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Evaluating the Effectiveness of Winter Safety Interventions for Motorized Two-Wheeler (MTW) Users: A Case Study of Mandi Gobindgarh, Punjab, India

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Abstract: ***Winter months present significant safety challenges for Motorized Two-Wheeler (MTW) users in India due to environmental risks such as fog, poor visibility, extreme cold, and slippery road surfaces. This study investigates the adoption and effectiveness of safety interventions among MTW users in Mandi Gobindgarh, Punjab. A structured survey (N = 280 riders), incorporating adapted items from the Motorcycle Rider Behaviour Questionnaire (MRBQ), particularly focusing on Protective Behaviours, was used. Supplementary interviews with traffic officers and observational studies were conducted to assess system-level perspectives. The study is guided by Risk Compensation Theory (RCT), the Theory of Planned Behaviour (TPB), and the Safe System Approach (SSA), offering a holistic view of both individual behaviour and systemic shortcomings. Findings reveal low adoption of key winter safety measures, including only 22.1% helmet usage and 7.1% of riders conducting battery checks. Stakeholders emphasized that enhancing safety awareness, visibility-enhancing gear, fog light usage, and route planning were critical. Despite widespread recognition of these interventions, adoption remains limited due to cultural beliefs (such as turban use in place of helmets), cost, awareness gaps, and infrastructure constraints. The study recommends targeted education, accessible safety gear, and seasonal campaigns to promote winter preparedness among MTW riders.***

Keywords: Motorized Two-Wheeler (MTW), Winter Safety, Protective Behaviour, Motorcycle Rider Behaviour Questionnaire (MRBQ), Road Safety Interventions, Mandi Gobindgarh

I. INTRODUCTION

Motorized Two-Wheelers (MTWs) — including motorcycles, scooters, and mopeds — are a preferred mode of transport in semi-urban India due to affordability, ease of use, and manoeuvrability. As of 2022, MTWs constituted 74.39% of all registered motor vehicles in India and were involved in 44.5% of all fatal road accidents (*MoRTH_Annual Report_2023-24.Pdf*, n.d.; *Road Accidents in India 2022*, n.d.).

The winter season introduces additional safety risks for MTW riders due to low temperatures, fog, poor visibility, and slippery road surfaces. In Punjab, 872 road accidents were attributed to fog and mist in 2022, resulting in 712 fatalities and 512 injuries (*The Tribune, 2025*). Though winter-specific safety measures such as fog lamps, warm clothing, route planning, and pre-ride checks are available, their actual usage and impact remain understudied, particularly in smaller urban centres.

This research addresses this gap by evaluating the effectiveness of winter safety interventions for MTW riders in Mandi Gobindgarh, Punjab, a semi-urban town with high MTW density and recurring winter fog conditions. The study aligns with Objective 3 of the broader research: *To identify and assess the effectiveness of recommended safety interventions for MTW users in winter conditions*.

II. LITERATURE REVIEW

MTW riders are highly vulnerable road users, and this vulnerability increases significantly in adverse seasonal conditions. While many studies explore general crash causation, few specifically investigate winter riding behaviour or the practical adoption of safety interventions in India.

(Elliott et al., 2007) developed and validated the Motorcycle Rider Behaviour Questionnaire (MRBQ), which is widely used to assess risky and protective behaviours in motorcyclists. (Özkan et al., 2012a) applied psychological models to analyse rider behaviour and accident proneness, emphasizing the role of protective behaviours like helmet use, reflective clothing, fog lights usage, and maintenance routines. Despite widespread recommendations, adoption of such protective behaviours is limited in India.

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(Goyal et al., 2022) reported seasonal patterns in motorcyclist crashes, highlighting low compliance with winter safety practices due to affordability, awareness, and cultural resistance.

Three theoretical frameworks support this study:

- Risk Compensation Theory (RCT): Suggests riders may take more risks when using protective gear, assuming it makes them invulnerable (Haworth et al., 2017).
- Theory of Planned Behaviour (TPB): Proposes that behavioural intent is shaped by attitudes, perceived norms, and perceived control (Reason et al., 1990).
- Safe System Approach (SSA): A system-wide responsibility for safety through better infrastructure, regulation, vehicle maintenance, and public awareness (Goyal et al., 2022; Özkan et al., 2012b).

Together, these frameworks allow for a comprehensive analysis of both behavioural and systemic reasons why safety interventions may succeed or fail in real-world winter riding conditions.

III. METHODOLOGY

This study employed a mixed-methods approach involving quantitative surveys, observational data, and stakeholder interviews to evaluate the effectiveness of winter safety interventions among MTW users in Mandi Gobindgarh, Punjab.

A. Study Area

Mandi Gobindgarh is in the Fatehgarh Sahib district of Punjab and is an industrial town with high MTW density and frequent winter fog. It lies along the NH-44 corridor, known for its accident hotspots, congested local roads, making it an ideal setting for winter riding risk analysis.

B. Data Collection

- Survey: A structured questionnaire was administered to 280 MTW riders, items were adapted from the MRBQ and focused on five domains: Traffic Errors, Control Errors, Speed Violations, Stunt & Reckless Riding, and Protective Behaviour. Responses were collected on a 5-point Likert scale (1 = Never, 5 = Always).
- Interviews: Two traffic enforcement officers were interviewed to capture institutional perspectives.
- Observations: Rider behaviour was observed at four high-risk locations: Bus Stand, Light Chowk, School Zone, and near Yes Bank.

C. Data Analysis

Quantitative data were analysed using SPSS and Excel for descriptive statistics. Interview transcripts and observation notes were thematically analysed to identify patterns and support survey findings.

IV. RESULTS AND DISCUSSION

A. Adoption of Protective Behaviours

TABLE I. FREQUENCY OF PROTECTIVE BEHAVIOUR PRACTICES (N = 280)

Behaviour	Percent of Cases (%)
Wearing helmet	22.1%
Wearing a turban (in place of a helmet)	52.1%
Wearing appropriate clothing	90.4%
Wearing gloves	76.8%
Using winter tyres	26.4%
Using fog lights	9.3%
Checking the weather forecast	45.7%
Wearing/using reflective gear	55.7%
Reducing speed and increasing following distance	60.7%
Checking battery health	7.1%
Avoiding riding during adverse conditions	78.6%
Checking tyres	10.4%

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Using an anti-fog visor	5.4%
Checking fuel levels	19.6%

Critical safety measures such as helmet usage, battery checks, and fog light use were adopted at very low rates. Turban use as a cultural and legal exemption remains a key safety issue. Although most riders wore warm clothing and gloves, essential vehicle and visibility checks were often skipped.

B. Stakeholder and Officer Perspectives

Traffic officers noted that enforcement of helmet laws was weak, and compliance was especially low on short trips. Both cited illiteracy and cultural norms, especially the turban exemption, as major challenges. One officer emphasized the importance of functional fog lights and reflectors; another suggested seasonal awareness drives and routine maintenance checks.

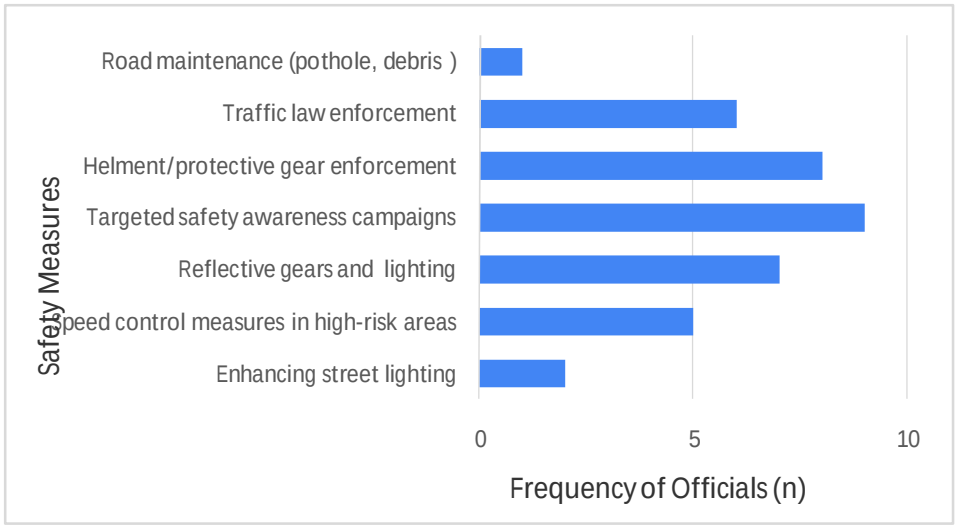

Figure 1. Stakeholder Recommendation for Winter Safety Interventions

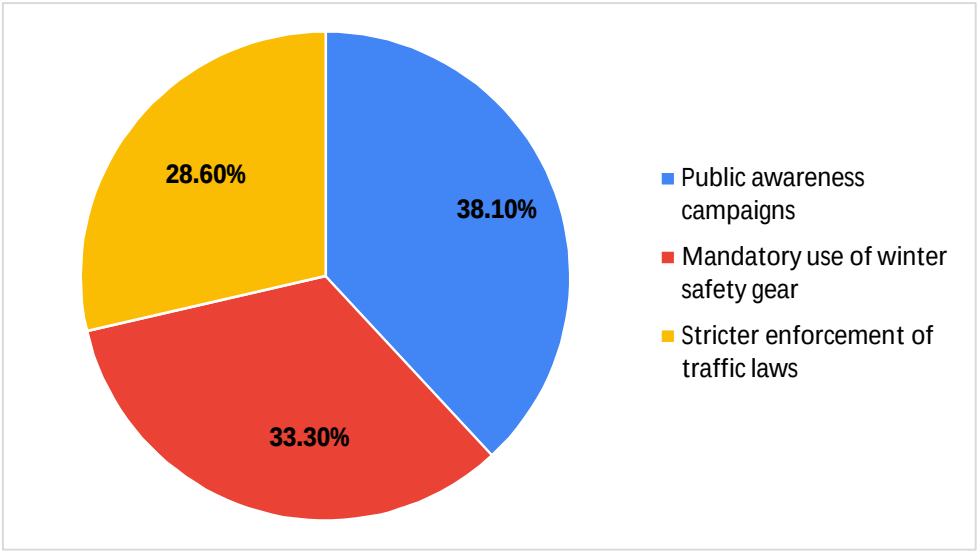

Figure 2. Most Effective Safety Measures to Reduce MTW Accidents (Stakeholders' Ratings)

C. Rider and Passenger Recommendations

TABLE II. SUMMARY OF RIDER AND PASSENGER RECOMMENDATIONS

Recommendation	Riders (%) of Cases	Passengers (%) of Cases
Winter safety training programs	68.2%	97.5%
Stricter traffic law enforcement	56.1%	71.7%
More traffic signals and reflective road markings	55.0%	60.0%
Awareness campaigns on safe winter riding	54.6%	56.7%
Improved road maintenance	52.5%	55.0%
Better street lighting for visibility	31.1%	30.8%

Passengers showed particularly strong support for rider training programs, indicating a gap in shared responsibility and safety education.

D. Observational Findings

Field observations supported survey findings, with low helmet usage, minimal reflective gear, and almost no use of fog lights. Less than 10% of riders wore visibility-enhancing equipment, and few showed signs of having conducted vehicle checks.

E. Interpretation Using Theories

- RCT: Some riders felt overly secure using helmets or gloves and engaged in higher-risk behaviour.
- TPB: Riders' actions were influenced by peer behaviour, lack of control, and social acceptance of unsafe habits.
- SSA: Deficiencies in infrastructure, signage, and enforcement directly undermined individual safety efforts.

V. CONCLUSIONS

This study reveals a critical gap between awareness and adoption of winter safety interventions among MTW riders in Mandi Gobindgarh. Cultural beliefs, low literacy, weak enforcement, and lack of affordable safety gear contribute to the problem. While there is recognition of the importance of safety practices, actual usage of helmets, fog lights, and maintenance checks remains low.
To improve winter safety outcomes, the study recommends:

1) Distribute affordable, winter-specific MTW safety kits.
2) Implement culturally sensitive training and education campaigns.
3) Improve lighting, signage, and surface maintenance in accident-prone areas.
4) Strictly enforce helmet laws, including during short-distance trips.
5) Promote pre-winter safety inspections through public-private partnerships.

A combination of behavioural change strategies and systemic improvements is essential to enhance winter riding safety for MTW users in high-risk regions.

REFERENCES

[1] MoRTH Annual Report 2023–24. Ministry of Road Transport and Highways, Government of India. Retrieved February 21, 2025, from https://morth.nic.in/sites/default/files/AR-MoRTH_Annual%20Report_2023-24_English.pdf
[2] Road Accidents in India 2022. Ministry of Road Transport and Highways, Government of India. Retrieved February 21, 2025, from https://morth.nic.in/sites/default/files/RA_2022_30_Oct.pdf
[3] Fog claimed 712 lives, left 512 hurt in road accidents in Punjab last year: Study. The Tribune. Retrieved February 26, 2025, from https://www.tribuneindia.com/news/punjab/fog-claimed-712-lives-left-512-hurt-in-road-accidents-last-year-study-562446
[4] Elliott, M. A., Baughan, C. J., Sexton, C. R., Maycock, G. R., & Hoskins, B. (2007). Motorcycle Rider Behaviour Questionnaire (MRBQ) and its validation. Accident Analysis & Prevention, 39(3), 455–462.
[5] WHO Global Status Report on Road Safety (2023)
[6] Singh, S., & Sharma, A. (2020). Influence of road surface and weather on motorbike accidents in North India.
[7] Haworth, N., Rowden, S., & Wishart, J. (2017). Behavioral adaptation to weather in motorcycling. Transportation Research Part F: Traffic Psychology and Behaviour, 46, 494–503.
[8] Goyal, V., Mishra, A., & Chauhan, S. (2022). Seasonal crash patterns among motorcyclists in India: A data-driven approach. Journal of Traffic and Transport Engineering, 9(2), 123–131.

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[9] Özkan, T., Lajunen, T., Doğruyol, B., Yıldırım, Z., & Çoymak, A. (2012). Motorcycle accidents, rider behaviour, and psychological models. Accident Analysis & Prevention, 49, 124–132. https://doi.org/10.1016/j.aap.2011.03.009
[10] Reason, J. (1990). Understanding Driver Behavior: A Theoretical Framework for Risk Assessment. Ergonomics, 33(10–11), 1235–1249.Haworth, N., et al. "Behavioural adaptation to weather in motorcycling." Transp. Res. Part F, 2017.
[11] Goyal, V., et al. "Seasonal crash patterns among motorcyclists in India." J. Traffic Inj. Prev., 2022.
[12] Elliott, M. A., et al. "The MRBQ: Psychometric Properties." Accid. Anal. Prev., 2007.
[13] MoRTH, "Road Accidents in India 2023." Ministry of Road Transport and Highways.
[14] Reason, J. "Driver Behaviour Questionnaire." Ergonomics, 1990.

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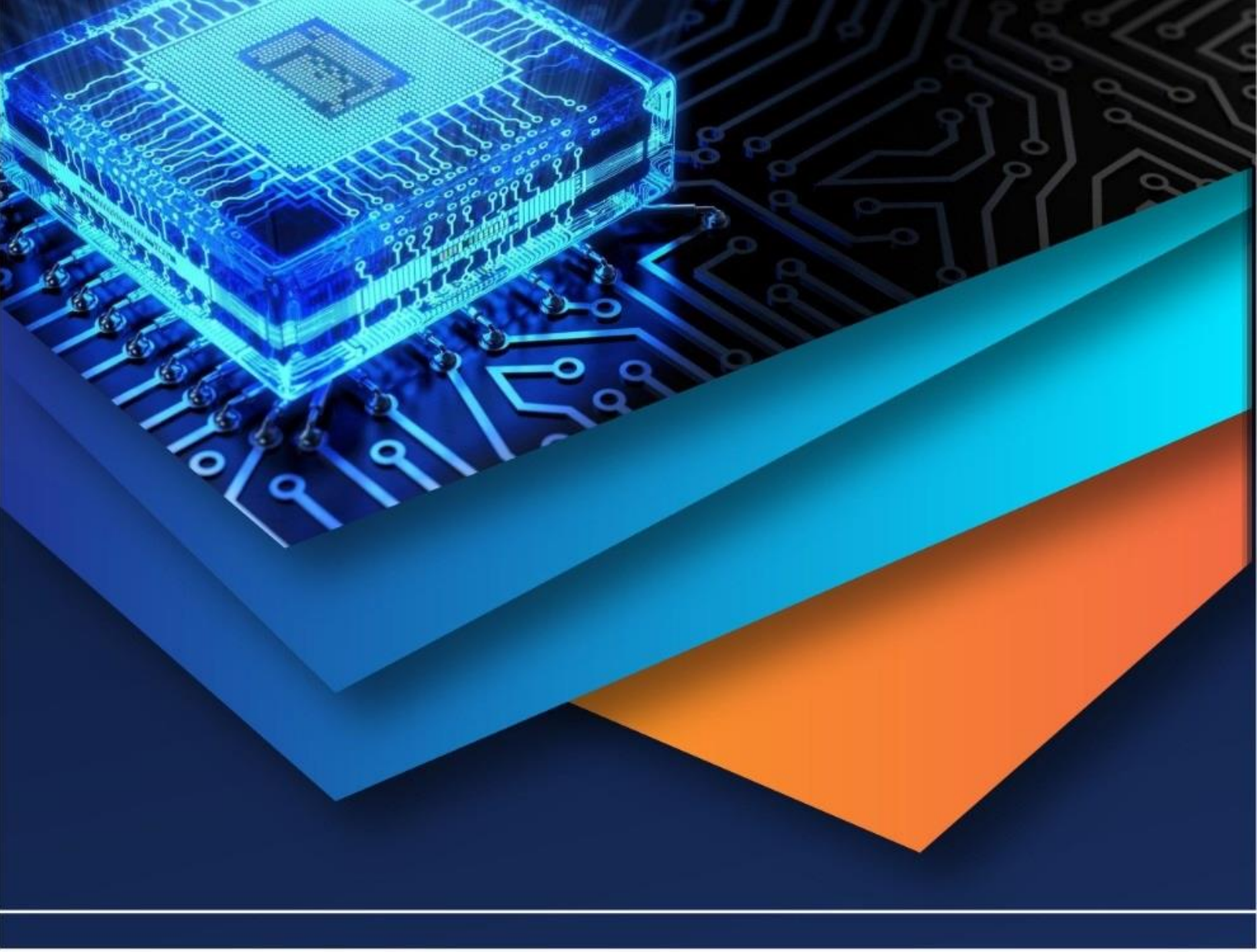

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