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Descriptive analysis of road traffic accidents in children aged 0-2 years*

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ABSTRACT

Aims: This study aims to investigate road traffic accidents (RTAs) involving infants and toddlers, defined as children from birth to 2 years old, focusing specifically on their epidemiology and outcomes.

Methods: A retrospective, single-center, observational, and cross-sectional study was conducted in the Emergency Department of a university-affiliated training and research hospital. Data were collected from July 1, 2019, to January 1, 2024.

Results: During the study period, 659 cases involved pediatric RTAs patients (individuals under 17 years old), with 41 cases specifically concerning infants and toddlers. These patients had a mean age of 12.98 ± 5.64 months, and 27 (65.9%) were boys. The median Pediatric Trauma Score for was 9 (range: 5-12) while the median pGCS score was 15 (range: 14-15). Motor vehicle accidents were the leading cause of injuries, accounting for 92.6% of cases, followed by motorcycle accidents (4.8%) and pedestrian-vehicle collisions (2.6%). Hospitalized patients exhibited various injuries, including femur fractures, subdural hematoma, orbital roof fracture, scalp hematomas, and lung contusion. Surgical intervention was required in only one case for a femur shaft fracture. Fortunately, no in-hospital deaths occurred among the study participants.

Conclusion: This study underscores the importance of adult supervision to prevent RTAs and emphasizes the critical need for strict enforcement of child passenger safety laws to reduce the incidence of motor vehicle accidents involving infants and toddlers.

Keywords: Toddler, traffic accident, infant, emergency department, trauma

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INTRODUCTION

Road traffic accidents (RTAs) pose a formidable global public health challenge, placing a profound burden on societies and healthcare systems, particularly concerning pediatric populations. According to the World Health Organization (WHO), RTAs are a leading cause of injury-related mortality in children, causing not only immediate physical trauma but also long-term disabilities, psychological distress, and significant economic strain.[1] Despite extensive efforts to mitigate the general impact of RTAs, there remains a critical need to investigate the specific vulnerabilities associated with early childhood.[2]

Neonates, infants, and toddlers constitute an exceptionally vulnerable demographic within the spectrum of RTAs. Their developmental immaturity, limited mobility, and complete reliance on caregivers for safety render them particularly susceptible to severe injuries, even in relatively minor collisions. Their small physical size and physiological fragility exacerbate these risks, while their limited capacity for communication can hinder effective diagnosis and treatment. Additionally, their dependence on properly fitted safety restraints and the absence of motor and cognitive skills to anticipate or avoid hazards significantly heighten their risk of severe outcomes in traffic accidents.[3]

In 2021, the United States reported 42,939 traffic fatalities, of which 1,184 (3%) were children. Analysis of trends over nearly a decade reveals significant disparities among pediatric age groups, with fatalities among the youngest children increasing markedly, while older age groups experienced declines. This trend underscores the particular vulnerability of very young children in RTAs.[4] However, there is a notable lack of similar data in Turkey, highlighting the need for targeted research to address this gap and inform effective preventive strategies.

This study aims to fill this gap by providing a comprehensive analysis of the characteristics, patterns, and outcomes of RTAs specifically affecting neonates, infants, and toddlers. To our knowledge, this is the first study in Turkiye to focus on RTAs within this age group. By concentrating on this highly vulnerable population, the research seeks to offer nuanced insights that extend beyond the general pediatric context, thereby facilitating the development of targeted preventive strategies.

METHODS

Study Design and Setting

This retrospective, single-center, observational, and cross-sectional analysis was performed in the Emergency Department (ED) of a university-affiliated training and research hospital located in Muğla, Turkiye. The study involved a systematic collection of data from consecutive neonates, infants, and toddlers patients admitted to the ED during the period from July 1, 2019, to July 1, 2023. The institution, boasting over 600 beds, handles an estimated 140,000 ED visits annually. Ethical approval was secured from the Institutional Ethics Review Board of Muğla Sıtkı Koçman University (Date: 17.07.2024, decision number: 88). Given the retrospective design, the requirement for obtaining written informed consent from patients was waived. All procedures were carried out in accordance with the ethical rules and the principles of the Declaration of Helsinki.

Selection of Participants:

The pediatric age cutoffs in this study were categorized according to the Munich Age Classification System (MACS), a widely recognized and universal age classification system used in pediatric emergency medicine: Neonate (up to the 27th day of life), infant (30 days – 12 months), and toddler (13 months – 2 years).[5] Our study included only children aged 0-2 years who were involved in an RTA, while those older than 2 years were excluded. Additionally, patients who were lost to follow-up or had missing data were also excluded from the study.

Data Collection

Data collection was rigorously executed using a standardized spreadsheet to ensure comprehensive and precise documentation of relevant parameters. Upon admission to the ED, age, sex, and types of RTAs were meticulously documented. Additionally, a comprehensive range of ancillary data was systematically collected, encompassing diagnostic methods, imaging findings, laboratory test results, final in-patient diagnoses, and key outcome variables, including the need for hospital admission, surgical interventions, length of hospital stay (LOS), and all-cause mortality. Notably, the initial Pediatric Glasgow Coma Scale (pGCS) score and Pediatric Trauma Score (PTS) were calculated for each patient, offering crucial assessments of trauma severity and aiding in the evaluation of clinical outcomes.

Statistical Analysis

The normality of the data distribution was assessed using the Kolmogorov-Smirnov test. Continuous variables were presented as either mean±SD or median (range) depending on their normality. Categorical variables were expressed as absolute values and percentages. Demographic, laboratory, and clinical variables were compared between the two groups, with differences in admission and discharge status assessed using the Mann-Whitney U test for continuous variables and Chi-squared test for categorical variables. For all tests, p>.05 was considered statistically significant. All analyses were performed using SPSS version 25.0 statistical software (SPSS Inc., Chicago, Ilinois).

RESULTS

Our study includes 41 children under the age of 2 who were brought to the emergency department due to RTAs. Of these cases, 8 occurred in the first year, 6 in the second year, 10 in the third year, and 17 in the final year of the study period. The patient flow diagram of the study design is illustrated in Figure.

The distribution across age groups was as follows: 0 neonates (0%), 18 infants (43.9%), and 23 toddlers (56.1%). Our study focused on a cohort of 41 infants and toddlers, with a mean age of 12.9 ± 5.6 months (range: 3 to 24 months), of whom 27 (65.9%) were male. The median PTS for this cohort was 9 (range: 5-12), while the median pGCS score was 15 (range: 14-15). Table details the baseline characteristics of the enrolled patients, categorized by their admission or discharge status.

Injury mechanisms varied, with motor vehicle collisions (MVCs) (n=38, 92.6%) being the predominant cause, followed by motorcycle accidents (n=2, 4.8%) and pedestrian-vehicle collisions (n=1, 2.6%). RTAs were most frequent in the summer (n=21, 51.2%), with the highest occurrence in July (n=9, 22%) and on weekdays (n=23, 56.1%).

Table. Baseline characteristics of enrolled patients by admission or discharge status

Variables	Total (n=41)	Discharged (n=32)	Admitted (n=9)	P value*
Demographic data				
Age (months)	12.9 ± 5.6	13.5 ± 5.8	11.0 ± 4.6	0.195
Sex (man/woman)	27/14	21/11	6/3	0.954
Day type (weekdays/weekends)	23/18	19/13	4/5	0.425
Hematology profile				
White blood cell count (x10^3/µL)	13.3±5.1	13.6±5.2	12.1±4.8	0.429
Red blood cell count (x10^6/µL)	4.3±0.5	4.2±0.5	4.7±0.5	0.060
Hemoglobin (g/dL)	11.6±1.6	11.5±1.7	12.0±1.1	0.154
Hematocrit (%)	35.1±5.4	34.7±5.5	36.3±3.6	0.164
Platelet count (x10^3/µL)	319.6±110.7	341.0±143.1	243.5±194.0	0.269
Serum chemistry				
Glucose (mg/dL)	112.7±42.9	115.7±47.0	102.2±21.4	0.343
Blood urea nitrogen (mg/dL)	19.4±1.3	19.0±8.2	20.7±9.6	0.793
Creatinine (mg/dl)	0.34±0.09	0.35±0.09	0.32±0.11	0.312
Sodium (mmol/L)	136.5±2.7	136.8±2.7	135.4±2.4	0.242
Potassium (mmol/L)	4.6 ±0.5	4.6±0.5	4.6±0.3	0.865
Calcium (mg/dl)	10.3±0.7	10.3±0.7	10.5±0.8	0.297
Albumin (g/dl)	45.0±3.5	44.8±3.5	45.7±3.3	0.609
Aspartate transaminase (IU/L)	56.5±41.5	60.5±45.4	42.2±18.1	0.128
Alanine transaminase (IU/L)	25.9±25.2	27.1±27.9	21.7±11.3	0.841
Clinical scoring tools				
Pediatric trauma score	9 (5-12)	9 (9-12)	8 (5-9)	<0.001
Pediatric Glasgow coma scale score	15 (13-15)	15 (15-15)	15 (13-15)	0.327

Data are expressed as mean ± SD, median (range), or count for categorical variables unless otherwise indicated. *: The *P* value reflects the comparison between discharge and admission patient variables.

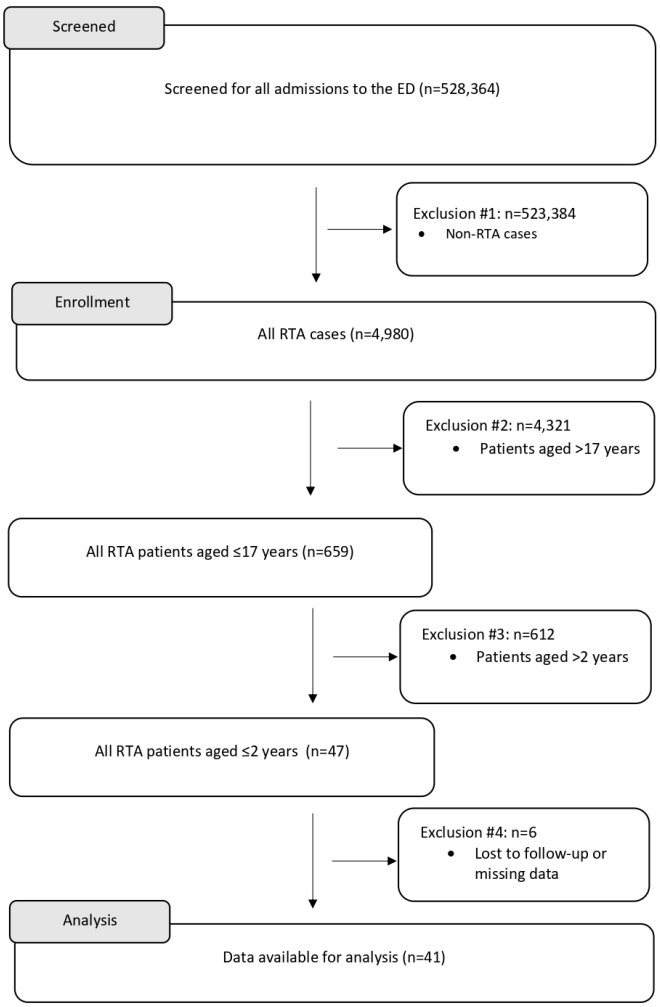

Figure. Flow diagram of the study design

Diagnostic management revealed that nearly all patients (n=38, 92.6%) underwent extended focused assessment with sonography in trauma. Computed tomography (CT) scans, primarily for suspected head injuries, were conducted in 21 cases (51.2%), while plain X-rays were performed in 10 cases (24.3%). Among these patients, injuries included 2 femur fractures, 1 subdural hematoma, 1 orbital roof fracture, 2 extensive scalp hematomas, 1 lung contusion, and 2 cases of vital abnormalities, leading to the hospitalization of 9 patients (21%). Additionally, only 1 patient was admitted to the pediatric ICU, and surgical intervention was necessary for 1 patient with a femur shaft fracture. The mean LOS for the cohort was 4.7 ± 2.9 days, and no in-hospital deaths were reported.

DISCUSSION

This study offers critical insights into the underexamined subset of RTAs affecting children from birth to 2 years of age, highlighting the urgent need to address the unique epidemiological and outcome-related aspects of these incidents in this particularly vulnerable group. Our findings reveal that motor vehicle accidents are the predominant cause of injuries within this age cohort, underscoring the necessity for targeted preventive strategies. Moreover, the high frequency of head injuries identified through CT scans points to a pressing need for the development of age-specific imaging guidelines to minimize the risks associated with radiation exposure in such young patients.

In 2021, the United States reported 42,939 traffic fatalities, of which 1,184 (3%) were children. A detailed analysis from 2012 to 2021 reveals significant disparities in trends among different pediatric age groups. Fatalities in the under-1 age group increased by 52%, from 60 to 91, while the 1-to-3 age group saw a 31% decrease from 269 to 186. Specifically, from 2020 to 2021, there was a 54% increase in fatalities among children under 1 year, rising from 59 to 91, while the number of fatalities in the 1-to-3 age group remained constant at 186. These statistics underscore the vulnerability of very young children in road traffic accidents.[4]

The injury mechanisms observed in this study reveal that MVCs were the predominant cause of trauma among infants and toddlers, accounting for 92.6% of cases. This underscores the urgent need for targeted preventive measures to address this critical issue. The high incidence of MVCs in our study highlights a significant area for intervention, particularly given the developmental vulnerabilities of this age group. Existing literature underscores the crucial role of targeted safety interventions in mitigating the severity of MVCs involving young children. The use of child safety seats has been shown to significantly lower the risk of fatal injuries, achieving a 71% reduction in infants under 1 year of age and a 54% reduction in toddlers aged 1 to 4 years in passenger cars. In light trucks, these reductions are 58% for infants and 59% for toddlers, respectively.[6] Moreover, research by Rice et al.[7] provides compelling evidence that the proper utilization of car seats substantially decreases the risk of severe injury and mortality among children aged 3 years or younger involved in RTAs. Their findings underscore the superior effectiveness of child safety seats in preventing fatalities during severe collisions, surpassing the protective capability of traditional seat belts. However, it is important to note that our study did not collect data regarding the pre-hospital use of child safety seats or other child safety measures. This absence represents a limitation, as it precludes a comprehensive analysis of the potential protective effects of such interventions in our patient population. Future studies should aim to include these variables to provide a more complete understanding of the factors influencing injury outcomes in this vulnerable demographic.

Effective injury prevention in young children requires a multifaceted approach that extends beyond the deployment of safety devices to include comprehensive educational and awareness initiatives. Britton et al.[8] emphasize the critical importance of educational programs aimed at parents and caregivers to enhance the safety outcomes of child restraint systems (CRS). Despite high levels of self-reported confidence in CRS use among parents, especially those with experience installing only a single system, this confidence often does not align with actual proper installation and usage. This discrepancy reveals a need for further investigation into the factors contributing to the gap between perceived competence and the actual effectiveness of CRS. Moreover, public awareness campaigns focusing on child passenger safety have demonstrated efficacy in promoting safer practices. Bakhurji et al.[9] illustrated that educational interventions delivered via social media substantially increased parental knowledge and awareness regarding the correct use of car seats. Their study highlights the significant impact of social media in disseminating essential safety information and improving

adherence to child restraint protocols, underscoring the potential of these campaigns to advance child passenger safety and reduce risks associated with RTAs involving young children. Policymakers must consider enacting and enforcing stricter regulations on car seat usage, implementing educational programs for parents and caregivers about the importance of proper restraint systems, and enhancing public awareness campaigns focused on child passenger safety.

The use of CT scans in diagnosing injuries in pediatric patients, particularly following RTAs, raises critical concerns about ionizing radiation exposure. Infants and toddlers are especially vulnerable due to their developing tissues and longer life expectancy, which heightens the risk of radiation-induced malignancies. In our study, half of the patients underwent CT scans, a statistic that underscores the importance of meticulously evaluating imaging practices in pediatric trauma care. This widespread use of CT imaging in young patients has sparked an ongoing debate in the medical community, with many experts advocating for the development of age-specific guidelines to ensure CT scans are used judiciously and only when absolutely necessary. Aligning with the ALARA (As Low As Reasonably Achievable) principle, there is an increasing emphasis on minimizing radiation exposure by optimizing CT protocols and considering alternative diagnostic modalities when possible. These efforts are vital to safeguarding the long-term health of pediatric patients while still providing the critical diagnostic information needed to guide effective treatment.[10]

The outcomes observed in our study cohort provide valuable insights into the clinical course and management of RTAs among infants and toddlers. While the majority of patients did not require hospitalization, a notable proportion exhibited significant injuries necessitating further medical intervention. The absence of in-hospital deaths among our study population is reassuring; however, it is imperative to recognize the potential long-term consequences of RTAs in this vulnerable age group, including physical, cognitive, and emotional sequelae. Future research endeavors should focus on longitudinal follow-up studies to elucidate the full spectrum of outcomes and inform comprehensive rehabilitation strategies tailored to the unique needs of infant and toddler survivors of RTAs.

Despite the valuable insights provided by our study, several limitations warrant consideration. Firstly, the retrospective nature of the study design may have introduced selection bias and hindered the comprehensive capture of all relevant data. Secondly, the reliance on a single-center setting limits the generalizability of our findings to broader populations with varying demographic and geographic characteristics. Thirdly, the inclusion of COVID-19 lockdown periods in the study may have led to a relatively small sample size of infants and toddlers involved in RTAs, potentially restricting the statistical power and precision of our analyses. Additionally, the exclusion of patients with missing data or those transferred to other facilities may have influenced the representativeness of our study cohort. Moreover, our study did not collect data regarding the pre-hospital use of child safety seats or other child safety measures, which limits our ability to analyze the potential protective effects of such interventions. Lastly, the absence of long-term follow-up data precludes a comprehensive assessment of the sustained impact and outcomes of RTAs among infants and toddlers beyond the acute care setting. Furthermore, our study is limited by the absence of pre-hospital mortality data, which may affect the comprehensive understanding of the overall outcomes of RTAs involving infants and toddlers.

CONCLUSION

As a result, our study provides valuable insights into the epidemiology and clinical outcomes of RTAs in infants and toddlers, a uniquely vulnerable population. By identifying distinct injury patterns and seasonal trends, we emphasize the need for targeted preventive strategies. The predominance of motor vehicle accidents underscores the critical importance of optimizing child restraint systems and educating caregivers on their correct use. Our findings also reveal the necessity for age-specific diagnostic and management protocols. Future research should focus on evaluating the long-term outcomes of RTAs in this age group and the effectiveness of current preventive interventions.

ETHICAL DECLARATIONS

Ethics Committee Approval

The study was initiated with the approval of the Muğla Sıtkı Koçman University Medical Sciences Ethics Committee (Date: 17.07.2024, Decision No: 88).

Informed Consent

Because the study was designed retrospectively, no written informed consent form was obtained from patients.

Referee Evaluation Process

Externally peer-reviewed.

Conflict of Interest Statement

The authors have no conflicts of interest to declare.

Financial Disclosure

The authors declared that this study has received no financial support.

Author Contributions

All of the authors declare that they have all participated in the design, execution, and analysis of the paper, and that they have approved the final version.

REFERENCES

1. World Health Organization (WHO). Fact sheet on road traffic injuries. 2023. Accessed September 4, 2024. https://www.who.int/news-room/fact-sheets/detail/road-traffic-injuries
2. Popa Ş, Ciongradi CI, Sârbu I, Bîcă O, Popa IP, Bulgaru-Iliescu D. Traffic accidents in children and adolescents: A complex orthopedic and medico-legal approach. *Children (Basel).* 2023;10(9):1446. doi:10.3390/children10091446
3. Doong JL, Lai CH. Risk factors for child and adolescent occupants, bicyclists, and pedestrians in motorized vehicle collisions. *Traffic Inj Prev.* 2012;13:249-257.

4. National Highway Traffic Safety Administration (NHTSA). Traffic safety facts 2021: A compilation of motor vehicle crash data. Washington, DC: National Highway Traffic Safety Administration; 2023. Report No.: DOT HS 813 456. Accessed September 4, 2024. https://crashstats.nhtsa.dot.gov/Api/Public/ViewPublication/813456

5. Althammer A, Prückner S, Gehring GC, Lieftüchter V, Trentzsch H, Hoffmann F. Systemic review of age brackets in pediatric emergency medicine literature and the development of a universal age classification for pediatric emergency patients: The Munich Age Classification System (MACS). *BMC Emerg Med*. 2023;23(1):77. doi:10.1186/s12873-023-00851-5. Erratum in: *BMC Emerg Med*. 2024;24(1):145. doi:10.1186/s12873-024-01064-0

6. National Highway Traffic Safety Administration (NHTSA). Countermeasures that work: Seat belts and child restraints. Washington, DC: National Highway Traffic Safety Administration; 2023. Accessed September 4, 2024. https://www.nhtsa.gov/book/countermeasures-that-work/seat-belts-and-child-restraints

7. Rice TM, Anderson CL. The effectiveness of child restraint systems for children aged 3 years or younger during motor vehicle collisions: 1996 to 2005. *Am J Public Health*. 2009;99(2):252-257. doi:10.2105/AJPH.2007.131128

8. Britton J, Jacobs K, Haidar T, et al. Child restraint systems: Understanding confidence in proper use and addressing the need for education. *Heliyon*. 2023;9(7). doi:10.1016/j.heliyon.2023.e17409

9. Bakhurji EA, Alqahtani AM, Alwashmi ES, Husain M, Gaffar BO. The effect of social media campaign on parental knowledge, attitudes, and practices regarding the use of children car seats in the Gulf region. *BMC Public Health*. 2023;23(1):1816. doi:10.1186/s12889-023-16742-0

10. Granata C, Sofia C, Francavilla M, et al. Let's talk about radiation dose and radiation protection in children. *Pediatr Radiol*. 2024;1:11. doi:10.1007/s00247-024-06009-0