

Mortality and health-related quality of life following injuries and associated factors: A cohort study in Chandigarh, North India

Jagnoor Jagnoor^{1*}, Shankar Prinja², Ha Nguyen^{1,3}, Belinda Gabbe⁴, Margie Peden¹, Rebecca Ivers^{1,5}

¹ Injury Division, The George Institute for Global Health, India and UNSW Sydney, Australia

² Postgraduate Institute of Medical Education and Research, Chandigarh, India

³ John Walsh Centre for Rehabilitation Research, the University of Sydney, Australia

⁴ Epidemiology & Preventative Medicine, Medical School, Monash University, Australia

⁵ School of Public Health and Community Medicine, UNSW, Sydney, Australia

***Corresponding Author**

Dr Jagnoor Jagnoor

The George Institute for Global Health

Injury Division

311-312, Third Floor, Elegance Tower

Plot No. 8, Jasola District Centre

New Delhi 110025, India

Email: jjagnoor1@georgeinstitute.org.in

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Key Messages

What is already known on this subject?

- In the next 25 years injuries are predicted to become one of the leading causes of death and disability in India.
- There is limited information about the impact of non-fatal injuries in India, particularly on long-term functioning and health-related quality of life.

What this study adds?

- This is one of the first cohort studies reporting on the burden of fatal and non-fatal injuries in India with a large sample size.
- It is one of the first studies to highlight the post –discharge mortality rate for trauma.

Abstract

Introduction

Injuries are among the ten leading causes of deaths worldwide. In recent years, the quality and reporting of injury mortality has improved but little or no data is available on the morbidity burden and impact of non-fatal injuries in India. This study evaluates health recovery status post-injury, identifying predictors of recovery in North India.

Methods

Prospective cohort study recruiting patients from one tertiary and two secondary-level hospitals in North India between April-June 2014 hospitalised due to any injury. Health-related quality of life was assessed at baseline and at 1-, 2-, 4- and 12-months post-injury using the EuroQol five-dimensional (EQ-5D-5L) questionnaire. Multivariable linear regressions with generalized estimating equations were used to examine the relationship between socio-demographic and injury-related factors with the EQ-5D-5L single utility score and the visual analogue scale (VAS) score.

Results

A total of 2416 eligible patients aged ≥ 18 years were enrolled in the study. Of these, 2150 (74%) completed baseline and all four follow-up EQ-5D-5L questionnaires. Almost 7% ($n=172$) patients died by the first follow-up and the overall mortality at 12-months was 9% ($n=176$). Both EQ-5D-5L utility and VAS scores dropped significantly at 1-month post-injury but gradually improved at 2-, 4- and 12-months. Severe injuries, defined as those requiring hospital stay of ≥ 7 days were associated with lower utility scores at 1-, 2- and 4-months follow-up ($p<0.001$).

Conclusion

This is the first study to examine health outcomes following injuries in India. The findings highlight the need to understand the social, psychological and biological factors influencing recovery outcomes. High mortality following discharge emphasises the need to invest in secondary and tertiary injury prevention in India.

Introduction

Injuries can have long-term adverse effects on patients' overall health and quality of life ¹.

Inadequate data exists on injury morbidity and recovery outcome from low- and middle-income countries (LMICs). Data sources in LMICs are often low quality, not representative, difficult to access, or contain a limited number of relevant variables². Recent estimates from the 2015 Global Burden of Disease study report 4.73 million injury deaths, globally³.

India is the second most populous country in the world, with a population of over 1.2 billion people ⁴. Economic development in India has brought with it a rapid increase in motorisation contributing to the road injury burden, followed by falls with increasing life expectancy and changing population demographics ⁵. Among intentional injuries, suicides were the leading cause of deaths in India in 2016 among people aged 15-39 years. ^{6 7}. A recent analysis of data from the Global Burden of Disease showed that between 1990 and 2016 there was significant increase in incidence of the leading causes of injuries in India. Deaths from road injuries and falls increased by over 80% in this time period and both are now among the top ten leading causes of deaths in India. Further, in 2016 road injuries were among the top ten leading causes of DALYs increasing by 65% since 1990 ⁸.

Road traffic injuries and falls are the leading causes of traumatic brain injury in India and it is estimated that 1.6 million people will sustain traumatic brain injury (TBI) every year and over 1 million will require some form of rehabilitation services ⁹. Similarly, occupational injuries often leading to amputations or limb fracture, experience significant problems such as pain/discomfort, functional limitations and anxiety/depression, long after the injury, affecting quality of life adversely¹⁰. A review by Gururaj in 2002 that reported on outcomes of patients with TBI admitted in hospitals in one Indian state showed poor short-term recovery outcomes after injury with only 23% reporting good recovery after four months follow-up ⁹. However, there is limited information about the long-term impact of non-fatal injuries in India, particularly related to functioning and health-related quality of life. Understanding the factors that influence health status following an injury can identify patients that require further intervention(s), follow-up, or those that might be at high risk of poor recovery outcome.

This study aimed to measure the change in health-related quality of life following hospitalisation due to injuries and to investigate the contribution of socio-demographic factors and circumstances of injury on health-related quality of life.

Methods

Study design and setting

This was a prospective cohort study. The study protocol was published in 2015 ¹¹ focusing on road injuries. This has now been extended to include all injuries. A paper reporting the health-related quality of life for paediatric participants was also published in 2017 ¹². In this article we focus on outcomes for participants aged 18 years or more who were followed-up at 1-, 2-, 4- and 12-months post-injury.

The study sites included three public healthcare facilities in North India: The Advanced Trauma Centre of the Postgraduate Institute of Medical Education and Research (PGIMER) – a tertiary care hospital in Chandigarh – and two secondary care public sector hospitals, viz. the Government Multi-Speciality Hospital (GMSH) in Chandigarh and a district-level hospital in Panchkula, Haryana. PGIMER is a large 1850-bed super specialty hospital. The Advanced Trauma Centre (ATC) at PGIMER is a specialized and fully equipped centre catering specifically to the needs of trauma victims. In addition to the injury patients who come to ATC directly, this hospital also serves as a referral centre for hospitals in surrounding cities and neighbouring states including Punjab, Haryana, Himachal Pradesh, and Uttar Pradesh. GMSH on the other hand is a 500-bed secondary care hospital providing care to the residents of Chandigarh and the surrounding states. The District level hospital is a 300-bed secondary care hospital located in Panchkula, Haryana. Here, trauma patients are treated alongside other emergency patients in the emergency centre at the hospital. Patients with severe trauma presenting to this hospital are often referred to other tertiary-level hospitals in the region.

Study participants and eligibility criteria

Participants were recruited between April and July 2014 from the three health care facilities in North India. The sample size calculations for 1500 were calculated for 90% power, to detect independent effects of about 5% of the size, based on the planned variables in multiple linear regression analysis. Based on the time period the data collection continued till the end of the study period.

The inclusion criteria was any patient requiring overnight admission to one of the participating hospitals due to any injury as defined by the International Classification of Disease, Chapter XX (ICD-10) ¹³, i.e. road traffic injuries, falls, burns, mechanical injuries, animal bites, poisoning and drowning. In total, 2789 participants were enrolled in the study. Of these, 2416 were aged 18 years or more and we report here the findings from this adult cohort.

Recruitment procedure and follow-up

Participants were recruited during their in-patient stay at the three study hospitals. Eligible participants were identified by trained research staff in the emergency departments who screened admission registers daily for newly admitted injured patients. The research staff explained the study and consent process to prospective participants and invited them to participate. All participants provided informed consent prior to participating. For those unable to give informed consent due to injury at the time of recruitment, consent was initially sought from a relative or carer, and later obtained from the patient when they were well enough to provide consent. At that time, they could also decide to continue or withdraw from the study. Ethical approval for the study was granted by the institutional ethics committee at the Postgraduate Institute for Medical Education and Research (Approval no: PGI/IEC/2014/2262) and administrative approvals were sought at each participating hospital.

Six research staff with nursing and physiotherapy backgrounds were provided training on study tools for three days. All baseline interviews were conducted in Hindi by the research staff and administered face-to-face at the hospital. Our research staff familiar with terminology and knowledgeable in both English and Hindi, did the forward translation. The investigators (SP, JJ) back translated it and made the essential revisions in discussion with interviewing staff, followed by 10 pre- testing interviews before the version as finalised. The focus was on cross-cultural and conceptual, rather than on linguistic/literal equivalence. Follow-up interviews were conducted by telephone with participants (or a proxy where appropriate, i.e. in cases of death) at standardised time points over the first 12 months (at 1-, 2-, 4- and 12-months). These time points were selected based on the recommendations of an injury outcomes study consensus paper ¹⁴. Participants who missed any of the follow-up interviews were still contacted at subsequent follow-up time points.

Measures

Baseline interview

Participants were administered a standardized interview at baseline during their hospital stay to collect data on socio-demographic characteristics such as sex, age, average monthly household income, employment status, education level and marital status. Information was also obtained about the intent and mechanism of injury. For road traffic injuries, additional information such as the mode of transport (pedestrian, non-motorised vehicle, motorcycle, car, truck, bus etc.), the type of road user (pedestrian, driver/operator, and passenger), helmet use (among motorcycle riders) and seat-belt use (among car occupants) was collected. Injury severity was measured using a proxy

variable, i.e. length of stay (LOS) in hospital and categorised as mild (LOS 0-1 day), moderate (LOS 2-7 days) or severe (LOS 8+ days) ¹⁵.

Quality of life, functioning and disability

The five-level version of the EuroQoL five dimensions questionnaire (EQ-5D-5L) was used to collect information about health-related quality of life (HQoL). HRQOL is a multi-dimensional concept commonly used to examine the impact of health status on quality of life. EQ-5D was first developed in 1990 and originally had three level responses – commonly known as EQ-5D-3L – for each of the five distinct dimensions: mobility, self-care, usual activities, pain/discomfort and anxiety/depression¹⁶.

The tool consists of two parts – a descriptive system and a visual analogue scale (VAS). The descriptive instrument assesses general health based on responses to each of the five dimensions. A new scoring algorithm for the five-level score was developed by Devlin et al. (2018) to provide a single summary index (utility) score, ranging from 1 for full health to 0 for death ¹⁷. The VAS on the other hand records overall self-rated health status using a vertical visual analogue scale where 100 corresponds to the “best imaginable health state” (100) and 0 to the “worst imaginable health state” ¹⁸. This quantitative measure of health outcome reflects the respondent’s own judgement. Data for EQ-5D-5L was assessed at baseline with a retrospective recall 4 weeks pre-injury and then again at 1-, 2-, 4- and 12-months post injury

Statistical analysis

Descriptive summary statistics, including counts, proportions, mean and median, were obtained for all socio-demographic and injury characteristics at baseline. Outcomes examined included mean scores for EQ-5D-5L utility and VAS at baseline, with retrospective recall 4 weeks pre-injury) and follow-up at 1-, 2-, 4- and 12-months and were reported for all participants and stratified by socio-demographic and injury characteristics. We also reported the proportions of participants with some problems in each of the five dimensions (i.e. levels 2 to 5) at all study time points.

Multivariable linear regression modelling was used to identify socio-demographic and injury characteristics associated with improved EQ-5D-5L utility scores during follow-up because EQ-5D-5L is a continuous outcome. The data included repeated measures on EQ-5D-5L clustered within study participants, therefore correlated data methods were used. The generalised estimating equations (GEE) models were selected because the model can estimate coefficients that have a population-average interpretation and it can also produce robust variance estimates (i.e. valid inference) when the working variance or covariance matrix is unspecified ¹⁹. GEE models with identity link, normal distribution and exchangeable correlation were fit to the outcomes adjusting for baseline score and

participants' socio-demographic and injury characteristics. Those included in the final multi-variable models were variables were hypothesised a priori to potentially affect EQ-5D-5L utility scores during follow-up and found to be statistically significantly associated with the outcome over time. P-value of 0.05 was considered statistically significance. All analyses were performed using STATA version 12 (Stata Corporation, College Station, TX, USA).

Results

Of the 2574 eligible participants identified, 2416 (6%) were aged 18 years or older and consented to the baseline interviews (Figure S1, Appendix). A total of 599 (25%) participants were lost to follow-up by the final 12-month interview. The number of participants with an EQ-5D-5L recorded at 1-, 2-, 4- and 12-months after the injury were 1797 (90% of those followed-up), 1753 (88%), 1714 (88%) and 1810 (100%), respectively.

Socio-demographic characteristics of the study participants are shown in Table 1. Most participants were male. Forty percent were aged between 19-30 years, while nearly one-third were between 31-45 years. Over two-thirds of participants had completed at least 12 years of education or higher. Over one-third of participants were salaried or wage employees, 20% were cultivator or wage labourers; and 10% were unemployed. In terms of household monthly income, almost one-quarter earned less than USD 100 per month and about 40% earned between USD 100-199. Over 90% of participants did not report having any co-morbidity and less than 20% had insurance.

Table 1 describes the injury characteristics of participants included in the study. The majority of injuries were unintentional injuries (n=2200; 91.1%). Road traffic injury (RTIs) was the most common mechanism of unintentional injury, accounting for 60.1% (n=1451), followed by falls (n= 475; 19.7%). Intentional injuries, in particular assaults, accounted for 8.5% (n=206) and less than 1% were from self-harm or were undetermined.

Among those that sustained a RTI, almost two-thirds (n= 929; 64.0%) were drivers of a vehicle and 28.3% (n=410) were passengers. At the time of their crash almost two-thirds were driving a motorized two-wheeler (motorcycle, moped, etc) while the remainder were occupants of a car, bus or truck or were bicyclists or pedestrians. Of those who were injured on a motorized two-wheeler, less than one-third (n=281/908; 31%) reported using a helmet; while only one-third (n=54/152; 36%) of those injured as occupants of 4-wheelers reported using a seat-belt. The mean LOS following an injury was 6.5 days while the median was 4 days (range: 1-80 days). About half of those admitted had injuries that were considered to be of moderate severity and a quarter were classified as severe (LOS of 8 days or more). Less than 2% (n=39) reported having surgery.

Table 1: Baseline socio-demographic characteristics of participants aged 18 years or older (N = 2416)

Socio-demographic characteristics	n	%	Injury characteristics	n	%
Gender			Intent of injury		
Males	1942	80.4	Unintentional	2200	91.1
Females	474	19.6	Intentional (self-harm)	8	0.3
Age			Intentional (Assault)	206	8.5
19-30	983	40.7	Undetermined	2	0.1
31-45	735	30.4	Mechanism of injury		
46-60	468	19.4	RTI	1451	60.1
>60	230	9.5	Falls	475	19.7
Education			Mechanical	158	6.5
Illiterate	547	22.6	Others^	332	13.7
Year 9 and below	707	29.3			
Year 10 and above	822	34.0			
Grad & post-grad	311	12.9			
Others	29	1.2			
Marital status			Mode of transportation (RTI only; N=1451)		
Married	1807	74.8	Motorized two-wheeler	908	62.6
Unmarried	577	23.9	Car	152	10.5
Others	32	1.3	Bus/truck	67	4.6
Employment			Other (pedestrian, bicycle, animal)	275	19.0
Salaried/wage employee	863	35.7	Unknown	49	3.4
Cultivator/wage labourer	481	19.9	Type of road (RTI only; N=1451)		
Unpaid family worker	451	18.7	Main road	1232	84.9
Employer/Own account worker	385	15.9	Others	202	13.9
Unemployed/others	236	9.8	Unknown	17	1.2
Household monthly income (USD)			Use of helmet (two-wheeler RTIs only; N=908)		
<100	572	23.7	Yes	281	30.9
100-199	1021	42.3	No	571	62.9
200-299	310	12.8	Unknown	56	6.2
300+	509	21.1	Use of seat-belt (car RTIs only; N=152)		
Unknown	4	0.2	Yes	54	35.5
Co-morbidity			No	72	47.4
No	2184	90.4	Unknown	26	17.1
Yes	216	8.9	Length of stay (LOS) in hospital (days)		
Unknown	16	0.7	Mean (Standard deviation)	6.52 (7.89)	
Insurance			Median (Range, IQR)	4 (1 – 80, 6)	
No	1982	82.0	Severity based on LOS		
Yes	430	17.8	Mild (1 day)	389	16.1
Unknown	4	0.2	Moderate (2-7 days)	1196	49.5
			Severe (8+ days)	607	25.1
			Unknown	224	9.3
			Surgery		
			Yes	39	1.6
			No	2377	98.4

^Others refers to burn, poisoning and other injuries

Table 2 reports the distribution by socio-demographic and injury characteristics of participants who were followed-up and lost to follow-up at 12 months. Of 2416 participants recruited at baseline, 1810 remained in the study by the 12-month follow-up. Generally, there were no statistically significant differences between participants followed-up and those lost to follow-up at 12-month follow-up in terms of gender (p-value = 0.787), marital status (p-value = 0.238), co-morbidity (p-value = 1.000) and insurance status (p-value = 0.117) distribution. On the other hand, statistically significant differences between participants and non-participants 12-month follow-up in distribution by age group (e.g. greater proportion of people aged 60 years and older in the followed-up group), education (e.g. greater proportion of illiterate people in the followed-up group), employment status (e.g. greater proportion of unpaid family worker and unemployed in the followed-up group), household monthly income (e.g. greater proportions of people in lower family income brackets in the followed-up group). The distribution of intent of injury and mechanism of injuries were also significantly different between followed-up and lost to follow-up participants.

Table 2. Distribution by socio-demographic and major injury characteristics of participants who were followed-up and lost to follow-up at 12 months

Socio-demographic characteristics	Followed-up at 12 months		Socio-demographic and Injury characteristics	Followed-up at 12 months	
	Yes (1810)	No (606)		Yes (1810)	No (606)
Gender	<i>p value = 0.787</i>		Household monthly income (USD)	<i>p value < 0.001</i>	
Males	80.8	80.3	<100	27.2	22.5
Females	19.2	19.8	100-199	45.5	41.3
Age	<i>p < 0.001</i>		200-299	12.5	13.0
19-30	36.2	42.2	300+	14.7	23.3
31-45	29.4	30.8	Co-morbidity	<i>p = 1.000</i>	
46-60	19.2	19.4	No	91.0	91.0
>60	15.1	7.6	Yes	9.0	9.0
Education	<i>p value < 0.001</i>		Insurance	<i>p = 0.117</i>	
Illiterate	30.8	19.9	No	80.1	82.9
Year 9 and below	29.8	29.1	Yes	19.9	17.1
Year 10 and above	30.6	35.2			
Grad & post-grad	8.1	14.5			
Others	0.8	1.3			
Marital status	<i>p value = 0.238</i>		Intent of injury	<i>p value = 0.001</i>	
Married	21.4	24.7	Unintentional	94.9	89.8
Unmarried	77.1	74.0	Intentional (self-harm)	0.5	0.3
Others	1.5	1.3	Intentional (Assault)	4.6	9.9
Employment	<i>p value = 0.039</i>		Undetermined	0.0	0.1
Salaried/wage employee	34.7	36.1	Mechanism of injury	<i>p value = 0.042</i>	
Cultivator/wage labourer	17.9	18.9	RTI	56.5	61.3
Unpaid family worker	23.2	18.8	Falls	23.6	18.4

Employer/Own account worker	13.2	16.9	Mechanical	6.1	6.7
Unemployed/others	11.0	9.4	Others^	13.8	13.7

^Others refers to burn, poisoning and other injuries

Figure S2 (Appendix) shows the mean EQ-5D-5L utility score and VAS for male and female participants at pre-injury, (baseline) and during the four follow-up periods up to 12-months post injury. Broadly, the patterns in utility and VAS scores were nearly identical in male and female participants. Most participants scored nearly full health at baseline. Utility and VAS scores were at the lowest levels (above 0.72 in terms of utility score and 80 in terms of VAS score) at 1-month after the injury. After that, the scores sharply increased between 1- and 2-months post-injury and gradually improved between 4- and 12-months post-injury.

The mean EQ-5D-5L utility scores according to injury characteristics over time for male and female participants are presented in Table 3. For all sub-groups of injury characteristics, similar to the general trend of utility score over time, male and female participants had nearly full health at baseline, the lowest utility score was at 1 month, and slightly lower than full health at 12 months after the injury. Across the different injury intents, male participants, who were intentionally self-harmed, had particularly low utility scores at 1 month (0.477), 2 months (0.552) and 4 months (0.734) after injury. Among those who sustained an unintentional injury, male participants had lower utilities scores than female participants throughout follow-up. In terms of mechanisms of injury, participants (both males and females) who sustained a fall injury appear to have lower utility scores than other injuries at 1-, 2- and 4-month follow-ups. Among participants that sustained RTIs, both male and female car occupants had lower utility scores at 1-, 2- and 4-month follow-up compared to other modes of transport. For both male and female participants, those in the more severe or longer hospital stay groups had lower utility scores at all follow-up points.

Table 3. EQ-5D-5L Utility scores over time by injury characteristics and context for males and females

Injury characteristics	Males					Females				
	BL (N=1936)	1m (N=1447)	2m (N=1416)	4m (N=1383)	12m (N=1453)	BL (N=473)	1m (N=350)	2m (N=337)	4m (N=331)	12m (N=357)
Intent of injury										
Unintentional	0.998	0.709	0.876	0.962	0.979	0.989	0.723	0.874	0.969	0.981
Intentional self-harm	1.000	0.477	0.552	0.734	1.000	1.000	0.880	0.890	1.000	1.000
Assault	0.999	0.836	0.927	0.984	0.996	0.978	0.852	0.943	0.952	0.989
Undetermined	1.000	1.000	1.000	1.000	1.000
Mechanism of injury										
RTI	0.999	0.721	0.884	0.966	0.980	0.994	0.768	0.893	0.971	0.974

Falls	0.993	0.678	0.848	0.950	0.973	0.974	0.587	0.810	0.954	0.995
Mechanical	1.000	0.674	0.874	0.965	0.989	1.000	0.913	0.951	0.992	1.000
Others	0.999	0.803	0.911	0.974	0.991	0.991	0.804	0.927	0.973	0.994
Mode of transportation (RTI only)										
Car/bus/truck	1.000	0.647	0.847	0.955	0.989	0.985	0.755	0.888	0.971	0.994
Two-wheeler	0.999	0.742	0.894	0.969	0.977	0.997	0.795	0.906	0.969	0.963
Others (pedestrian, bicycle, animal)	0.998	0.721	0.882	0.961	0.986	0.991	0.758	0.906	0.972	0.987
Unknown	1.000	0.673	0.861	0.967	0.961	0.995	0.553	0.737	0.991	0.996
Severity										
Mild (LOS 0-1 days)	0.999	0.862	0.952	0.983	0.995	0.998	0.862	0.957	0.982	0.987
Moderate (LOS 2-7 days)	0.997	0.746	0.894	0.973	0.987	0.986	0.759	0.890	0.978	0.979
Severe (LOS 8+ days)	0.999	0.597	0.813	0.935	0.959	0.984	0.584	0.791	0.934	0.982

Abbreviations: BL- baseline

Figure 1A shows the proportion of participants experiencing some problems (i.e. levels 2 to 5) by specific EQ-5D-5L dimensions at baseline and during follow-ups (only those with complete EQ-5D-5L at baseline and all follow-ups). In both males and females, the dimension with the largest proportions of participants with problems following injury was with “Usual activity” (58% and 57% at 1 month in males and females, respectively); and the dimension with the lowest proportions of participants with problems was “Anxiety/Depression” (20% and 17% at 1 month in males and females, respectively). Between 1- and 12-month follow-ups, decreases in the proportions of participants with problems were observed across all five dimensions. In both males and females, and across all health dimensions, there were statistically significant differences in the proportion of participants with problems (p – values < 0.001).

Figures 1B presents the proportion of participants experiencing some problems by EQ-5D-5L dimensions stratified by injury severity measured in terms of length of hospital stay. Similar to the trajectories observed by gender, “Usual activity” was the dimension with the largest proportions of participants with problems following injury regardless of injury severity. However, those with severe injuries or hospital stay of 8 days or more had the highest proportion of participants with some problem in “Usual activity” (75%), followed by those with moderate injuries or hospital stay between 2-7 days (54%). While there were statistically significant reductions in the proportion of participants with some problem across all five EQ-5D-5L dimensions in all injury severity groups (p – values < 0.001), even among those sustained only a minor injuries, there remained a small proportion (1.2-1.9%) participants having some problem in one or more health dimensions.

[Insert Figure 1]

Table 4 shows the results of the multivariable GEE models undertaken to identify socio-demographic and injury characteristics associated with improved EQ-5D-5L utility scores over time. The models presented only include age group and characteristics found to be statistically significant ($p < 0.05$) associated with increased utility score in the univariable analysis, including type of employment, insurance status, mechanism of injury, severity categories based on LOS. Characteristics that were not associated with EQ-5D-5L utility scores over time were participants' age group, education level, marital status, comorbidity status and injury intent. Among males, the characteristics that were associated with better improvement in EQ-5D-5L score were "being employed with salary/wage", "sustained an injury other than RTI, fall or mechanical injury", and mild injury (i.e. LOS of no more than 1 day) were. In females, those with mechanical injury and with mild injury were associated with larger increase in EQ-5D-5L scores over time.

Table 4. Changes in EQ-5D-5L utility scores during follow-up for male and female participants adjusted for participants' socio-economic and injury characteristics

Socio-demographic and injury characteristics	Males (n=1577)			Females (n=378)		
	Coef.	p-value	95% CI	Coef.	p-value	95% CI
Follow-up period						
1 month **	0.000			0.000		
2 months	0.157	<0.001	0.145 to 0.169	0.142	<0.001	0.117 to 0.167
4 months	0.241	<0.001	0.224 to 0.257	0.232	<0.001	0.197 to 0.266
12 months	0.255	<0.001	0.237 to 0.273	0.244	<0.001	0.208 to 0.280
Age						
19-30 **	0.000			0.000		
31-45	-0.007	0.488	-0.025 to 0.012	-0.027	0.150	-0.064 to 0.01
46-60	-0.016	0.193	-0.039 to 0.008	-0.029	0.146	-0.069 to 0.01
>60	0.020	0.220	-0.012 to 0.052	-0.026	0.356	-0.083 to 0.03
Employment						
Salaried/wage employee**	0.000			0.000		
Unpaid family worker	-0.055	0.003	-0.091 to -0.019	0.030	0.167	-0.013 to 0.073
Cultivator/wage labourer	-0.040	<0.001	-0.061 to -0.019	-0.008	0.863	-0.097 to 0.082
Employer/Own account worker	-0.036	<0.001	-0.056 to -0.016	0.017	0.670	-0.063 to 0.098
Unemployed/others	-0.030	0.054	-0.061 to 0.001	-0.004	0.907	-0.071 to 0.063
Insurance						
No**	0.000			0.000		
Yes	-0.012	0.242	-0.033 to 0.008	0.000	0.990	-0.041 to 0.04
Mechanism of injury						
RTI**	0.000			0.000		
Falls	-0.029	0.024	-0.054 to -0.004	-0.058	0.009	-0.102 to -0.014
Mechanical	-0.018	0.220	-0.047 to 0.011	0.044	0.012	0.009 to 0.078
Others	0.029	0.004	0.010 to 0.049	0.029	0.139	-0.009 to 0.068

Severity based on LOS						
Mild (1 day)**	0.000			0.000		
Moderate (2-7 days)	-0.046	<0.001	-0.063 to -0.029	-0.046	0.010	-0.080 to -0.011
Severe (8+ days)	-0.121	<0.001	-0.143 to -0.098	-0.111	<0.001	-0.150 to -0.071
	Males (n=582)			Females (n=121)		
Two-wheeler RTIs only						
Use of helmet*						
No**	0.000			0.000		
Yes	0.022	0.081	-0.003 to 0.047	-0.062	0.186	-0.153 to 0.030
	Males (n=91)			Females (n=22)		
Car RTIs only^						
Use of seatbelt						
No**	0.000			0.000		
Yes	0.014	0.676	0.080 to -0.052	-0.071	0.188	0.035 to -0.176

Note: Coff- the adjusted difference in mean score

*Among two-wheelers RTIs only adjusted for participants' occupation, insurance status, severity based on LOS and baseline EQ-5D-5L.

^Among car RTI occupants and adjusted for participants' occupation, insurance status, severity based on LOS and baseline EQ-5D-5L.

** Referant

Of all 176 deaths, over half were from a RTI, followed by falls (24%). Of those that died following an RTI, two-thirds (64%) were driving or operating a vehicle, while 8% were passengers. The majority of RTI deaths occurred when a car/bus or truck was the mode of transport (Data not shown).

Discussion

To our knowledge, this is the first study from India, and one of few reporting on health-related quality of life measured by EQ-5D-5L among people hospitalised due to an injury. Given non-fatal injuries account for nearly 15% of the total global burden of injuries, and with the majority in low- and middle-income settings,²⁰ our findings report much needed evidence on key contributing factors that impact on health related quality of life outcomes.

The EQ-5D-5L instrument has been used in India to examine quality of life in patients with spinal cord injuries and other chronic diseases²¹⁻²³. A validated tool in Hindi is not available with most studies using translations of the English version; however, validation has been done in one Indian language²². A recent review of generic health outcome tools such as EQ-5D-5L for assessing the complete range of effects of injury on health and wellbeing captured only 6% of health outcomes and 12% of concepts relating to activity and participation. Environmental factors such as education, access to support service and trauma systems, and health insurance are important factors that impact on outcome but are not comprehensively captured¹. However, it is one of the most widely

used tools and easiest to administer thus the advantage of comparing injury burden to other diseases/conditions.

Most injury patients requiring hospitalisation were people aged 45 and younger and a high proportion of the injured were from lower socio-economic status. Similar to the trend of injuries in other LMIC settings, road traffic crashes and falls were the most common causes of injury^{24 25}. The majority of RTIs occurred among motorized two-wheelers where less than one-third were using a helmet at the time of their collision. Challenges related to implementation of a law for helmet use among motorcyclists and seat-belt use among car occupants are often reported as common risk factors for injuries as a result of road traffic collisions in many LMICs, including India²⁴.

Over time, the period with greatest rate of recovery was between the first and the second month following the injury, which is consistent with that found in other studies^{26 27}, in both LMIC and high-income country settings. This highlights the importance of providing follow up care and rehabilitation in the first few months after an injury because only small improvements are achievable after the fourth month of the injury. While quality of life scores were highest at 12 months after injury, they still remained lower than pre-injury, signifying long-term impact and limitation for full recovery, particularly in the Anxiety/Depression dimension or mental health.

Pain and anxiety domains are strong predictors of poor recovery in similar cohorts from high income countries. In our study, usual activities, self-care and mobility were key domains of poor health related quality of life^{28 29}.

Although a much longer follow up period would be required to assess whether lower HRQoL scores continued to persist or if scores returned to normal after a longer time, it raises important concerns about the impact of injuries and the need for trauma registries with longitudinal follow-up is needed to document recovery outcomes and comprehensively understand the predictors of recovery. A study by Black et al. (2011) also found similar residual impairment after one year in their systematic review of studies using the EQ-5D-5L instrument to assess recovery after injury³⁰. It is of interest to review implementation of Good Samaritan Law³¹, its impact on timely access to medical attention and road injury outcomes.

It was observed that four wheel driver/passengers died in higher proportion, which is contrary to what is known from population data. Thus these findings should be interpreted with caution, as this is a hospital based study and as reported earlier a large proportion of severe injury deaths occur at the crash site³².

The significant proportion of post-hospitalisation deaths in our study is also a cause for concern regarding immediate post-discharge care for patients. *It is likely that with resource restraints, patients with poor prognosis are sent home. However,* quality audits of care provided in the acute setting could help to understand where improvements can be made in the hospital, with further understanding also needed on of discharge practices, for patients with poor prognosis for recovery.

Substantially better health-related quality of life was reported after a one-year following the injury in 19-30-year olds as well as those over 60 years. Although EQ-5D-5L scores were lowest in the oldest age group at the first follow up, they improved substantially by the 12-month time point. This is in contrast to a study done in Australia that found poorer outcomes in older people aged over 65 years following road traffic crashes,³³ however the instruments (EQ-5D-5L) used to measure outcomes differed and this was in a high-income setting. Better scores among older ages at 12 months could perhaps be associated with cultural context of care by family members and/or better management of other morbidities, thus leading to overall better health.

A large proportion (77%) of the cohort was referred to the study hospital. However, in the context when referred to emergency department, the cases are not admitted to the previous health facility, they are triaged and sent to the referral hospital. Thus, it is unlikely to change the days of hospitalisation and the inferences drawn from using days of hospitalisation as a proxy measure of injury severity.

Patients with a co-morbidity showed improved EQ-5D-5L scores compared to those without any other health issues. This could be because these patients might have had more regular contact with a health service provider for their other health conditions post discharge where they might have incidentally received treatment or monitoring for their injury as well.

Strengths and limitations

The major strength of this research is that it is one of the first cohort studies reporting on the burden of fatal and non-fatal injuries in India with a large sample size of over 2200 participants from both secondary and tertiary health facilities and covering a wide range of injuries. Our study is also one of the first to report on health-related quality of life, quantifying how much loss in terms of health-related quality of life would occur due to injuries. Another strength of this study is the collection of pre-injury EQ-5D at recruitment which allows measuring the health impact of injury, however this is subject to perceived recall bias as pre-injury status was collected at baseline. This retrospective method of data collection may potentially be a small upward bias and is a study limitation^{34 35}.

A limitation of this study was the lack of direct measure of injury severity. The protocol did aim for AIS, however the absence of research staff trained in AIS coding, insufficient details, and lack of standardisation in reporting of clinical information across hospital sites, precluded reliable injury severity scoring. The use of EuroQoL instrument to measure quality of life in this population without having been validated for use in Hindi is a study limitation. Further, as follow up assessments were done by telephone this may have affected the ability of participants to understand the questions and accurately ascertain VAS scores. The indirect measure using the length of hospital stay may not have been sensitive enough to observe distinct recovery trajectories. This could be because the length of hospital stay may not only be dependent on the severity of the injury but also other factors including socio-economic status (such as whether they have health insurance to cover their hospital stay and/or their affordability to stay in the hospital) as well as accessibility and availability of hospital services close to participants' place of residence.

Conclusion

Recent years have seen investment in trauma care centres across India accompanied with measures across financial risk protection and attempt to improve pre-hospital care. These efforts need to be monitored and robust longitudinal data on recovery outcomes is needed to evaluate the impact of these efforts in trauma care. The study findings highlight the need for comprehensive data on recovery outcomes to better inform policy and practice for secondary and tertiary injury prevention.

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