scooter, you can easily put the helmet near the footrest or the deck. Nevertheless, carrying a helmet on motorcycles is difficult. Also, if you put your helmet in the rear mirror, there are high chances of it being stolen. This all reason just demotivates young riders to use a helmet."* (P2, Female)

> *"Many of us have seen that on one bike, there are three, four people going altogether. So, I think it is challenging to manage the motorcycle, and sometimes they lose their balance, which can lead to crash. Moreover, the pillion does not use a helmet."* (P1, Female)

> *"Since in Manipal, young student riders usually buy second-hand bikes, and the mentality is why to buy helmets also. No one is interested in buying helmets. Because it is like you will not be using it after two years. I have seen that the rental agencies do not provide helmet to their customers."* (P7, Male)

5.2.3. Access to Motorcycles

Many of the participants referred to the accessibility to motorcycles at an early age being much easier today as another important safety issue. Parents provide their children with sports bikes and do not follow up on how they ride or whether they use a helmet. Access to motorcycles is seen even before reaching the rightful age to obtain a valid motorcycle license. The lack of parental supervision is especially problematic among resident students who are away from home:

> *"The accessibility to bikes has increased tremendously since the past decade. Now the condition is that even after passing class 10th, parents are giving motorcycles to their son and daughter. So, the culture has changed. The parents seem to have completely surrendered in front of their kid's demand."* (P17, Female)

> *"There is no parental guidance to look over riding behaviors. The young student riders who are not staying with their parents have a sense of freedom and often indulge in rebel riding. These days, students are not telling everything to their parents. Therefore, the parents are not aware of what their child is doing when they are in some other town for education."* (P35, Male)

Related to ease of access, most participants reported that youngsters often start riding motorcycles without proper initial training, for instance, from an officially recognized driving school. Consequently, they lack basic knowledge of safe riding practices and are allowed to ride even without obtaining a valid license:

> *"Some young students have access to motorcycles even if they do not have a license. I have seen them riding without any proper training and license. They somehow manage to escape the checkpoints by paying some money. Yes, they are not trained; they just have a bit of knowledge about riding a bike and other safety measures. This finally leads to crashes."* (P3, Male)

5.3. Theme 3: Environmental Factors

Environmental factors have emerged as an essential issue. Participants identified and discussed specific climatic and road conditions, the absence of basic safety infrastructure, and system accountability.

5.3.1. Climatic and Road Conditions

Almost all participants claimed that the number of crashes increases during the rainy season. Especially during the monsoon season, dilapidated roads and potholes get filled with rainwater, creating slippery surface conditions. This, in turn, increases the difficulty of the riding task and puts pressure on riders' vehicle control skills:

> *"It is probably more during the rainy season because the roads are repaired inadequately before the rainy season, and again it has been damaged during the rainy season. Furthermore, again, the cycle goes on."* (P14, Male)

> *"If there are potholes on the road, the vehicles cannot be adequately balanced on the road. So, they tend to lose our balance and fall. Moreover, if they are at high speed, then they will not be able to maintain the balance. Moreover, even in the rainy season, the holes get filled with water. So, they cannot judge if it is a hole or plane."* (P4, Female)

Participants also mentioned that Manipal has a hilly and uneven terrain. Straight roads are relatively scarce in the city and its outskirts. Sharp bends, sudden downhills, and robust curves sometimes make riding conditions challenging and require riders to be cautious and mindful when riding on these roads. Correspondingly a rider stated:

> *"Manipal is a hilly terrain, and there are a lot of blind curves and narrow roads. Additionally, there are a lot of remote roads and blind curves, so these all conditions make riding risky and are one of the reasons for crashes."* (P1, Female)

5.3.2. Absence of Basic Safety Infrastructure

Participants reported the lack of basic road safety infrastructure in as another safety obstacle. According to them, it is essential to have at least the basic safety infrastructure such as streetlights, signboards, and traffic calming measures such as speed breakers and barricades to minimize the occurrence of crashes. Many of the participants claimed that they had not witnessed adequate safety infrastructure in Manipal. Furthermore, riding at night in the outskirts of the city was considered difficult due to low visibility as there are no streetlights. As one rider commented:

> *"The streets of Manipal are not well lighted. Like the area beyond the KFC and Udupi roads, there are hardly any streetlights. Construction is happening in the entire stretch, and movement of heavy traffic makes the road dangerous for riding."* (P6, Male)

Many participants highlighted that signboards were also missing on substantial parts of the local road network. Road maintenance work zones were mentioned as one illustrative example of how road signs were sometimes removed without being properly replaced afterward. The absence of traffic calming measures was deemed particularly problematic since speeding is one of the predominant risky behaviors among young riders:

> *"There are no signboards on the town roads. Now because of road construction, the signboards have been misplaced here and there. This creates confusion and sometimes crashes."* (P2, Female)

> *"They are overconfident about their driving skills. There are not many speed breakers on Manipal roads, so controlling the speed becomes difficult. So, they go freely with high speed."* (P12, Male)

5.3.3. Accountability of Regulating & Enforcement System

Participants also explicitly raised the loopholes in the existing regulating system and enforcement authorities as an important issue. For example, many participants felt that prospective young riders were trained inadequately and that they lack basic theoretical knowledge on the syllabus of road safety and traffic rules. Another point raised, was the lenient nature of the authorities in issuing a license for a two-wheeler. Furthermore, they mentioned that usually, the Regional Transport Office (RTO) is located far from the city and requires some travel time, prompting license-seekers to go through an agent and obtain a license without any training or examination. This is illustrated by statements as:

> *"There is no government body, or there is no one to educate us like what should be the traffic rules and regulations and what should be the ideal traffic behavior. Even when we go to the RTO to get the license, they hardly take any examination kind of thing, or they hardly teach us something about the traffic signals and rules, what are the hand signals should be, and what should be the indicator manners."* (P4, Female)

> *"The RTO like in most of the cities are not located in the main city and sometimes very far off area which you have to travel. You have to travel and so avoid that people just opt to sit at home and get the license by other possible means. Furthermore, I think that is also one of the major reasons like nobody wants to stand in a queue."* (P11, Female)

> *"There has been an upsurge in the number of vehicles due to improvement in the purchasing power from the past few years. The RTO officers are very lenient when it comes to clearing the new license and vehicle. The process involved should be fair and free from corruption."* (P3, Male)

5.4. Theme 4: Suggestions for Crash Reduction

Participants also reflected on possible crash reduction measures. Emerging suggestions related to education and awareness-raising initiatives, use of supportive equipment and technology, enforcement policy, and road infrastructure. Most participants stressed the importance of stakeholder synergy for such countermeasures to be effective.

5.4.1. Education and Awareness Activities

Many respondents observed impaired riding to be common among young riders in Manipal. Proposed countermeasures were to have bar/pub owners play a more upfront role in the prevention of riding under the influence of alcohol. For instance, information, education, and communication materials could be displayed making the point that riding under alcohol impairment can be fatal. Furthermore, a limit on the amount of alcohol served could be imposed. Additionally, participants thought bar/pub authorities could be provided with breath analyzers to test customers' BAC-level before leaving the bar/pub. Some participants suggested that youngsters should use public transport (e.g., taxi or city bus) instead of their own vehicle to visit bars/pubs and return home:

> *"There should be a restriction on the amount of liquor served to young student riders in pubs/bars. This restriction can reduce toxication and can prevent crashes. The bar security guards should be given a breath analyzer, and they can test for those who are coming out of bars, so if the alcohol level is more than the permissible limit, that person should not be allowed to drive. They can display digital IEC (Information, education and communication) material in a pub/bar. It should have messages on it like 'Do not mix and drive."* (P35, Male)

> *"One of the major problems in Manipal was drinking and driving. So, the solution is that the bars and pubs wherever the young student riders go for drinking and other activity, they can have a rule that they cannot come with their vehicles. Instead, they can make an auto stand near the bar or pub so that after getting drunk, they can go by auto to their home."* (P9, Male)

Some participants argued in favor of more active involvement of university authorities in promoting road safety. Universities could, for instance, provide students with shuttle bus services to decrease the number of private vehicles. Security officials could be given the authority to conduct random checks for rash driving, possession of the required documents, and helmet use at the gates:

> *"They should start campus shuttle bus service within the campus so that the number of vehicles will be restricted during the peak hours. This will avoid the morning rush and will decrease the number of crashes."* (P6, Male)

> *"I feel that even university security guards should start conducting random checks at various points on the campus, particularly at the entry and exit. They can also see to it whether the students are using helmets, have a valid driving license, bike papers, and all. This will keep the young student riders on their toes, and they will behave properly."* (P29, Female)

Some participants suggested the need for collaborative awareness-raising activities between the university and the traffic unit of the police department, such as orientation

sessions for university students to sensitize them about the traffic rules and previous crashes in the city, recruitment of student volunteers from the university by the local police traffic unit, authorizing them for random checks on campus and in pubs:

> *"The police department can collaborate with students and can issue them temporary cards authorizing to volunteer traffic control and random checks. The volunteering students can also visit pubs and bars on the weekend and sensitize the youths not to drive after consuming alcohol."* (P2, Female)

> *"Inspectors will take a class on traffic rules regulations and other possibilities of crashes and how you need to behave on the roads. Moreover, sir, like a collaboration with the college and Regional Transport Office, can be done, and they can come to college to teach us about safe riding practices. The students should be sensitized in the beginning by Regional Transport Office and traffic police about the prevailing traffic conditions in Manipal and some safety measures."* (P16, Male)

5.4.2. Equipment and Technology

One of the valuable suggestions emerging from the FGDs was to encourage coordinated efforts between the engineering college and the traffic department to come up with advanced technology to reduce traffic violations and identify the violators. Additionally, inter-college competitions and hackathons to promote innovations and further technical development were proposed. Some participants proposed the installation of speed sensors to monitor speed and identify speed limit violations:

> *"I did not see any speed control systems in Manipal. So, I think they can use a little more technology to have control over speed. Inputs can be taken from the engineering college to initiate some kind of speed tracking intervention. There should be inter-college collaboration within the university to promote creativity."* (P16, Male)

> *"I would just like to add that engineering college students should be involved in designing certain technology which can reduce crashes. There can be some kind of a hackathon where all can participate and come out with some creativity, and the winner should be rewarded."* (P3, Male)

To reduce the number of crashes, one of the participants suggested implementing innovations such as sensitive alarms. The alarm can alert the vehicle owner if any part of the vehicle is damaged or non-functional. Like the car, the car does not start if the seatbelt is not used. As stated by a rider:

> *"Nowadays, many vehicles are coming out that if you do not put a seatbelt on the vehicle, it will not start. So, similarly, if such technology can come into bikes that if engine oil is in not proper, if backlight or indicators are not functioning, then the vehicle should not start. So, if such technology can be incorporated into bikes, I think I know it will be expensive, but it will surely help in reducing crashes."* (P18, Male)

Some of the participants felt the need to improve the road safety infrastructure of the city to reduce the number of crashes. Participants strongly recommended immediate fixation of the non-functional road safety equipment, i.e., traffic signals, streetlights, traffic barricades, signboards, and speed breakers. Installation should be done according to the junctions, peak hours, traffic status, and crash-prone zones. One of the participants pointed out the urgency to fix up the potholes as it becomes dangerous during the prolonged monsoon seasons. Participants deplored the approach of the authorities in fixing the potholes temporarily and were of the opinion to fix it permanently. See statement as:

> *"They can put speed breakers near the junction; if not, they can install zigzag traffic barricades, and exactly how they have done on the campus roads."* (P4, Female)

> *"The authorities should at least take initiatives to install traffic lights near the busy junction and crash-prone areas. So, just by keeping traffic signals or giving proper light will not reduce the accidents."* (P3, Male)

> *"Road condition should be improved; there are potholes on the road. During the rainy season, the road condition is bad, which needs to be permanently repaired". The authorities just do some temporary patchwork before the onset of the rainy season. It should be repaired permanently."* (P16, Male)

5.4.3. Strict Enforcement

For law and enforcement, many participants were of the view that the existing traffic rules should be enforced more strictly. Few of them suggested imposing hefty fines in case of any violations. Furthermore, it was also opined that the authenticity of the bike rental agencies should be verified on a regular interval:

> *"Penalizing should be more stricter."* (P23, Female)

> *"I think the young student riders should be charged with heavy penalties when they are not wearing their helmets. Furthermore, I think the government should regularly check the authenticity of various bike rental agencies in the town."* (P27, Male)

According to some of the participants, there can be surprise random checkpoints for the proper implementation of traffic rules. The offenders should be fined heavily to discourage them from committing the same offense in the future. Random checkpoints should be continuously maintained to thwart any escape plot by the young riders. Furthermore, extra traffic policemen can permanently be deputed at those random checkpoints to ensure efficacy. Correspondingly a rider stated:

> *"On weekends, there should be a strict vigil, and traffic police should do a thorough checking of drivers, and strict action should be taken if found guilty."* (P30, Male)

> *"There should be random checkpoints, not fixed checkpoints, as the youths are aware of the fixed checkpoints and will try to avoid that route. Also, it would be better if they could have more traffic policemen deployed at the checkpoints."* (P13, Female)

Many of the participants deplored the dishonest and fraudulent behavior of some people in authority. According to them, the enforcement authorities should be honest in implementing the laws among the young riders. Stringent enforcement of laws will discourage young riders from committing violations. Furthermore, the release of fake driving documents can be curbed and will prevent crashes:

> *"If corruption can be reduced, crashes will automatically come down as people with a bogus driving license cannot ride anymore. Strict law enforcement can also be ensured."* (P26, Male)

6. Discussion

The overall aim of this paper was to improve the understanding of typical characteristics of motorcycle crashes among young riders in Manipal (India), primarily focusing on the prevalence and role of risky riding behaviors. For that purpose, a qualitative study design was implemented, including five focus group discussions among a sample of young riders.

The present study responds to the need for a better understanding of the determinants of road crashes among young riders as they represent a high-risk group. The main factors derived from the FGDs responsible for road crashes are risky riding practices and gaps in the infrastructure of the city. The most prevalent risky riding practices mentioned were speeding, alcohol-impaired riding, use of the mobile phone while riding, not wearing a helmet, and improper maintenance of motorcycles. This is in line with several studies conducted in India and other countries [1,26,41,71,72]. Huth et al. [41] and Lucidi et al. [72] have identified the above-mentioned riding behaviors as commonly observed in their respective study settings. Also, this is in line with the data retrieved from the local authorities (personal communication, 5 May 2019), which showed that these riding practices were the leading causes of fatal road crashes from 2008–2018. It is worth noting that there is scarce empirical evidence in the Indian context regarding improper maintenance of motorcycles and road crashes. For instance, Pal et al. [1] do mention that improper maintenance of

motorcycles is a crash causative factor, but it does not elaborate further on how it causes crashes. This warrants further investigation.

Speeding the vehicle beyond the lawful limit is the most commonly reported risky riding behavior among the young riders, which is similar to findings of several previous studies [1,5,9,28,56]. The report published by the Ministry of Road Transport and Highways, which stated that over-speeding is the leading cause of fatal road crashes, accounting for 71.1% of the total crash [7]. The tendency for speeding can be explained by citing the work of Sharma et al. [28] in Bangalore, where "liking for chasing and competing", "sense of power and control," and "relief from anger" were identified as the main correlates. Looking at it from a psychosocial perspective by using the Theory of Planned Behavior, speeding behavior is strongly predicted by negative social norms and attitudes towards respecting speed limits [53]. Furthermore, the tendency to speed also aligns with the findings of some studies conducted in low-and middle-income countries [73]. For instance, Oltaye et al. [73] in Ethiopia and Konlan et al. [47] in Ghana reported speeding as one of the main causes of crashes among motorcyclists. Discussing it further in the context of a developed country, in a study conducted by Dubos et al. [74] in France, speeding was identified as the major cause of fatal road crashes among motorcyclists. The study pointed out that heavy motorcyclists were involved in 62% of fatal crashes. It was argued by Dubos et al. [74], heavy motorcyclists tend to run over the speed limit by a higher margin. Interestingly, speeding behavior may not always be intentional. Unintentional speeding may occur due to reasons including a lack of awareness of the current speed limit/travelling speed and not paying regular attention to the speedometer on the vehicle [75].

As for the use of a helmet, the current study revealed that youths are self-fixated with their appearances and peer praises, which prompts them to post their pictures and videos on social media. Many participants responded that they prefer not to wear a helmet as it is uncomfortable due to the humid climate and also opined that it ruins hairstyle. One of the other possible reasons for low helmet usage can be due to lack of awareness about the protective efficacy of helmet [64]. Few also mentioned that using a helmet restricts vision while riding and that the weight of the helmet makes them feel suffocated. Comparable findings have been reported for young adult motorcyclists in Cambodia [37]. In another study conducted by Faryabi et al. [76], it was reported that the heavy weight of the helmet, followed by a feeling of heat, neck pain, feeling of suffocation, and limitation of head and neck movements were the main reasons for not wearing helmet among Iranian motorcyclists. Additionally, young riders do not prefer to wear a helmet when they go out for short distances, which may be indicative of their unawareness of the importance of using protective equipment. This is similar to findings reported in other studies conducted in Taiwan and India [6,48].

Participants in the present study also highlighted the practice of using mobile phones while riding. Riders or pillion passengers are commonly observed recording videos and capturing pictures to post them on social media. Furthermore, they browse the internet for google maps, access social media, and attend calls. This aligns with the findings of the study conducted by Bates et al. [77] in Oman. Studies conducted in other regions of the India by the Save LIFE Vodafone Foundation [55] and by Hassan et al. [26] also reported high usage of mobile phones for various activities among young riders while riding. Overall, and in line with what was reported still recently by Nguyen et al. [25] for Vietnam, quotes provided by the FGD participants regarding the motives underlying risky rider behavior seem to suggest that risky ridership can best be understood as a dual process phenomenon, similar to what has been reported for car drivers [12]. In a study conducted by Widyanti et al. [78] among Indonesian motorcyclists, results showed that the prevalence of mobile phone usage among Indonesian motorcyclists was as high as 75%. It was argued that factors such as age, education, and marital status affect mobile phone usage among Indonesian motorcyclists. Interestingly, fines did not influence the use of mobile phones during motorcycling amongst them. Risky rider behavior can be explained as volitionally controlled, resulting from a conscious judgement of the pros and

cons, the cost and benefits related to a specific behavior (e.g., speeding or alcohol-impaired riding). On the other hand, risky behavior can be the outcome of a reactive decision-making pathway where risk-conducive contextual circumstances (e.g., the presence of peers, the lack of safe alternatives to travel back home after having drunk) trigger an unintentional willingness to take risks [25].

Alcohol-impaired riding was also identified as risky behavior. The culture of weekend celebration and riding after getting drunk in bars/pubs was mentioned by many of the participants as an important crash causative factor. This is also similar to what Romero et al. [79] found in Brazil. It is obvious that alcohol can affect most of the abilities and skills needed for safe riding. It can affect attention, motor skills, and decision-making. Noteworthy to mention, the current evidence shows that degradation of riding performance due to alcohol impairment can occur at a BAC-level 0.05 or even less than that. Although most of the study participants opined that riding under the influence of alcohol is dangerous, there are two major concerns that can well explain why riding under the influence of alcohol remains one of the major causes of road crashes. Alonso et al. [80] mentioned that riders are prone to neglect the "objective risk" of operating a vehicle under the influence of alcohol, as every time they don't encounter a crash. This prompts them to believe that there is no risk involved in riding under the influence of alcohol, which further reinforces the behavior. This can also somewhat be explained in a study conducted by Bazargan-Hejazi et al. [40] in Iran. Iranian motorcyclists were clustered into different groups based on specific cognitive dissonances and consonances associated with risky riding. This resulted in the identification of four groups, i.e., risk managers, risk utilizers, risk calculators, and risk-takers. Two of these profiles (i.e., risk managers and risk utilizers) somehow reflect the answers provided by participants in our study. Furthermore, looking it from the perspective of the Health Belief Model [81], people usually will not change their existing behaviors unless they think such action is necessary. Interestingly, there is enough empirical evidence to suggest that many road users are unaware about the required information regarding the effects of alcohol on personal functioning [82,83]. Furthermore, there is a common assumption regarding the actions one can take to nullify the impact of alcohol before driving (for e.g., taking a cold shower, having mint, drinking coffee [80]. As stated by the protection motivation theory, adopting a preventive behavior is not only dependent on a threat appraisal process (perceived severity) and the perceived probability that one can be more susceptible to the harm (perceived susceptibility) caused by that threat, but also on a coping appraisal process [84]. Important to mention is that an individual's gender is a key factor that affects their riding behavior. In a study conducted by Uttra, Laddawan et al. [85], it was reported that gender significantly affects the motorcycle riding behavior. For instance, the main factors that influenced motorcycle riding behavior were the attitude based on health motivation and perceived behavior control. For females, attitude based on health motivation is more impactful as compared to males.

Speeding behavior can also be explained in terms dual-process theory. Jongen et al. [86] was among the first to provide evidence for a dual process theory of risky riding by showing that a momentary reward leads to speeding among young riders, while cognitive control interacted with driving performance (i.e., lower inhibitory control related to increased lane-keeping variability). Nevertheless, they were not able to include a full test of a dual-process theory of risky driving, which included the component of cognitive control and a socio-reward context as stated by Lambert et al. [87]. Additionally, the study reveals seeking adventure and thrill as primary reasons young riders indulge in speeding, besides seeking peer attention, getting late to reach the destination, racing with fellow riders, and influencing movies. Stress was another reason given by the participants, which aligns with what was found in studies conducted by Kohli [88] in India and Romero et al. [79] in Brazil. The current study suggests that ego plays an essential role in shaping the behavior of young riders. This reflects the findings obtained by Romero et al. [79]: personality traits including impulsivity, ego, and violence contributed to a significant share of road crashes among young Brazilian riders. Moreover, youths are careless when it comes to

the regular and proper maintenance of their motorcycles. They set aside their pocket money for other expenses and do not get their motorcycles regularly serviced. Previous studies have reported an increased risk of road crashes if motorcycles are not adequately maintained [89].

The importance of environmental factors (i.e., climate and road infrastructure) emerged as another major theme from the current FGDs. This aligns with the study conducted by Huth et al. [41]. Climatological conditions such as extreme rainfall and humidity worsen road conditions, especially during the monsoon season. This, in turn, increases crash risk [48,90]. The discussion revealed the non-functioning of the basic road safety infrastructure in the city, making riders vulnerable to crashes, which reflects findings reported in another qualitative study where a broad selection of road safety stakeholders (e.g., government officials, subject experts, road traffic injury victims, trauma surgeons, medical interns, nurses and taxi drivers) were consulted for their perceptions of road safety in Hyderabad, India [90]. Participants were critical of the local authorities in maintaining the basic road safety infrastructure and the loopholes in issuing a license for a two-wheeler. The participants narrated their experiences in the RTO to justify their claims. It has been argued in other studies as well that the screening procedure in issuing a license should be strictly followed to curtail the presence of unskilled riders on the road [91].

As for ways to improve the road safety of younger riders, participants suggested conducting awareness programmes through the coordinated effort of public bodies, educational institutions, and the traffic department [90]. Additionally, authorization of student volunteers to monitor other youths if they are abiding by the traffic laws in and around the city was proposed. Walking and cycling could be promoted by creating a separate lane for the cyclist and via the construction of subways for pedestrians. Some of the participants felt the need to improve public transport facilities outside bars/pubs to minimize the risk of crashes due to alcohol impairment [91]. Bar/pub authorities could take up the responsibility of setting limits on serving liquor to the youths. Furthermore, information, education, and communication materials could be displayed on the premises for creating awareness. The potential for such on-site interventions has been demonstrated for instance, in Europe. To illustrate, the EU-funded project Focus on Alcohol Safe Environments focused on available evidence for the success of five intervention areas aimed at preventing alcohol-related harm in drinking environments, i.e., (1) training of responsible servers and staff, (2) reduction of underage access to alcohol, (3) policing and enforcement, (4) brief interventions in drinking establishments (e.g., offering of incentives for designated drivers), and (5) community-based multi-component programs. Although results were mixed across these five areas, the clearest evidence for success came from community-based programs that combine a range of coordinated measures implemented through string multi-agency partnership. The Swedish STAD-project (Stockholm Prevents Alcohol and Drug Problems) serves as a good practice example. A range of measures were implemented, including responsible beverage service training, community mobilization, and increased enforcement, resulting in a reduction of the number of crimes by 29% in the intervention area in a cost-effective way.

Most of the participants suggested the improvement and proper maintenance of the current road safety infrastructure in the city, which aligns with the findings of several previous studies [1,2,41,48,92]. Intradepartmental coordination to decide on the hot spots in the city to install traffic barricades, cameras, speed breakers, signboards, and signals can be initiated. Furthermore, it was opined that events such as hackathons could be conducted in the colleges, encouraging youth to come up with creative solutions to prevent road crashes. As a good practice illustration of that, in a hackathon organized by the Germany-based Bosch group in Bangalore, some engineering students developed a prototype of an ultrasonic sensor that can alert a rider about speeding vehicles nearby [93]. Even though a legislative framework for traffic violations is available, it was revealed that these regulations are not always properly enforced in the city. Participants stressed the fact that young riders of higher socio-economic status often commit traffic violations as they feel

that they can afford penalties and escape. A heavier penalty system should be implemented to discourage riders from committing violations [91]. Furthermore, it was also suggested to increase the number of random surprise checkpoints in various zones of the city. Curbing the malpractices concerning the issuing of riding licenses and enforcement by reforms can play a significant role in preventing road crashes among young riders [90].

7. Practical Implications

Based on the study results, several tentative recommendations are proposed. As a countermeasure, there is a need to rectify the erroneous assumptions to prevent the negative effects of alcohol, so that riders do not continue to falsely believe that they can adequately deal with alcohol and continue driving while intoxicated. Furthermore, certain techniques for behavioral change, such as persuasive communication techniques targeting on skills including self-assessment, self-anticipation, and self-actualization, are suitable to influence the volitional pathway towards risky ridership behavior [25].

The authorities should also think about improving the safety systems to make the riding environment safer. Important to mention here is the concept of "safe system approach". The Safe System is based on well-established safety principles—of known tolerance of the human body to crash forces, speed thresholds for managing crash impact energies to survivable levels, and the capacities of vehicles and forgiving infrastructure to reduce crash impact energy transfers to humans. Additionally, the Safe System approach—a core feature of the WHO Decade of Action for Road Safety—recognizes that road transport is complex and places safety at its core. It states that humans, vehicles, and the road infrastructure must interact in a cohesive way to ensure a high level of safety [94]. Hence, it is recommended to improve the safety system. Adequate lighting systems are required to improve visibility, particularly during the daytime [44]. It is interesting to note that, as per the Government of India guidelines, all new motorcycles, and scooters that came into the market need to feature "Automatic Headlight On" (AHO) from 1 April 2017 onwards. AHO is mandated to improve visibility during day and at dawn and dusk [95]. One important point which can be raised here is what about those vehicles which came out before 1 April 2017 and are currently in use. The local authorities can organize programs to raise awareness about the utility of AHO among the young riders and strategies to incorporate it in the older vehicles. Nevertheless, in a middle-income country such as India with a predominantly youth population dependent on the pocket received from their parents, it would be financially tasking for them to exchange their old running vehicles or pay for AHO to incorporate it.

A multi-sectoral approach by engaging all the relevant stakeholders and behavioral interventions, such as persuasive communication techniques, and an active experimental approach, such as the use of a simulator and regulating the licensing procedure, can bring a reduction in the number of road crashes. Although the participants were aware of the dangers of speeding and riding under the influence of alcohol, they were not well informed by a correct understanding of the exact reasons why speeding and riding under the influence of alcohol increases crash risk. It is recommended to have an active experimental approach, such as a simulator, where riders personally experience the impact of speeding to better assess the relationship between speeding and crash risk [96]. For instance, the Automobile Association of Upper India is non-profit organization based in New Delhi and conducts driving stimulator experiments [97]. This can even be implemented at the licensing procedure to sensitize future riders. Furthermore, the current study's findings suggest that decision-makers should implement strict regulations for those riding underage or without a proper valid license. It is noteworthy to mention that until and unless licensing procedures in India are regulated and closely monitored, the quality of the rider will be questioned [98].

The current study's findings have also generated evidence for the local authorities about the importance of strict law enforcement for any acts of traffic violations. Possible hazards for riders created by potholes and bad roads need to be taken into consideration. The local authorities should immediately focus on immediate fixation to neutralize any pos-

sible threats for the riders. Fixing the infrastructural issues with advanced road engineering under a coordinated multi-sectoral effort will end up in a more significant commitment to reducing road crashes [99].

It is noteworthy to mention that the study findings have international significance, particularly in LMICs. For instance, as indicated by Olatye et al. [73] in Ethiopia and Konlan et al. [47] in Ghana, speeding is identified as the main cause of road crashes. Therefore, the findings from the current study will provide impetus to the researchers in other LMICs and assess the underlying motives for risky riding behaviors using an in-depth approach. Furthermore, the study has highlighted the importance of road safety infrastructure, which largely remains neglected in LMICs [100]. More importantly, behaviors such as speeding have been identified as the crash causation among motorcyclists in high-income countries as well [74]. It can therefore be recommended for policymakers in those countries to initiate targeted interventions that focus on the predictors of risky riding to reduce crash and injury rates.

8. Limitations and Future Research

Inevitably, there are certain limitations to studies such as this one. Firstly, the study had a qualitative research design, and its findings first need to be further validated in larger samples. Even though exploratory in nature, the inputs provided by the participants generate important leads for the design of (quantitative) follow-up studies where more structured surveys can be used to verify the opinions collected during the FGDs. Secondly, few FGDs were conducted in Kannada and were then translated to English. Although the principal investigator was fluent in both languages, some information might have been missed or not properly interpreted during the translation process. Thirdly, Manipal is a cosmopolitan university town with a sizeable student population, which implies it is demographically different than other Indian cities and therefore the study only recruited young students as participants. Correspondingly, one should be cautious in generalizing the findings of this study to other Indian regions and other young riders as well. Lastly, the data analysis was done alone by the principal investigator himself and inter-reliability checks while coding the data was missed. There is a need for future research in several domains. As mentioned, study had a qualitative research design, and its findings first need to be further validated in larger samples. A cross-sectional survey research can be taken up in other settings of India to further validate the findings of the current study. Also, the study did not record information to what extent the participants themselves perform the risky riding behaviors. Furthermore, the study highlighted that participant might not consider this type of behavior as dangerous as speeding, ignorance in servicing motorcycles, and drink-drive culture. Whether these speculations are valid or not is an issue that warrants further exploration.

9. Conclusions

In the current study, characteristics of motorcycle crashes among young riders were investigated, primarily focusing on the prevalence and role of risky riding behaviors. To the best of our knowledge, a focused group study exploring the perspectives of young riders on risky riding behavior has not been conducted in India before. The main factors derived from the FGDs responsible for road crashes are risky riding practices and gaps in the infrastructure of the city. The most prevalent risky riding practices mentioned were speeding, alcohol-impaired riding [25,41], use of the mobile phone while riding, not wearing a helmet, and improper maintenance of motorcycles. Given the recent upsurge in the number of road crashes, there is an urgent need for targeted interventions to bring about behavioral change among the young riders. Multi-sectoral coordination by engaging the young riders, government authorities, university officials and RTO, behavioral interventions, such as persuasive communication techniques, active experimental approaches such as the use of a simulator, and regulating the licensing procedure can reduce the number of road crashes.

Fixing the infrastructural issues with advanced road engineering will end up in a more significant commitment to reducing road crashes.

Author Contributions: Conceptualization, K.S., V.R., G.W., R.A.C.R. and K.B.; methodology, V.R. and K.S.; formal analysis, K.S., R.A.C.R., V.R. and K.B.; Data acquisition, K.S.; original draft preparation, K.S. and V.R.; writing—review and editing, K.S., V.R., G.W., R.A.C.R. and K.B.; funding acquisition, K.B. and G.W. All authors have read and agreed to the published version of the manuscript.

Funding: The current research was funded by the Special Research Fund (BOF) of Hasselt University, Belgium (Project number—project R-9899). The statements made herein are solely the responsibility of the authors.

Institutional Review Board Statement: The study was conducted according to the guidelines of the Declaration of Helsinki and part of a larger study that was approved by the ethical committee of Kasturba Medical College, Manipal Academy of Higher education, India (KMC IEC-09/2018).

Informed Consent Statement: Informed consent was obtained from all subjects involved in the study.

Data Availability Statement: The data used to support the findings of this study are included within the article.

Acknowledgments: The authors would like to thank all the respondents for participating in the study.

Conflicts of Interest: The authors declare no conflict of interest.

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