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Original Research

A comparison of observed and self-reported helmet use and associated factors among motorcyclists in Hyderabad city, India[☆]



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ABSTRACT

Objectives: India has a high burden of fatal road traffic injuries (RTIs). A large proportion of fatal RTIs in India are among motorcyclists. The overall goal of this study is to assess and compare observed and self-reported prevalence of helmet use; and to identify factors associated with helmet use and over-reporting in Hyderabad city, India.

Study design: Roadside knowledge, attitude and practice interviews.

Methods: Six rounds of roadside interviews were conducted with motorcyclists (drivers and pillion riders) between July 2011 and August 2013 using a structured tool developed for this study. Observations on helmet use were recorded and respondents were also asked if they 'always wear a helmet'. Prevalence of helmet use was calculated and a paired t-test was used to compare observed and self-reported helmet use proportions. Unadjusted and adjusted odds ratios were calculated to identify factors associated with helmet use and over-reporting.

Results: A total of 4872 respondents participated in the roadside interview. The response rate was 94.4%. The overall observed helmet use was 34.5% and 44.5% of respondents reported that they 'always wear a helmet'. As the observed helmet use increased, the over-reporting of helmet use was found to decrease. However, factors associated with observed and self-reported helmet use are similar. Male gender, youth (≤ 24 years), a lower level of education and non-ownership of helmet were associated with a higher risk of not wearing helmets. Male gender, youth (≤ 24 years), no schooling, riding a lower engine capacity motorcycle and using a motorcycle for purposes other than travelling to school/work were associated with over-reporting of helmet use.

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Conclusions: Self-reports provide an overestimate of helmet use that lessens as actual helmet use increases. Interviews also allow identification of factors associated with helmet use. Increasing helmet ownership and enhanced enforcement may help increase helmet use.

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Introduction

Road traffic injuries (RTIs) are increasingly being recognized as a global public health problem accounting for about 1.24 million annual deaths.¹ RTIs are projected to be among the leading cause of global deaths by the year 2030.¹ Globally, RTIs are unequally distributed with residents of low- and middle-income countries (LMICs) accounting for about 90% of fatal RTIs.¹

According to the World Health Organization's (WHO) estimates for 2013, India had about 16.6 fatal RTIs per 100,000 population.¹ According to the national statistics, 38.9 road traffic crashes (RTCs) per 100,000 population were reported in 2013, which were associated with 11 fatalities and 39.6 injuries per 100,000 population.² A large proportion of fatal RTIs (34%) in India are among riders of motorized two- and three-wheelers.^{1,2} Motorcycles are one of the most popular vehicles in the Indian market and their use has been rapidly increasing. For instance, in 2012 motorized two- and three-wheelers constituted 72% of all registered vehicles in India.¹

Helmets are recommended for motorcyclists to reduce the risk of head injuries. They can lower mortality between 32% and 50%.³ India has a national helmet law that makes helmet use mandatory for both motorcycle drivers and pillion riders (co-passengers). However, the notification and enforcement of this law rests with individual states and is generally weak.^{1,4} In a recent exercise conducted by the WHO, the enforcement of helmet law in India was rated 4 on a scale of 10 (where 0 was least and 10 was highly effective).¹

In 2010, the Bloomberg Philanthropies Global Road Safety Programme (the programme) was initiated in 10 LMICs with an overall goal of reducing the burden of RTIs.^{5,6} India is one of these 10 countries and Hyderabad city is one of the implementation sites. Lack of helmet use was identified as a risk factor to address in Hyderabad city, a joint capital of both Andhra Pradesh and Telangana (Andhra Pradesh has recently split into two states—Andhra Pradesh and Telangana) with a population of over 8 million.⁷ Former Andhra Pradesh state, with a population of 85 million and vehicle population of 11 million was among the top five states in India with the highest rates of crashes, RTIs and fatalities.^{2,7,8} Hyderabad city is amongst the cities with the highest burden of RTIs in India.² In 2013, out of 100 RTCs in Hyderabad 19 were fatal.² Motorcycles constituted 73% of all registered vehicles in former Andhra Pradesh state and motorcyclists account for about 40% of fatal RTIs in Hyderabad.^{8,9}

In former Andhra Pradesh, helmet use was mandatory for both motorcycle drivers and pillion riders and the penalty for non-use was Indian rupees 100 (equivalent to USD 1.68).¹⁰

However, helmet enforcement in Hyderabad has faced political opposition and therefore this law is not consistently enforced.^{11–17} In the baseline assessment conducted in Hyderabad in July 2011 for the programme, helmet use was found to be low (17.4–29.3%) and perceived enforcement of the helmet law weak.¹⁸ Existing literature confirms that legislation and enforcement of helmet laws can increase compliance.^{19,20} Nonetheless, a reported lack of political will in Hyderabad to enforce the helmet law highlights a need to explore other ways to increase helmet use in the city.²¹

Two methods are commonly used to understand road behaviours—direct observations and self-reports.²² Direct observations provide a more valid estimate of road behaviour but they are resource intensive and require trained data collectors.²² On the other hand self-reports are biased because of the nature of self-reporting but these studies are relatively less expensive and unlike direct observations allow data to be collected on a larger set of factors associated with road behaviours.²² However, self-reports may also distort conclusions on associated factors as these may be associated with over-reporting rather than the road behaviour under study.²³ A comparison of factors associated with observed and self-reported helmet use can help assess reliability of self-reports while an understanding of factors associated with over-reporting would allow us to identify groups that are likely to give a discordant response.²³

This study builds on earlier work that reported discrepancy between observed and self-reported helmet use and factors associated with helmet use.¹⁸ We previously found a statistically significant cross-sectional association between age and observed and self-reported helmet use; and between education and self-reported helmet use.¹⁸ In the present study we are using a larger dataset collected over multiple rounds that would allow more robust analyses and comparison with earlier findings. The specific objectives of this study are: (1) to assess and compare the prevalence of observed and self-reported helmet use; (2) to identify and compare factors associated with motorcycle helmet use—observed and self-reported; and (3) to identify factors associated with over-reporting of helmet use in Hyderabad city, India. This study can help identify groups at higher risk of not wearing helmets and can help inform appropriate road safety interventions.

Methods

Six rounds of roadside knowledge, attitude and practice interviews were conducted over two years (July 2011, November 2011, March 2012, October 2012, April 2013 and August 2013) to

monitor the programme in Hyderabad city. In the first three rounds, in collaboration with local traffic police, eight high traffic volume sites were selected in six administrative zones (two from the larger zones).¹⁸ In the next three rounds the interview sites were reselected based on road categories in view of the fact that helmet use may vary depending on the type of the road (highway, city roads, rural roads) and six sites were selected from six different administrative zones. All sites for all rounds were considered geographically representative of Hyderabad. However, it should be noted that it is not valid to compare sites over time because sampling changed.

At each site, interviews were conducted on one weekday (Monday–Friday) and one weekend day (Saturday–Sunday) at three different times of the day (i.e. morning 10:00–11:30 h, afternoon 13:30–15:00 h and evening 17:00–18:30 h) by two interviewers at each site. Local traffic police randomly stopped motorcyclists and directed them to the study team that was positioned nearby. Observations on helmet use were recorded as the respondents approached the study team. The interviewers informed the motorcyclists of the purpose of the study and obtained verbal consent and no personal identifiers were collected in the interview, which lasted 5–10 min. Although the help of local traffic police was sought to stop potential respondents, they were not within the earshot of interviewer or interviewee. The participant was also informed during consent that their participation in the study is voluntary.

A structured questionnaire with 33 items was developed for this study and included questions about helmet use, motorcycle, police enforcement, headlight use and riding around ambulance (Box 1). Demographic data were also collected and observations were recorded on helmet use, motorcycle and site. Any helmet use (strapped or unstrapped) was counted as 'wearing helmet'. This questionnaire also included a question whether the respondent 'always wears a helmet'.

Data were entered into MS Excel and analysed using STATA 12.²⁴ All analyses focused on two outcomes—observed and self-reported helmet use. For each round of data collection, the prevalence of observed and self-reported helmet use was calculated and compared using paired t-test.²⁵ For each outcome (observed and self-reported), descriptive analyses

Box 1
Sample questions for roadside interview on helmet use.

Interviewer observed information.

- Was the motorcyclist wearing a helmet?
- Can you observe a certification marking/sticker on the back or side of helmet?
- In your opinion, is this a standard helmet?

Interviewer administered questionnaire.

- Do you always wear a helmet?
- In the past 30 days, how often did you wear a helmet when you drove or were a passenger on a motorcycle or scooter?
- In the past 3 months, have you ever been stopped by police to check helmet use?

were conducted separately to determine its association with sociodemographic and motorcycle-related factors. The explanatory variables were selected based on findings from other studies conducted in India and other LMICs.^{26–29} For each outcome—observed and self-reported helmet use—unadjusted and adjusted odds ratios were calculated using gender, age, education, driving status i.e. driver/pillion rider, engine capacity of motorcycle, motorcycle ownership, purpose of the trip and helmet ownership as explanatory variables.²⁵

Respondents who were not wearing a helmet at the time of interview and yet reported that they were always wearing a helmet were considered to be over-reporting their helmet use. To understand the factors associated with over-reporting, bivariate and multiple logistic regressions were conducted with the same explanatory variables. This analysis was limited to respondents who reported that they always wear a helmet. A P-value < 0.05 was considered to be statistically significant. The Institutional Review Board of the Johns Hopkins Bloomberg School of Public Health and the Institutional Ethics Committee of the Indian Institute of Public Health, Hyderabad, approved this study.

Results

Comparison of observed and self-reported helmet use

A total of 5160 motorcycle drivers and pillion riders were contacted for the interview and 4872 agreed to participate

Table 1 – Basic characteristics of respondents of roadside interviews on helmet use in Hyderabad, India.

Characteristics	n (%)
Gender (n = 4871)	
Male	4255 (87.3)
Female	616 (12.7)
Age group in years (n = 4868)	
≤24	815 (16.7)
25–39	3017 (62.0)
40–54	909 (18.7)
≥55	127 (2.6)
Education (n = 4867)	
No schooling	132 (2.7)
Primary/elementary	271 (5.6)
High school/secondary	1130 (23.2)
College and higher education	3334 (68.5)
Driving status (n = 4871)	
Pillion rider	97 (2.0)
Driver	4774 (98.0)
Capacity of motorcycle (n = 4872)	
Less than 100 cc	124 (2.5)
More than 100 cc	4748 (97.5)
Motorcycle ownership (n = 4870)	
No	241 (5.0)
Yes	4629 (95.0)
Purpose (n = 4870)	
Travelling to/from work/school/college	4429 (90.9)
Travelling for other activities	441 (9.1)
Helmet ownership (n = 4872)	
No	703 (14.4)
Yes	4169 (85.6)

(response rate 94.4%). Most of the respondents were men (87.3%, $n = 4255$) and motorcycle drivers (98%, $n = 4774$). About 80.7% ($n = 3926$) of the respondents were in the age group of 25–54 years and 68.5% had some college/university level education (Table 1). The majority of respondents (95%, $n = 4629$) owned their motorcycle, owned a helmet (85.6%, $n = 4169$) and were riding a motorcycle with engine capacity greater than 100 cc (97.5%, $n = 4748$). Most of the respondents (90.9%, $n = 4429$) were using their motorcycle to travel to and from work or school (Table 1).

Across six rounds of roadside interviews, the overall observed helmet use was 34.5% while 44.5% of respondents reported that they ‘always wear a helmet’ (Table 2). Self-reported helmet use was found to be nearly 1.3 times higher than the helmet use observed over the study period. A statistically significant difference between observed and self-reported helmet use was noted in all six rounds (Table 2).

Among those who reported to ‘always wear a helmet’, the observed helmet use was computed using total number of respondents as denominator i.e. all those who were wearing at the time of interview but reported that they do not always wear a helmet were excluded from the numerator. Here too,

the self-reported helmet use was found to be 1.4 times higher than the observed helmet use in the group (Fig. 1). A trend between observed and self-reported helmet use is noticed: as observed helmet use increases, the difference between self-reported and observed helmet use decreases (Fig. 1).

Factors associated with observed helmet use

In bivariate analysis a statistically significant association was found between observed helmet use and factors such as gender, age group, education, driving status, engine capacity of motorcycle, ownership of motorcycle, purpose of motorcycle trip and helmet ownership. After adjusting, a statistically significant association was found between observed helmet use and gender, age group, education, driving status, engine capacity of motorcycle, purpose of motorcycle trip and helmet ownership (Table 3). Results from multiple logistic regressions are detailed below.

Compared to men, women had 1.8 times higher odds to be observed wearing a helmet after adjusting for other covariates ($P < 0.001$). After controlling for other factors, older drivers (>25 years) had 1.6–1.9 times greater odds of wearing a helmet

Table 2 – Observed and self-reported helmet use among respondents of roadside interview in Hyderabad, India ($n = 4872$).

Round	n	Observed helmet use ^a (%)	Self-reported helmet use ^b (%)	P-value (paired t-test)	Over-reporting factor
Round 1	607	29.5	64.7	0.000	2.2
Round 2	720	34.7	45.3	0.000	1.3
Round 3	720	43.5	38.6	0.000	0.9
Round 4	1136	38.6	41.6	0.005	1.1
Round 5	832	29.7	38.7	0.000	1.3
Round 6	857	29.4	43.9	0.000	1.5
Total	4872	34.5	44.5	0.000	1.3

^a Those who were wearing properly strapped standard helmet were considered wearing helmet.

^b All those who responded ‘yes’ to the question ‘do you always wear a helmet?’

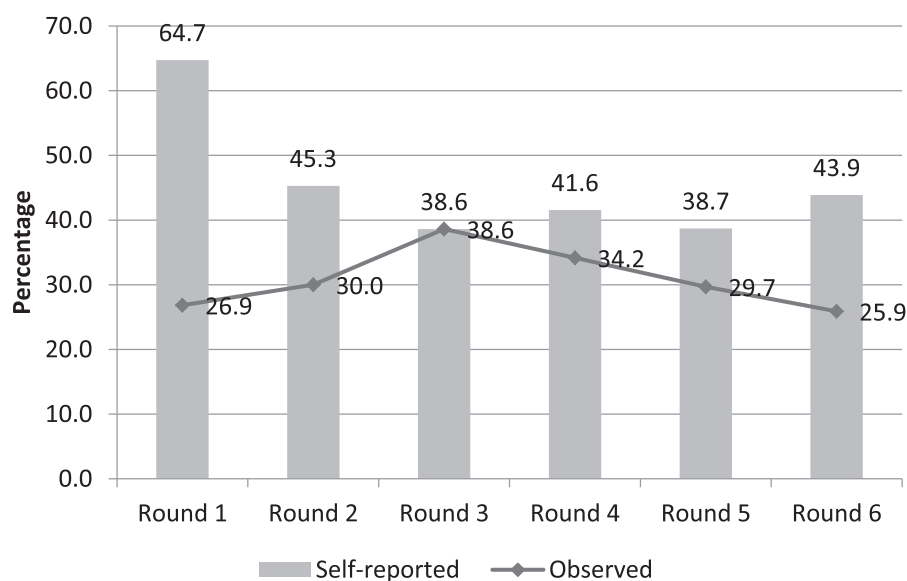


Fig. 1 – Observed helmet use among respondents reporting ‘always wear a helmet’ in roadside interview in Hyderabad, India ($n = 4872$).

Table 3 – Factors associated with observed and self-reported helmet use in Hyderabad, India (n = 4872).

Characteristics	Observed helmet use			Self-reported helmet use		
	Helmet use n (%)	Unadjusted OR (95% CI)	Adjusted OR (95% CI)	Helmet use n (%)	Unadjusted OR (95% CI)	Adjusted OR (95% CI)
Gender						
Male	1388 (32.6)	Ref	Ref	1849 (43.5)	Ref	Ref
Female	291 (47.2)	1.8 (1.6–2.2)***	1.8 (1.5–2.1)***	317 (51.5)	1.4 (1.2–1.6)***	1.2 (1.0–1.5)*
Age group in years						
≤24	207 (25.4)	Ref	Ref	277 (34.0)	Ref	Ref
25–39	1102 (36.5)	1.7 (1.4–2.0)***	1.6 (1.3–1.9)***	1424 (47.2)	1.7 (1.5–2.0)***	1.6 (1.3–1.9)***
40–54	329 (36.2)	1.7 (1.4–2.1)***	1.9 (1.5–2.4)***	410 (45.1)	1.6 (1.3–1.9)***	1.6 (1.3–2.1)***
≥55	40 (31.5)	1.4 (0.9–2.0)	1.7 (1.1–2.6)*	54 (42.5)	1.4 (1.0–2.1)	1.6 (1.1–2.5)*
Education						
No schooling	18 (13.6)	Ref	Ref	25 (18.9)	Ref	Ref
Primary/elementary	51 (18.8)	1.5 (0.8–2.6)	1.3 (0.7–2.3)	61 (22.5)	1.2 (0.7–2.1)	1.1 (0.6–1.8)
High school/secondary	236 (20.9)	1.7 (1.0–2.8)	1.5 (0.9–2.6)	357 (31.6)	2.0 (1.3–3.1)**	2.0 (1.2–3.1)**
College and higher education	1373 (41.2)	4.4 (2.7–7.3)***	3.3 (2.0–5.6)***	1721 (51.6)	4.6 (2.9–7.1)***	3.6 (2.3–5.8)***
Driving status						
Pillion rider	20 (20.6)	Ref	Ref	28 (28.9)	Ref	Ref
Driver	1659 (34.8)	2.1 (1.2–3.4)**	1.8 (1.1–3.1)*	2138 (44.8)	2.0 (1.3–3.1)**	1.8 (1.1–2.9)*
Capacity of motorcycle						
Less than 100 cc	32 (25.8)	Ref	Ref	58 (46.8)	Ref	Ref
More than 100 cc	1648 (34.7)	1.5 (1.0–2.3)*	1.6 (1.0–2.4)*	2109 (44.4)	0.9 (0.6–1.3)	0.9 (0.6–1.3)
Motorcycle ownership						
No	21 (8.7)	Ref	Ref	33 (13.7)	Ref	Ref
Yes	1658 (35.8)	5.8 (3.7–9.2)***	1.3 (0.8–2.2)	2133 (46.1)	5.4 (3.7–7.8)***	1.6 (1.0–2.5)
Purpose						
Travelling to/from work/school/college	1615 (36.5)	Ref	Ref	2046 (46.2)	Ref	Ref
Travelling for other activities	64 (14.5)	0.3 (0.2–0.4)***	0.5 (0.4–0.6)***	120 (27.2)	0.4 (0.4–0.5)***	0.8 (0.6–1.0)
Helmet ownership						
No	9 (1.3)	Ref	Ref	4 (0.6)	Ref	Ref
Yes	1671 (40.1)	51.6 (26.6–99.8)***	40.4 (20.8–78.5)***	2163 (51.9)	188.4 (70.4–504.4)***	151.0 (56.3–404.8)***

*P ≤ 0.05, **P ≤ 0.01, ***P ≤ 0.001.

compared to young riders (≤24 years). The adjusted odds of wearing a helmet were 3.3 times higher among those with some education at the college or higher level compared with those who had had no schooling ($P < 0.001$, Table 3). Motorcycle drivers had 1.8 times higher adjusted odds of wearing a helmet compared to passengers ($P < 0.05$). Compared to those who were riding a motorcycle with less than 100 cc capacity, those who were riding a motorcycle with greater than 100 cc capacity had 1.6 times higher odds to be observed wearing a helmet after controlling for confounding factors ($P < 0.05$). After adjusting for covariates, those who owned a helmet had 40 times higher odds ($P < 0.001$) to be observed wearing a helmet compared to non-owners. Observed helmet use was 50% less among those using a motorcycle for other activities compared to those travelling for work/school after controlling for other factors ($P < 0.001$, Table 3).

Factors associated with self-reported helmet use

In bivariate analysis, a statistically significant association was found between self-reported helmet use and factors such as gender, age group, education, driving status, motorcycle ownership, purpose of motorcycle trip and helmet ownership. After adjusting for covariates, a statistically significant association was found between self-reported helmet use and

factors such as gender, age group, education, driving status and helmet ownership (Table 3). Results from multiple logistic regressions are presented below.

Compared to men, women had 1.2 times higher odds of self-reporting helmet use after controlling for other covariates ($P < 0.05$). After adjusting, older riders had 1.6 times higher adjusted odds of self-reporting helmet use compared to younger riders (≤24 years). Compared to respondents with no schooling, those with high school education had 2 times higher adjusted odds ($P < 0.01$) while those with college/higher education had 3.6 times higher adjusted odds ($P < 0.001$) of reporting that they 'always wear a helmet'. Compared to pillion riders, drivers had 1.8 times higher odds of reporting helmet use after controlling for confounding factors ($P < 0.05$). Those who owned a helmet had 151 times greater odds of self-reporting helmet use compared to non-owners after controlling for other factors ($P < 0.001$, Table 3).

Characteristics associated with over-reporting of helmet use

Among all respondents, about 65% were observed not wearing helmets and about 52% ($n = 2539$) were neither wearing a helmet nor did they claim that they always wear a helmet. However, overall about 13% of respondents were found over-reporting their helmet use i.e. they were not wearing helmet

at the time of interview and yet claimed that they always wear a helmet (Table 4). Table 5 shows characteristics associated with over-reporting. In bivariate analysis, a statistically significant association was found between over-reporting and variables such as gender, age, education, engine capacity of motorcycle, motorcycle ownership and purpose of motorcycle trip. However, after adjusting the effects of motorcycle ownership was no longer statistically significant (Table 5).

In multivariate analysis, after adjusting for other factors in the model, women were 60% less likely to over-report their helmet use as compared to men ($P < 0.001$). After controlling

for confounding factors, compared to younger riders (≤ 24 years) older driver (25–54 years of age) were 30–40% less likely to over-report helmet use. Those with some college or higher education were 60% less likely to over-report their helmet use compared to those with no schooling after controlling ($P < 0.05$). After adjusting, those with higher capacity motorcycles were 50% less likely to over-report their helmet use when compared to those who had lower capacity motorcycles ($P < 0.01$). Also, compared to those travelling for school or work, those using motorcycle for other purposes had 4 times higher adjusted odds of over-reporting helmet use ($P < 0.001$).

Table 4 – A comparison of observed and self-reported helmet use among respondents of roadside interview, Hyderabad (n = 4872).

Helmet use	Observed		Total	
	Yes	No		
Self-reported	Yes	1514 (31.1)	653 (13.4) ^{a,b}	2167 (44.5)
	No	166 (3.4)	2539 (55.5) ^b	2705 (55.5)
Total		1680 (34.5)	3192 (65.5) ^b	4872 (100)

Chi-squared test P -value = 0.000.
^a Group over-reporting.
^b Groups requiring interventions.

Table 5 – Factors associated with over-reporting of helmet use in Hyderabad, India (n = 2167).

Characteristics	Unadjusted OR (95% CI)	Adjusted OR (95% CI)
Gender		
Male	Ref	Ref
Female	0.3 (0.3–0.5)***	0.4 (0.3–0.5)***
Age group in years		
≤ 24	Ref	Ref
25–39	0.8 (0.6–1.0)	0.7 (0.5–1.0)*
40–54	0.7 (0.5–1.0)*	0.6 (0.4–0.8)***
≥ 55	0.8 (0.4–1.6)	0.6 (0.3–1.1)
Education		
No schooling	Ref	Ref
Primary/elementary	0.5 (0.2–1.2)	0.5 (0.2–1.5)
High school/secondary	0.7 (0.3–1.7)	0.9 (0.4–2.0)
College and higher education	0.3 (0.2–0.7)**	0.4 (0.2–1.0)*
Driving status		
Pillion rider	Ref	Ref
Driver	0.7 (0.3–1.4)	0.7 (0.3–1.6)
Capacity of motorcycle		
Less than 100 cc	Ref	Ref
More than 100 cc	0.4 (0.2–0.7)***	0.5 (0.3–0.8)**
Motorcycle ownership		
No	Ref	Ref
Yes	0.3 (0.1–0.6)***	0.6 (0.3–1.3)
Purpose		
Travelling to/from work/school/college	Ref	Ref
Travelling for other activities	4.8 (3.2–7.0)***	4.0 (2.7–6.0)***
Helmet ownership		
No	Ref	Ref
Yes	1	1

* $P \leq 0.05$, ** $P \leq 0.01$, *** $P \leq 0.001$.

Discussion

Our study found self-reported helmet use to be nearly 1.3 times higher than observed helmet use. This difference between observed and self-reported helmet use may be attributable to the respondents' giving a socially desirable response.³⁰ The overestimation of self-reported helmet use has been reported in other studies as well.^{28,29,31} For instance, Bachani et al.²⁸ found self-reported helmet use in Cambodia to be 1.5 times and 8.7 times higher than observed helmet use among motorcycle drivers and passengers, respectively. The difference between observed and self-reported use has been extensively studied for seatbelt use, suggesting that compared to self-reports, observational studies provide a more correct estimate of seatbelt use.^{23,32–36} Our study reaches a similar conclusion in the estimation of helmet use. Nonetheless self-reported use can also give an estimate of helmet use provided the results are adjusted for over-reporting and our study allows estimation of this adjustment factor for helmet use.³³ Based on the findings of our study we recommend that an adjustment factor of 0.78 be applied to self-reported helmet use to get a better estimate of helmet use.

In our study we found no evidence that odds of over-reporting change over time, but over-reporting was least when the observed rates were higher, and the over-reporting increased when the observed rates were low. A similar trend has been observed for seatbelt use where the difference between self-reported and observed use was found to be greater in populations where the seatbelt use was low.^{32,34,35} This could be attributed to a decline in social desirability with increasing use.³⁵

Overall we found low prevalence of helmet use in Hyderabad and our findings were comparable with those of other studies conducted in Hyderabad.^{26,37} It is well documented that legislation and enhanced enforcement increases helmet use while the use decreases when the laws are repealed.^{4,19,20,38} In our study, the police had stopped only 2.8% of respondents in the 30 days preceding the interview to check their helmet use and this could explain the low prevalence of helmet use.

In this study we found the factors associated with both observed and self-reported helmet use to be similar suggesting that despite limitations, self-reports can help in identifying target groups for helmet interventions. Similar to findings of another study in Hyderabad, we found men to be at a higher risk for not wearing helmets.²⁶ Contrary to our findings, some studies in India have found women to be a higher risk for not wearing helmet and this was because they were

not legally required to do so.^{27,39} In our study we also found men to be at higher risk of over-reporting their helmet use. Zambon et al.³³ found higher over-reporting regarding seat-belt use among women.

We found youth to be at a higher risk of not wearing helmets; consistent with our earlier findings.¹⁸ Youth are known to be involved in many high risk road behaviours, including non-use of helmets and require focussed interventions.⁴⁰ We also found an association between education status and helmet use. Other studies have shown that persons with higher educational attainment are more likely to wear helmets and that they are also more likely to support helmet laws.^{26,41,42} This may be explained by a greater awareness of the risk of head injury and resulting disability and mortality, and benefits of helmet use among persons with higher levels of education.⁴² This may also partially account for the higher proportion of helmet ownership among them.⁴¹ However, education alone may not increase helmet use but it can create a conducive environment for helmet legislation and enforcement by increasing awareness and reducing political resistance.²⁰

As expected, those not owning a motorcycle were at higher risk of not wearing a helmet. However, after adjusting for other factors the relationship between motorcycle ownership and helmet use did not remain significant. It is generally observed that people who rent or borrow motorcycles from friends for journeys of short distances generally do not borrow helmets as well. Lack of motorcycle ownership is identified as a risk factor for both non-use of helmets and for the use of non-standard helmets.^{26,43} However, with poor enforcement helmet use may remain low despite higher helmet ownership.⁴¹ This calls for a combined effort that includes increasing ownership of standard helmets as well as enhanced enforcement. Making standard helmets available at affordable prices can increase helmet ownership while enhanced enforcement can encourage both helmet ownership as well as helmet use.⁴¹ In this study, the majority of those wearing a helmet (96.8%) had a standard one.

The results of this study should be interpreted in the light of the following limitations. First, helmet interviews were not conducted at night. Studies have reported lower helmet use at night.^{28,29} However, our study could not capture the variation in helmet use after 18:30 h. Second, respondents for the interview were stopped with the help of local traffic police and this may have influenced their self-reported helmet use. Third, while the interview sites were selected to be representative of Hyderabad city; the results may not be generalisable to other sites in India. Fourth, over six rounds of data collection the observed helmet use varied even though there were no changes in helmet legislation and enforcement in Hyderabad. Last, the roadside interviews included fewer female respondents (12.7%) and pillion riders (2%), thus the generalisability to those populations is limited. This is because police stopped fewer women for interview.

Conclusions

This study emphasizes that observational studies provide a valid estimate of helmet use compared to self-reported data. The factors associated with observed vs self-reported helmet use were found to be consistent. Men, youth and

motorcyclists with lower levels of education were found to be at a higher risk of not wearing a helmet in both self-report and observation. Increasing helmet ownership and enhanced enforcement are strategies that may help increase helmet use in Hyderabad.

Author statements

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Ethical approval

The Institutional Review Board of the Johns Hopkins Bloomberg School of Public Health and the Institutional Ethics Committee of the Indian Institute of Public Health, Hyderabad, approved this study.

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Competing interests

None declared.

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