

# The Age- And Sex- Specific Burden of Transport Injuries in India Over a Decade From 2010-2019: A Systematic Analysis from Global Burden of Diseases 2019

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## ABSTRACT

**Background:** In India, transport injuries persist as leading preventable causes of mortality and morbidity for a large number of people, including children, young adults and elderly people. The objective is to estimate the transport injury-related mortality and morbidity in India over the past decade from 2010-2019.

**Methodology:** By using the Global Burden of Diseases, Injuries, and Risk Factors 2019 Study (GBD), we analysed mortality, Disability-Adjusted Life-Years (DALYs), Years Lived in Disability (YLDs), Years of Life Lost (YLL), prevalence rate (per 100K) attributed to transport injuries for all ages, in India. Burden is reported in absolute numbers and percentage changes over a decade period from 2010 to 2019; stratified by sex ratio, and age groups, with 95% confidence intervals (CIs).

**Results:** Transport injuries had accounted for 235,444 deaths (2.51%) in 2019; and 231,177 deaths (2.68%) in 2010. Transport injuries are the leading cause of death among people aged 15-49 years with more than 50% of burden in India. Death-rate due to transport had declined from 18.77 to 16.93 per 100,000 populations over a decade (2010-2019).

**Conclusions:** Over a decade, progress made in the burden of transport injuries was limited and the burden had started to rise after achieving some success till 2016. India needs to sustain and improve the progress made in order to achieve UN goals for 2030.

**Key words:** Transport injuries, Prevalence, Mortality, Morbidity, DALY's

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## INTRODUCTION

At least one out of 10 people killed on roads across the world is from India, according to the World Health Organization. The cost of road accidents is borne not only by the victims and their family, but by the economy as a whole in terms of untimely deaths, injuries, disabilities and loss of potential income. It is indeed a matter of great concern that despite the continuing efforts of the Government in this regard and our commitments for halving fatalities we have not been able to register significant progress on this front. India, ranks at the top with highest number of fatalities with about 11% share in the world.<sup>1</sup>

Deaths and injuries resulting from transport injuries (i.e., road injuries and other transport injuries) remains a serious problem globally, as well as in developing country like India. Transport injuries are a significant yet neglected cause of morbidity and mortality with millions of injury-related deaths that occur each year reflecting a large disparity in terms of gender, race, and socioeconomic status.<sup>2,3</sup> In 1990, transport injuries in general were ranked as the 12<sup>th</sup> contributor to global disease burden in terms of disability adjusted life years (DALY) for all ages, rising to 7<sup>th</sup> rank in 2010 and is likely to reach 5<sup>th</sup> by the year 2030.<sup>4,5</sup> Transport injury is now the leading cause of death among children and young adults, signaling a need for a shift in the current health agenda, which has largely neglected transport safety. It is the currently eighth leading cause of death for all age groups surpassing HIV/AIDS, tuberculosis and diarrheal diseases.<sup>6</sup>

Transport injuries had cause substantial disability worldwide, including in developing country like India. In 2016, 2.9% (equivalent to 221,335 deaths) of all-cause of death; and approximately 28% of total DALYs lost due to injuries are attributed to transport injuries alone in India.<sup>7</sup> In 2020, India had reported 336,248 persons injured and 146,354 deaths due to transport injuries. A rising trend was seen in absolute number of deaths in transport injuries since 2016 to 2019.<sup>8</sup> Age group of 30- 59 years is the most vulnerable population group, though males face higher level of fatalities and injuries than their female counterparts. Without increased efforts and new initiatives, the total number of transport injuries and deaths in India will likely to cross the mark of 250,000 by the year 2025.<sup>9</sup>

Transport injuries are preventable, and investment in the prevention of injury-related harms for all age groups will not only enhance health and wellbeing, improve socioeconomic growth and development, and but also contribute towards the attainment of the UN Sustainable Development Goals (SDGs) by 2030, and halve the number of global deaths and injuries from road traffic accidents.<sup>10</sup> The aim of this study was to describe the latest estimated burden of transport injury-related mortality and morbidity in India for all age groups, in both sexes and to report

the trends over the last decade between 2010 and 2019 by using the Global Burden of Diseases, Injuries and Risk Factors (GBD) Study 2019.<sup>11</sup>

To our knowledge; there is minimal information available<sup>1</sup> on burden of transport injuries in India and it is the first kind of its study being done to estimate the burden of transport injuries in terms of absolute numbers, DALYs, YLL, YLDs and Prevalence, rate along with the decade trend from 2010 to 2019 in India. While other publications have estimated burden of injuries due to transport, but those injuries have not previously been comparable to over a decade period. On a national level, the estimates generated by our study provide an important detail information to policy makers on the burden of transport injuries and a road map to attain the UN goal for 2030 in India.

## METHODOLOGY

**Study design, Participants, and Data sources:** The present study is a comprehensive assessment of burden of transport injuries in India providing time trends for a decade period 2010-2019. It is a part of GBD 2019 data that estimated the incidence, prevalence, mortality, years of life lost (YLLs), years lived with disability (YLDs), and DALYs (Disability Adjusted Life Years) that were caused by 369 diseases and injuries across 204 countries and territories.<sup>11</sup> Each of these diseases and injuries were arranged in a 4-level mutually exclusive and collectively exhaustive cause hierarchy; most were analyzed as causing both death and disability. The first level (level 1) of the cause list has 3 categories: communicable, maternal, neonatal, and nutritional conditions (CMNN); NCDs; and injuries. At level 2, there are 22 cause groups, and level 3 includes more disaggregated causes of burden (169 causes), as does level 4 (293 causes).<sup>12</sup> This study includes all age groups of people from birth till 70+ years old stratified by age and sex.

The full Global Burden of Disease cause list, including corresponding International Classification of Diseases (ICD), Ninth Revision (ICD-9) and Tenth Revision (ICD10) codes, is detailed in appendices to the GBD 2017 summary publication.<sup>13</sup> Case definitions for injury, including the International Classification of Diseases (ICD) external cause codes used to identify injury, are mentioned in the attached appendix (page 1-4). The GBD 2019 complies with the Guidelines for Accurate and Transparent Health Estimates Reporting (GATHER) statement.<sup>14</sup>

The input data have been extracted from a wide range of sources, including censuses and household surveys, civil registration and vital statistics, disease registries, data for health-service use, air-pollution monitors, satellite imaging, and disease notifications. Cause-specific death rates and cause fractions were calculated using the Cause of Death Ensemble model and spatiotemporal Gaussian process regression.

Cause-specific deaths were adjusted to match the total all-cause deaths calculated as part of the GBD population, fertility, and mortality estimates. Deaths were multiplied by standard life expectancy at each age to calculate YLLs. A Bayesian meta-regression modeling tool, DisMod-MR 2.1, was used to ensure consistency between incidence, prevalence, remission, excess mortality, and cause-specific mortality for most causes. Prevalence estimates were multiplied by disability weights for mutually exclusive sequelae of diseases and injuries to calculate YLDs. For changes over time, we present annualized rates of change as the difference in the natural log of the values at the start and end of the time interval divided by the number of years in the interval. Uncertainty Intervals (UIs) were generated for every metric using the 25th and 975th ordered 1000 draw values of the posterior distribution. The detail methods for the GBD study, including the burden of injuries, have been published previously.<sup>15</sup>

**Data inclusions and exclusions for injury:** Outcome measures include absolute numbers, rate of death (per 100K), DALYs, YLDs, YLL, prevalence rate along with the percent changes in all ages (0-70+years) among both male and female population over a decade period (2010-2019). From the GBD Study hierarchy of injury cause codes, we downloaded the transport injuries group (C.1), which is further delineated into road injuries or other transport injuries. Injuries caused by unintentional injuries such as falls, drowning; others like self-harm, interpersonal violence, conflict, terrorism, execution, and police conflict were excluded from the present study.

**Study Variables:** Our analysis was stratified by age groups (0-14, 15-49, 50-69 and 70+ years) and sex ratio (Male: Female) for mortality, prevalence, DALY's, YLL's and YLD's.

**Data analysis:** All the data for this study can be downloaded from <https://vizhub.healthdata.org/gbd-compare/> and were analyzed by using Microsoft excel and SPSS version 21. Absolute numbers and death rates per 100,000 population, DALYs YLDs, YLL, and prevalence rate (per 100K) were downloaded by sex, and age group, along with 95% confidence intervals (CIs). Trends over time comprised of the percentage changes in absolute numbers and deaths rates between 2010 and 2019. Additionally, we reported the rate of change for estimated burden due to transport injuries across the predefined time period of 2010-2019. Endnote X9 software (9.1 version) was used for reference citations.

## RESULTS

The present study tried to analyze and estimate the burden of transport injuries over a decade period from 2010 to 2019 in India, by using GBD 2019 study data. The results are as follows:

**Age-and Sex-specific burden:** The present study

found that in India, transport injuries had accounted for 235,444 annual deaths (2.51% of all causes of death) in 2019; and 231,177 annual deaths (2.68% of all causes of death) in 2010, for all ages among both sexes. Highest burden of transport injuries was among working age group people (15-49 years) with more than 50% deaths, followed by 50-69 years with more than 20% of deaths. In India, transport injuries had accounted for 183,400 deaths (77.89%) in males and 52,022 deaths (22.11%) among females in 2019. Similarly in 2010, 186,784 deaths (80.79%) were reported in males, while in females it was 44,393 deaths (19.21%). Over a period of 10 years (2010-2019), it was noticed that males were have higher fatalities and injuries than female counterparts. (Figure 1)

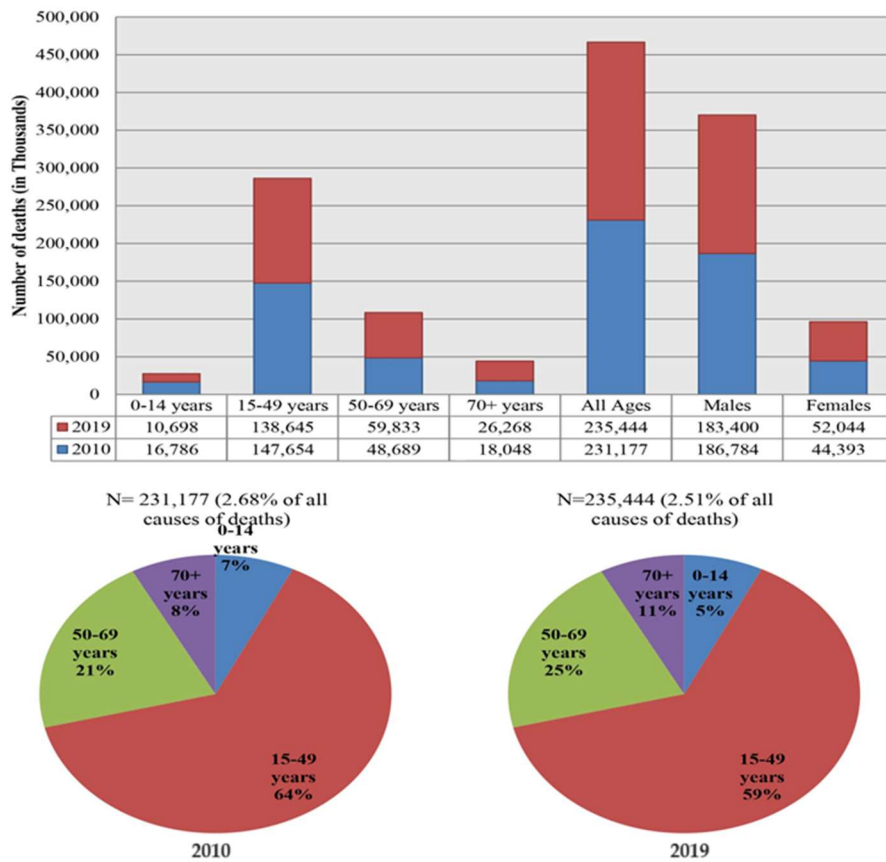
The death rate for all ages among both sexes had declined, from 18.77 deaths in 2010 to 16.93 deaths per 100K populations in 2019. The total number of deaths due to transport injuries had gradually decreased till 2016 followed by an increase to 0.235 million deaths in 2019. During a period of 2010-2019, the absolute number of deaths (in millions) and the death rate (per 100K populations) due to transport injuries had increased in the year of 2012 followed by a decline as shown in the below figure 2. During this period there was an improvement in the death rates and total number of fatalities due to road injuries and other transport injuries; however, it was not consistent. The absolute numbers of deaths and death rate are again started to increase in 2018-2019.

In India during 2019, there were more than 16.86 million (95% CI: 13.60, 19.73) of DALYs lost due to transport injuries, which was the highest global burden. Major contributions were noticed in 15-49 years with 10.78 million (95% CI: 8.53, 12.53) of DALYs lost. Similarly, in 2010, there were more than 17.54 million (95% CI: 14.29, 19.83) of DALYs lost in India due to transport injuries. However, over a period of decade from 2010 to 2019; there was a decrease of approximately 0.7 million of DALYs lost. Overall in India during 2019, the total burden was substantially higher among males than in females (male: female [M:F] ratio 3.09) in India 2019, with the highest contributions in the age group of 15-49 years where males had four times the burden as in females (male: female [M:F] ratio 4.36). Similarly in 2010, DALYs lost in males was three times more than in females (male: female [M:F] ratio 3.38). During last decade period of 2010-2019, it was important to note that there was an improvement in the burden of transport injuries as measured by DALYs among males in all age groups, but still, it remains considerably high as shown in the below Table 1.

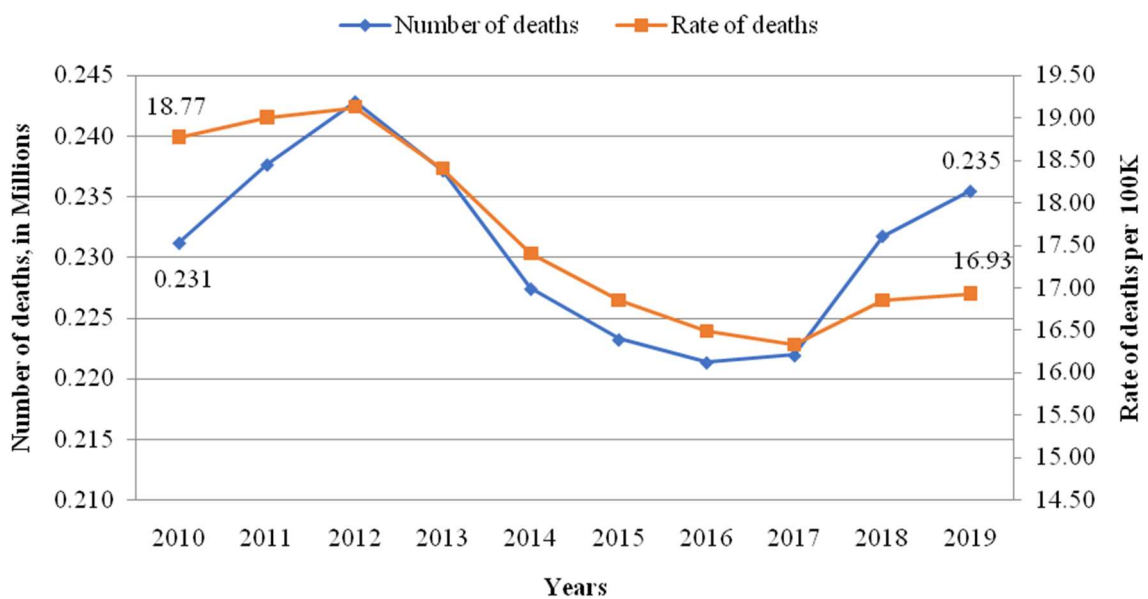
In 2019, the total number of YLDs (Years Lived in Disability) due to transport injuries in India were 5.97 million (95% CI: 4.38, 7.90) for all ages, while it was almost similar in 2010 with 5.93 million (95% CI: 4.33, 7.78) of YLDs. More than 50% of contributions to this burden of YLDs came from an age group

of 15-49 years in both 2010 and 2019. Highest percentage change over a decade period (2010-2019) was noticed in 0-14 years with - 0.41% (95% CI: - 0.43, -0.38). Years lived in Disability among males was two times higher than in females (male: female

[M:F] ratio 2.15; in 2010) and (male: female [M:F] ratio 2.07; in 2019). Males in the age group of 15-49 years had reported the highest burden of YLDs than any other age groups in 2010-2019 period as shown in the table 2.



**Figure 1: Total number of deaths and death percent due to transport injuries, in different age groups, among both sexes, India: 2010-2019**



**Figure 2: Number and rate of deaths per 100,000 population due to transport injuries, both sexes, in India: 2010-2019**

**Table 1: Total number and percent change of DALY's (Disability Adjusted Life Years, in millions); both sexes India: 2010-2019**

Age in years	2010		2019		% change in DALY's (95% CI: LL, UL <sup>†</sup> )
	DALY's in Millions (95% CI: LL, UL <sup>†</sup> )	M:F ratio*	DALY's in Millions (95% CI: LL, UL <sup>†</sup> )	M:F ratio*	
0-14 years	1.52 M (1.80, 1.22)	1.60	0.96 M (0.77, 1.19)	1.57	-0.37 (-0.47, -0.24)
15-49 years	11.97 M (9.45, 13.46)	4.57	10.78 M (8.53, 12.53)	4.36	-0.10 (-0.19, 0.01)
50-69 years	3.28 M (2.66, 3.90)	2.35	4.02 M (3.23, 4.87)	2.05	0.22 (0.13, 0.34)
70+ years	0.77 M (0.63, 0.93)	1.69	1.10 M (0.88, 1.35)	1.68	0.43 (0.36, 0.51)
All ages	17.54 M (14.29, 19.83)	3.38	16.86 M (13.60, 19.73)	3.09	-0.04 (-0.13, 0.06)

\*M:F: Male: Female; †CI=confidence interval (Lower limit, Upper Limit)

**Table 2: Total number and percent change of YLD's (Years lived in Disability, in millions); both sexes India: 2010-2019**

Age in years	2010		2019		% change in YLD's (95% CI: LL, UL <sup>†</sup> )
	YLD's in Millions (95% CI: LL, UL <sup>†</sup> )	M:F ratio*	YLD's in Millions (95% CI: LL, UL <sup>†</sup> )	M:F ratio*	
0-14 years	0.15 M (0.10, 0.20)	1.76	0.09 M (0.06, 0.12)	1.71	-0.41 (-0.43, -0.38)
15-49 years	3.51 M (2.51, 4.63)	2.46	2.99 M (2.16, 3.97)	2.48	-0.15 (-0.17, -0.13)
50-69 years	1.79 M (1.30, 2.36)	1.87	2.17 M (1.58, 2.90)	1.79	0.21 (0.19, 0.23)
70+ years	0.49 M (0.36, 0.64)	1.55	0.71 M (0.52, 0.94)	1.61	0.45 (0.44, 0.47)
All ages	5.93 M (4.33, 7.78)	2.15	5.97 M (4.38, 7.90)	2.07	0.01 (-0.02, 0.03)

\*M:F: Male: Female; †CI=confidence interval (Lower limit, Upper Limit)

**Table 3: Total number and percent change of YLL (Years of Life Lost, in millions); both sexes India: 2010-2019**

Age in years	2010		2019		% change in YLL (95% CI: LL, UL <sup>†</sup> )
	Total YLL in Millions (95% CI: LL, UL <sup>†</sup> )	M:F ratio*	Total YLL in Millions (95% CI: LL, UL <sup>†</sup> )	M:F ratio*	
0-14 years	1.37 M (1.07, 1.65)	1.59	0.87 M (0.69, 1.10)	1.53	-0.37 (-0.47, -0.22)
15-49 years	8.46 M (6.16, 9.35)	6.42	7.79 M (5.75, 9.26)	5.75	-0.08 (-0.22, 0.08)
50-69 years	1.49 M (1.09, 1.66)	3.15	1.84 M (1.36, 2.24)	2.41	0.24 (0.03, 0.49)
70+ years	0.28 M (0.22, 0.31)	2.04	0.39 M (0.31, 0.46)	1.87	0.38 (0.20, 0.59)
All ages	11.61 M (8.63, 12.75)	4.47	10.89 M (8.22, 12.85)	4.01	-0.06 (-0.19, 0.10)

\*M:F: Male: Female; †CI=confidence interval (Lower limit, Upper Limit)

**Table 4: Total prevalence, rate (per 100,000 populations) and percent change; both sexes India: 2010-2019**

Age in years	2010		2019		% change in Prevalence rate (95% CI: LL, UL <sup>†</sup> )
	Prevalence rate (95% CI: LL, UL <sup>†</sup> )	M:F ratio*	Prevalence rate (95% CI: LL, UL <sup>†</sup> )	M:F ratio*	
0-14 years	521 (441; 605)	1.65	341 (285; 400)	1.64	-0.35 (-0.38, -0.31)
15-49 years	7,648 (6,934; 8,368)	2.35	5770 (5241; 6353)	2.35	-0.25 (-0.26, -0.23)
50-69 years	19,482 (17,901; 21,277)	1.96	17875 (16371; 19639)	1.90	-0.08 (-0.10, -0.07)
70+ years	24,620 (22,837; 26,563)	1.90	24674 (22870; 26740)	1.89	0.0 (-0.01, 0.02)
All ages	7,370 (6,796; 7,983)	2.08	6797 (6321; 7377)	1.99	-0.08 (-0.10, -0.06)

\*M:F: Male: Female; †CI=confidence interval (Lower limit, Upper Limit)

Table 3 shows that, YLLs (Years of Life Lost) in India, due to transport injuries were more than 10 million during 2010-2019 period for all ages. Similarly, like other burden measures, substantial contribution of more than 50% came from 15-49 years of age group in 2010 and 2019. During 2010-2019 period, improvement in transport injuries was recorded in an age group of 0-14 years from 1.37 million (95% CI: 1.07, 1.65) of YLLs in 2010 to 0.87 million (95% CI: 0.69, 1.10) of YLLs in 2019 {-0.37% (95% CI: -0.47%, -0.22%)}. YLLs were four times higher in males when compared with female counterparts (male: female

[M:F] ratio 4.47; in 2010) and (male: female [M:F] ratio 4.01; in 2019). It is also worth to mention that the highest burden of transport injuries as measured by YLL among males came from 15-49 years of age group, where the burden was five times higher in 2019 and six times higher in 2010 than females.

In India, the prevalence rate of transport injuries per 100,000 populations had remained same in all age groups over a period of decade (2010-2019). Highest prevalence rate was noticed in age group of 70+ years with 24,674 (95% CI: 22,870; 26,740) in 2019 and 24,620 (95% CI: 22,837; 26,563) per 100,000



populations in 2010. The prevalence rate among males had decreased slightly over a period of decade (male: female [M:F] ratio 2.08; in 2010 to 1.99; in 2019). But the prevalence rate tends to remain high in 15-49 years, where the males are still having more than double burden of transport injuries than in females (male: female [M:F] ratio 2.35; in 2019) as shown in Table 4.

## DISCUSSION

This study estimated the burden and tracked trends in transport injury morbidity and mortality in both sexes for all ages from birth to 70+ years, between 2010 and 2019 in India. Our findings suggest that in India, transport injuries continue to be substantial cause of harm that have remained largely unchanged as a proportion of all-cause deaths with only minimum deviations. Although transport injuries death rates are declining over the past decade due to various efforts by the Indian government like education measures such as publicity and awareness campaigns to the public and engineering measures such as identification and rectification of accident black-spots were taken<sup>16</sup>, this result conceals variability and inequities by injury mechanism, time, place, and mode of transport. There was a slight increase in the absolute number of deaths due to transport injuries in females over a decade period, where-as in young adult males it had decreased minimally between 2010 and 2019. It might be due to an increase in the number of young adult female working force taking on roads and other transports for labor market. Graduated driver licensing schemes, enforcement of minimum drinking-age laws, lower blood alcohol content levels for drivers, wearing motorbike helmets, laws about seat-belt and helmet use, and reducing speed limits near to schools, residential areas, and play areas are interventions that have been effective in reducing injury-related harms.<sup>17</sup> Interventions applicable to all age groups, such as the enforcement of speed-limits and drink-driving bans, have been found to be very effective in reducing road traffic deaths,<sup>18</sup> and it should also be prioritized.

Burden of transport injuries as measured by DALYs, YLDs, YLL, and prevalence rate had mainly remained unchanged over 10 years of period (2010-2019) in India, with minimal variations. Most of the burden of transport injuries was reported in 15-49 years, as it was the most economically productive and active age group and also the most vulnerable population group to all injuries in India.<sup>9</sup> Our study had proved that the transport injuries had accounted for the greatest proportion of number of deaths, DALYs, YLDs, and YLL in 15-49 years of age group. Rise in population growth is a contributor,<sup>19</sup> but other factors also affect injury risk and outcomes in the developing countries like India, including lack of good transport facilities, no time-frame for movement of big vehicles and low capacity for the tertiary care facilities for transport

injuries. The rise in the number of injuries is becoming increasingly visible as mortality and morbidity from other causes (e.g., maternal and infectious diseases) declines.<sup>20</sup>

In this study, it was also found that males had comparatively more burden of transport injuries than females as measured by absolute number of deaths, DALYs, YLDs, YLL, and prevalence rate in all age groups, between 2010 and 2019 in India. Preventing injury in early ages through the adoption of effective interventions that improve safety behaviors will have an effect that extends into adulthood and aged life, because road injuries are also the leading cause of DALYs among adults aged 25-49 years.<sup>11</sup> Increasing urbanization has led to an increase in the number of vehicles on unsafe roads without adequate protection for vulnerable road users such as children, adolescents and elderly people.<sup>6</sup> Road traffic crashes may be an everyday occurrence but they are both predictable and preventable, as illustrated by the large body of evidence on key risk factors and effective road safety measures that work in practice.<sup>21</sup> Establishing good public transport and active-transport infrastructure that prioritizes safe travel is also crucial, and provides additional benefits for both young adults (eg, physical activity) and other wider community groups of people.<sup>22</sup>

Our study is subjected to the limitations of the GBD study methods, such as scarcity and reporting of data in developing country like India.<sup>10,13</sup> Also, there are further challenges associated with the estimation of injuries within the GBD Study framework that have been reported previously.<sup>12</sup> In brief, these include data restrictions around quantifying non-fatal injury and full disability associated with several injuries, misclassification of injuries in regard to intent, and a lack of data on the nature of injury measurement.<sup>12,23</sup>

## CONCLUSION

By presenting transport injuries in this study, we tried to highlight the persistent burden of such injuries in the all-age groups including children, adolescent and elderly. The responsibility for the prevention of transport-related injuries should likely to extend across different government agencies and sectors; therefore, in India it should map responsibility to relevant ministries and authorities in order to minimize this burden of transport injuries in current decade and achieve the UN goal by 2030.

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