Determinants of road traffic injury at Khulna division in Bangladesh: a cross sectional study of road traffic incidents

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Abstract

Background: Road traffic injury (RTI) is one of the major causes of death, injury and disability worldwide and most of which occur in developing countries like Bangladesh. The main objective of this study was to identify the role of various socio-demographic and economic factors regarding the knowledge and consciousness about RTI at Khulna division in Bangladesh.

Methods: Primary data were collected from 200 respondents in Khulna Medical College Hospital and Satkhira Sadar Hospital and several private clinics, generated by interviewing people who had experienced a traffic accident in Khulna division, Bangladesh. The Chi-square test and logistic regression model were utilized in this study to analyze the data.

Results: The results show that there was a significant association between education (primary to higher secondary school: OR = 3.584, 95% CI = 0.907-14.155; higher educated: OR = 24.070, 95% CI = 4.860-119.206); occupation (farmer and labor: OR = 0.528, 95% CI = 0.208-1.340; others: OR = 0.263, 95% CI = 0.097-0.713); if they were driving a motorcycle (OR = 4.137, 95% CI = 1.229-13.932); proper treatment (OR = 4.690, 95% CI = 1.736-12.673); consciousness about the RTI (OR = 18.394, 95% CI = 6.381-53.025); if they were an unskilled driver (OR = 8.169, 95% CI = 0.96-16.51), unfit vehicles (OR = 3.696, 95% CI = 1.032-13.234), if they were breaking traffic rules (OR = 6.918, 95% CI = 2.237-21.397), faulty road and traffic management (OR = 3.037, 95% CI = 1.125-8.196) with having knowledge about traffic rules in Khulna division, Bangladesh.

Conclusion: According to the results of the study, by increasing knowledge and awareness about traffic rules among people through education and awareness programs, imposing strict traffic rules, not giving licenses to unskilled drivers, not allowing unfit vehicles on the road, reconstruction and proper road management RTI's can be
reduced.

**Keywords**
Road Traffic Injury (RTI); Knowledge and Awareness; Traffic Rules;
Socio-demographic and economic characteristics; Bangladesh.

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Introduction
Road traffic Injury (RTI) is one of the leading causes of deaths, injuries and disabilities worldwide, for both developed and developing countries. Every year about 1.25 million of people die worldwide due to RTI’s, and a high burden of traffic fatalities and injuries occur in low and middle-income countries (LMICs); this burden is enhanced due to rapid urbanization and motorization. Road traffic accident deaths are projected to increase to 2.1 million in 2030, mainly due to the increase in the use of motor vehicles related to economic growth in low and middle-income countries. Bangladesh is a developing country situated in South Asia and its located between 20°34’ to 26°38’ north latitude and 88°01’ to 92°42’ east longitude, with an area of 1,47,570 sq.km, with a population of 162.9 million and density of 1251.5 people per sq.km. Presently the total length of roads in Bangladesh is 21,125,082 km. In Bangladesh, road traffic accidents, injuries and fatalities are an area of great concern. According to the Bangladesh Road Transport Authority, the number of death stood at 2376 and injuries at 1958 as of 2015 in Bangladesh. Khulna is an industrial and divisional city of Bangladesh, with an area of 45.65 km². The total number of vehicles running in Khulna city is greater than 20990, including about 13360 non-motorized and 7630 motorized vehicles as of 2005.

The World Health Organization (WHO), has reported on RTIs that “Approximately 1.3 million people die each year on the world’s roads and between 20 and 50 million sustain non-fatal injuries”. Developing countries carry the greatest share of the burden. Reviewing literature across different countries, it shows that people aged 15–49 years are more vulnerable to road traffic deaths. Men are involved in a greater proportion of road traffic accidents and fatalities in comparison to women (17). Motorcycles are the most common vehicles to be associated with RTIs. According to Nantulya et al., buses, trucks, pedestrians and passengers have the highest burden of morbidity and mortality in RTIs. For Asian countries, income, road design and management, and accidents involving vehicles are also important predictors of RTIs. Different studies identified various reasons behind RTIs like excessive speed of the vehicles, inexperienced drivers, reckless driving, violation of traffic rules and signals etc. A study from the Accident Research Center (ARC) of Bangladesh University of Engineering and Technology found that the death rate of road accidents in Bangladesh is much higher, about sixty deaths per 10,000 vehicles per every year, as compared with rates of two in the USA.

RTI’s are the 2nd most common cause of injury and deaths in Bangladesh and the road traffic accident situation in Khulna city as well as the rest of Bangladesh is a vital issue, and the loss of lives and damage of valuable assets are expected to continue if proper measures are not adopted accordingly. Almost 1.8% to 2.2% of gross domestic product (GDP) is lost in road accidents in this country, which itself demonstrates the severity both in terms of deaths and injuries. So, extensive research and investigation is needed urgently to improve the RTI situation.

Therefore, the main purpose of this study is to find out the socio-demographic differentials and socio-economic factors related to RTI, as well as knowledge and awareness about RTI, and to recommend suggestions regarding study results.

Methods
Study design
In this study we performed a cross-sectional study of road traffic incidents.

Study setting and procedure
Primary data were collected from orthopedics, neurosurgery and general wards of Khulna Medical College Hospital, Satkhira Sadar Hospital and several private clinics from Khulna and Satkhira district using purposive sampling. Socio-economic and demographic, injury information, data related to treatment and cost, effect on family and information related to knowledge and awareness were collected by questionnaires (Supplementary File 1 and Supplementary File 2) with face-to-face interviews from 200 respondents with a recent RTI. The inclusion and exclusion criteria applied included all respondents with a recent RTI in Khulna Division at the time of interview. The data was collected during January and February, 2017.

Data analysis
To analyze the data, SPSS windows version 23.0 was used. Cross tables were used to study the association of what was known about traffic rules by the respondents with their background characteristics. χ²-test was used to test the significance of the association. Moreover, to identify the determinants of RTI of the respondents, a logistic regression model was fitted. Here, knowledge of traffic rules is treated as the dependent variable which is addressed as follows:

\[ Y = \text{Knowledge about traffic rules} = \begin{cases} 1, & \text{have known about traffic rules} \\ 0, & \text{not known about traffic rules} \end{cases} \]

Age, gender, education, occupation, religion, monthly income, family member, earning members, place of road traffic injuries, accident by motor cycle, bicycle, car, bus, truck, proper treatment, position during RTIs, effect on family, financial effect type, if treatment cost is burden, reasons of accident, consciousness about RTIs, knowledge of traffic laws from television, radio, newspaper, appropriate application of traffic rules, the government rules for reducing RTIs are proper were treated as explanatory variables.

Model validation technique
To test out the validity of the logistic regression analysis over the population, the cross validity prediction power (CVPP), \( \rho_{cv} \), was applied. The mathematical formula for CVPP is

\[ \rho_{cv} = 1 - \frac{(n-1)(n-2)(n+1)}{n(n-k-1)(n-k-2)}(1-R^2); \]

Where, \( n \) is the number of classes, \( k \) is the number of repressors in the fitted model and the cross-validated \( R \) is the correlation.
between observed and predicted values of the dependent variables\(^2\). The shrinkage (\(\alpha\)) of the model is the positive value of \((\sigma^2 - R^2)\); where \(\sigma^2\) is CVPP and \(R^2\) is the coefficient of determination of the model. Furthermore, the stability of \(R^2\) of the model is \((1-\alpha)\). The information of shrinkage coefficients is presented at the bottom of the respective tables. It is noted that this technique is also used as model validation technique\(^{24-27}\).

Results
The results of association between knowledge about traffic rules among the selected socio-demographic and economic characteristics of respondents in Bangladesh are presented in Table 1 and Table 2. In this study, 58% of the respondent had knowledge about traffic rules. Most of the victims were aged 15–44 years (65%), and most (58%) of the respondents had knowledge about traffic rules.

| Variable            | Knowledge of traffic rules | Cal. \(\chi^2\), \(d.f, p\)-value |
|---------------------|----------------------------|----------------------------------|
| Age:                |                            |                                  |
| 0–14 years          | 6(7.1%)                    | 8(6.9%)                          |
| 15–44 years         | 45(53.6%)                  | 85(73.3%)                        |
| 45+ years           | 33(39.3%)                  | 23(19.8%)                        |
| Total               | 84(100%)                   | 116(100%)                        |
| Gender:             |                            |                                  |
| Male                | 67(79.8%)                  | 107(92.2%)                       |
| Female              | 17(20.2%)                  | 167(13.8%)                       |
| Total               | 84(100%)                   | 200(100%)                        |
| Residence:          |                            |                                  |
| Urban               | 18(21.4%)                  | 48(41.4%)                        |
| Rural               | 66(78.6%)                  | 68(58.6%)                        |
| Total               | 84(100.0%)                 | 200(100.0%)                      |
| Education:          |                            |                                  |
| Illiterate          | 24(28.6%)                  | 5(4.3%)                          |
| Primary to Higher Secondary | 47(56.0%) | 43(37.1%) |
| Higher Educated     | 13(15.5%)                  | 68(58.6%)                        |
| Total               | 84(100%)                   | 116(100%)                        |
| Religion:           |                            |                                  |
| Muslim              | 56(66.7%)                  | 84(72.4%)                        |
| Non-Muslim          | 28(33.3%)                  | 32(27.6%)                        |
| Total               | 84(100%)                   | 116(100%)                        |
| Occupation:         |                            |                                  |
| Job & Business      | 22(26.0%)                  | 72(62.0%)                        |
| Farmer & Labor      | 42(50.0%)                  | 22(19.0%)                        |
| Others              | 20(23.8%)                  | 22(19.0%)                        |
| Total               | 84(100%)                   | 116(100%)                        |
| Monthly income in taka: |                      |                                  |
| <10000 (10001–25000) | 30(35.7%)                  | 25(21.6%)                        |
| >25000              | 42(50.9%)                  | 57(49.1%)                        |
| Total               | 84(100.0%)                 | 116(100.0%)                      |
| Monthly expenditure in taka: |                |                                  |
| <10000 (10001–25000) | 28(33.3%)                  | 33(28.4%)                        |
| >25000              | 47(56.0%)                  | 63(54.3%)                        |
| Total               | 84(100.0%)                 | 116(100.0%)                      |
| Family member:      |                            |                                  |
| <5 person           | 48(57.1%)                  | 76(65.5%)                        |
| >5 person           | 36(42.9%)                  | 40(34.5%)                        |
| Total               | 84(100.0%)                 | 116(100.0%)                      |
### Table 2. Bivariate distribution of Road Traffic Injuries (RTI) according to the selected injury, effect and awareness related variables of the respondents.

| Variable                     | Knowledge of traffic rules | Cal. $\chi^2$, d.f, p-value |
|------------------------------|----------------------------|-----------------------------|
|                              | No            | Yes       | Total         |                                |
| **Earning members:**         |               |           |                       |                                |
| ≤2                           | 72(85.7%)     | 99(85.3%) | 171(85.5%)     | Cal. $\chi^2 = 0.005$ d.f = 1 (p = 0.942) |
| 3≤                           | 12(14.3%)     | 17(14.7%) | 29 (14.5%)     |                                |
| Total                        | 84(100.0%)    | 116(100.0%) | 200(100.0%)    |                                |
| **Earning capability:**      |               |           |                       |                                |
| No                           | 24(28.6%)     | 21(18.1%) | 45(22.5%)      | Cal. $\chi^2 = 3.062$ d.f = 1 (p = 0.080) |
| Yes                          | 60(71.4%)     | 95(81.9%) | 155 (77.5%)    |                                |
| Total                        | 84(100.0%)    | 116(100.0%) | 200(100.0%)    |                                |
| **Places of RTIs:**          |               |           |                       |                                |
| Rural road                   | 35(41.7%)     | 31(36.9%) | 66(33.0%)      | Cal. $\chi^2 = 6.508$ d.f = 2 (p = 0.039) |
| Urban road                   | 18(21.4%)     | 41(35.3%) | 59(29.5%)      |                                |
| Highway road                 | 84(100.0%)    | 116(100.0%) | 200(100.0%)    |                                |
| **Accident vehicle:**        |               |           |                       |                                |
| **Truck**                    |               |           |                       |                                |
| No                           | 75(89.3%)     | 109(94.0%) | 184(92.0%)     | Cal. $\chi^2 = 1.450$ d.f = 1 (p = 0.223) |
| Yes                          | 9(10.7%)      | 7(6.0%)   | 16(8.0%)       |                                |
| Total                        | 84(100.0%)    | 116(100.0%) | 200(100.0%)    |                                |
| **Bus**                      |               |           |                       |                                |
| No                           | 72(85.7%)     | 94(81.0%) | 166(83.0%)     | Cal. $\chi^2 = 0.756$ d.f = 1 (p = 0.385) |
| Yes                          | 12(14.3%)     | 22(19.0%) | 34(17.0%)      |                                |
| Total                        | 84(100.0%)    | 116(100.0%) | 200(100.0%)    |                                |
| **Motor cycle**              |               |           |                       |                                |
| No                           | 69(82.1%)     | 61(52.6%) | 130(65.0%)     | Cal. $\chi^2 = 18.708$ d.f = 1 (p = 0.0001) |
| Yes                          | 15(17.9%)     | 55(47.4%) | 70(35.0%)      |                                |
| Total                        | 84(100.0%)    | 116(100.0%) | 200(100.0%)    |                                |
| **Car**                      |               |           |                       |                                |
| No                           | 72(85.7%)     | 101(87.1%) | 173(86.5%)     | Cal. $\chi^2 = 0.77$ d.f = 1 (p = 0.782) |
| Yes                          | 12(14.3%)     | 15(12.9%) | 27(13.5%)      |                                |
| Total                        | 84(100.0%)    | 116(100.0%) | 200(100.0%)    |                                |
| **Three-wheeler**            |               |           |                       |                                |
| No                           | 56(66.7%)     | 87(75.0%) | 143(71.5%)     | Cal. $\chi^2 = 1.660$ d.f = 1 (p = 0.198) |
| Yes                          | 28(33.3%)     | 29(25.0%) | 57(28.5%)      |                                |
| Total                        | 84(100.0%)    | 116(100.0%) | 200(100.0%)    |                                |
| **Bicycle**                  |               |           |                       |                                |
| No                           | 67(79.8%)     | 107(92.2%) | 174(87.0%)     | Cal. $\chi^2 = 6.709$ d.f = 1 (p = 0.010) |
| Yes                          | 17(20.2%)     | 9(7.8%)   | 26(13.0%)      |                                |
| Total                        | 84(100.0%)    | 116(100.0%) | 200(100.0%)    |                                |
| **Position during RTI:**     |               |           |                       |                                |
| Passerby                     | 39(46.4%)     | 39(33.6%) | 78(39.0%)      | Cal. $\chi^2 = 6.194$ d.f = 2 (p = 0.045) |
| Driver                       | 15(17.9%)     | 38(32.8%) | 53(26.5%)      |                                |
| Passenger                    | 30(35.7%)     | 39(33.6%) | 69(34.5%)      |                                |
| Total                        | 84(100.0%)    | 116(100.0%) | 200(100.0%)    |                                |
| Variable                        | Knowledge of traffic rules | Cal. $\chi^2$, d.f, p-value |
|--------------------------------|---------------------------|-----------------------------|
|                                | No                        | Yes                        | Total                        |
| **Level of accident:**         |                           |                            |                              |
| Death and permanent            | 18(21.4%)                 | 17(14.7%)                  | 35(17.5%)                    | Cal. $\chi^2 = 1.565$  |
| Short-term                     | 38(45.2%)                 | 58(50.0%)                  | 96(48.0%)                    | $D.f = 2$  |
| Long-term                      | 28(33.3%)                 | 41(35.3%)                  | 69(34.5%)                    | ($p = 0.457$)  |
| Total                          | 84(100.0%)                | 116(100.0%)                | 200(100.0%)                  |               |
| **Proper treatment:**          |                           |                            |                              |
| No                             | 34(40.5%)                 | 22(19.0%)                  | 56(28.0%)                    | Cal. $\chi^2 = 11.182$  |
| Yes                            | 50(59.5%)                 | 94(81.0%)                  | 144(72.0%)                   | $D.f = 1$  |
| Total                          | 84(100.0%)                | 116(100.0%)                | 200(100.0%)                  | ($p = 0.001$)  |
| **Effect on family:**          |                           |                            |                              |
| No                             | 19(22.6%)                 | 45(38.8%)                  | 64(32.0%)                    | Cal. $\chi^2 = 5.857$  |
| Yes                            | 65(77.4%)                 | 71(61.2%)                  | 136(68.0%)                   | $D.f = 1$  |
| Total                          | 84(100.0%)                | 116(100.0%)                | 200(100.0%)                  | ($p = 0.016$)  |
| **Effect type (Financial):**   |                           |                            |                              |
| No                             | 42(50.0%)                 | 77(66.4%)                  | 119(59.5%)                   | Cal. $\chi^2 = 5.424$  |
| Yes                            | 42(50.0%)                 | 39(33.6%)                  | 81(40.5%)                    | $D.f = 1$  |
| Total                          | 84(100.0%)                | 116(100.0%)                | 200(100.0%)                  | ($p = 0.020$)  |
| **Treatment cost is burden:**  |                           |                            |                              |
| No                             | 33(39.3%)                 | 71(61.2%)                  | 104(52.0%)                   | Cal. $\chi^2 = 9.380$  |
| Yes                            | 51(60.7%)                 | 45(38.8%)                  | 96(48.0%)                    | $D.f = 1$  |
| Total                          | 84(100.0%)                | 116(100.0%)                | 200(100.0%)                  | ($p = 0.002$)  |
| **Consciousness about rti:**   |                           |                            |                              |
| No                             | 56(66.7%)                 | 16(13.8%)                  | 72(36.0%)                    | Cal. $\chi^2 = 59.116$  |
| Yes                            | 28(33.3%)                 | 100(86.2%)                 | 128(64.0%)                   | $D.f = 1$  |
| Total                          | 84(100.0%)                | 116(100.0%)                | 200(100.0%)                  | ($p = 0.0001$)  |
| **Reasons of accident:**       |                           |                            |                              |
| Unskilled driver:              |                           |                            |                              |
| No                             | 69(82.2%)                 | 81(69.8%)                  | 150(75.0%)                   | Cal. $\chi^2 = 3.941$  |
| Yes                            | 15(17.9%)                 | 35(30.2%)                  | 50(25.0%)                    | $D.f = 1$  |
| Total                          | 84(100.0%)                | 116(100.0%)                | 200(100.0%)                  | ($p = 0.047$)  |
| Unfit vehicles:                |                           |                            |                              |
| No                             | 77(91.7%)                 | 92(69.8%)                  | 150(75.0%)                   | Cal. $\chi^2 = 5.679$  |
| Yes                            | 7(8.3%)                   | 24(20.7%)                  | 31(15.5%)                    | $D.f = 1$  |
| Total                          | 84(100.0%)                | 116(100.0%)                | 200(100.0%)                  | ($p = 0.017$)  |
| Extra passenger:               |                           |                            |                              |
| No                             | 79(94.0%)                 | 109(94.0%)                 | 188(94.0%)                   | Cal. $\chi^2 = 0.001$  |
| Yes                            | 5(6.0%)                   | 7(6.0%)                    | 12(6.0%)                     | $D.f = 1$  |
| Total                          | 84(100.0%)                | 116(100.0%)                | 200(100.0%)                  | ($p = 0.981$)  |
| Breaking traffic rules:        |                           |                            |                              |
| No                             | 70(83.3%)                 | 78(67.2%)                  | 148(74.0%)                   | Cal. $\chi^2 = 6.557$  |
| Yes                            | 14(16.7%)                 | 38(32.8%)                  | 52(26.0%)                    | $D.f = 1$  |
| Total                          | 84(100.0%)                | 116(100.0%)                | 200(100.0%)                  | ($p = 0.010$)  |
| Lack of footpath and over bridge: |                       |                            |                              |
| No                             | 62(73.8%)                 | 95(81.9%)                  | 157(78.5%)                   | Cal. $\chi^2 = 1.888$  |
| Yes                            | 22(26.2%)                 | 21(18.1%)                  | 43(21.5%)                    | $D.f = 1$  |
| Total                          | 84(100.0%)                | 116(100.0%)                | 200(100.0%)                  | ($p = 0.169$)  |
prior knowledge on traffic rules, of which 6.9%, 73.3% and 19.8% were 0–14 years, 15–44 years and 45+ years age groups respectively. Males (87%) are at higher risk of RTI, however, of those with prior knowledge of traffic rules 92.2% were male. Among all the respondents, 67% and 33% live in rural and urban areas, respectively, where 58.6% and 41.4%, respectively, have knowledge of traffic rules. In Khulna division, 14.5% of people were illiterate and 45% and 40.5% of people had completed “primary to higher secondary school (HSC) level education and higher level of education, respectively and of which 4.3%, 37.1% and 58.6%, respectively, knew about traffic rules. It appears that knowledge of traffic rules increase with level of education. 47% of respondents belong to the occupation group job and business, of which 62% have knowledge about traffic rules. A total of 49.5% of the respondents had a monthly family income of 10001–25000 taka, termed as middle class level of education. 47% of respondents belong to the occupation group job and business, of which 62% have knowledge about traffic rules, when compared to illiterate respondents. So it was clear that higher educated people were more likely to know traffic rules than others. In the case of occupation, the regression odds ratio for farmers and labors was 0.528 (95% CI = 0.208-1.340), and for others was 0.263 (95% CI = 0.097-0.713) times less likely to know traffic rules than the respondents who were engaged in job and business.

Most of the participants had RTI’s on urban roads (37.5%), followed by rural (33%) and highway roads (29.5%). 37.9% and 35.3% of respondents who had RTI’s on urban and rural roads, had known about traffic rules. We can define motorcycles as the most vulnerable vehicle based on this study. In this case, 47.4% reported a motorcycle as their RTI vehicle. 7.8% of respondents whose accident vehicle was a bicycle had prior knowledge of traffic rules. In the case of victim’s position during the RTI, passersby were most affected (39%) followed by passengers (34.5%). In this study area, 72% of participants received proper treatment, 81% of them had knowledge of traffic rules, and 68% claimed that they had a negative effect on family due to the RTI, especially financial 40.5%. With regards to the reasons behind RTIs, respondents who had knowledge of traffic rules said unskilled drivers (30.2%), unfit vehicles (20.7%), breaking traffic rules (32.8%) and faulty roads and road management (39.7%). The number of participant who believed current traffic rules were not sufficient (71%) was significantly higher than those who believed the rules were sufficient (29%). 63.8% had knowledge of the current traffic rules and they felt traffic rules were not sufficient. 65.5% of the participants said government rules inadequate and 66.5% of respondents indicated about NGO roles adequate.

A logistic regression analysis was applied to identify the factors which were significantly associated with knowledge of traffic rules. The results of the logistic regression analysis are presented in Table 3 and Table 4. In this study, the regression odd ratio for primary to HSC educated respondents was 3.584 (95% CI = 0.907-14.155), and for higher educated was 24.070 (95% CI = 4.860-119.206), indicated that primary to HSC level educated respondents had 3.584 times more chances, and higher educated respondents had 24.070 times more chances to know traffic rules, when compared to illiterate respondents. So it was clear that higher educated people were more likely to know traffic rules than others. In the case of occupation, the regression odds ratio for farmers and labors was 0.528 (95% CI = 0.208-1.340), and for others was 0.263 (95% CI = 0.097-0.713) times less likely to know traffic rules than the respondents who were engaged in job and business.

| Variable                        | No       | Yes      | Total    | Cal. χ², d.f, p-value |
|---------------------------------|----------|----------|----------|-----------------------|
| Faulty road and management:    |          |          |          |                       |
| No                              | 67(79.8%)| 70(60.3%)| 137(68.5%)| Cal. χ² = 8.513       |
| Yes                             | 17(20.2%)| 46(39.7%)| 63(31.5%)| D.f = 1               |
| Total                           | 84(100.0%)| 116(100.0%)| 200(100.0%)| (p=0.004)            |
| Traffic rules are sufficient:   |          |          |          |                       |
| No                              | 68(81.0%)| 74(63.8%)| 142(71.0%)| Cal. χ²=6.967         |
| Yes                             | 16(19.0%)| 42(36.2%)| 58(29.0%)| D.f = 1               |
| Total                           | 84(100.0%)| 116(100.0%)| 200(100.0%)| (p = 0.008)          |
| Government role are proper in RTIs |         |          |          |                       |
| No                              | 57(67.9%)| 74(63.8%)| 131(65.5%)| Cal. χ²=0.356        |
| Yes                             | 27(32.1%)| 42(36.2%)| 69(34.5%)| D.f = 1               |
| Total                           | 84(100.0%)| 116(100.0%)| 200(100.0%)| (p = 0.551)          |
| N.G.O have role to prevent RTIs |          |          |          |                       |
| No                              | 35(41.7%)| 32(27.6%)| 67(33.5%)| Cal. χ²=4.336       |
| Yes                             | 49(58.3%)| 84(72.4%)| 133(66.5%)| D.f = 1               |
| Total                           | 84(100.0%)| 116(100.0%)| 200(100.0%)| (p = 0.037)          |

NGO: non-government organization, RTIs: Road Traffic Injuries. p<0.05 is the significance level
### Table 3. Logistic regression for Road Traffic Injuries according to the selected socio-demographic variables of the respondents.

| Explanatory Variables | Co-efficient β | S.E of β | p-value | Odds ratio, Exp(β) | 95% C.I of OR |
|-----------------------|----------------|----------|---------|-------------------|--------------|
|                       |                |          |         |                   | Upper        |
|                       |                |          |         |                   | Lower        |
| Age:                  |                |          |         |                   |              |
| 0–14 years (RC)       | .......        | .......  | 0.558   | 1.000             |              |
| 15–44 years           | -0.578        | 0.767    | 0.451   | 0.561             | 0.125        |
| 45≤ years             | -0.868        | 0.831    | 0.296   | 0.420             | 0.082        |
| Gender:               |                |          |         |                   |              |
| Male (RC)             | .......        | .......  | ....... | 1.000             |              |
| Female                | -0.761        | 0.600    | 0.204   | 0.467             | 0.144        |
| Educational status of respondents: | | | | |
| Illiterate (RC)       | .......        | .......  | 0.001   | 1.000             |              |
| Primary to HSC        | 1.276         | 0.701    | 0.069   | 3.584             | 0.907        |
| Higher educated       | 3.181         | 0.816    | 0.001   | 24.070            | 4.860        |
| Occupation:           |                |          |         |                   |              |
| Job & business (RC)   | .......        | .......  | 0.026   | 1.000             |              |
| Farmer & labor        | -0.638        | 0.475    | 0.179   | 0.528             | 0.208        |
| Others                | -1.336        | 0.509    | 0.009   | 0.263             | 0.097        |
| Residence             |                |          |         |                   |              |
| Urban (RC)            | .......        | .......  | ....... | 1.000             |              |
| Rural                 | -0.538        | 0.394    | 0.173   | 0.584             | 0.270        |
| Monthly family income:|                |          |         |                   |              |
| <10000 (RC)           | .......        | .......  | 0.405   | 1.000             |              |
| 10001–25000           | -0.611        | 0.510    | 0.231   | 0.543             | 0.200        |
| >25000                | -0.772        | 0.627    | 0.218   | 0.462             | 0.135        |
| Constant              | 0.631         | 1.028    | 0.539   | 1.880             |              |
| Model summary:        |                |          |         |                   |              |
| Model Chi-Square       | 64.298 (0.0001) | 207.819 |       |                   |              |
| -2Log Likelihood      | =             |          |         |                   |              |
| Cox and Snell R Square| = 0.275        | 0.370   |        |                   |              |
| Nagelkerke R Square   | = 0.2253       | 0.2253  |        |                   |              |

HSC: higher secondary school, RC: Reference Category and p<0.005 is the significance level.

Discussion

Knowledge about traffic rules is a very important factor in reducing RTIs\textsuperscript{17,28}. According to this study, it is observed that the age group at most risk of being involved in an RTI in Khulna division is 15–44 years. Similar results showed up in Ethiopia in 2014\textsuperscript{29} and in Nigeria\textsuperscript{30} as well as India\textsuperscript{31}. It was observed that those aged 15–44 years had more knowledge than the other age groups. Males were at relatively higher risk when compared to females, like other developing countries\textsuperscript{14,32}. Similarly, deaths from RTIs was higher for males in Iran\textsuperscript{33}, and in India\textsuperscript{34}, and knowledge of traffic rules was higher in the male population. In Khulna, the majority of victims are from the rural areas, this is similar to the findings of Mishra \textit{et al.}\textsuperscript{35}, with an education level of “primary to HSC level”. Most of the individuals had prior knowledge of traffic rules than who were not conscious. In the case of reasons behind RTI, unskilled driver had an odds ratio of 8.169 (95% CI = 0.96-16.51), unfit vehicles had an odds ratio of 3.696 (95% CI = 1.032-13.234), breaking traffic rules had an odds ratio of 6.918 (95% CI = 2.237-21.397), faulty roads and management had an odds ratio 3.037 (95% CI = 1.125-8.196), indicating respondents were 8.169, 3.696, 6.918 and 3.037 times more likely to know about the traffic rules than the respondents that answered was “No” respectively.

Dataset 1. Khula data set

http://dx.doi.org/10.5256/f1000research.15330.d212933
Table 4. Logistic regression estimates for the effect on Road Traffic Injuries (RTI) according to the selected injury, effect and awareness related variables of respondents.

| Explanatory Variables                | Co-efficient $\beta$ | S.E of $\beta$ | $p$-value | Odds ratio, $\text{Exp}(\beta)$ | 95% C.I of OR |
|--------------------------------------|----------------------|----------------|-----------|----------------------------------|---------------|
|                                      |                      |                |           |                                  | Upper        |
|                                      |                      |                |           |                                  | Lower        |
| Place of RTI:                        |                      |                |           |                                  |              |
| Rural road (RC)                      |                      |                | 0.661     | 1.00                             |              |
| Urban road                           | 0.462                | 0.550          | 0.401     | 1.587                            | 0.541        |
| Highway road                         | 0.419                | 0.598          | 0.484     | 1.520                            | 0.470        |
| Accident by motorcycle:              |                      |                |           |                                  |              |
| No (RC)                              |                      |                | 1.00      |                                  |              |
| Yes                                  | 1.420                | 0.619          | 0.022     | 4.137                            | 1.229        |
| Yes                                  |                      |                |           |                                  | 13.932       |
| Accident by bicycle:                 |                      |                |           |                                  |              |
| No (RC)                              |                      |                | 1.00      |                                  |              |
| Yes                                  | -0.399               | 0.768          | 0.603     | 0.671                            | 0.149        |
| Yes                                  |                      |                |           |                                  | 3.021        |
| Position during RTI:                 |                      |                |           |                                  |              |
| Passerby (RC)                        |                      |                | 0.253     | 1.00                             |              |
| Driver                               | 1.065                | 0.672          | 0.113     | 2.902                            | 0.778        |
| Passenger                            | -0.053               | 0.551          | 0.923     | 0.948                            | 0.322        |
| Passenger                            |                      |                |           |                                  | 2.791        |
| Proper treatment                     |                      |                |           |                                  |              |
| No (RC)                              |                      |                | 1.00      |                                  |              |
| Yes                                  | 1.546                | 0.507          | 0.002     | 4.690                            | 1.736        |
| Yes                                  |                      |                |           |                                  | 12.673       |
| Effect on family:                    |                      |                |           |                                  |              |
| No (RC)                              |                      |                | 1.00      |                                  |              |
| Yes                                  | -0.257               | 0.638          | 0.687     | 0.773                            | 0.221        |
| Yes                                  |                      |                |           |                                  | 2.702        |
| Effect type (Financial):             |                      |                |           |                                  |              |
| No (RC)                              |                      |                | 1.00      |                                  |              |
| Yes                                  | -0.302               | 0.613          | 0.622     | 0.739                            | 0.222        |
| Yes                                  |                      |                |           |                                  | 2.459        |
| Treatment cost is burden:            |                      |                |           |                                  |              |
| No (RC)                              |                      |                | 1.00      |                                  |              |
| Yes                                  | -0.467               | 0.558          | 0.402     | 0.627                            | 0.210        |
| Yes                                  |                      |                |           |                                  | 1.871        |
| Conscious about RTI                  |                      |                |           |                                  |              |
| No (RC)                              |                      |                | 1.00      |                                  |              |
| Yes                                  | 2.912                | 0.540          | 0.001     | 18.394                           | 6.381        |
| Yes                                  |                      |                |           |                                  | 53.025       |
| Reasons for accident:                |                      |                |           |                                  |              |
| Unskilled driver:                    |                      |                |           |                                  |              |
| No (RC)                              |                      |                | 1.00      |                                  |              |
| Yes                                  | 2.100                | .657           | 0.001     | 8.169                            | 2.254        |
| Yes                                  |                      |                |           |                                  | 29.607       |
| Unfit vehicles:                      |                      |                |           |                                  |              |
| No (RC)                              |                      |                | 1.00      |                                  |              |
| Yes                                  | 1.307                | 0.651          | 0.045     | 3.696                            | 1.032        |
| Yes                                  |                      |                |           |                                  | 13.234       |
| Breaking traffic rules:              |                      |                |           |                                  |              |
| No (RC)                              |                      |                | 1.00      |                                  |              |
| Yes                                  | 1.934                | 0.576          | 0.001     | 6.918                            | 2.237        |
| Yes                                  |                      |                |           |                                  | 21.397       |
| Explanatory Variables | Co-efficient β | S.E of β | p-value | Odds ratio, Exp(β) | 95% C.I of OR |
|-----------------------|----------------|----------|---------|-----------------|---------------|
|                       |                |          |         |                 | Upper | Lower |
| Faulty road and management: |                |          |         |                 |       |       |
| No (RC)               | ........       | ........  | ........ | 1.00            | ....  | ....  |
| Yes                   | 1.111          | 0.507    | 0.028   | 3.037           | 1.125 | 8.196 |
| Traffic rules are sufficient: |            |          |         |                 |       |       |
| No (RC)               | ........       | ........  | ........ | 1.00            | ....  | ....  |
| Yes                   | 0.557          | 0.530    | 0.293   | 1.746           | 0.618 | 4.934 |
| NGO have steps to prevent RTI |             |          |         |                 |       |       |
| No (RC)               | ........       | ........  | ........ | 1.00            | ....  | ....  |
| Yes                   | -0.425         | 0.536    | 0.428   | 0.654           | 0.229 | 1.869 |
| Constant              | -4.278         | 1.068    | 0.000   | 0.014           |       |       |

Model summary:

- Model Chi-Square 126.566 (0.001)
- -2Log Likelihood = 145.550
- Cox and Snell R Square = 0.469
- Nagelkerke R Square = 0.631

Note: Significant at p<0.05 and ‘RC’ = Reference Category and RTIs: Road Traffic Injuries, SE – standard error

educated to a higher level were familiar with traffic rules. Education can play a positive role in preventing RTIs. In this area, the majority of the respondents had jobs or businesses, and had good knowledge about traffic rules compared to laborers, farmers etc. Middle-income individuals were termed as middle class families. A number of victims were from middle class families. Among these respondents, victims experienced RTIs on the urban and rural roads. We found motorcycles to be the most vulnerable vehicle, a result is similar to those found in Thailand in 200936 and also in Nigeria30,37 and many other studies31,38, where the majority had no knowledge of traffic rules. In the case of victim’s positioning at RTIs, passersby were affected most39 along with passengers. A study in India showed similar findings31,34,38. In this study area, the majority of participants got proper treatment and had knowledge about traffic rules. RTIs had an adverse effect on families, mostly financial, as victims take treatment cost due to RTI as a burden to them. Respondents identified several reasons behind RTIs; unskilled drivers40, unfit vehicles, breaking traffic rules and faulty roads & management which shows similarities with the results from Iran41 and other developing countries15,42. Disabilities and deaths caused by RTIs can only be addressed with a change in attitude43. Most of the participants think traffic rules were not sufficient and the Government’s steps were not enough to reduce RTIs. The majority of respondents indicated about the role of NGO’s, similarly to Mohan & Roberts, that to reduce RTIs government and private partnership is needed44. Further intervention studies are needed to put more focus on reducing RTIs.

Conclusion

This study has tried to explain the general characteristics of RTIs and their associated factors with RTIs in the Khulna division, Bangladesh. With the growing population and urbanization, a safe, properly managed and systematic transportation system is very urgent for Bangladesh to fulfill both current and future demand. Based on the study results increased emphasis on education is advised as well as increasing public awareness about RTIs. NGOs could play a role here. Awareness of RTIs through different training and awareness related programs especially in less well educated rural areas. Strict legislation must be compiled and followed. The government should not give licenses to unskilled drivers and those with unfit vehicles. Road management systems must be well planned and systematic, and all damaged roads must be repaired in time. Government and private organizations both are needed to eradicate road traffic accidents.

Ethical statement

Ethical approval (Number 0089) was obtained from the department of Population Science and Human Resource Development, University of Rajshahi, Rajshahi-6205, Bangladesh.

Data availability

Dataset 1: Khula data set 10.5256/f1000research.15330.d212934

Competing interests

No competing interests were disclosed.

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The funders had no role in study design, data collection and analysis, decision to publish, or preparation of the manuscript.
Supplementary material

Supplementary File 1 – Study questionnaire (English).
Click here to access the data.

Supplementary File 2 – Study questionnaire (Bengali).
Click here to access the data.

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Thanks authors, for an interesting submission article entitled “Determinants of road traffic injury at Khulna division in Bangladesh: a cross sectional study of road traffic incidents”. The manuscript addresses the issue of Road Traffic Injuries (RTIs) in Bangladesh. Therefore, identifying the role of various socio-demographic and economic factors regarding the knowledge and consciousness about RTIs is effective in reducing this hazard type. There are a few points that seem to be of interest to the authors of this manuscript. Overall, this submission can be approved with reservations. Please see the following comments:

- The title of the article needs to be modified to: “Determinants of road traffic injuries at Khulna division in Bangladesh: a cross sectional study”.
- In terms of writing, it requires some editing. For example, please be correct RTI’s, and NGO’s. Capitalize each word in Gross Domestic Product (GDP) and the Cross Validity Prediction Power (CVPP). In the abstract, please rewrite the conclusion. In table 2, please correct d.f., rti.
- In the discussion, “A study in India showed similar findings …”, the sentence refers to three references that needs to be edited in here.
- It is recommended that the authors use the 2018 report of WHO: Global status report on road safety.
- Please revise this sentence: "According to the Bangladesh Road Transport Authority, the number of death stood at 2376 and injuries at 1958 as of 2015 in Bangladesh."
- Please review this sentence: "According to Nantulya et al. buses, trucks, pedestrians and passengers have the highest burden of morbidity and mortality in RTIs". Usually, in the introduction of the article, this kind of writing is not customary. There is no need to rely on the author name.
- What exactly was the reason for doing a study in Khulna city? Provide statistics regarding RTIs, from this city, if available.
- If possible, describe, in the study method, what is the reason for choosing these variables?
- Why haven't face to face interviews with other stakeholders, such as the medical staff, been
conducted to get their experiences about the determinants of traffic injuries?

○ How is the sampling size selected? How did you find this number (n=200) in this study?

○ This study did not mention potential confounders. Potential bias sources in the study, are not included. Please explain how missing data was addressed.

○ Please indicate the number of participants with missing data for each variable of interest.

○ In the results, please report other analyses that were done, if applicable. For example, note analyses of subgroups and interactions, as well as sensitivity analyses.

○ In Table 1, why is a colon ("\:" ) used after gender, age, etc.?

○ In the discussion, please summarize the main results regarding the reference to study objectives.

○ In the discussion, please discuss the generalizability (external validity) of the study results.

○ In the discussion section, please summarize the main findings, with a focus on the study objectives.

○ Please give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence.

Is the work clearly and accurately presented and does it cite the current literature?
Yes

Is the study design appropriate and is the work technically sound?
Yes

Are sufficient details of methods and analysis provided to allow replication by others?
Yes

If applicable, is the statistical analysis and its interpretation appropriate?
I cannot comment. A qualified statistician is required.

Are all the source data underlying the results available to ensure full reproducibility?
No

Are the conclusions drawn adequately supported by the results?
Partly

**Competing Interests:** No competing interests were disclosed.

I confirm that I have read this submission and believe that I have an appropriate level of expertise to confirm that it is of an acceptable scientific standard, however I have significant reservations, as outlined above.

Reviewer Report 15 August 2018

https://doi.org/10.5256/f1000research.16703.r37038
English needs to be improved a lot. The major challenge is in the method section. Specially why Khulna was chosen for the study settings was not justified. The sample size, how was calculated is not described (this is one of the big issue). Logistic regression model variables should come from the binary analysis, this is not the case here.

Is the work clearly and accurately presented and does it cite the current literature?
Partly

Is the study design appropriate and is the work technically sound?
No

Are sufficient details of methods and analysis provided to allow replication by others?
No

If applicable, is the statistical analysis and its interpretation appropriate?
Partly

Are all the source data underlying the results available to ensure full reproducibility?
Yes

Are the conclusions drawn adequately supported by the results?
Partly

Competing Interests: No competing interests were disclosed.

I confirm that I have read this submission and believe that I have an appropriate level of expertise to confirm that it is of an acceptable scientific standard, however I have significant reservations, as outlined above.
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