

Analysis of Injuries from Sports and Recreational Equipment in the US

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Abstract: Injury data in tabular form from the National Electronic Injury Surveillance System (NEISS), in USA, are summarized and analysed to determine the pattern of injuries caused by, or associated with sports and recreational equipment (SRE). The NEISS data are estimates based on a sample 96 hospitals from over 5,000 with emergency departments, across the U.S. and its territories. Analyses are performed for 28 listed products, across five age-groups (0-5, 5-14, 15-24, 25-64, and over 65 years), for five consecutive years (2012-2016). Tables and several graphs are produced in this study to depict magnitudes and trends in injuries. The analyses categorized the SRE in three groups of sports – ball games, equipment for moving the body but controlled by the person, equipment for moving not under direct control of the person. The injury-age trend for most of the products was an increasing decreasing trend with the 5-14 and 15-24 age groups showing the greatest amount of injuries, unlike the bath tub trend found in home products (in a previously published study). The 5-14 year group showed most injuries for equipment used for propelling the body by muscular effort, and the 15-24 year group, for moving without direct control of the equipment (product). These trends proved to be very similar from year to year across the 5 year period, indicating that predictions of injury trend (but not necessarily injury magnitude), in the near future, may be reliable. Annual data are also analysed by sex. The greater injury numbers for males are most likely due to greater exposure but exact exposure data are not available from NEISS to make a more detailed and useful analysis.

Keywords: Video gaming, joint angle, joint velocity, joint acceleration, electromyography (EMG), interphalangeal joint, metacarpophalangeal joint.

1. Introduction

The National Electronic Injury Surveillance System (NEISS) of the Consumer Product Safety Commission (CSPC) has been collecting data, for over 45 years, on consumer product-related injuries in the United States (US), and using it to produce nationwide estimates of product related injuries. The data gathered is based on a nationally representative probability sample of approximately 100 hospitals from over 5,000 hospitals with emergency departments in the US and its territories. The data is collected for every department visit that is related to a consumer product or poisoning. The actual number of reported cases of injuries has been used to derive an estimated number for the total population. The data are published in tabular form as NEISS Data Highlights. The causes of injuries are not stated in the tables; the data indicate that the injury was associated with the product. Each table, covering a year, lists the data according to sex, age group (0-4, 5-14, 15-24, 25-64, and 65+ years), and product category. The recording system allows an injury to be associated with up to two products. The objective of this study was to analyse the NEISS data to detect trends in injury occurrence for sports and recreational equipment across age group and year of occurrence.

2. Methods

Tabular data (estimated number of injuries) from NEISS, from 2012 and 2016 were, were downloaded from NEISS website and analyzed for trends in injuries versus age, for each year, for each product associated with an injury. Only the eight products with the highest number of injuries were analyzed (Table 1). The data showed that there were small changes in the order (ranked according to estimated number of injuries) of the products from year to year, thus the worst 8 in any one year was not necessarily exactly the worst 8 in all years. However, the changes were small enough to be ignored. Consequently, year 2016 was used as a base year, and the top 8 products for that year was tracked across the other years.

3. Results and Discussion

The eight products that had the highest injury occurrence were Basketball, Exercise & Exercise Equipment, Baseball & Softball, (American) Football, Soccer, Playground Equipment, Bicycle and Accessories, and ATVs, Mopeds, Minibikes, etc. The data from 2016 are presented below, in Table 1, as representative of the data from 2012-2016. Seven of the eight products showed a similar pattern of a general increasing-decreasing trend with a peak injury occurrence at one of the age groups within the 5-64 year range (Figure 1). This trend was the opposite for home products, where most products had a bath tub trend (Proma and Imrhan, 2013). For four of the products -- baseball and softball, football, soccer, and playground equipment -- the peak injury occurred at age group 5-14 years. For basketball, the peak occurred at 15-24 years; and, for exercise/exercise equipment and ATVs/Mopeds/Minibikes, etc., the peak occurred at 25-64 years. For seven of the eight products (playground equipment not included), the smallest rates occurred in the youngest (0-4 years) and oldest age group (65+ years). The reason seems to be clearly related to the level of exposure of the age groups to the various products. The 0-4 year group would most likely use playground equipment more than any of the other seven products. It is, therefore, understandable why the 0-4 year group would have the second highest (after the 5-14 year) rate of occurrence for playground equipment; and also why the 15-64 year range would show very small amounts of injury. Baseball, softball, football, and soccer are played mostly in elementary and high schools; and exercise/exercise equipment and ATVs/Mopeds/Minibikes, etc. seem to be the products that adults seem to interact mostly with. For seven of the eight products, the 0-4 year group had the lowest or second lowest rate of occurrence. 'Bicycles and accessories' had an occurrence-age distribution that was different from the distribution of the other seven products, with maxima at two age groups (5-14 and 25-64 years) and a minimum at 15-24 years -- an M-shaped trend, probably due to the 15-24 year age group being more dexterous in riding bicycles.

Table 1. NEISS estimated number of injuries from 'Sports and Sports Equipment' in 2016, by age group

Sports/Sports Equipment	0-4 yr	5-14 yr	15-24 yr	25-64 yr	65+yr	Total
Exercise, Exercise Equipment	7,601	54,439	115,516	264,466	61,415	503,437
Basketball	1,598	166,039	225,170	89,310	1,731	483,848
Bicycles & Accessories	18,152	137,158	78,706	200,939	33,926	468,881
Football	1,228	191,830	149,654	32,766	715	376,193
Playground Equipment	58,650	163,995	7,857	11,360	945	242,807
Soccer	1,386	104,031	85,774	34,954	434	226,579
ATV's, Mopeds, Minibikes, etc.	3,872	40,382	57,014	100,096	13,954	215,318
Baseball, Softball	4,344	86,611	64,127	50,479	4,237	209,798

*The 2016 data is presented as representative of the data for all years, 2012-2016.

For most of the eight products, injury occurrence decreased gradually from 2012 to 2016. Also, the decrease seems to be greater in the age groups with the highest occurrence. The individual product trends are described below from examination of the graphical plots:

Basketball: An increasing-decreasing trend across age groups, with the maximum occurrence for the 15-24 year group. The number of injuries in the 0-4 and 65+ age groups were very low compared to the maximum. In 2016, it was 1,598 and 1,731 vs 225,171 injuries. The injury rate fell steadily from 2012 to 2016 (Figure 2), especially over the three age groups between 5-64 years of age. The smallest decrease occurred with the youngest and oldest age groups where the injury rates were the smallest, and the greatest drop at 15-24 year group where the occurrence was the greatest.

Baseball & Softball: An increasing-decreasing trend with the maximum at 5-14 years, and a steadily decreasing rate from group 5-14 years to 65+ years. As for basketball, the smallest decrease occurred with the youngest and oldest age groups where the injury rates were the smallest, and the greatest drop at 5-14 year group where the occurrence was the greatest.

Football: The trend is similar to that for baseball & softball basketball, except that the percentage drop from 5-14 to 15-32 years of age was not as steep as for baseball & softball. However, the decrease in number of injuries from 2012 to 2016 was similar to that for basketball and baseball/softball.

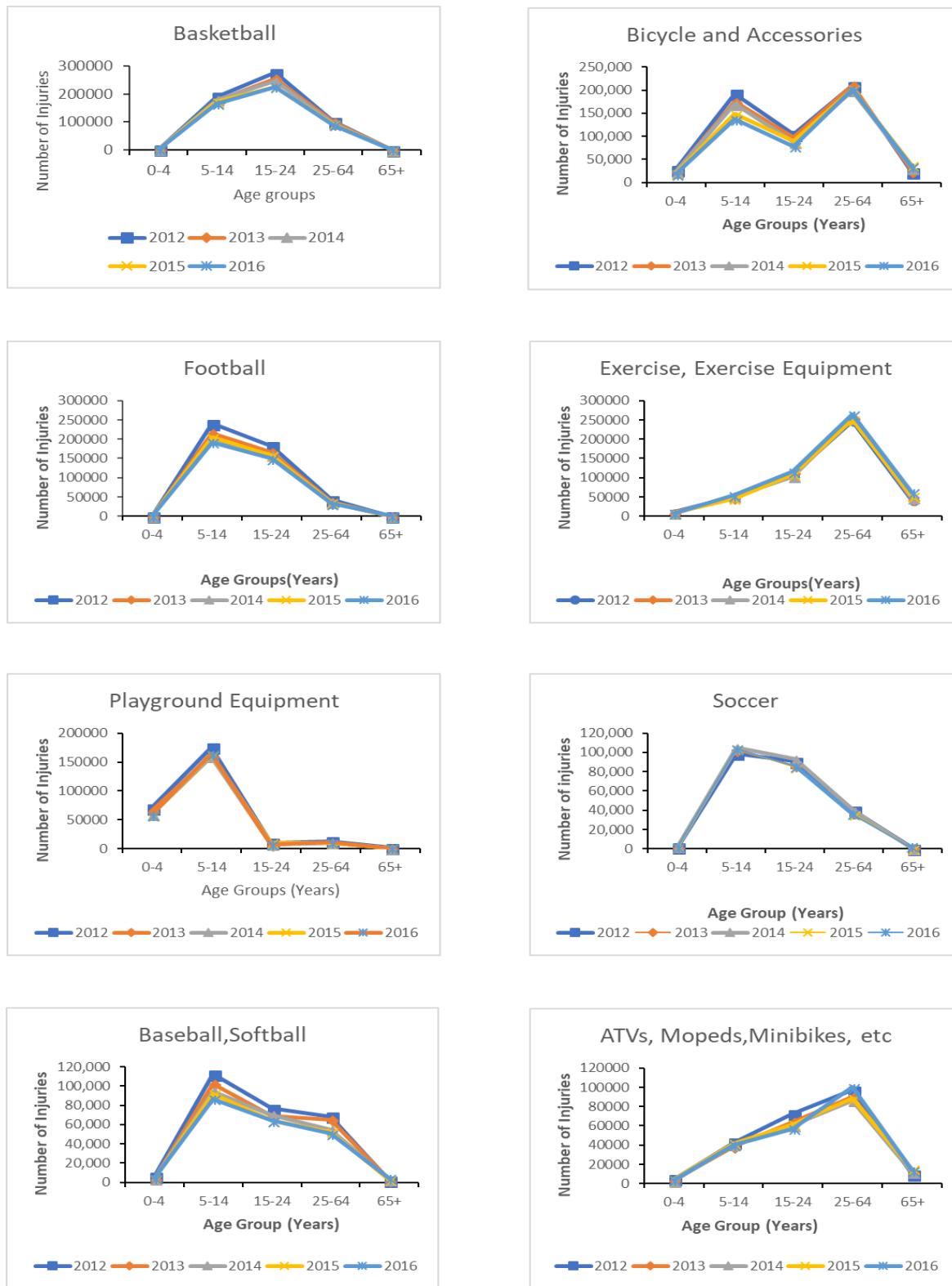


Figure 1. Plots of distribution of number of injuries vs age group of the injured for eight of the worst products for Sports and Recreational Equipment in the US. Seven of the eight products have an increasing-decreasing trend.

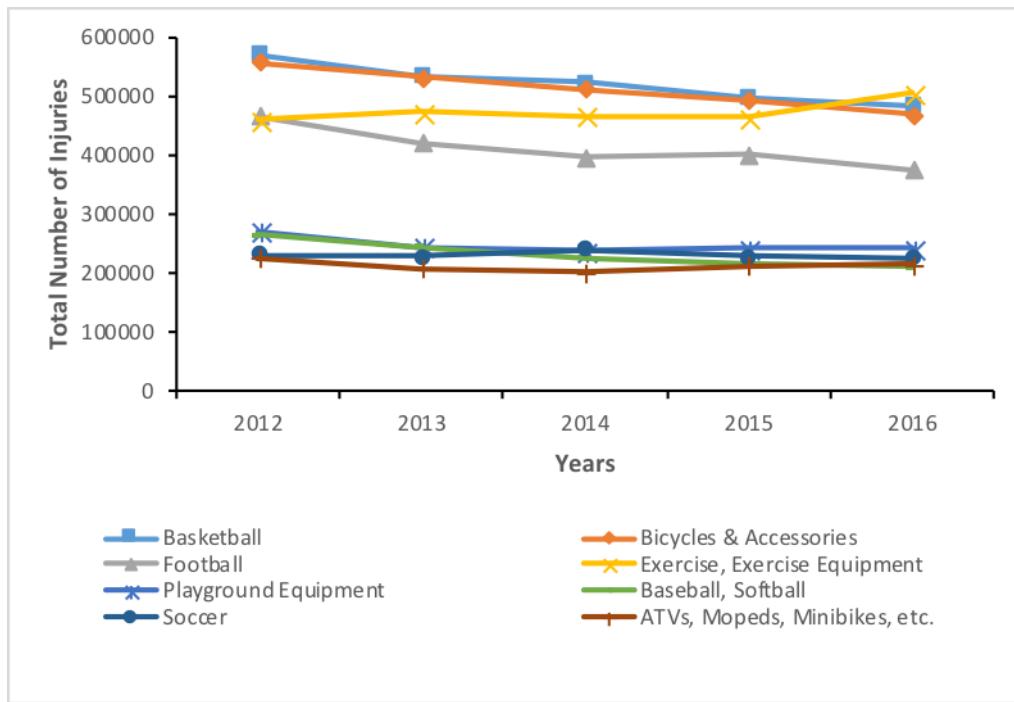


Figure 2. The distribution of the number of injuries for Sports and Recreational Equipment over years 2012-2016. The trend is upward (increase in number of accidents) for Basketball, Bicycles and Accessories, Football, and Baseball & Softball. There is upward for Exercise & Exercise Equipment.

Soccer: The injury-year trend was very similar to that for football, but there was no steady decrease from 2012 to 2016.

Playground Equipment: An increasing-decreasing trend with a very sharp drop after the maximal occurrence age group (5-14 years). The decrease from 2012 to 2016 was small.

Bicycles and Accessories: There are two maxima (at 5-14 and 25-64 years) with a sharp drop in occurrences at 15-24 years of age, yielding an M-shaped distribution of injuries with age. There was a steady decrease from 2012-2016, especially in the age groups from 5-64 years of age.

Exercise/Exercise Equipment: Increasing-decreasing trend with the maximum occurrence at the 25-64 year group. This group had 264,466 injuries out of a total of 503,437 injuries. The decrease in injury rate from 2012 to 2016 was relatively small.

ATVs, Mopeds, Minibikes, etc.: An almost linear increase from 0-4 year followed by a sharp drop at 65+ years. Unlike the other products mentioned above, there was only a slight decrease in injuries from 2012 to 2016, except at the 15-24 year group where the decrease was larger than at other age groups.

3. Conclusions

The trends in the occurrence of injuries seem to follow our expectations that the number of injuries is related to exposure to or usage of the equipment associated with the injury. Children below 14 years probably spend more time in playgrounds and, hence, are responsible for most of the playground injuries. Likewise older children and young adults are more exposed to football, basketball, and other games in school and are likely to sustain most of the injuries for those products. The results of the trends with age seem to be predictable, on the average, for all of the products mentioned in this study.

4. Cited References

Proma, F.A. and Imrhan, S.N.. (2013). A Comparison of Trends in Injuries in the Home in Two Time Periods. *XXVth Annual International Occupational Ergonomics and Safety Conference*, June 6-7, 2013 Atlanta, GA, USA, pp. 5-9.
 United States Consumer Product Safety Commission, Bethesda, MD, National Electronic Injury Surveillance System (NEISS), <https://www.cpsc.gov/Research--Statistics/NEISS-Injury-Data/>.