**Interaction of age and gender on post-discharge quality-of-life in adult trauma patients in urban India – a cohort study**

**Introduction**

Trauma contributes to one-tenth of the global disability-adjusted life-years (DALYs), with low-and middle-income countries (LMICs) bearing a disproportionate burden of the morbidity (1,2). To address this burden, it is important to understand the long-term outcomes of trauma and the different factors associated with these outcomes, especially in LMICs (3–5). This encompasses a range of socioeconomic outcomes including health-related quality of life (QOL) (6–9).

Age and gender are associated with post-discharge QOL among trauma patients. Elderly populations and women tend to have limited access to resources, reduced social capital, disparities in support, poor health-seeking behavior, and restricted education and employment opportunities(10–14). This can shape their post-discharge well-being and outcomes after trauma (15–18). Consequently, older age and being a women can make trauma patients more vulnerable to poorer post-discharge QOL (19–22). There is some evidence that older women may have higher morbidity in LMIC settings (23,24). Additionally, age and gender shape health outcomes, working not as an additive but a multiplicative interaction across different age groups and sex (25,26).

However, there is little research on the interaction between age and gender on QOL among post-discharge trauma patients in this setting. Understanding the interaction between age and gender on QOL may provide insights for improving trauma management and developing support services in LMIC settings (27,28). The aim of this study is to assess the interaction of age and gender with post-discharge QOL among adult trauma patients using the context of urban India.

**Methods**

*Study Design*

This study is a cross-sectional study using data from an ongoing interrupted time series trial of trauma patients discharged from four tertiary-care hospital in urban India between November 2019 and June 2020.

*Setting*

India accounts for nearly 20% of global trauma burden (1). More than one-tenth of all the DALYs in India are due to trauma and it is among the top five causes of morbidity (29). The patients were enrolled from the on-going Trauma Audit Filters Trial (TAFT) in four participating tertiary-care hospitals in Indian cities (30). These were the Grant Medical College and Sir Jamshedjee Jeejeebhoy Hospital in Mumbai, Lok Nayak Hospital of Maulana Azad Medical College (MAMC) in Delhi, the Institute of Post-Graduate Medical Education and Research and Seth Sukhlal Karnani Memorial Hospital (SSKM) in Kolkata and St. John's Medical College, Bengaluru. The first three are public hospitals that have nominal fees catering to patients from lower socioeconomic sections of the population, while the fourth is a charitable private hospital catering to a mix of different socioeconomic sections of the population.

*Participants*

We include patients aged 18, which is the legal age for consent in in India (31) presenting to the casualty department with a history of trauma---as per the V01-Y36, chapter XX of the International Classification of Disease version 10 (ICD-10) (32)--who are admitted and discharged alive. Majority of the participants in the study were from low-income households often living in poorly-maintained dense slum buildings with limited piped water or sewage and use communal public toilets. Additionally, most trauma patients in India are young male adults.

*Variables*

Age and gender were the main variables for this study. We also included variables that has been shown in literature to influence injury severity and can consequently affect post-discharge QOL. Vital sign measures such as systolic blood pressure (SBP), respiratory rate (RR), heart rate (HR), oxygen saturation (SPO), Injury severity scores (ISS) and Glasgow Coma Scale (GCS) and injury aetiology measures like mode of transport to hospital, type of injury, and mechanism of injury were included in the study.

*Outcomes*

Health-related quality-of-life outcome was measured using the EQ-5D Tool (33). EQ-5D is a standardized measure of quality of life using five dimensions: mobility, self-care, usual activities, pain/discomfort, and anxiety/depression. Each dimension in the tool has three levels: no problems, some problems, and extreme problems. Additionally, there is a visual analog scale (VAS) The patients were followed up at 3-months. EQ-5D tool can be administered over the telephone and has translations available in multiple Indian languages (33).

*Table 1: Description of study variables and outcomes*

|  |  |
| --- | --- |
| Name | Description |
| *Variables* | |
| Age | Patient's age rounded up to closest whole year |
| Sex | Patient's sex:  Female  Male |
| Vital Signs | Systolic blood pressure (SBP), respiratory rate (RR), heart rate (HR), oxygen saturation (SPO), and Glasgow Coma Scale (GCS) |
| Injury Etiology | Mode of transport, type of injury, mechanism of injury |
| Injury Severity | Injury Severity Score |
| *Outcomes* | |
| Quality of Life | The participant's reply to the EQ-5D questionnaire and VAS on health state at 3 months after arrival at the study site. |

*Data Source*

Data was collected by one dedicated independent project officer in each of the hospitals who prospectively gather data on a standardized intake form for eight hours per day, five days a week, by directly observing the staff delivering trauma care. Vital signs such as systolic blood pressure, heart-rate, and oxygen saturation was recorded by the project officer independently. The project officer was rotated daily through each eight-hour shift in the morning, evening and night. Data for the variables was collected from patient records, or from the patient or patient representatives when they are at the hospital. Additionally, the project officer followed the patient or the patient relatives at 3-months after discharge by telephone the for information on the outcomes and any missed variables.

*Bias*

There could be bias in collection of data and recording of vital signs used to calculate injury severity. Adequate training of the project officers, periodic quality control of the data with external project officers and weekly online review meetings was done to reduce this bias.

*Statistical Methods*

In this study we divided study population into three groups: young adults-18-32 years, middle-aged adults-33-59 years, and old adults-60 years and above. We used multivariate linear regression to study the association of age and gender with the EQ-5D VAS score and multivariate ordinal logistic regression was used to measure the association with the different domains of EQ-5D which have multilevel responses. In order study the interaction between age and gender, we used the interaction term which was the product of age and gender (gender \* age groups) (26). In order to account for the effects of multicollinearity we calculated the variance inflation factor (VIF) and we centered those variables having a value above 5 were centered by subtracting the mean. The statistical software R was used for all statistical analyses We estimated 95% confidence intervals and denote associations with a p-value of less than 0.05 as statistically significant (34). The statistical software R was used for all statistical analyses (35).

*Study Size*

The five EQ5D domains have three outcomes each. For example, the domain on mobility has: "No problems in walking about", "Some problems in walking about", "Confined to bed". for regression analysis there should be adequate observations in each of the three categories relative to the 18 predictors. Previous studies indicate that 10 to 50 events per variable (EVP) is adequate to obtain stable estimates for logistic regression in multivariate analysis (36,37). Preliminary review of the data showed that some outcomes categories did not have the required number of subjects and the lowest prevalence of any outcome category was 34%. Therefore, the outcomes for each domain were combined into two "Having no problems" and "Having any problems". For an EVP 20, with the lowest prevalence across the outcome categories being 34%, we need at least 60 subjects for each predictor. Given that our model includes around 18 free parameters (Table 1), we need a minimum sample size of 1080. For linear regression there should be at least 2 subjects per variable (37). Therefore, the EQ 5D VAS score analysis would require a minimum sample of 36.

*Ethics*

Ethical clearance for the data collection was obtained from the four participating hospitals as amendments to the existing ethical clearance for the on-going TAFT project (Grant Medical College & Sir J.J., Group of Hospitals, Mumbai---No. IEC/Pharm/CT/111/A/2017, Dated 22nd August 2017; Institute of Post-Graduate Medical Education, Kolkata---Memo No. IPGME&R/IEC/2017/396, Dated 21st August 2017; Maulana Azad Medical College, New Delhi-F.1/IEC/MAMC/(53/2/2016/No.97), Dated 3rd August 2016; St. John's Medical College, Bengaluru---No. IEC/1/671/2017, Dated 24th August, 2017). Waiver of informed consent was granted for collection of clinical data which was routinely collected for the patients, as they were all admitted after trauma, often arriving in an altered level of consciousness and in severe physical and psychological distress. The amendment granted permission to collect the additional data necessary for this study (Grant Medical College & Sir J.J., Group of Hospitals, Mumbai---No. IEC/Pharm/CT/2059/2019, Dated 16th September 2019; St. John's Medical College, Bengaluru---No. IEC/1/530/2019, Dated 25th June, 2019).

*Data management*

Each center was assigned a center identification number and each patient a locally unique study identification number. Project officers first entered data on paper without any personal identification data. The project officers then transferred this data to an electronic format using a dedicated data entry application. The electronic data did not include any direct identifiers such as name, hospital record number, and telephone numbers. The only way to link an electronic record to a paper intake form was by combining the record's hospital and study identification numbers. Paper forms were kept locally at each center for the duration required by locally applicable laws and regulations, or at least five years, whichever is longest. The adequacy of their storage was the responsibility of the principal investigator at each center. Care was taken to ensure that at no time where they stored with less than reasonable care.

**Results**

Out of a total of 2427 trauma patients enrolled, 1769 were excluded for missing data. The final cohort of 658 included in this study had a median age of 36 years (IQR: 26.0-50.0) with 19.9 per cent of patients were female. The most common mechanisms of injury were road traffic injuries (56.4 per cent). Majority of the injuries were blunt (98.1 per cent) and 78.2 per cent were transferred to the study hospitals. The all cause 30-day mortality was 25.3 per cent. The median injury severity score was xxx. Details of the study population is given in Table 2.

*Table 2: Description of study sample characteristics*

|  |  |  |
| --- | --- | --- |
| *Variable* |  | *Numbers* |
| Age in years (median [IQR]) |  | 36.0 [26.0, 50.0] |
| Gender (%) | Female | 19.9 |
| Mechanism of injury (%) | Road traffic injuries | 56.4 |
| Falls | 23.2 |
| Assault | 6.1 |
| Railway injuries | 1.8 |
| Other | 12.5 |
| Type of injury (%) | Blunt | 98.1 |
| Penetrating | 1.9 |
| Mode of transport (%) | Ambulance | 69.1 |
| Police van | 4.9 |
| Private Vehicles | 25.6 |
| On Foot | 0.4 |
| Transferred (%) | Transferred | 78.2 |
| SBP (median [IQR]) |  | 118.0 [110.0, 130.0] |
| RR (median [IQR]) |  | 21.0 [18.0, 22.0] |
| HR (median [IQR]) |  | 84.0 [78.0, 93.0] |
| SpO2 (median [IQR]) |  | 98.0 [97.0, 98.0] |
| GCS (median [IQR]) |  | 15.0 [12.0, 15.0] |
| ISS (median [IQR]) |  | Not calculated |
| 30-day mortality (%) | Dead | 25.3 |

*EQ-5D Scores*

658 completed the EQ-5D questionnaire at 3 months after the trauma. The mean EQ5D health status score was 76.6 (SD = 20.5). Just over half the patients (54.8%) reported no problems with mobility while two-thirds reported no problems with self-care. While less than half the patients (43.0%) could carry on usual activities without any problems and only one-third of the patients (34.7%) reported no pain or discomfort after three-months of post-discharge. Around 40% of the patients reported experiencing some form of anxiety or depression. Again, the proportion of young males reporting any problems across all the five domains was the lowest while the proportion middle-aged females reported experiencing the problems across all the five domains was the highest. The overall EQ-5D scores are provided in Table 3.

*Table 3. Proportion of EQ-5D scores in the sample population*

|  |  |  |
| --- | --- | --- |
| EQ-5D Domain | Levels | Numbers |
| EQ5D Health Status (median [IQR]) |  | 80.0 [65.0, 90.0] |
| EQ5D Mobility (%) | No Problems | 360 (54.8) |
|  | Some Problems | 216 (32.9) |
|  | Confined to bed | 81 (12.3) |
| EQ5D Self Care (%) | No Problems | 415 (63.2) |
|  | Some Problems | 182 (27.7) |
|  | Unable to wash or dress | 60 (9.1) |
| EQ5D Usual Activities (%) | No Problems | 283 (43.0) |
|  | Some Problems | 245 (37.2) |
|  | Unable to perform usual activities | 130 (19.8) |
| EQ5D Pain/Discomfort (%) | No Pain | 228 (34.7) |
|  | Moderate Pain | 401 (60.9) |
|  | Extreme Pain | 29 (4.4) |
| EQ5D Anxiety/Depression (%) | No Anxious/depressed | 385 (58.9) |
|  | Moderately Anxious/depressed | 200 (30.6) |
|  | Extremely Anxious/depressed | 69 (10.6) |
| 30-day mortality (%) | Alive | 1196 (74.7) |
|  | Dead | 406 (25.3) |

*EQ-5D in relation to gender and age*

*Health Status*

Overall females had a slightly higher mean EQ5D health status score (83.1) than males (80.3) After adjusting for injury etiology, vitals, and severity, young females (18-32 years) had the highest health status score (85.0) followed by younger males (84.4) while middle aged males (79.8) and older females reported the lowest scores (81.8) (Table 4).

*Table 4. Adjusted EQ-5D Health status across age and gender categories*

|  |  |  |
| --- | --- | --- |
| Gender and Age Characteristics | EQ5D Score | |
| Mean | SE |
| Overall | 81.75 | 7.8 |
| Male 18-32 years | 84.4 | 5.27 |
| Male 33-59 years | 79.8 | 5.28 |
| Male 60 years and above | 82.0 | 20.22 |
| Female 18-32 years | 85.0 | 5.27 |
| Female 33-59 years | 82.7 | 4.9 |
| Female 60 years and above | 81.8 | 5.86 |

*Adjusted for age, gender, mechanism of injury, mode of transport, transfer status, heart rate, oxygen saturation, systolic blood pressure, respiratory rate, type of injury, and Glasgow Coma Scale*

The linear regression of health status with the interaction effect of age and gender was not significant even after adjusting for injury etiology, vitals, and severity. The adjusted linear regression analysis of health status, keeping young males as the reference group, was statistically significant only for middle-aged males (Table 5).

*Table 5. Regression analysis summary of EQ-5D health status with interaction of age and gender and across different groups*

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Group** | **Coefficient** | **95% CI** | | **p-value** |
| Interaction Term [Age\*Gender] |  | -5.36 | 2.16 | 0.40 |
| Male 18-32 years | Reference | | | |
| Female 18-32 years | 0.63 | -5.42 | 6.68 | 0.84 |
| Male 33-59 years | -4.57 | -8.43 | -0.70 | 0.02\* |
| Female 33-59 years | 2.27 | -5.96 | 10.51 | 0.59 |
| Male 60 years and above | -2.39 | -8.97 | 4.20 | 0.48 |
| Female 60 years and above | -0.89 | -12.27 | 10.50 | 0.88 |

*Adjusted for age, gender, mechanism of injury, mode of transport, transfer status, heart rate, oxygen saturation, systolic blood pressure, respiratory rate, type of injury, and Glasgow Coma Scale*

*CI = Confidence Interval, \* statistically significant at 0.05*

*Mobility*

The adjusted logistic regression analysis in the mobility dimension keeping young males as the reference group, shows that the adjusted odds of reporting mobility problems was 0.78 in young females, 1.44 in middle-aged females, and 0.77 in old females. In middle-aged males the odds were 0.77 and in old males the odds were 0.72. Thus, all groups had lower odds of reporting some mobility problems than young males except middle-aged females. Only the odds for middle aged males were statistically significant.

*Self-care*

The adjusted logistic regression analysis in the self-care dimension keeping young males as the reference group, shows that the adjusted odds of reporting problems performing self-care activities was 0.74 in young females, 1.15 in middle-aged females, and 1.05 in old females. In middle-aged males the odds were 0.82 and in old males the odds were 0.66. Thus, all groups had lower odds of reporting problems performing self-care activities than young males except middle-aged and old females. No group had odds that were statistically significant.

*Usual Activities*

The adjusted logistic regression analysis in the usual activities dimension keeping young males as the reference group, shows that the adjusted odds of reporting problems performing usual activities was 0.70 in young females, 1.40 in middle-aged females, and 0.90 in old females. In middle-aged males the odds were 0.70 and in old males the odds were 0.73. Thus, all groups had lower odds of reporting problems performing usual activities than young males except middle-aged females. No group had odds that were statistically significant.

*Pain/Discomfort*

The adjusted logistic regression analysis in the dimension keeping young males as the reference group, shows that the adjusted odds of reporting having pain and discomfort was 0.54 in young females, 1.36 in middle-aged females, and 3.43 in old females. In middle-aged males the odds were 0.54 and in old males the odds were 0.31. Thus, all groups had lower odds of reporting having pain and discomfort than young males except middle-aged and old females. No group had odds that were statistically significant.

*Anxiety/Depression*

The adjusted logistic regression analysis in the dimension keeping young males as the reference group, shows that the adjusted odds of reporting anxiety and depression was 1.59 in young females, 0.55 in middle-aged females, and 0.77 in old females. In middle-aged males the odds were 1.31 and in old males the odds were 1.35. Thus, young females and middle- and old males had higher odds of reporting anxiety and depression than young males. No group had odds that were statistically significant.

Though the odds of reporting any problems across the EQ5D domains were not statistically significant, middle-aged females had the higher odds of reporting problems with across all domains except anxiety and depression (Table 6).

*Table 6. Adjusted odds ratio of reporting any problem in the EQ-5D domains across different groups*

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Group** | **Mobility** | | | **Self-Care** | | | **Usual Activity** | | | **Pain/Discomfort** | | | **Anxiety/Depression** | | |
| *OR* | *95% CI* | | *OR* | *95% CI* | | *OR* | *95% CI* | | *OR* | *95% CI* | | *OR* | *95% CI* | |
| Male 18-32 years | *Reference group* | | | | | | | | | | | | | | |
| Male 33-59 years | 0.77\* | 0.51 | 1.15 | 0.82 | 0.54 | 1.24 | 0.70 | 0.47 | 1.05 | 0.54 | 0.27 | 1.04 | 1.31 | 0.86 | 1.97 |
| Male 60 years and above | 0.72 | 0.36 | 1.41 | 0.66 | 0.33 | 1.31 | 0.73 | 0.37 | 1.44 | 0.31 | 0.35 | 0.82 | 1.35 | 0.68 | 2.67 |
| Female 18-32 years | 0.78 | 0.41 | 1.47 | 0.74 | 0.39 | 1.42 | 0.70 | 0.76 | 2.31 | 0.54 | 0.13 | 0.70 | 1.59 | 0.84 | 2.99 |
| Female 33-59 years | 1.44 | 0.61 | 3.39 | 1.15 | 0.49 | 0.48 | 1.40 | 0.62 | 3.40 | 1.36 | 0.53 | 3.47 | 0.55 | 0.23 | 1.31 |
| Female 60 years and above | 0.77 | 0.23 | 2.57 | 1.05 | 0.34 | 4.14 | 0.90 | 0.26 | 3.09 | 3.43 | 0.91 | 12.80 | 0.77 | 0.23 | 2.53 |

*Adjusted for age, gender, mechanism of injury, mode of transport, transfer status, heart rate, oxygen saturation, systolic blood pressure, respiratory rate, type of injury, and Glasgow Coma Scale*

*OR = odds ratio, CI = Confidence Interval, \* statistically significant at 0.05*

**Discussion**

This study examined the interaction of age and gender on QOL in trauma patients discharged from four tertiary-care hospital in urban India at 3-months after discharge. We did not find statistically significant differences across all age groups and gender as well as no interaction effect between age and gender in this population. The sub-group analysis showed differences in QOL between males and females across young (18-32 years), middle-aged (33-59), and older (60 years and above) groups. In each of the five EQ5D domains, odds of reporting problems varied between the groups. We found middle-aged males report lower overall QOL scores while middle aged females had the highest odds of reporting problems across almost all the QOL domains.

The mean EQ5D index score of 81.7 of trauma patients in this study is lower than the general population norm for South Asia of 86 (38). A recent study of a similar cohort of trauma patients from north India, reported index scores of around 90 at 3-months post-injury, higher than our findings (39). This could be because two of the three study sites of that study were secondary-care hospitals, which treat less severe trauma patients. The score is however, higher than other studies from Sweden and Australia which report scores between 48 to 66 for trauma patients

at 3-months (40,41). This indicates that, even after 3-months since discharge, trauma patients still face limitations to achieve full recovery for a long-time after trauma. Pain and inability to perform usual activities were the main drivers of poor QOL in our study, with nearly two-thirds of participants reporting some form of pain at 3-months. This is consistent with other literature on similar cohorts in other settings (40,41).

In this study females reported slightly better overall QOL than males, which is consistent with the study from North India (39). Evidence on this remains mixed with some studies reporting lower scores for females (22) while other report lower scores for males (39). Studies that report females having better QOL scores than males also tend to have a smaller proportion of females in their study sample. In this study, the middle-aged cohort, had the highest odds of poor QOL outcomes. The middle-aged males had the lowest EQ-5D index scores than the other groups, followed by middle-aged females (coefficients respectively of −4.86 (95% CI −9.07; −0.65) and −2.01 (95% CI -11.41; 7.37)). Better QOL was reported after 3-months following the injury in younger age adults as well as those over 60 years. This is in contrast with findings from high-income settings where older adults perform worse (41,42) but similar to the findings from India (39). Better scores among the younger and older adults could be due to physiological factors and among the old it could be associated with the cultural context of care by informal caregivers leading to overall better health (43).

In this study more females reported pain and barriers to self-care than their male counterparts across all age groups. On the other hand, problems with mobility and usual activities increased with age. These findings are in line with other studies from high-income settings showing that females report more problems in the pain, and usual activities domain than males (42). Anxiety and depression also increased with age but after categorizing by gender it was seen that young females reported higher odds than males while older males reported higher odds than females. There is evidence of younger age and female gender being predictive of anxiety and depression after injury in high income settings (42). Women having higher prevalence of anxiety and depression has also been observed in the general population in India (44). The reasons for injured middle-aged and older males reporting higher odds for anxiety and depression is unclear and the reasons for this needs to be studied in-depth. However, the proportion of patients reporting anxiety and depression (41%) was almost twice as high as seen in previous studies (39,41). This underscores the need to account for psychological issues faced by trauma as part of the long-term consequences of trauma in this setting.

Our study showed that while middle-aged females had the highest odds of reporting problems in the mobility, self-care, pain, and usual activities than other groups, they did not report lower overall health status. This could be because of the gendered norms influencing healthcare-seeking behavior among women in the Indian settings, where women may not consider their health status as requiring care despite having more health problems (24,45,46). This difference in reporting overall health status with respect to individual domains needs to investigated in future studies on trauma from urban India.

The findings from our study indicate that males and females do not recover QOL at 3-months post trauma the same way across different age groups in the urban Indian context. The reasons for these differences should be explored in detail in future qualitative studies. Additionally, future research should focus on specific cohorts of trauma such as traumatic brain injury or spinal cord injuries and road traffic injuries or falls to study the differences in QOL outcomes and the reasons for the same. The findings of this study highlight that healthcare providers should consider options for addressing the persistent pain among post-discharge trauma patients. Moreover, it emphasizes the need for providing psychosocial care as part of trauma management to improve overall QOL among trauma patients. Additionally, given the differences between reporting overall health status and health-related problems faced, especially among women, healthcare providers could probe for these problems during post-discharge follow-ups visits.

*Limitations*

The EQ5D tool has not been validated for trauma patients in the Indian context and conducting a telephonic interview could have affected the ability of participants to understand the questions and thereby the reported responses. However, the tool has been validated in non-trauma settings and culturally similar populations in South Asia. Additionally, the tool has details on how to collect the information over the telephone. This study only captures those who responded during the follow-up calls, leaving out drop-outs. Another limitation is that using QOL measured at a single point of time does not allow in observing changes in QOL across time between the different age and gender groups. Longitudinal studies from low resource settings would help in understanding patterns and changes over time.

**Conclusion**

TBD

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