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Barriers And Factors Influencing Helmet Usage Among Bike Riders In Salem, India : A Cross-Sectional Study

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ABSTRACT

Introduction: Motorcycle road injuries constitute a public health emergency. Helmets are crucial in preventing deaths and head injuries. The WHO estimates 1.19 million road deaths every year, with motorcyclists being extremely susceptible. In spite of legislation, helmet use is low in most regions, such as Tamil Nadu, India. Salem, a high-risk crash area, has persistently low use, which requires investigation into compliance factors. **Objective:** To estimate the proportion of effective helmet users and identify the barriers and factors influencing helmet-wearing behaviour among bike riders in Salem, India. **Materials and Methods:** A cross-sectional study was conducted in Salem, Tamil Nadu, using purposive sampling approach, selecting five study locations. Data were collected with 512 randomly selected motorcyclists. Observers recorded helmet-wearing patterns, while structured interviews assessed knowledge, attitudes, and factors influencing helmet use. Effective helmet use was defined as wearing a standard full-face helmet with a properly fastened chin strap. Data were analysed using SPSS Version 28, with proportion tests, bivariate analysis, and logistic regression. **Results:** 63.1% of participants were using helmet but effective helmet use was observed in just 27.9% of helmet users.Key barriers included discomfort (13.5%), inconvenience (12.2%), and concerns about hair and appearance (8.8%). Significant predictors of non-compliance included female gender, lower education, rural residence, and absence of prior fines ($p < 0.001$). **Conclusion:** Despite existing regulations, helmet compliance and effective helmet use remain low in the observed participants. Strengthening enforcement, raising awareness, and promoting proper use of helmets are essential for improving compliance and reducing road traffic injuries.

Key Words: Helmet compliance, Effective helmet use, Road traffic injuries, Motorcycle safety, Salem, India

INTRODUCTION:

Over the past few years, India has seen a remarkable spike in the usage of two wheelers due to rapidly expanding urban centres and improving economic standards of people. Although this serves as an essential means of transport, it is also accompanied by concerning statistics regarding two-wheeler related injuries and fatalities, particularly those involving head injury.

The WHO Global Status Report on Road Safety 2023 states that annual road traffic fatalities have reached 1.19 million, with road injuries remaining the leading cause of death among children and young people aged 5–29 years[1]. The prevalence of helmet use in motorcyclists around the world: a systematic review and meta-analysis of 5,006,476 participants states that wearing a motorcycle helmet can alleviate the risk of death and head injuries by approximately 42% and 69%, respectively[2].

In India, two-wheelers make up 73.9% of the 253 million registered vehicles (as of 2017)[3]. Fatalities among two-wheeler riders account for 34–71% of all road accident deaths[4]. In 2011 alone, 1,36,834 people lost their lives due to road traffic injuries (RTIs)[5]. In 2022, India recorded 4,61,312 road crashes, resulting in 1,68,491 deaths and injuries to 4,43,366 individuals. Among the fatalities, 50,629 individuals were not wearing helmets, accounting for approximately 30% of total road crash deaths[6].

Head and neck injuries are the primary causes of death and disability among motorcyclists, and helmet use significantly reduces these risks. Studies indicate that wearing a helmet lowers the likelihood of death by approximately 42% and the risk of head injuries by 69%[7]. Non-compliance with helmet use is associated with higher medical costs in the event of an accident[7].

The Motor Vehicles (Amendment) Act (MVAA) of 2019 and the Central Motor Vehicles Rules (CMVR) of 2022 emphasize helmet use as a critical safety measure[8]. Section 129 of the MVAA mandates that all individuals above four years of age, including pillion riders, wear protective headgear that meets government standards. Additionally, for children aged 9 months to 4 years, the CMVR requires the use of crash or bicycle helmets when traveling on two-wheelers[9]. Despite these legal mandates and public awareness efforts, helmet usage remains low among motorcyclists, particularly in East Asian countries, where compliance rates are often below 50%, with some areas reporting as little as 3% usage[6].

Tamil Nadu reported the highest number of road crashes in India, contributing 13.9% of the total incidents and ranking second in fatalities[2].Salem, the fifth-largest city in Tamil Nadu, has a population of 7.54 lakhs[10]. A helmet compliance survey conducted across Tamil Nadu revealed that in many districts, including Salem, the rate of helmet usage remains below 50%[11]. Due to limited research on the factors influencing helmet use, we conducted an assessment to identify the barriers and determinants affecting helmet-wearing behaviour among motorcycle riders in Salem.

OBJECTIVE: To estimate the proportion of effective helmet users and identify the barriers and factors influencing helmet-wearing behaviour among motorcycle riders in Salem, India.

MATERIALS AND METHODS

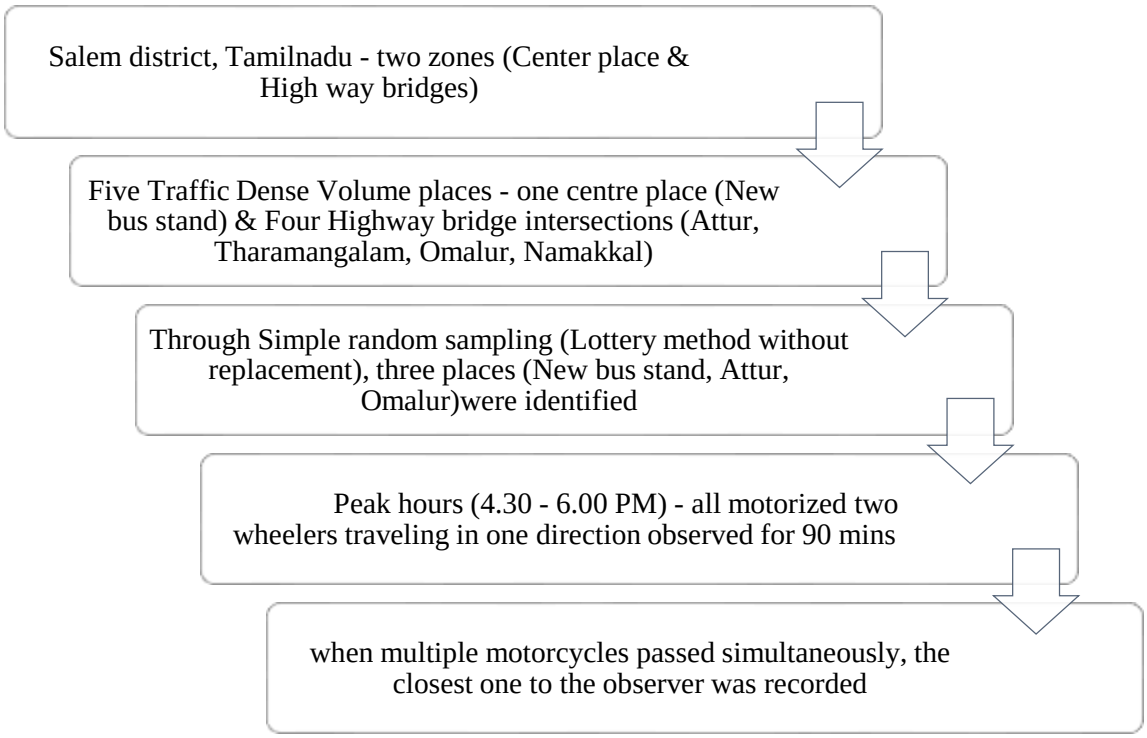
This cross-sectional study was conducted in Salem, Tamil Nadu, among motorcyclists, including riders of motorcycles, scooters, and mopeds. A study conducted in Mysuru by Naveen et al. found that only 28.1% of motorcyclists were effective helmet users[12]. Using OpenEpi, the required sample size was determined using the formula $n = [DEFFNp(1-p)]/ [(d^2/Z^2_{1-\alpha/2}(N-1)+p*(1-p)]$, resulting in an estimated 466 participants. To account for a 10% non-response rate, the final sample size was increased to 512. Purposive sampling method was applied. In collaboration with the city's traffic police, five study locations were selected based on safety considerations for observers and interviewers, clear visibility of motorcyclists, and a preference for areas frequented by local residents rather than tourists. The selected sites included the central new bus stand in Salem and four major highway bridge intersections from Attur, Tharamangalam, Omalur, and Namakkal, chosen to represent different geographic directions[13].

Data collection involved both direct observation and roadside interviews with randomly selected motorcyclists. Observational data provided insight into the prevalence of helmet use, while interviews explored knowledge, attitudes, and behaviors related to helmet-wearing. Trained interviewers conducted the roadside interviews at the same locations and time frames as the observational study. Observers recorded helmet usage by continuously monitoring motorcyclists traveling in one direction for 90 minutes during peak hours (4:30 PM – 6:00 PM). If multiple motorcycles passed at the same time, the one closest to the observer was interviewed. Two teams worked simultaneously: one group focused on categorizing

helmet usage—distinguishing between standard and non-standard helmets, full-face and open-face designs—and assessing whether helmets were properly fastened. The other team conducted structured interviews with riders.

The semi-structured questionnaire used in interviews covered three key areas: demographic information (age, gender, and education level), helmet usage habits (helmet type, frequency of use, and fastening behaviour), and enforcement-related factors (experience with police checks, penalties for non-compliance, and interactions with traffic police regarding helmet laws). Interviewers explained the study's purpose and obtained verbal consent before proceeding. Data from both observational records and interviews were compiled in MS Excel and analysed using SPSS Version 28. The helmet usage rate was evaluated through proportion tests, comparing observed behaviour with self-reported compliance. A descriptive analysis of interview responses provided insights into motorcyclists' knowledge, attitudes, and practices. Additionally, bivariate and multiple regression analyses were conducted to identify factors influencing both observed and self-reported helmet use.

Figure 1: Sampling technique



RESULTS

Table 1 describes the socio-demographic characteristics of the study participants. The population profile of the respondents is a largely young, urban-biased sample with a clear gender bias. The preponderance of men (70.7%) and those with undergraduate qualifications (63.7%) indicates that the results may be most relevant to this group. The pattern of income points to possible economic susceptibility within this subgroup, as 32% have incomes below ₹10,000 per month. Lastly, urban residents (51.2%) slightly outnumber rural residents (48.8%), but ensuring a balanced representation of the place of residence.

Table 2 shows an alarming gap between helmet ownership and regular use among the participants. Although most of them own helmets, a substantial number never use them or use them improperly, as indicated by the high percentage who do not fasten their chin straps. This implies a possible ignorance of the protective advantage of helmets or a disregard for safety standards. The frequency of mid-range CC

bikes and moderate daily riding distances suggests a population regularly exposed to possible road hazards. Furthermore, the high percentage of respondents who have never worn a helmet or have worn it for less than one year underlines an urgent need for specialized road safety interventions aimed at raising awareness and advocating for helmet wearing and proper usage. These observations point to a serious lacuna in road safety awareness and enforcement that requires instant redress to prevent avoidable injuries and death.

Table 3 shows that the main barriers to habitual helmet use arise from perceived inconvenience and discomfort, which implies that helmet design and usability are of key importance to user compliance. There is a widespread myth about the requirement for helmets for short journeys, which implies a need for targeted education campaigns focusing on the omnipresent threat of accidents. In addition, social attitudes and vanity seem to have an impact on helmet use, especially among younger people. Cost is also a barrier for some, emphasizing the importance of availability and affordability. Although a few question the value of helmets, a significant proportion of satisfied users indicate that pleasant experiences can encourage acceptance.

Open-ended questions revealed that the main reason for wearing a helmet is to avoid serious life-threatening head injuries in case of an RTA. Few others also mentioned that, in a hurry, they sometimes forget to put the helmet in the storage space of their vehicle. Some respondents also shared that they have survived a major accident due to wearing a helmet, reinforcing their belief in its importance. Overall, these results emphasize the need to overcome both functional and perceptual obstacles in order to encourage broad helmet use and enhance road safety.

Table 4 highlights a contradictory state of affairs: whereas understanding of the protective value of helmets approaches universality, misunderstanding of their necessity and perceived absence of regular enforcement seem to deter regular use. The high percentage of people who feel helmets are needed only on fast speeds or accidents can be averted without helmets shows the extent of an education gap with regard to the prevalent risk of road accidents. The belief in poor enforcement and, along with mixed effect of sanctions on attitude alteration, is another indicator that increased penalties may be too much in trying to foster universal helmet wearing. Rather, a multi-pronged strategy that integrates education campaigns, focused enforcement, and the removal of misconceptions regarding helmet need is probably required to fill the gap between awareness and regular helmet use.

Table 5 shows a significant correlation between different socio-demographic variables and proper helmet use with certain groups being at increased risk of non-compliance. Upon univariate analysis, older age, female sex, lower level of education, rural dwelling, employment status, and lack of previous fines were found to be significantly linked to improper helmet use. This was further confirmed by logistic regression (Table 6), which found female gender and rural living to be particularly strong predictors of not using helmets effectively. These results indicate that targeted interventions must be developed to meet the specific needs and challenges of these high-risk populations. For instance, campaigns for education should be specifically designed to address the issues of concern to older persons and rural dwellers, while enforcement efforts could be directed at ensuring penalties are applied consistently to discourage non-compliance. Additionally, the strong association with lower levels of education and employment status highlights the necessity of incorporating road safety education in schools and workplaces.

Table 1: Socio-Demographic Factors (n= 512)

Variable	Category	Frequency (n)	Percentage (%)
Age Category (years)	18 - 25	180	35.2%
	26 - 35	188	36.6%
	36 - 45	116	22.7%
	Above 45	28	5.5%

Gender	Male	362	70.7%
	Female	150	29.3%
Education	Below High School	28	5.5%
	High School Graduate	123	24.0%
	Undergraduate Degree	326	63.7%
	Postgraduate Degree	35	6.8%
Occupation	Self-Employed	59	11.5%
	Student	203	39.6%
	Unemployed	39	7.6%
	Working Professional	211	41.2%
Income (Monthly in ₹)	Less than 10,000	164	32.0%
	10,000 - 20,000	133	26.0%
	20,000 - 30,000	98	19.1%
	30,000 - 40,000	39	7.6%
	40,000 - 50,000	8	1.6%
	Above 50,000	8	1.6%
	Not Applicable	62	12.1%
Place of Residence	Urban	262	51.2%
	Rural	250	48.8%

Table 2: Details of Helmet Use (n= 512)

Variable	Category	Frequency (n)	Percentage (%)
Owns a Helmet	Yes	323	63.1%
	No	189	36.9%
Type of Helmet	Full Face	187	36.5%
	Half Face	130	25.4%
	Open Face	10	2.0%
	Don't Know Type	24	4.7%
	None	161	31.4%
Frequency of Use	Always	120	23.5%
	Sometimes	215	41.9%
	Never	177	34.6%
Fastening Chin Strap	Always Properly Fastened	226	44.2%
	Loosely Fastened	72	14.0%
	Do Not Fasten	214	41.8%
Bike Type (CC)	100 - 150 CC	219	42.8%
	160 - 250 CC	236	46.0%
	260 - 300 CC	22	4.3%
	Above 300 CC	35	6.9%
Distance Ridden Daily	0 - 10 km	139	27.1%
	11 - 20 km	155	30.3%
	21 - 30 km	156	30.5%
	31 - 40 km	55	10.7%
	41 - 50 km	04	0.8%
	Above 50 km	04	0.8%
Years of helmet usage	<1 year	133	26.0%
	1-3 years	91	17.8%
	>3 years	112	21.9%
	Never	177	34.6%

Table 3: Reasons for not wearing a helmet

S. No	Reason for Not Wearing a Helmet*	n	%
1	Helmet is too heavy	110	8.6
2	It gives me neck pain	96	7.5
3	It affects my visibility	113	8.8
4	It causes suffocation / feeling of discomfort	173	13.5
5	It messes up my hair or appearance	113	8.8
6	Not fashionable / doesn't look good	53	4.1
7	Fear of being ridiculed by friends	4	0.3
8	I forget to take it	47	3.7
9	Good quality helmet is expensive	96	7.5
10	Will wear when it is only needed (e.g., like on a long drive)	104	8.1
11	I don't feel like it is that much needed compulsorily	104	8.1
12	I don't feel like it plays a big role in road safety	29	2.3
13	It is inconvenient to carry with me when I'm not riding	156	12.2
14	None of the above. I'm so comfortable with my helmet	84	6.6

**Multiple responses*

Table 4: Awareness and Attitude towards helmet use (n= 512)

S. No	Questions	Response	n	%
Awareness towards helmet use				
1.	Are you aware that wearing a helmet reduces the risk of head injury in accidents?	Yes	508	99.2
		No	4	0.8
2.	How often do you encounter traffic police enforcing helmet use?	Frequently	64	12.5
		Occasionally	126	24.6
		Rarely	215	42.0
		Never	107	20.9
3.	Have you ever been stopped by the police for not wearing a helmet?	Yes	227	44.3
		No	285	55.7
4.	Have you ever been fined or penalized for not wearing a helmet?	Yes	151	29.5
		No	361	70.5
Attitude towards helmet use				
5.	Do you think wearing a helmet is necessary only when riding at high speeds?	Yes	289	56.4
		No	223	43.6
6.	Do you believe you can avoid accidents and stay safe without wearing a helmet?	Yes	186	36.3
		No	326	63.7
7.	How do you feel about the current penalty for not wearing a helmet?	Too lenient	40	7.8
		Fair	347	67.8
		Too harsh	125	24.4
8.	What was your feeling after paying the penalty for not wearing a helmet?	Will definitely wear helmet every time hereafter	87	17.0
		Will carry with me and wear only in strict checking areas	89	17.4

		I don't bother; I won't wear a helmet even after penalty	3	0.6
		I will wear helmet only during long drive	12	2.3
		I don't feel any change in me even after penalty	12	2.3
		I was never penalised for not wearing a helmet	309	60.4

Table 5: Association between socio-demographic variables and effective helmet use (n=512)

Characteristics		Effective helmet use		p value
		Yes (n=143)	No (n=369)	
Age	<35 years	119 (32.3%)	249 (67.7%)	<0.001
	≥36 years	24 (16.7%)	120 (83.3%)	
Gender	Female	24 (16.0%)	126 (84.0%)	<0.001
	Male	119 (32.9%)	243 (67.1%)	
Education	UG/PG level	123 (34.1%)	238 (65.9%)	<0.001
	School level	20 (13.2%)	131 (86.8%)	
Occupation	Student/ unemployed	79 (32.6%)	163 (67.4%)	<0.001
	Working	64 (23.7%)	206 (76.3%)	
Residence	Rural	31 (12.4%)	219 (87.6%)	<0.001
	Urban	112 (42.7%)	150 (57.3%)	
Unfavourable weather conditions	Doesn't avoid use	104 (29.5%)	249 (70.5%)	0.287
	Avoid use	39 (24.5%)	120 (75.5%)	
Ever stopped by police for no helmet	No	60 (21.1%)	225 (78.9%)	<0.001
	Yes	83 (36.6%)	144 (63.4%)	
Ever fined or penalized for not wearing helmet	No	76 (21.1%)	285 (78.9%)	<0.001
	Yes	67 (44.4%)	84 (55.6%)	

Table 6: Logistic regression on Predictors for not using helmet effectively (n=512)

Parameters		aOR (95% CI)	p
Age	<35 years	Ref	
	≥36 years	1.33 (0.70-2.55)	0.378
Gender	Male	Ref	
	Female	4.11 (2.24 -7.55)	<0.001
Education	UG & PG level	Ref	
	School level	2.32 (1.28-4.22)	0.006
Occupation	Student	Ref	
	Working/unemployed	2.10 (1.22-3.64)	0.008
Residence	Urban	Ref	
	Rural	4.14 (2.50-6.84)	<0.001
	Yes	Ref	

Ever stopped by police for no helmet	No	1.08 (0.56-2.11)	0.806
Ever fined or penalized for not wearing helmet	Yes	Ref	
	No	2.17 (1.14-4.12)	0.018

DISCUSSION

Research, including a Cochrane review by Liu et al., reinforces the life-saving benefits of helmets, showing a 69% reduction in head injury risk and a 42% decrease in fatalities among helmeted riders[13]. This study highlights a critical gap between helmet ownership and actual use, raising serious road safety concerns. While 63.1% of respondents own a helmet, 36.9% do not, leaving themselves at risk of severe head injuries in accidents. However, ownership alone does not ensure protection—only 27.9% of owners use their helmets regularly, exposing a clear divide between possession and proper use. The findings align with a hospital-based study by Khan et al., which found that 51% of female healthcare staff never wore a helmet, and only 19% used one consistently, despite 93% owning one[14].

"Effective helmet use" requires wearing a standard full-face helmet that is securely strapped, providing complete protection for the head and chin. Full-face helmets, which offer the highest level of coverage, were worn by only 36.5% of respondents, while one-fourth preferred half-face helmets. A major concern, however, is improper fastening, as only 44.2% of respondents always secure their chin strap correctly, whereas 41.8% never fasten it at all. A study by Shruthi MN et al. found that only 65% of individuals used helmets properly, with 79.5% fastening the strap correctly and 78.3% using full-face helmets[15]. The frequency of helmet use further highlights safety concerns. Alarmingly, 31.4% of respondents reported never wearing a helmet, while only 12.2% wear one consistently. Infrequent helmet use has been strongly linked to increased injury severity in crashes[16]. The data also highlight the types of motorcycles used, with most respondents riding 160-250cc (46.0%) and 100-150cc (42.8%) motorcycles. Regarding daily travel distance, 30.5% of respondents cover 21-30 km, while 30.3% travel 11-20 km. Commuters traveling longer distances may be more aware of road safety risks, but a lack of enforcement and helmet promotion campaigns might contribute to the low helmet use rates observed.

Research consistently identifies physical discomfort as the primary reason for helmet non-use, though specific concerns differ across studies. Physical discomfort emerged as a major deterrent in our study, with participants citing suffocation (13.5%), helmet weight (8.6%), visibility issues (8.8%), and neck pain (7.5%). Similarly, Faryabi J et al. found helmet weight (77%), heat discomfort (71.4%), neck pain (69.4%), suffocation (67.7%), and restricted head and neck movement (59.6%) as significant concerns[17], while Khan also reported physical discomfort (44%) as a key factor discouraging helmet use[14]. Environmental factors played a role in our study, with 30.1% avoiding helmets in hot weather, while only 0.8% refrained from using them in rainy conditions. In contrast, Khan did not highlight environmental concerns[14]. Regulatory and awareness issues were significant in previous findings, where ignorance (53%) and lack of strict rules (10%) contributed to helmet non-use, suggesting that better enforcement and education could enhance compliance. Convenience and practical barriers were also evident, as 12.2% of our respondents found carrying helmets inconvenient, aligning with prior findings that irritation (7%), the need for glasses (3.5%), and poor visibility (1%) discouraged helmet use[14].

Additionally, situational factors influenced helmet use, as Conrad et al. found in Indonesia that helmet use varied by time and location, with motorcyclists rarely wearing helmets at night due to the lack of police surveillance[18]. While our study did not examine time-based helmet use, it reinforced the role of habit and forgetfulness, with 12.2% reporting that inconvenience led to helmet non-use, mirroring previous findings on inconsistent compliance[18]. However, our study indicated a greater acceptance of helmets, with 6.6% of respondents reporting complete comfort. Perceived safety concerns were relatively low in our study, with only 2.3% doubting helmet safety benefits.

The findings from this study align with those of Setty et al., highlighting key factors influencing effective helmet use among motorcycle riders[12]. Both studies emphasize the role of law enforcement, as riders who were stopped by the police were more likely to wear helmets properly. This suggests that police interventions play a crucial role in promoting compliance. Additionally, this study found that riders traveling for work or school were more likely to use helmets effectively, indicating that safety awareness may be higher among those commuting for essential purposes. In contrast, Setty et al. identified factors such as gender, education level, rural residence, and employment status as significant predictors of helmet non-use, emphasizing the impact of demographic and socioeconomic factors. These findings suggest that while enforcement strategies are effective, targeted awareness campaigns addressing specific groups, such as rural residents and individuals with lower education levels, could further improve helmet compliance.

CONCLUSION AND RECOMMENDATIONS

This study underscores the significant gap between owing an helmet and actual use, emphasizing the need for improved awareness and enforcement to enhance road safety. Despite the well-documented benefits of helmet use, factors such as physical discomfort, improper fastening, and social perceptions continue to hinder compliance. To address these issues, targeted awareness campaigns, stricter law enforcement, and the promotion of comfortable, well-ventilated helmet designs are recommended. Additionally, workplace and educational institutions should encourage regular helmet use through mandatory policies. However, this study has certain limitations, including self-reported data, which may introduce response bias, and the lack of time-based helmet use analysis. Future research should explore regional differences and the impact of enforcement measures on sustained helmet use trends.

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Ethical statement:

Institutional ethical committee accepted this study. The study was approved by the Institutional Ethical Committee , Vinayaka Missions Kirupananda Variyar Medical College and Hospitals ; VMKVMC&H/IEC/23/027. Informed written consent was obtained from all the study participants and only those participants willing to sign the informed consent were included in the study. The risks and benefits involved in the study and the voluntary nature of participation were explained to the participants before obtaining consent. The confidentiality of the study participants was maintained.

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