**Road crashes among underage motorcyclists’ compared with motorcyclists of legal driving age: A Cross-Sectional Study from an Urban Setting in Low-Middle Income Country, Karachi, Pakistan**

Adolescents have the highest burden of road traffic deaths.[1] Underage adolescents’ drivers are involved in fatal crashes three times more often compared with adults.[2] The number of road traffic crashes per million miles driven is six times higher in adolescents compared with adult drivers.[3] Adolescents are vulnerable to road traffic crashes due to limited experience and risky taking behaviors.[4,5]

In most countries the minimum driving age is 18 years but many adolescents start to drive earlier than the legal age if they have access to vehicle in the household. Underage driving is linked to adolescents’ aspiration of becoming independent and experience adventure, augmented with peer pressure.[6]

Demographics, socioeconomic factors, behaviours and consequences related to road crashes by adolescent drivers have been studied in high- income countries (HICs) [7,8] where at least one vehicle is available for every two persons. The common crash risks in HICs among adolescent drivers are speeding, violation of safety rules, drink driving and use of cell phones. [8-10] Graduate driving license program in some high income countries aims to restrict the road traffic exposure of adolescent drivers; and have been shown to successful in reducing fatal crashes in young drivers.[11]

It is unclear how underage drivers are contributing to the crash burden in low-income settings where the number of vehicles per population is lower. Understanding underage driving can be critical in suggesting preventive measures in low-income settings, as these countries account for about 90% of road deaths in adolescents globally.[12]

Unlike high-income countries, many low-income settings lack stringent rules for obtaining driving license. Previous studies report high crash rates in early licensure period regardless of age of licensure compared to adults. [5,13-18] The risk of crashes is particularly high in first 12 to 18 months of independent driving after obtaining license which eventually decline. [19]

Our aim is to determine and compare the burden and characteristics of underage adolescent drivers’ age 15 to 17 years, 18-19 years, young drivers 20-24 years and adults 25-35 years involved in road crashes in Karachi, Pakistan.

**Methods**

Design

The study is cross-sectional design during the period 2007-2014.

Setting

The study setting is Karachi, a large urban area of Pakistan (about 3,530 square kilometers), with an estimated population of 18 million and a total length of the road network of over 8,000 kilometers.

Injury data were extracted from an ongoing road traffic injury surveillance project based on emergency departments (ED) in all of the three government trauma centers in the city, and the two private tertiary care hospitals. The detailed methods have been described previously.[20]

These hospitals receive nearly all major trauma cases from the city. The data collectors of the surveillance project gather demographic information on the injured patients and details of the crash by asking victims, their relatives, ambulance drivers or any eyewitnesses. The system was piloted in late 2006 and formally launched in 2007.

Participants

Road traffic crash victims of age 13-24 years categorized in 13-17 years, 18-19 years and 20-24 years who were drivers of motorcycles or any other vehicle and reported to emergency departments of participating hospitals with injuries.

Outcomes

ISS >= 16 and death

Exposure

Age groups 13-17 years (underage), 18-19 years (early licensure period) and 20-24 years (experienced young drivers)

Study variables

Gender, injured body type, vehicle involved in crash, time of the crash, days of the week, helmet use and type of location (intersection or midblock).

Ethics approval

Ethics of study methods were approved from the Institutional Review Board of the Jinnah Post Graduate Medical Center, which is coordinating site of this road surveillance project.

Data analysis

We performed the analysis using R.[21] The categorical variables are described using frequencies and percentages (age, gender, injury patterns, vehicle type etc). Chi-square tests were used to assess crash characteristics associated with drivers of motorcycles versus other drivers. We used logistic regression to assess the association of age groups (13-17 years, 18-19 years compared with 20-24 years) and the outcomes severe injury (ISS ≥ 16) and death.

Results:

Table 1: Characteristics of underage motorcyclists versus young motorcyclists of legal age (n=46, 155)

|  |  |  |  |
| --- | --- | --- | --- |
| Variables | 13-17 years  n=9800 | 18-19 years  n=9859 | 20-24 years  n=26496 |
| Gender  Male | 9780 ( 99.8) | 9837 ( 99.8) | 26435 ( 99.8) |
| Time of crash  Daylight  Dark | 5400 ( 55.1)  4400 ( 44.9) | 4791 ( 48.6)  5068 ( 51.4) | 13860 ( 52.3)  12636 ( 47.7) |
| Day of the week  Weekday  Weekend | 6346 ( 64.8)  3454 ( 35.2) | 6393 ( 64.8)  3466 ( 35.2) | 17794 ( 67.2)  8702 ( 32.8) |
| Helmet use  Yes  No | 188 (2.0)  9027 (98.0) | 241 (2.6)  9165 (97.4) | 1301 (5.1)  24038 (94.9) |
| Crash Location  Intersection  Midblock | 2491 ( 26.2)  7003 ( 73.8) | 2739 ( 28.8)  6758 ( 71.2) | 7690 ( 30.3)  17676 ( 69.7) |
| Patient transfer  Private  Ambulance  Public  Police  Others | 7314 ( 76.1)  2127 ( 22.1)  134 ( 1.4)  20 (0.2)  13 (0.1) | 7300 ( 75.6)  2166 ( 22.4)  133 ( 1.4)  31 (0.3)  27 (0.3) | 18841 ( 72.6)  6572 ( 25.3)  411 ( 1.6)  71 (0.3)  52 (0.2) |
| Body region Injured (multi response variable)  Head  Face  Chest  Abdomen  Extremities  External | 2940 (30.0)  2778 (28.3)  118 (1.2)  395 (4.0)  5079(51.8)  5453 (55.6) | 3170 (32.2)  3061 (31.0)  89 (0.9)  380 (3.9)  5119 (51.9)  5777 (58.6) | 8439 (31.9)  7852 (29.6)  325 (1.2)  1092 (4.1)  13592 (51.3)  15243 (57.5) |
| Injury Severity score  Less than 16  More than or equal to 16 | 9101 ( 97.6)  220 ( 2.4) | 9150 ( 97.1)  276 ( 2.9) | 24598 ( 97.6)  640 (2.4) |
| Deaths  Yes  No | 177 ( 1.8)  9595 ( 98.2) | 191 ( 1.9)  9640 ( 98.1) | 459 ( 1.7)  25954 ( 98.3) |

Table 2: Univariate and multivariable association of Road traffic deaths with age of young motorcyclists

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Variables** | **No road traffic deaths**  **n=**45189 | **Road traffic deaths**  **n=**827 | **Unadjusted OR (95% CIs)** | **Adjusted OR**  **(95% CIs)** |
| Age groups  20-24 years  18-19 years  13-17 years | 25954 ( 57.4)  9640 ( 21.3)  9595 ( 21.2) | 459 ( 55.5)  191 ( 23.1)  177 ( 21.4) | 1  1.12 (0.94, 1.33)  1.04 (0.87, 1.24) | 1  0.98(0.75, 1.28)  1.09 (0.98, 1.46) |
| Gender  Male  Female | 45088 ( 99.8)  88 ( 0.2) | 827 (100.0)  0 ( 0.0) | 1  0 | 1  0 (0.00, 0.28) |
| Time of crash  Daylight  Dark | 23561 ( 52.1)  15307 ( 33.9) | 422 ( 51.0)  405 ( 49.0) | 1  1.05 (0.91, 1.2) | 1  1.16 (0.94, 1.44) |
| Day of the week  Weekday  Weekend | 29882 ( 66.1)  15709 (33.8) | 558 ( 67.5)  269 ( 32.5) | 1  0.94 (0.81,1.09) | 1  1.10 (0.88,1.37) |
| Helmet use  Yes  No | 1695 (3.9)  41460 ( 96.1) | 9 (1.3)  669 (98.7) | 1  3.04 (1.67, 6.36) | 1  4.57 (2.18, 11.20) |
| Crash Location  Intersection  Midblock | 12729 ( 29.2)  30795 ( 70.8) | 173 ( 24.8)  524 ( 75.2) | 1  1.25 (1.06, 1.49) | 1  0.70 (0.55, 0.90) |
| Patient transfer  Ambulance  Private  Public  Police  Others | 10284 ( 23.2)  33215 ( 74.9)  635 ( 1.4)  110 ( 0.2)  89 ( 0.2) | 562 ( 75.2)  133 ( 17.8)  38 ( 5.1)  11 ( 1.5)  3 ( 0.4) | 1  0.07 (0.06,0.09)  1.1 (0.77,1.51)  1.83 (0.92. 3.27)  0.62 (0.15, 1.65) | 1  0.28 (0.22, 0.36)  1.29 (0.73, 2.22)  1.15 (0.37, 3.34)  1.15 (0.05, 7.27) |
| Injury Severity score  Less than 16  More than or equal to 16 | 42579 ( 98.5)  628 ( 1.5) | 157 (25.3)  464 (74.7) | 1  200 (164, 244) | 1  128(101, 162) |

Table 3: Univariate and Multivariable association of Injury severity with age of young motorcyclists

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Variables** | **ISS less than 16**  **n = 42849** | **ISS more than or equal to 16**  **n = 1100** | **Unadjusted ORs (95% CIs)** | **Adjusted ORs (95% CIs)** |
| **Age groups**  20-24 years  18-19 years  13-17 years | 24598 ( 57.4)  9150 ( 21.4)  9101 ( 21.2) | 604 ( 54.9)  276 ( 25.1)  220 ( 20.0) | 1  1.23 (1.06, 1.42)  0.98 (0.84, 1.15) | 1  1.28 (1.05, 1.55)  1.10 (0.90, 1.35) |
| Gender  Male  Female | 42746 ( 99.8)  88 ( 0.2) | 1100 (100.0)  0 ( 0.0) | 1  0 | 1  0 |
| Time of crash  Daylight  Dark | 22393 ( 52.3)  20456 ( 47.7) | 575 ( 52.3)  525 ( 47.7) | 1  1.0 (0.89, 1.13) | 1  1.02 (0.87, 1.19) |
| Day of the week  Weekday  Weekend | 28364 ( 66.2)  14485 ( 33.8) | 716 ( 65.1)  384 ( 34.9) | 1  1.05 (0.93, 1.19) | 1  1.09 (0.92, 1.28) |
| Helmet use  Yes  No | 1577 ( 3.9)  39375 ( 96.1) | 40 ( 3.9)  980 ( 96.1) | 1  0.98 (0.72, 1.37) | 1  0.65 (0.46, 0.94) |
| Crash Location  Intersection  Midblock | 12225 ( 29.5)  29147 ( 70.5) | 202 ( 19.3)  843 ( 80.7) | 1  1.75 (1.5 , 2.05) | 1  2.01 (1.65, 2.47) |
| Patient transfer  Ambulance  Private  Public  Police  Others | 9458 ( 22.5)  31892 ( 75.7)  599 ( 1.4)  107 ( 0.3)  66 ( 0.2) | 777 ( 72.2)  241 ( 22.4)  43 ( 4.0)  13 ( 1.2)  2 ( 0.2) | 1  0.09 (0.08, 0.11)  0.87 (0.63, 1.19)  1.48 (0.79, 2.54)  0.37 (0.06, 1.18) | 1  0.13 (0.11, 0.16)  0.79 (0.50, 1.21)  1.25 (0.48, 2.76)  0.17 (0.01, 1.08) |
| Patients’ outcome  Survived  Deaths | 42579 ( 99.6)  157 ( 0.4) | 628 ( 57.5)  464 ( 42.5) | 1  201 (164, 244) | 1  127 (100, 162) |

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