Retrospective review of paediatric patients involved in pedestrian vehicle accidents in the greater Cape Town area

by

Izelle Möller

MLLIZE001

This study is in partial fulfilment of the requirements for the degree

Master of Medicine in Forensic Pathology

University of Cape Town

Supervisor(s): Dr. L. Liebenberg, Dr. L. Heathfield

Department of Pathology, Division Forensic Medicine and Toxicology

University of Cape Town

July 2019

Table of Contents

PART C: ADDENDA

Declaration

I, Izelle Möller, hereby declare that the work on which this thesis is based is my original work (except where acknowledgements indicate otherwise) and that neither the whole work nor any part of it has been, is being, or is to be submitted for another degree in this or any other university. I authorise the University to reproduce for the purpose of research either the whole or any portion of the contents in any manner whatsoever. I further declare the following:

1. I know that plagiarism is a serious form of academic dishonesty.
2. I have read the document about avoiding plagiarism, am familiar with its contents and have avoided all forms of plagiarism mentioned there.
3. Where I have used the words of others, I have indicated this by the use of quotation marks.
4. I have referenced all quotations and properly acknowledged other ideas borrowed from others.
5. I have not and shall not allow others to plagiarise my work.
6. I declare that this is my own work.
7. I am attaching the summary of the Turnitin match overview.

Signature:

Signed by candidate

Date: 31 July 2019

ABSTRACT

Pedestrian vehicle injuries are a growing public health threat worldwide. In South Africa, pedestrian accidents are the leading cause of injury related deaths in children younger than 15 years. There is international and national research looking at various aspects of pedestrian vehicle accidents. Previous studies have highlighted the general distribution of injuries sustained in paediatric pedestrian accidents. However, the specific types of injuries sustained by children pedestrians in different age groups have not been widely researched. We conducted a retrospective review of children involved in road traffic accidents as pedestrians in the greater Cape Town area from 2011 to 2015. The study population included patients below the age of 13 years that were admitted to Red Cross Children's Hospital (RCCH), as well as those subjects that died and presented to the Forensic Pathology Laboratory in Salt River also known as Salt River Mortuary (SRM). The age group 0-12 years was selected because RCCH is a referral paediatric hospital that only admits children under the age of 13 years. Data obtained from the study population were analysed according to age, gender, time, date (day of week and month) and area of accident, as well as injuries sustained. Cases were grouped according to age in order to analyse and compare changes in injury patterns for different groups. Age groups 0-4 years, 5-9 years and 10-12 years were selected. Further comparison of the injuries sustained was made between children admitted to RCCH (survivors) and subjects admitted to SRM (deceased). During the 5-year period 552 children were admitted to RCCH and 109 cases were admitted to SRM with 2:1 male to female predominance in both study groups. In our study, the group with the highest number/percentage of deaths was children aged 0 – 4 years, which contrasts with previous research. Most of the accidents (75-80%) occurred in lower socio-economic areas. Significantly more head injuries occurred in children who died from their injuries than those who survived (96% versus 18%) ($p < 0.0001$). Out of the children who demised, 27% had spinal injuries, 61% had chest injuries and 43% had abdominal injuries, all of which were significantly higher than children who survived ($p < 0.0001$ for each). Upper limb injuries were equal between the two groups (12% vs 13%) and lower limb injuries were more common in the survivors (46% vs 24%). These results are the first to be documented in Cape Town and provide insight into the nature of injuries sustained by children involved in pedestrian vehicle accidents.

ACKNOWLEDGEMENTS

To everyone who supported me through this journey especially my husband for all his advice and input.

To the consultants in the Division of Forensic Medicine and Toxicology, thank you for your time and mentorship.

To Dr Linda Liebenberg, for teaching me how to care for the dead and to never compromise on the quality of my work.

And last but not the least, to Dr Laura Heathfield, my greatest thanks for all your effort and advice.

LIST OF FIGURES AND TABLES:

Part A: Literature review

Part B: Manuscript in article format

List of abbreviations:

WHO: World Health Organization

UNICEF: United Nations Children's Fund

NIMMS: National Injury Mortality Surveillance System

ITF: International Transport Forum

RCCH: Red Cross Children's Hospital

SRM: Salt River Mortuary

PACS: Picture Archiving and Communication System

PART A: LITERATURE REVIEW

INTRODUCTION

The World Health Organization's 2018 Global status report on road safety revealed that 1,35 million people are killed each year on roads around the world.[1] This amounts to 100 000 more lives lost per year than reported in 2015.[2]

Dr M Chan, the previous director-general of the World Health Organization (WHO) said: "Thousands of people lose their lives on the roads every day and millions more are left with disabilities and/or emotional scars. Children are among the most vulnerable due to their physical and developmental immaturity and their dependence on adults. This is a tragedy that we can change. We need to challenge the notion that road traffic accidents are unavoidable and make room for a pro-active, preventative approach to reduce deaths on our roads."[3]

Road safety has become a global health emergency to such an extent that the United Nations launched the "Decade of Action for Road safety" (2011-2020) during which they call upon all countries to act and make their roads safer by implementing internationally identified road safety measures.[2-4] The plan is based on five key pillars of action namely road safety management, safer infrastructure, safer vehicles, safer road user behaviour and improved post-accident response.[4]

According to the World report on child injury prevention (2008), a joint report by the World Health Organization and the United Nations Children's Fund (UNICEF), 21% of all road traffic related deaths, worldwide, were children.[5] It is our responsibility as adults to minimize this tragedy because children depend on us to protect them. As the late president Nelson Mandela said: "Our children are our greatest treasure. They are our future. We owe them, the most vulnerable citizens in any society – a life free from violence and fear."

We as South Africans are legally obliged by the **Children's Act No 38 of 2005** to give effect to the constitutional right of children to be protected from any form of harm (maltreatment, neglect, abuse or degradation); and to always seek the best interests of a child in every matter concerning a child, and in general, to promote the

protection, development and well-being of all children.[6] To do this, it is necessary to research every aspect associated with child pedestrian vehicle accidents so that we can act upon the results and raise awareness, educate individuals and inspire stakeholders to take our children into consideration when roads are built, vehicles are designed, and road safety programmes are implemented.[3]

The aim of the study is to look at the demographic aspects and the injury patterns in paediatric pedestrian vehicle accidents that occurred in the Greater Cape Town area from 2011 to 2015.

Objectives of literature review

1. To determine the global as well as the local extent of the disease burden, and the economic burden of road traffic injuries including child pedestrian injuries.
2. To determine the demographics (age, gender) of paediatric pedestrian vehicle accidents and the time/space correlation.
3. To identify the risk factors for road traffic accidents in the general population, and more specifically child pedestrian vehicle accidents.
4. To review previously described injury patterns in child pedestrian vehicle accidents.
5. To review preventative interventions created to improve road safety for all road users, including children.

Literature search strategy

A literature search was performed using Google as well as Google Scholar and Primo Ex Libris Discovery via the UCT Library website. The articles found via these search engines allowed for further expansion of the literature search through their references. The search criteria were “child pedestrian injuries or accident” and “paediatric pedestrian injuries or accident”.

A Google search for “child pedestrian injuries”, resulted in 12000 articles, Google Scholar cited 572 articles, and UCT Primo Ex Libris cited 469 articles. A Google search for “paediatric pedestrian injury” cited 4750 articles, Google Scholar cited 460 articles, and UCT Primo Ex Libris cited 67 articles.

Quality of Research

All research related to this topic, is retrospective in nature. Therefore, the level of evidence is that of a retrospective review. No prospective research is possible for this topic, due to its nature.

RESULTS AND DISCUSSION

1. Extent of child pedestrian injuries

According to the World Health Organization 1,35 million people are killed and another 50 million people are injured each year due to road traffic accidents.[1,3] Road traffic injury is currently the eighth leading cause of death for all age groups surpassing HIV/AIDS, Tuberculosis and diarrhoeal disease.[1] It is predicted that by the year 2030 road traffic injuries will be the fifth leading cause of death worldwide and the seventh leading cause of disability-adjusted life years lost with ischaemic heart disease, cerebrovascular disease (stroke), chronic obstructive pulmonary disease (COPD) and lower respiratory infections (mainly pneumonia) as the other causes. [5] Pedestrians account for 23% of all road traffic deaths worldwide.[1]

At this point in time road traffic injury is the leading cause of death in children aged 5-18 years.[1] It is estimated that 10 million children are injured and/or disabled annually due to road traffic accidents which makes it the leading cause of disability in children worldwide.[5] The World report on child injury prevention (2008) states that approximately 33% of all children that die in road traffic accidents are pedestrians.[5]

In 2006 20% of children killed on roads in the United States were pedestrians, and 25% of pedestrians injured in road traffic accidents were children under the age of 15 years.[7] A study done in California revealed that child pedestrian injuries are the third leading cause of injury-related deaths and the fourth leading cause of hospitalization for serious but non-fatal injuries.[8] A Canadian study (2007-2008) showed that pedestrian injuries are the leading cause of injury-related deaths in children below the age of 14 years.[9] In Japan almost 70 000 pedestrians were injured in motor vehicle accidents during 2010 and 17% of this 70 000 were children under the age of 13 years.[10]

According to the 2018 Road Safety Annual Report compiled by the International Transport Forum (ITF), of which South Africa is an observer country, 90% of road traffic deaths around the world occur in low and middle income countries.[4] Road traffic death rates in these countries are more than double in comparison to those in high income countries.[2] Africa for example has the highest prevalence of pedestrian deaths where 40% of all road traffic deaths are pedestrians.[1,2] Child pedestrians account for 30-40% of road traffic deaths in low and middle income countries compared to the 5-10% in high income countries.[5,11] A study done in Lagos Nigeria found that over a two year period (2012-2014) almost 70% of children injured in road traffic accidents were pedestrians.[12]

NIMSS (National Injury Mortality Surveillance System) data from 2005 shows that transport-related injuries in South Africa accounted for more than 70% of accidental deaths.[13] Kopits et al (2003) predicted that road traffic injuries in Sub-Saharan Africa will show a staggering 80% increase from 2000 to 2020.[14,15] According to the Arrive Alive Road traffic fatality report, 28 121 people died on South African roads for the year 2016-2017, of which 2496 fatalities occurred in the Western Cape (ranking sixth in the country).[16] Pedestrians account for 38% of road traffic fatalities in South Africa which is the highest of all road user groups, and 17% of these pedestrian fatalities were children below the age of 14 years.[16]

NIMSS data from 2003 showed that pedestrian vehicle accidents were the largest single cause of injury-related death among children in South Africa aged 1 to 14 years.[14,17] A study done at Red Cross Children's Hospital showed that the leading cause of road traffic injuries among children seen at the hospital over a period of two

decades (1992-2012) was pedestrian vehicle accidents and that 80% of children admitted with severe injuries were pedestrians.[11] A more recent study (2014) also done in Cape Town found that 72,5% of children under the age of 13 that died in road traffic crashes were pedestrians, and that more than 70% of fatal as well as non-fatal injuries occurred in pedestrians.[18] Norman et al (2007) blames unsafe road environments, poor law enforcement, speeding, road rage and alcohol misuse for the high death toll on South African roads.[13,19]

2. Economic burden of injury

"Human suffering for victims and families of road traffic related injuries is incalculable. There are endless repercussions like family break-ups, high counselling costs for bereaved relatives, no income for a family if the breadwinner is lost and thousands of Rands to care for injured or disabled victims."

- Moira Winslow, chairman of Drive Alive SA.

The burden of an injury is often overwhelming for the individual, their families and society as a whole.[20] In 2007 the global economic burden of road traffic accidents and pedestrian injuries totalled 500 billion US dollars which amount to 6,7 trillion rand. [20,21]

Road traffic accidents place a massive burden on a country's health care system and its economy in general.[3] In 2000 the cost of all road traffic accidents in the USA was 230,6 billion US dollars in total. This amount included loss of productivity, legal costs, property damage, emergency services, medical costs and insurance fees.[20] In 2003 paediatric pedestrian fatalities in the USA accounted for the largest number of years lost which amount to a substantial economic burden for society.[7] Road traffic injuries reduce productivity and ultimately economic performance. Socio-economic costs of road crashes for the European Union are estimated to be more than 500 billion euros (R 7,6 trillion). Most of the costs are related to serious injuries sustained.[4]

The problem is even more severe in regions like Africa and Asia where the youth makes up a larger proportion of the population and child pedestrian injuries are

common due to road sharing.[3] The costs of road traffic accidents in low and middle-income countries are estimated to be 65-100 billion US dollars (R 878-1352 billion) per year which is more than these countries receive in development assistance.[3,21] A research and development report titled “Cost of crashes in RSA” prepared for the Road Traffic Management Corporation, stated that the total cost of road traffic accidents on South African roads during 2015 amounted to an estimated R143 billion.[22] The 2018 International Transport Forum Annual Road Safety report stated that the total economic cost of SA road traffic accidents for 2017 was estimated to be R162 billion.[4]

Injuries sustained during road traffic accidents place large physical and psychosocial strain on families as well as financial strain because many of these victims are left with long term injuries and disabilities like children who sustained traumatic brain injuries.[3] Members of poor communities are statistically more commonly involved in road traffic accidents and are affected the most by this economic burden. This is highlighted by research done in Bangladesh and India which showed a further decline into poverty when injuries were sustained by the poor.[21]

3. Demographics

Most studies agree that child pedestrian **injury and deaths** rates are highest for the age group 5-9 years and that boys are almost two times more at risk than girls across all age groups.[3,5,8,11,14,25,26,33] The World report on child injury prevention (2004) states that child pedestrians aged 5-14 years are most at risk to sustain injuries or to be killed during a road traffic accident and boys are high risk due to their greater propensity in risk taking.[3,5,8]

According to ITF Road safety annual report (2018) most traffic fatalities occur on rural roads.[4] However, more than 50% of child pedestrian deaths and 95% of child pedestrian injuries in Canada occur in urban areas.[9] A Cape Town study showed that during 1992-2000 the bulk of pedestrian injuries treated at Red Cross Children’s Hospital came from informal settlements (Langa, Nyanga, Khayelitsha, Atlantis and Gugulethu).[14]

In the USA most of the pedestrians aged 6-16 years are killed after school hours and nearly 40% of these deaths result from accidents occurring between 3-8pm which suggests children at play.[7,8] According to NIMMS (2003) child pedestrian accidents in SA peaks at times when children travel to and from school[14] while Mabunda et al (2007) found that they are primarily killed during weekday afternoons/evenings with peak times at 18:00–19:00 followed by 16:00–17:00.[14,23]

A New York study found that most paediatric pedestrian injuries occur on Fridays with injuries less common over weekends [24] while a study in Ghana showed that pedestrian fatalities were significantly greater on Fridays and least common on Tuesdays.[25] In the USA most child pedestrian injuries are sustained during the summer months.[8] South African studies have shown an almost equal distribution across the months of the year with peaks in January, June and September.[14,23]

4. Risk factors

There are children that work, play and even live on roads. This exposes them to certain risks and hazards because the development of the road environment rarely takes their needs into consideration.[5] This along with the risk factors inherent to childhood, make them particularly vulnerable in traffic.[5] It is crucial to understand why childhood road users are at risk so that effective preventative strategies can be developed and implemented.[3]

a) Physical and developmental factors

- Children's limitation in size (short stature) make it difficult for them to see oncoming traffic and to be seen by other road users.[3]
- Their head size to body ratio are greater which put them at greater risk for sustaining head injuries.[3]
- It is difficult for children to judge the distance between themselves and others because their perception of depth is less developed.[3] They also have limited peripheral vision and accuracy.[7]
- Due to limited hearing abilities children struggle to determine where a sound or car is coming from.[3]

- Children are often impulsive and easily distracted which may result in sudden movement like running into the road.[3]
- Due to their short concentration span it is difficult for them to cope with multiple problems which is needed to make decisions.[3]
- It is also difficult for a child to judge the speed a vehicle is travelling at.[3]
- Children do not understand traffic signals and the concept of safe street crossing.[7]

b) Socio-economic factors

- Previous research repeatedly shows that children from poor families more frequently suffer pedestrian injuries.[9]
- Peden et al (1998) proved that a high number of pedestrian injuries occur in and around informal settlements which is known for overcrowding and limited play areas.[26]
- Children in informal settlements depend heavily on walking as primary means of transportation and because these settlements are mainly located alongside highways they are forced to cross busy roads.[26]
- It is reported that children from disadvantaged areas cross streets significantly more than those from affluent areas.[26]
- Children living in unsafe neighbourhoods may influence where they choose to walk[9] eg. avoidance of foot bridges which are high risk zones for muggings.

c) Low and middle-income countries

- Resource constraints and inadequate consideration in urban planning force children to share road space with high-speed traffic for playing, walking and in some cases to run small businesses.[3]
- Environmental factors associated with low income countries and neighbourhoods like higher speed limits, high density of moving and stationary vehicles and restricted play areas increase the risk of child pedestrian vehicle accidents.[9,25]
- The lack of safe efficient public transport and infrastructure, like in South Africa, increase pedestrians' exposure to road traffic.[14]

d) Other general risk factors
    - Poor child supervision, poor vehicle design and upkeep, poor road conditions.[20]
    - Speeding; a pedestrian struck by a vehicle speeding at 50 km/hour has an eight times higher risk to be killed than when struck by a vehicle travelling at 30 km/hour.[9,20]
    - Drinking and driving.[3,20]

The Arrive Alive Road traffic fatality report for 2016/2017 states that human error, specifically speeding and failure to keep the vehicle under control, contributes to almost 90% of road traffic fatalities in South Africa. Vehicle error (burst tyre and faulty brakes) contributes only 7% and the environment (wet surface and potholes) a mere 3%.[16]

5. Pathologic features of paediatric pedestrian injuries / injury patterns

The safety of child pedestrians is a major public health problem which necessitates in depth analysis of the particular injuries they sustain. Children suffer different injury patterns than adults due to their unique anatomical and physiological features. The pliability of their bodies facilitates the transfer of energy through acceleration and deceleration causing internal injuries without significant external signs. This calls for clarification of child pedestrian injury patterns.[10]

Child pedestrians have the tendency to get hit while facing the vehicle and injury occur at three typical impact points called Waddell's Triad – the bumper, the hood/windshield and the ground. Impact with the bumper generally results in lower limb fractures (hip to toe). The child is usually thrown unto the hood or windshield after the initial impact which typically affects the head and/or spine.[7] In child pedestrians aged 9 years and younger the point of centre gravity is situated below the bumper. In these cases, the first point of contact with the bumper is the head and/or chest after which the child is flung away from the vehicle unto the ground resulting in a second impact.[9]

At a high impact speed, the body of a child can be thrown toward the vehicle or just slide over the hood of the vehicle with the upper body (head and chest) striking the windshield and/or its stiff surroundings eg. cowl and A-pillar.[27] At a low impact speed the forces are not sufficient enough to rotate the body around its centre of gravity and is therefore simply thrown forward or knocked down without sweeping the feet from the ground.[27] Typically the body of a child does not end up far from the vehicle which unfortunately increases the risk of being run over.[9]

In 1999, Peng and colleagues published a study done in Los Angeles, California. This retrospective study involved 5000 pedestrians of which almost 40% were child pedestrians below the age of 15 years. They found the following:

- Injuries were mainly to the head, face, and neck (35%) and musculoskeletal system (22%).[28]
- Intracranial injuries were the predominate finding in the head, face and neck region.[28]
- Traumatic brain injuries were more life threatening while injuries to the lower extremities lead to long term disabilities.[20,28]
- Lower extremity injuries (14,4%) occurred more frequently than upper extremity injuries (3,6%).[28]
- Minor external injuries (abrasions and superficial injuries) occurred in 35% of cases.
- Injuries to the spine, chest, abdomen and pelvis occurred in less than 3% of the cases respectively.[28]
- The 5000 paediatric pedestrians required 700 operations in total and had an average hospital stay of 5 days.[28]
- Most of the clinical findings were consistent with impacts to the vehicle hood/windshield and vehicle/bumper.[28,29]

A retrospective study in South Australia (1999) looked at **fatal** childhood pedestrian accidents over a 20-year period and found that the head (91,2%), abdomen (50%), chest (47%) and neck (38,2%) were the most common sites of significant injury. Injuries to the limbs (88%) involved mainly the legs and consisted of lacerations, abrasions and fractures which were not considered to be life-threatening in the

reported cases.[30] In this particular study the significant types of injuries were listed as follow:

- Head: degloving injuries of the scalp, complex skull fractures, and serious brain injuries.[30]
- Neck: atlanto-occipital fracture/dislocation with or without spinal cord injury.[30]
- Chest: open and complex rib fractures, laceration and avulsion of the lungs, laceration of the heart, and aortic transections.[30]
- Abdomen: lacerations, ruptures and avulsions of organs with severe parenchymal damage.[30]

A review of paediatric pedestrian injuries done at the University of Virginia, USA (2002) looked at the distribution of injuries by severity, body region and age. They found the following:

- The most vulnerable body regions are the head and lower limbs.[31]
- The rate of head injuries (soft tissue injury, fractures and intracranial haemorrhage) decrease with increasing age.[31]
- Lung injuries are the most common injury to the chest.[31]
- Chest wall injuries, including rib fractures, were rare in all paediatric age groups.[31]
- Injuries to the kidneys and adrenals occur at the same rate as injuries to the liver and spleen.[31]
- Children younger than 10 years are more likely to suffer injuries to the femur.[31]
- Injuries to the tibia/fibula and ankle/foot are more common in older (>10 years) than younger children.[31]
- Most of the lower limb fractures (femur and tibia) were mid-shaft regardless of the age.[31]
- There is a higher rate of knee injuries in older children (above 10 years).[31]
- The rate of pelvic fractures is highest in children aged 0-4 and 15-18 years.[31]

Table A. Summary of findings of different studies conducted with regard to paediatric pedestrian injuries:

Country	Year	Age of child	Injury		
			Head	Lower extremities	Other
RSA[3]	2003	<13 years	34%	35%	
Canada[9]	2007	Unspecified	25%	34%	10%
Nigeria[12]	2014	≤15 years	42,9%	35,4%	21%
Singapore[32]	2015	≤16 years	82,4%	41,2% (including upper extremities)	23,5%

Note that the discrepancies in the occurrence of head injuries are due to different data collection parameters e.g. age of child. The Canadian study showed that "traumatic brain injuries" occurred in 25% of cases which exclude injuries to the soft tissue of the head and face, while the higher number of head injuries in Singapore is due to the fact that only **fatal** injuries were included in this study. The occurrence of lower extremity injuries is very similar in all the studies.

6. Prevention and intervention

The Haddon matrix for motor vehicle crashes is an analytical tool that assists in the identification of factors associated with an accident/crash. According to Haddon there are three factors (human, vehicle and environment) subjected to three phases of an event (pre-crash, crash and post-crash). By using this tool sources of error can be identified which again allow for opportunities to develop countermeasures or interventions in order to reduce road traffic injuries and the severity thereof.[20,33]

In the past, education of children regarding road safety was aimed at changing the child's behaviour to adjust to the dangers associated with road use. Although there seems to be some gain from providing this education, the effectiveness thereof is limited by the development of a child.[34] Over the years it was proven not to be an effective preventative measure if not used in conjunction with change in driver behaviour, the safety of vehicles and the road itself.[5,34]

The more recent “Safe System approach,” originally developed in Sweden, is a proven effective way to save lives and reduce serious injuries. It aims for a more forgiving road system that takes human fallibility and vulnerability into account. It moves away from the idea that children should adapt their behaviour to cope with traffic, and rather focuses on changing the design and management of the transport system, taking the needs and behaviour of children into consideration, e.g. speed limits, child seats.[5]

Modifying effective strategies used in developed countries to adjust to the adverse conditions found in developing countries where children are at greater risk, may actually save lives and reduce the rate of injuries sustained.[5] The literature is not short of recommendations, therefore the question that needs to be asked in developing countries is why these strategies are not being implemented.[12] A study done at Red Cross Children’s Hospital in Cape Town showed persistent high numbers of child pedestrian injuries from 1992 to 2012 which lead to the conclusion that existing prevention initiatives need to be reassessed and increased efforts are needed in order to reduce this burden.[14]

Injury prevention programmes should use existing data and apply it to proven theoretical frameworks to meet the challenge of reducing injury mortality and morbidity in youth, which will result in reduced health care costs and better community health.[35] Political commitment and financial funding is also critical for these preventative programmes to successfully reduce the road traffic toll among children.[3]

FURTHER RESEARCH

There is international and national research looking at various aspects of pedestrian vehicle accidents, all with the aim to highlight the burden caused by these accidents and with the objective to find new or improved ways to reduce the morbidity and mortality of these vulnerable road users.

However, despite all research done up to date, road traffic accidents remain a major public health problem particularly in developing countries like South Africa where the incident rates are double that of first world countries and where there is a relative lack of scientific research regarding determinants causing these accidents compared to developed countries.[11] Therefore further research into all aspects associated with pedestrian vehicle accidents are essential in our local setting. It is necessary to expand on current knowledge in order to assist in the development and improvement of strategies aimed to prevent childhood injuries.[14]

In the chapter "Assessing the prevention response to child road traffic injuries" in the book "Overview of crime, violence and injury prevention in SA: Data to Action" it is recommended that research efforts need to be refined in order to determine the precise nature of the risks for pedestrian injuries.[14] It also states that research in the health sector is crucial for effective design, coordination and implementation of health intervention, policy formulation and service delivery.[14]

Road traffic mortality rates in South Africa remain significantly high partly due to an insufficient response to available preventative strategies. Therefore, it is important to continue to assess the impact of current road safety strategies used in SA and the cost-effectiveness thereof especially because it has such a big impact on the safety of our children.[11,34]

AIMS AND OBJECTIVES OF RESEARCH

The magnitude of the problem is so great that the United Nations felt it necessary to dedicate a whole decade to "Action for Road Safety" with the aim to open people's eyes and to encourage stakeholders to take action regarding determinants proven to be efficient in reducing road traffic injuries and fatalities.[2] The only effective way to contribute to this "Decade of Action for Road Safety" in my professional capacity is to focus my research project on those innocent bodies that lie on my dissection table almost on a daily basis, and their injuries that I document in a meticulous way in order to bring them some justice if at all.

The aim of the study is to look at the specific injuries sustained by children of different age groups that were involved in road traffic accidents as pedestrians in the greater Cape Town area for the time period 2011-2015. If feasible a comparison will be done between the injuries sustained by children that survived and those that demised in order to see if one can prognosticate different injury patterns. The study will also look at the demographics of the children involved, and the area where the accident occurred will be documented to identify possible high-risk areas.

However, the main purpose of my research project is to bring the reality of this problem to the attention of influential policy makers and to emphasize the urgency to address it adequately, especially where children are involved, as they are innocent bystanders who are dependent on society to be safe and protected from harmful factors created by our modern lifestyle.

REFERENCES

1. World Health Organisation. Global status report on road safety 2018. Geneva, Switzerland: World Health Organisation, 2018. Retrieved from http://www.who.int/violence_injury_prevention/road_safety_status/2018
2. World Health Organisation. Global status report on road safety 2015. Geneva, Switzerland: World Health Organisation, 2015. Retrieved from http://www.who.int/violence_injury_prevention/road_safety_status/2015
3. World Health Organisation. Youth and road safety 2007. Geneva, Switzerland: World Health Organisation, 2007. Retrieved from http://www.who.int/management/programme/ncd/Youth and Road Safety.pdf
4. International Transport Forum. Road safety annual report 2018. Paris, France: Organisation for Economic Co-operation and Development (OECD)/International Transport Forum (ITF), 2018. Retrieved from http://www.itf-oecd.org/road-safety-annual-report-2018
5. Peden, M., Oyegbite, K., Ozanne-Smith, J., Hyder, A.A., Branche, C., Rahman, A.F., Rivara, F. and Bartolomeos, K. World report on child injury prevention. Geneva, Switzerland: World Health Organisation, 2008. Retrieved from http://www.who.int/violence_injury_prevention/child/injury/world_report/World_report.pdf

6. South Africa. Children's Act No. 38 of 2005.
7. Hotz, G., Kennedy, A., Lutfi, K. and Cohn, S.M. Preventing paediatric pedestrian injuries. Journal of Trauma 2009 May; 66(5): 1492-1499. http://dx.doi.org/10.1097/TA.0b013e31819d9c9b
8. Walton-Hayes, L. Pedestrian injuries to young children (EPICgram). California Department of Health Service, Epidemiology and Prevention for Injury Control Branch, 2002 May. Report No. 5. Retrieved from http://www.kidsandcars.org/wp-content/uploads/pdfupload/2002-05-ped-inj-young-children-study.pdf
9. Safe Kids Canada. Child pedestrian injury report 2007-2008. Toronto, Canada: Safe Kids Canada, 2008. Retrieved from http://www.parachutecanada.org/downloads/injurytopics/ChildPed_Report_07:08.pdf
10. Hitosugi, M., Kawato, H., Gomei, S., Mizuno, K. and Tokudome, S. Severity of child pedestrian injuries due to bonnet-type-vehicle collision. Paediatrics International 2013 October; 55(5): 624-628. http://dx.doi.org/10.1111/ped.12140
11. Kihurani, I., Van Niekerk, A. and Van As, A.B. Child road traffic crash injuries at the Red Cross war memorial children's hospital in Cape Town South Africa in 1992, 2002, 2012. International Journal of Injury Control and Safety Promotion 2015; 22(4): 352-358. http://dx.doi.org/10.1080/17457300.2014.912236
12. Solaqberu, B.A., Osuoji, R., Ibrahim, N.A., Oludara, M.A., Balogun, R.A., Ajani, A.O., Idowu, O.E., Mustafa, I.A. and Sanni, F.O. Child pedestrian injury and fatality in a developing country. Pediatric Surgery International 2014 June; 30(6): 625-632. http://dx.doi.org/10.1007/s00383-014-3516-8
13. Statistics South Africa. Road traffic accident deaths in South Africa, 2001-2006: Evidence from death notification. Pretoria, South Africa: Statistics South Africa, 2009. Retrieved from http://www.statssa.gov.za/publications/Report-03-09-07/Report-03-09-07.pdf
14. Matzopoulos, R., Du Toit, N., Dawad, S. and Van As, S. Assessing the prevention response to child road traffic injuries. In: Van Niekerk, A., Suffla, S. and Seedat, M. (Eds.) Crime, violence and injury prevention in South Africa: Data to action. Cape Town, South Africa: Medical Research Council – University of South Africa, Crime, Violence and Injury Lead Programme, 2008: 14-27.

15. Kopits, E. and Cropper, M. Traffic fatalities and economic growth. Accident Analysis Prevention, 2005 January; 37(1): 169-178. http://dx.doi.org/10.1016/j.aap.2004.04.006
16. Road Traffic Management Corporation. Road fatality report for 2017. Midrand, South Africa: Road Traffic Management Corporation, 2017. Retrieved from http://www.arrivealive.co.za/stats.aspx
17. Harris, C., Sukhai, A. and Matzopoulos, R. National fatal injury profile. In: Matzopoulos, R (editor) A profile of fatal injuries in South Africa: Fifth annual report of the National Injury Mortality Surveillance System, 2003. Cape Town, South Africa: Medical Research Council – University of South Africa Crime, Violence and Injury Lead Programme, 2004
18. Albertyn, Z., Mathews, S., Coetzee, D. and Van As, A. B. Morbidity and mortality from road traffic crashes in children in Metro West, city of Cape Town – 2014. International Journal of Injury Control and Safety Promotion 2019; 26(1): 115-123. http://dx.doi.org/10.1080/17457300.2018.1508165
19. Norman, R., Matzopoulos, R., Groenewald, P. and Bradshaw, D. The high burden of injuries in South Africa. Bulletin of the World Health Organization 2007 September; 85(9): 695-702. http://dx.doi.org/10.2471/BLT.06.037184
20. Chakravarthy, B., Lotfipour, S. and Vaca, F.E. Pedestrian injuries: Emergency care considerations. The California Journal of Emergency Medicine 2007 February; 8(1): 15-21. http://www.ncbi.nlm.nih.gov/pubmed/20440388
21. Peden, M., Scurfiled R., Sleet, d., Mohan, D., Hyder, A. A., Jarawan, E. and Mathers, C. The world report on road traffic injury prevention. Geneva, Switzerland: World Health Organisation, 2004. Retrieved from http://www.who.int/violence_injury_prevention/publications/road_traffic/world_report
22. Labushagne, F. J. J. The cost of crashes in South Africa, Research and Development report. Midrand, South Africa: Road Traffic Management Corporation, 2016. Retrieved from http://www.arrivealive.co.za/stats.aspx
23. Mabunda, M. M., Swart, L. A. and Seedat, M. Magnitude and categories of pedestrian fatalities in South Africa. Accident, Analysis and Prevention 2008 March; 40(2): 586-593. http://dx.doi.org/10.1016/j.aap.2007.08.019
24. DiMaggio, C. and Durkin, M. Child Pedestrian Injury in an Urban Setting: Descriptive Epidemiology. Academic Emergency Medicine 2002 January; 9(1): 54-62. https://onlinelibrary.wiley.com/doi/pdf/10.1197/aemj.9.1.54

25. Damsere-Derry, J., Ebel, B. E., Mock, C. N., Afukaar, F. and Donkor, P. Pedestrians injury patterns in Ghana. Accident, Analysis and prevention 2010 July; 42(4): 1080-1088. http://dx.doi.org/10.1016/j.aap.2009.12.016
26. Arendse, N., Swart, L. A., Van Niekerk, A. and Van As, S. Pedestrian Safety. In: Van Niekerk, A., Suffla, S. and Seedat, M. (Eds.) Third review: Crime, violence and injury prevention in South Africa: 21st Century solutions for child safety. Cape Town, South Africa: Medical Research Council – University of South Africa, Safety and Peace Promotion Research Unit, 2012: 8-22.
27. Roudsari, B. S., Mock, C. N. and Kaufman R. An evaluation of the association between vehicle type and the source and severity of pedestrian injuries. Traffic Injury Prevention 2005; 6(2): 185-192. http://dx.doi.org/10.1080/15389580590931680
28. Peng, R. Y. and Bongard, F. S. Pedestrian versus motor vehicle accidents: An analysis of 5000 patients. Journal of the American College of Surgeons 1999 October; 189(4): 343-348. http://www.ncbi.nlm.nih.gov/pubmed/10509458
29. Gunnels, M. D. Pedestrian trauma: What types of injury can we expect to see when an injured child arrives. Journal of Emergency Nursing 2002 June; 28(3): 259-261. http://dx.doi.org/10.1067/men.2002.123719
30. Byard, R. W., Green, H., James, R. A. and Gilbert, J. D. Pathological features of childhood pedestrian fatalities. The American Journal of Forensic Medicine and Pathology 2000 June; 21(2): 101-106. https://www.ncbi.nlm.nih.gov/pubmed/10871121
31. Woods, W., Sherwood, C., Ivarsson, J., Crandall, J., Orzechowski, K. and Eichelberger, M. A review of pediatric pedestrian injuries at a Level I Trauma centre. Proceedings, 18th International Technical Conference on the Enhanced Safety of Vehicles, DOT HS 809 543; Washington DC, NHTSA. 2003. https://pdfs.semanticscholar.org/80ff/c4deec59dbd574e4d343d625be391e70245b.pdf
32. Feng, X.Y., Nah, S.A., Lee, Y.T., Lin, L.C. and Chiang, L.W. Pedestrian injuries in children: who is most at risk? Singapore Medical Journal 2015; 56(11): 618-621. http://dx.doi.org/10.11622/smedj.2015170
33. Mohan, D., Tiwari, G., Khayesi, M. and Nafukho, F. M. Unit 2: Risk factors for road traffic injuries. In: Road traffic injury prevention: Training manual.

Geneva, Switzerland: World Health Organization, 2006: 21-36. http://apps.who.int/iris/handle/10665/43271

34. Mhlanga, M. Investigation of the road safety measures around schools in eThekwini. [MEng minor dissertation]. University of Cape Town, 2018. Retrieved from: https://open.uct.ac.za/handle/11427/29828
35. Laraque, D., Barlow, B. and Durkin M. Prevention of youth injuries. Journal of the National Medical Association 1999 October; 91(10): 557-571. http://www.ncbi.nlm.nih.gov/pubmed/10599188

PART B: MANUSCRIPT IN ARTICLE FORMAT

Retrospective review of paediatric patients involved in pedestrian vehicle accidents in the greater Cape Town area

I Möller,[1] MBChB, Dip For Med (SA) Path, FC For Path (SA); **L Liebenberg**,[1] MBChB, Dip For Med (SA), MMed Path (Foren); **L Heathfield**,[1] BSc, Genetics and Physiology, BSc (Med) Hons, Human Genetics, MSc, Forensic Science, PgDip, Health Professions Education, PhD Human Genetics.

[1]Division of Forensic Medicine and Toxicology, Department of Pathology, Faculty of Health Sciences, University of Cape Town, South Africa

Corresponding author: I Möller (mollerizelle@yahoo.co.uk)

Background: Pedestrian vehicle injuries are a growing public health threat worldwide. In South Africa, pedestrian accidents are the leading cause of injury related deaths in children younger than 15 years.

Methods: Retrospective review of children involved in road traffic accidents as pedestrians in the greater Cape Town area from 2011 to 2015. The study population included patients below the age of 13 years that were admitted to Red Cross Children's Hospital (RCCH), as well as those subjects that died and presented to Salt River Mortuary (SRM). The age group 0-12 years was selected because RCCH is a referral paediatric hospital that only admits children under the age of 13 years. Data obtained were analysed according to age, gender, time, date and area of accident, as well as injuries sustained. Cases were grouped according to age in order to analyse and compare changes in injury patterns for different groups.

Results: During the 5-year period 552 children were admitted to RCCH and 109 cases were admitted to SRM with 2:1 male to female predominance in both study groups. The age group with the highest number of deaths was 0-4 years. Most of the accidents (75-80%) occurred in lower socio-economic areas. There were significantly more head injuries in children who died (96%) compared to those who survived (18%) ($p < 0.0001$). Deceased children also had significantly more spinal injuries (27%), chest injuries (61%) and abdominal injuries (43%) compared to children who survived ($p < 0.0001$ for each). Upper limb injuries were equal between the two groups (12% vs 13%) and lower limb injuries were more common in the survivors (46% vs 24%).

Conclusion: Injuries to the head and extremities are common in both study groups (survivors and deceased). However, we found a significantly larger number of

injuries to the spine, chest and abdomen in the deceased versus survivors of pedestrian vehicle accidents.

Level of evidence: Level III, Retrospective comparative study

Key words: Pedestrian vehicle accident, injury pattern, paediatric trauma.

Institutional Review Board approval: Human Ethics Research Committee, Faculty of Health Sciences, University of Cape Town, project number 852/2016.

INTRODUCTION

Pedestrian vehicle injuries are a growing public health threat worldwide.[1] The 2018 Global status report on road safety by the World Health Organization (WHO) states that 1,35 million people are killed and another 50 million people are injured each year due to road traffic accidents.[2] Pedestrians account for 23% of these deaths[2] and approximately 33% of the children that die in road traffic accidents around the world are pedestrians.[4]

In Africa, the road traffic death rate is twice as high compared to that in high income regions and has the highest prevalence of pedestrian deaths (40% of all road traffic deaths).[2,3] Child pedestrians account for 30-40% of road traffic deaths in low and middle income countries compared to the 5-10% in high income countries.[4,5]

In South Africa, pedestrian accidents are the leading cause of injury related deaths in children younger than 15 years.[6] According to the Arrive Alive Road traffic fatality report, 28 121 people died on South African roads for the year 2016-2017, of which almost 2500 fatalities occurred in the Western Cape (ranking sixth in the country).[7] Pedestrians account for 38% of road traffic fatalities in South Africa which is the highest of all road user groups, and 17% of these pedestrian fatalities were children below the age of 14 years.[7]

In Cape Town a recent study (2014) revealed that the overall road traffic crash mortality rate for children under the age of 13 years was 8,7 per 100 000 population and that 72,5% of these fatalities were pedestrians.[8]

There is international and national research looking at various aspects of pedestrian vehicle accidents. Previous studies have highlighted the general distribution of injuries sustained in paediatric pedestrian accidents. However, the specific types of injuries sustained by child pedestrians in different age groups have not been widely researched.

The “Decade of Action for Road safety” (2011-2020) launched by the United Nations in 2010,[9] and the high number of paediatric pedestrian accidents in South Africa, including Cape Town, highlights the importance for further research into this matter.

The aim of the study is to look at the demographic aspects and the injury patterns in paediatric pedestrian vehicle accidents that occurred in the Greater Cape Town area.

METHODS

We conducted a retrospective review of children involved in road traffic accidents as pedestrians in the greater Cape Town area from 2011 to 2015. This area was defined by the service delivery area of the Forensic Pathology Laboratory located in Salt River, Cape Town which is a M6 mortuary handling more than 3000 bodies per annum. The service delivery area involves part of the Western Cape Metropole which includes the Cape peninsula and extends to Atlantis in the north and Khayelitsha in the east.

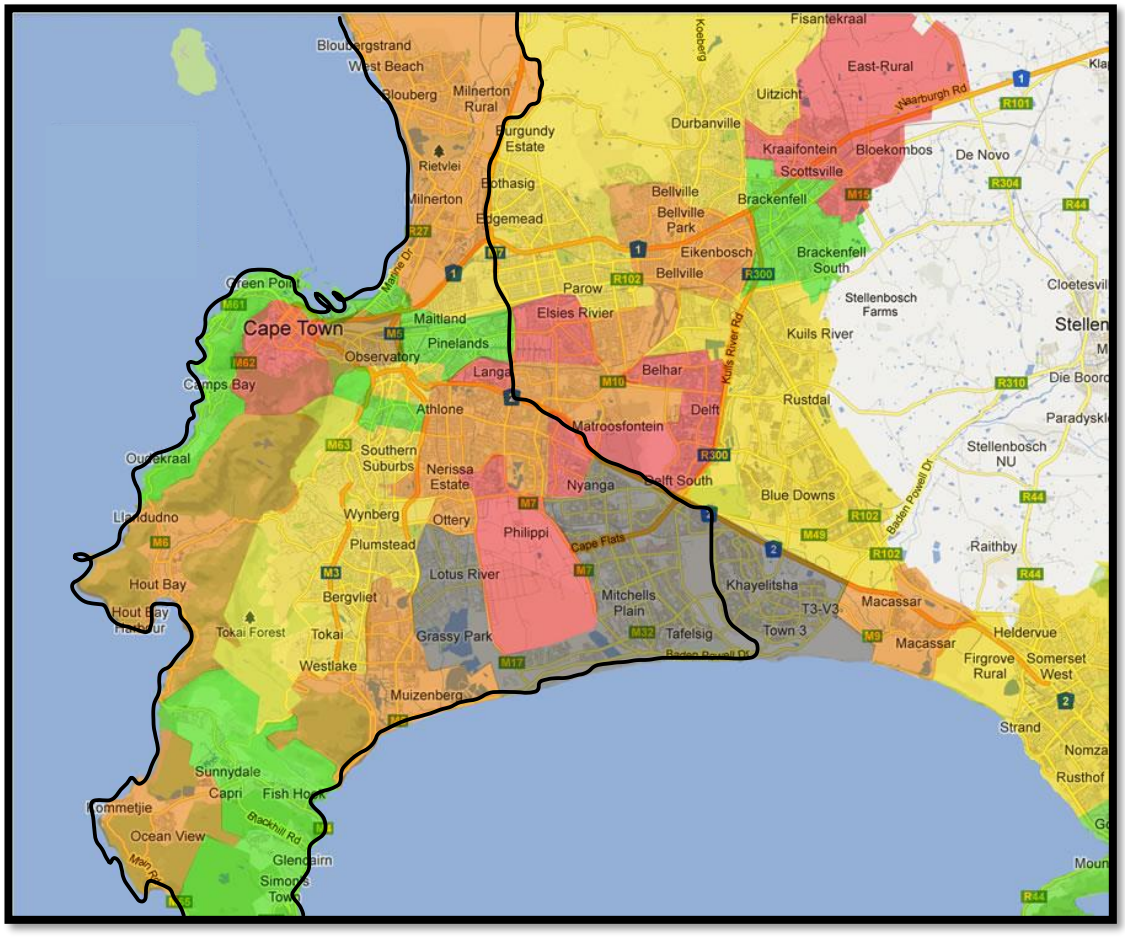


Figure 1. Salt River Mortuary service delivery area.

(Reproduced from www.capetownsafety.com)

The study population included patients below the age of 13 years that were involved in a pedestrian vehicle accident from 2011 to 2015, and were admitted to Red Cross Children's Hospital (RCCH), as well as those subjects that died and presented to the Forensic Pathology Laboratory in Salt River also known as Salt River Mortuary (SRM). The RCCH is a referral paediatric hospital for children under the age of 13 years in Cape Town. It is a public hospital that provides trauma care to the bulk of the paediatric population in the greater Cape Town area as well as referrals from other areas in the Western Cape.

After obtaining approval for the study from the Departmental Research Committee and Human Research Ethics Committee of the University of Cape Town suitable cases were identified for inclusion in the study.

To identify all children that died due to pedestrian vehicle accidents the "Office Autopsies" database at the Division of Forensic Medicine and Toxicology, University of Cape Town, was interrogated. All cases where the accident occurred outside the usual service area of Salt River Mortuary were excluded from the study. The post-mortem reports of all the cases included in the study were reviewed in order to document the injuries sustained by the deceased.

To identify the patients that presented to RCCH for injuries sustained during a pedestrian vehicle accident, the database of Childsafe South Africa was interrogated. Childsafe South Africa is a non-governmental organisation that maintains a trauma surveillance system based on data captured at RCCH since 1991. The following cases were excluded: children that presented to RCCH following pedestrian vehicle accidents but was not admitted, children 13 years and above, children involved in accidents that occurred outside the defined area of the study, and fatalities that were referred to SRM for post-mortem examination as these cases were already included in the deceased group. Duplication of data was eliminated by cross-checking hospital numbers, sex and age.

After interrogation of the information obtained from the database of Childsafe South Africa it became clear that the description of the injuries sustained was inadequate for the purposes of this study. Permission was obtained from the Red Cross Research Review Committee to access the radiological reports available on the Picture Archiving and Communication System (PACS) in order to get more detailed

information regarding injuries sustained. PACS is an electronic radiology database via which clinicians can access radiological imaging and reports.

The information obtained from the Childsafe South Africa database and the RCCH PACS were used to document the injuries sustained by children admitted to RCCH following pedestrian vehicle accidents. However, the RCCH PAC System only contained radiological reports from 2013 onwards. Therefor the injury data for the years 2011 and 2012 could not be used for analysis.

To improve analysis the information obtained via the above-mentioned methods were captured on spreadsheets. This information included age, gender, time, date (day of week and month) and area of accident, as well as injuries sustained. The time of day was divided into two hourly intervals to try and identify daily activities that may place children at risk for road traffic accidents for example time traveling to and from school.

Injuries sustained were categorised by body region and injury type. The main body regions included the head, spine, chest, abdomen, upper extremities and lower extremities. The injury types were in general based on organ or anatomical location for instance kidney and hip. However, some of the injury types required more detailed description especially injuries to the head. Injuries to the skin, peripheral blood vessels and nerves, and facial features were referred to as “soft tissue injuries”.

Cases were grouped according to age in order to analyse changes in injury patterns for different groups. Age groups 0-4 years, 5-9 years and 10-12 years were selected. This is in line with previous paediatric trauma literature.[10] For each body region and age group, the injury data were normalized and presented as a percentage of injured subjects to allow for comparison among age groups and between subjects that survived the injuries and those that died due to injuries sustained.

RESULTS

In the 5-year period between 2011 and 2015 3143 children presented to RCCH following pedestrian vehicle accidents. Only 552 of the 3143 children (18%) were admitted to RCCH. During the same period 109 cases of children, below the age of 13 and that died due to injuries sustained from pedestrian vehicle accidents, were admitted to SRM.

Figure 2 shows the age distribution of all the cases (survivors and deceased) included in the study.

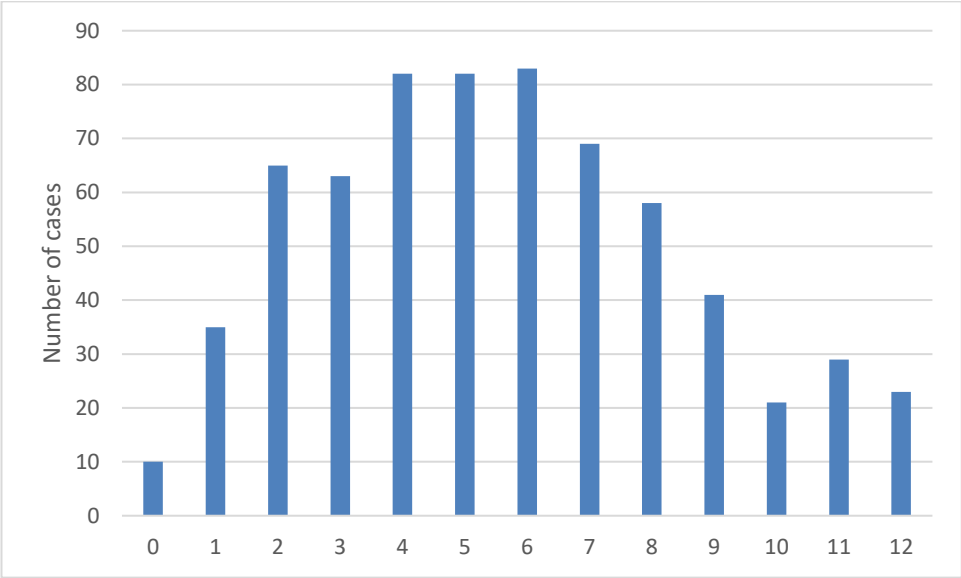


Figure 2. Age distribution

Of the 552 children admitted to RCCH 180 were female and 372 were male, and of the 109 cases admitted to SRM 36 were female and 73 were male. This shows a 2:1 male to female predominance across the two study groups.

The time of day, the day of the week and the month of the year in which the accidents occurred were analysed to identify possible high-risk periods. The results are demonstrated by figures 3, 4 and 5.

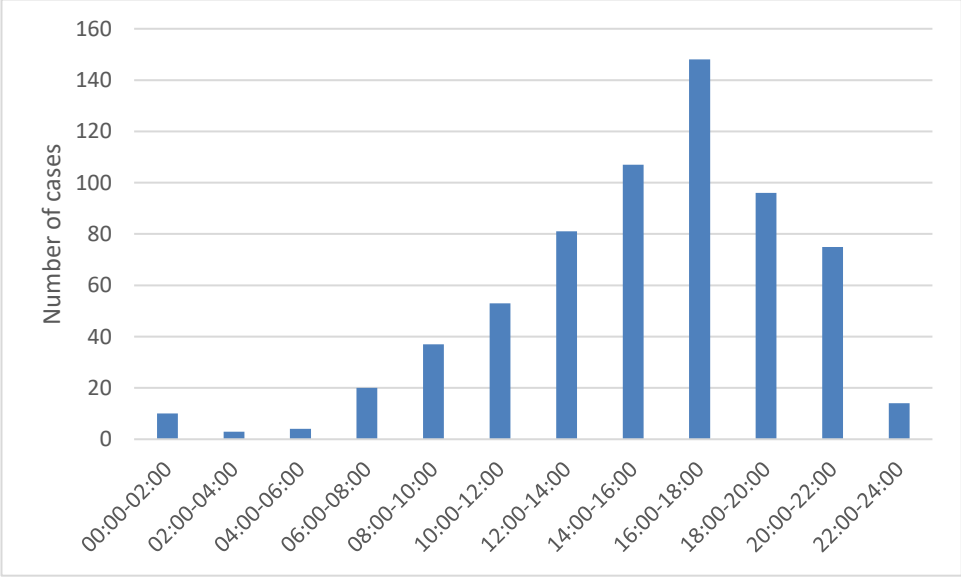


Figure 3. Time distribution

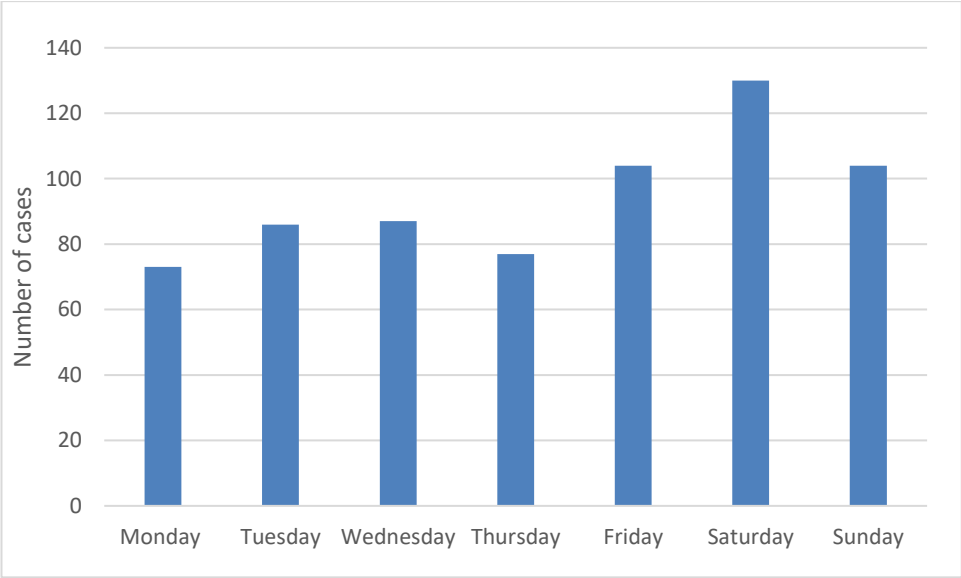


Figure 4. Distribution of weekdays

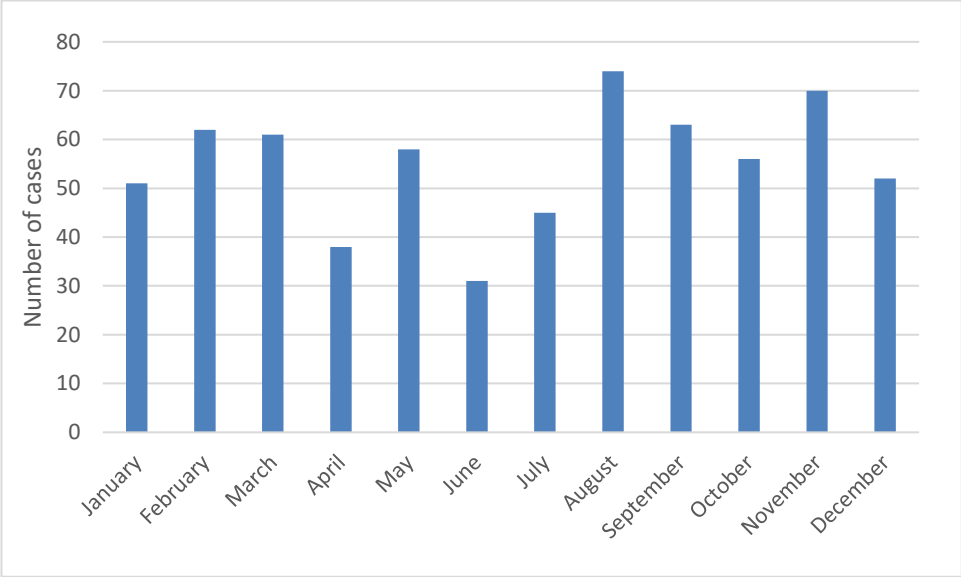


Figure 5. Monthly distribution

The geographic distribution of these incidents showed that the bulk of the accidents (75-80%) occurred in lower socio-economic areas within the greater Cape Town region.

Table 1 demonstrates the distribution of injury types by body region and age groups **as a percentage** of injured subjects admitted to RCCH and SRM respectively. Note that the total calculated injuries per body region exclude **isolated** soft tissue injuries (excl ST) to that region.

TABLE 1	RCCH cases			SRM cases		
Age (years)	0-4	5-9	10-12	0-4	5-9	10-12
	n = 123	n = 158	n = 39	n = 52	n = 42	n = 15
Head						
Total (excl ST)	19	20	28	96	96	93
Fractures	16	17	18	87	74	53
• Skull	11	14	13	81	62	47
• Base of skull	4	7	5	75	67	47
• Facial	5	3	3	12	12	20
Intracranial injuries	7	11	21	96	98	93
• Intracranial haemorrhage	6	9	15	77	79	87
• Cerebral oedema	1	5	10	62	81	47
• Parenchymal brain injury	2	4	5	73	52	33
• Diffuse axonal injury	0	4	0	17	5	40
Soft tissue (head and face)	51	52	41	92	83	80
Spine						
Total (excl ST)	0	1	3	17	33	40
Atlanto-occipital dislocation	0	1	0	4	17	27
Cervical spine	0	1	3	12	17	13
Thoracic spine	0	0	0	2	2	7
Cord injury	0	0	0	6	17	33
Cord injury not specified	0	0	0	6	2	7
Soft tissue neck	2	3	5	8	7	7
Chest						
Total (excl ST)	4	4	0	50	69	80
Rib fractures	0	1	0	12	19	27
Haemo-/pneumothorax	2	1	0	19	29	33
Lung	3	3	0	46	64	60
Cardiac	0	0	0	8	10	27
Vascular	0	0	0	2	7	0
Soft tissue	2	2	3	31	50	53
Abdomen						
Total (excl ST)	3	1	5	35	55	40
Haemoperitoneum	2	0	0	19	26	13
Stomach/Bowel/Mesentery	0	0	0	0	2	7
Diaphragm	0	0	0	6	7	7
Liver	2	1	3	29	33	27
Spleen	2	0	0	10	24	0
Pancreas	0	0	0	6	0	0
Kidney/ Adrenal	1	1	3	10	7	0
Bladder/Urethra	0	0	3	0	0	0
Vascular	0	0	0	0	2	0
Soft tissue	4	1	5	19	31	37
Upper limb						
Total (excl ST)	10	8	5	17	10	7
Clavicle	5	2	3	8	7	0
Shoulder	0	0	0	4	0	7
Humerus	4	3	3	10	2	0
Elbow	0	0	0	0	0	0
Forearm	2	2	0	4	0	0
Hand/ Wrist	1	2	0	0	0	0
Soft tissue	10	8	10	31	52	60
Lower limb						
Total (excl ST)	36	50	62	10	36	40
Pelvis	6	4	8	2	7	1
Hip	0	1	0	0	2	7
Femur	13	14	10	6	24	13
Knee	0	0	0	0	1	0
Tibia/Fibula	21	28	44	2	17	27
Ankle/Foot	2	5	3	0	0	0
Soft tissue	32	31	31	50	71	87

DISCUSSION

This study reviews the demographic aspects and the injury patterns across different age groups in children below the age of 13 years that were either admitted to RCCH or presented to SRM following paediatric pedestrian vehicle accidents that occurred in the Greater Cape Town area from 2011 to 2015. During this 5-year period 552 children were admitted to RCCH and 109 cases to SRM.

The age distribution of the target population shown in Figure 2 suggests that children age 2-7, which accounts for 75% of the study population, have a higher risk to be victims of pedestrian vehicle accidents.

The majority of studies agree that child pedestrian **injury and deaths** rates are highest for the age group 5-9 years.[4,9,11] In our study the occurrence of injuries was similar for the age group 5-9 years, however, most deaths occurred in the 0-4 year age group, with 50% of all deaths occurring in this group. Comparing this to a study done in New York USA by DiMaggio where the death rate in the age group 5-9 was double that of the age group 0-4[12] highlights a significant problem in our area/setting as children aged 0-4 years are not supposed to be unsupervised road users.

The gender distribution across all subjects included in this study is consistent with previous research which shows a 2:1 male to female predominance. This is in accordance with the popular belief that boys are known to be greater risk takers than girls.[4,5,9,11]

If one looks at the time of day during which the incidents occurred, it is clear that child pedestrian accidents peak in the afternoons from 14:00 to 20:00 and especially from 16:00 to 18:00. This time period suggests children returning home from school or at play and adults returning home from work (16:00-18:00). International and national studies show similar peak times for child pedestrian accidents.[13-15]

Figure 4 shows that child pedestrian accidents in the greater Cape Town area occur more commonly over weekends with a peak on Saturdays while global (other international) studies shows a peak on Fridays.[12,16] Albertyn et al suggests that this is because children spend more time playing around the house over weekends than during the week when they are at school or in day care.[8]

The distribution across the months of the year (figure 5) shows no identifiable pattern or high-risk season. There is also no consistency regarding this distribution from previous South African studies.[13,15] This is interesting as one would have

thought that pedestrian vehicle accidents would increase during holiday months, such as July and December when people in general are more out and about, especially children.

To identify high risk areas, we looked at the geographic distribution of where these incidents occurred which showed that the bulk of the accidents occurred in lower socio-economic areas within the greater Cape Town region. This is once again in accordance with a previous study done at RCCH (1992-2000) which showed that most pedestrian injuries treated at RCCH came from informal settlements (Langa, Nyanga, Khayelitsha, Atlantis and Gugulethu).[13] Possible reasons for this phenomenon are overcrowding, limited play areas, walking as primary means of transportation, and the location of informal settlements alongside busy roads like highways.[6]

To facilitate comparison among age groups the discussion of injuries is delineated by body region.

Head Injuries:

Head injuries remain the most significant contributor to mortality for children involved in pedestrian vehicle accidents. All previous literature reports high rates of significant head injuries for children injured in this manner.[17-19] Our study supports these findings.

Children that required admission to hospital sustained a high number of head injuries with an increase in the incidence of intracranial injuries with increasing age. This is not in agreement with previous literature. Woods et al reported a decrease of severe head injuries with increasing age. They proposed that this is because the primary impact with the vehicle is not to the head in older children and that they may be more tolerant to injury than younger children.[20] Although the incidence of skull fractures remain similar across the age groups in our study, the intracranial injuries (intracranial haemorrhage, cerebral oedema and parenchymal injuries) increased significantly with advancing age.

Soft tissue injuries to the head are common following these accidents. Further analysis shows that it is also a common reason for admission especially in younger children. At RCCH 28% of child pedestrians below the age of five were admitted for isolated soft tissue injuries to the head. This is most likely due to trauma doctors

having a lower threshold to admit younger children with head injuries for observation and further imaging.

Across all age groups, head injuries occurred in 96% of the children who died from their injuries. This is similar to reported numbers above 91% in previous studies.[21,22] Our study shows that children below the age of five have the highest incidence of skull fractures and this number decreases with increasing age. This is due to the fact that the primary impact with the vehicle is to the head because of the short stature of this age group.[23]

Spinal injuries:

Spinal injuries in children are not common. Spinal injuries are usually sustained by patients involved in high energy trauma, which explains the presence of these injuries in our study population.

When looking at the overall picture, fewer than 1% of the subjects included in our study sustained significant spinal injuries. Almost all of these injuries were sustained by subjects that did not survive the accident. There is also a slight increase of spinal injuries with age, with 40% of the deceased subjects older than nine years sustaining spinal injuries. A study from Australia showed a 38% incidence of spinal injuries in fatal accidents, which is very similar to our study.[21]

Chest injuries:

In children there is a predictable pattern of chest injuries, with the compliance of the chest wall preventing rib fractures, most of the injuries involve structures within the chest cavity. The reported incidence for chest injuries is around 10%, with all age groups affected equally.[20] On assessment of all the subjects included in our study there is an 18% incidence of significant chest injuries.

There was however a large difference in the occurrence of chest injuries between the deceased group (61% had chest injuries) and the survivors (3% had chest injuries), and older children also had more chest injuries compared to younger children (80% in the 10-12 years compared to 50% in the 0-4 years). The incidence of 61% does not differ much from a study done in Australia which showed a 47% incidence of chest trauma in fatal childhood pedestrian accidents.[21]

For all four age groups, the most common type of chest injury is lung injury which is consistent with a study done by Woods et al.[20]

Abdominal injuries:

Abdominal injuries are also uncommon following pedestrian vehicle accidents. Previous studies have reported significant injuries affecting less than 10% of patients.[20] On assessment of the survivors included in our study, there was also a low incidence (1-4%) across all age groups.

There is however a significantly higher number of abdominal injuries in the deceased group with 43% of subjects sustaining significant abdominal injuries. There was an almost equal distribution across all age groups.

Woods et al reported a similar rate of kidney/adrenal injuries compared to liver and spleen injuries.[20] This is different to our findings which showed a substantially higher number of liver injuries compared to kidney/adrenal injuries.

Upper limb injuries:

Upper limb injuries are less common than lower limb injuries. The overall occurrence reported for upper limb injuries is below 10%, with the humerus and clavicle the most commonly affected.[20]

The overall incidence of upper limb injuries in our study is 12% with the survivors and deceased showing a similar risk. The 0-4 age group is the most affected. This may be explained by the fact that the first point of impact with the vehicle is at the height of the shoulder and humerus of these children.

The low number of forearm and wrist injuries indicates that children are unable to try and protect themselves by extending their arms in defence after being hit by the vehicle, and that most upper limb injuries are caused by direct impact with the vehicle.

Lower limb injuries:

Lower limb injuries are much more common than upper limb injuries in paediatric pedestrian accidents. Wood et al reported that femur injuries are more common in

younger than in older children, with an increase in the risk for tibia and ankle injuries with increasing age.[20]

In our study population, the overall risk for lower limb injuries was 40% with a significantly higher risk in the survivor group (46%) when compared to the deceased group (24%). Femur fractures had a similar distribution between the age groups when the survivor group was compared to the deceased group with a peak incidence in the 5-9 age group. As in previous research, the incidence of tibia and ankle injuries showed a steady increase with increasing age.[20] This is because older children are more likely to be struck below the knee due their increased height.

LIMITATIONS

This study sheds some much needed light on a very important subject. There are however limitations to the study. The retrospective nature of the study leads to some inherent weaknesses like absence of specific data required for this particular study if the data was captured by personnel not involved in this study. Comparison between studies is difficult; inclusion criteria vary between studies as well as the definition of injury types (e.g. head injury) and the classification of injury severity. Subjects are also grouped differently which limits direct comparison.

RECOMMENDATIONS

Pedestrian vehicle accidents are globally a significant cause of death and injury for adults and children.[8] Vulnerable groups, like children, are at great risk for sustaining injuries in this fashion. This study highlights the different injuries that children sustain at a certain age and what injury patterns may be predictive of a poor outcome.

Road traffic safety is currently under much scrutiny with various studies looking at different aspects of traffic accidents. The main aim of research is to expand our knowledge in order to facilitate changes that will reduce the number of deaths and injuries caused by road traffic accidents.

The Haddon matrix, developed by William Haddon in 1970, is the most commonly used paradigm in the injury prevention field. It looks at different factors influencing the events before, during and after the crash, and provides us with a platform to make changes that could result in safer roads. The 3 factors that contribute to road traffic accidents is the human, the vehicle and the environment.[24]

In pedestrian vehicle accidents human behaviour in general refer to the behaviour of the driver and/or the pedestrian, but in the case of child pedestrians the importance of the caregiver/supervisor cannot be over emphasised.

In a recent study done by Mhlanga in KwaZulu Natal revealed that child behaviour contributed to 77% of the road traffic crashes that occurred around primary schools in the eThekwini Metro, and in almost 70% of these cases the child crossed the road when it was not safe to do so.[25] Children have low cognitive skills and are unable to assess the road for potential danger.[26] Although her study was done in a geographically different site (Cape Town vs Durban), there are so many corresponding findings, that our study confirms and supports Mhlanga's recommendations for child pedestrian safety policy implementation across South Africa.

Although many education programmes have been instituted to educate children and drivers (#SeeAndBeSeen and Safe Roads,Safe Kids) to improve road safety, children of younger ages cannot be expected to be responsible for their own road safety. This responsibility lies with their parents and caregivers. They are the group of people that should be educated, not only in road safety but also to have insight in the abilities and inabilities of a child.

Amendments to traffic laws like the National Road Traffic Amendment Act 64 2008 have attempted to change driver behaviour by lowering the blood alcohol limits and reducing speed limits. However, these laws require strict enforcement to make them effective.[8]

Vehicle design have also come under scrutiny in recent times as past research concentrated exclusively on increasing the survival of car occupants.[27] Lower limb trauma is the commonest pedestrian injury while head injuries are responsible for most pedestrian fatalities especially in children due to their restricted height, as highlighted in our study. Research showed that front structures of a vehicle are responsible for most pedestrian injuries[27] and that using a softer material on the bonnet will reduce the severity of these injuries.[4] Since early 2000 energy absorbing components like compliant bumpers and windscreen airbags have been developed by crash engineers to improve pedestrian protection.[27] Sadly, none of the proposed changes have been made. One can only postulate as to the reason for this, but vehicle manufacturers have not shown any interest in these design changes. In general, African countries lags in implementation of intervention methods to make vehicles and infrastructure safe for all road users.[3]

All roads should be designed to promote the safety of all road users. Areas around schools and other areas that are frequently used by children require special attention to help protect these vulnerable road users.[25] Pedestrians have a 90% chance of survival if hit by a vehicle travelling at 30 km/h or less but less than 50% chance of surviving impacts at 45 km/h or higher.[1] Therefor it is imperative that speed control measures such as speed bumps and severely lowered speed limits should be implemented in all high-risk areas. A study done by Lambert and Venter in the City of Tshwane proved that the rate of road traffic accidents decreases if the speed limit around schools is reduced to 30 km/h.[28] Once again, the problem is the enforcement of these laws which hinder its effectiveness.

The response to the accident by emergency services provides another opportunity to reduce child pedestrian mortality. The early recognition of a child with multiple injuries especially to the head, chest and abdomen as highlighted in our study, could facilitate early transfer to the appropriate hospital with the appropriate available modalities e.g. helicopter.

Over the last three decades there has been substantial research, recommendations and development into road safety and interventions to prevent these tragic accidents. The big challenge however is the gap between what is known to be effective, what is being implemented and the enforcement thereof.[1]

CONCLUSION

We performed a retrospective review of children involved in road traffic accidents as pedestrians in the greater Cape Town area from 201 to 2015. An in-depth analysis was performed of the specific injuries sustained in order to compare the pattern of injuries across different age groups and between those that survived the injuries versus those that died due to the injuries.

Our study confirms the high incidence of head and limb injuries sustained during child pedestrian accidents as reported by previous studies. We found that the addition of spinal, chest and abdominal injuries increases the risk of death significantly. Injury to the extremities does not have an impact on the mortality risk.

More knowledge of all the aspects of these incidents will help to improve the safety of this very vulnerable group of our society.

REFERENCES

1. Peden, M., Scurfield R., Sleet, d., Mohan, D., Hyder, A. A., Jarawan, E. and Mathers, C. The world report on road traffic injury prevention. Geneva, Switzerland: World Health Organisation, 2004. Retrieved from http://www.who.int/violence_injury_prevention/publications/road_traffic/world_report
2. World Health Organisation. Global status report on road safety 2018. Geneva, Switzerland: World Health Organisation, 2018. Retrieved from http://www.who.int/violence_injury_prevention/road_safety_status/2018
3. World Health Organisation. Global status report on road safety 2015. Geneva, Switzerland: World Health Organisation, 2015. Retrieved from http://www.who.int/violence_injury_prevention/road_safety_status/2015
4. Peden, M., Oyegbite, K., Ozanne-Smith, J., Hyder, A.A., Branche, C., Rahman, A.F., Rivara, F. and Bartolomeos, K. World report on child injury prevention. Geneva, Switzerland: World Health Organisation, 2008. Retrieved from http://www.who.int/violence_injury_prevention/child/injury/world_report/World_report.pdf
5. Kihurani, I., Van Niekerk, A. and Van As, A.B. Child road traffic crash injuries at the Red Cross war memorial children's hospital in Cape Town South Africa in 1992, 2002, 2012. International Journal of Injury Control and Safety Promotion 2015; 22(4): 352-358. http://dx.doi.org/10.1080/17457300.2014.912236
6. Arendse, N., Swart, L. A., Van Niekerk, A. and Van As, S. Pedestrian Safety. In: Van Niekerk, A., Suffla, S. and Seedat, M. (Eds.) Third review: Crime, violence and injury prevention in South Africa: 21st Century solutions for child safety. Cape Town, South Africa: Medical Research Council – University of South Africa, Safety and Peace Promotion Research Unit, 2012: 8-22.
7. Road Traffic Management Corporation. Road fatality report for 2017. Midrand, South Africa: Road Traffic Management Corporation, 2017. Retrieved from http://www.arrivealive.co.za/stats.aspx
8. Albertyn, Z., Mathews, S., Coetzee, D. and Van As, A. B. Morbidity and mortality from road traffic crashes in children in Metro West, city of Cape

Town – 2014. International Journal of Injury Control and Safety Promotion 2019; 26(1): 115-123. http://dx.doi.org/10.1080/17457300.2018.1508165

9. World Health Organisation. Youth and road safety 2007. Geneva, Switzerland: World Health Organisation, 2007. Retrieved from http://www.who.int/management/programme/ncd/Youth and Road Safety.pdf
10. Lozano, R., Naghavi, M., Foreman, K., Lim, S., Shibuya, k., Aboyans, V.,… Memish, Z.A. Global and regional mortality from 235 causes of death for 20 age groups in 1900 and 2010: A systematic analysis for the Global burden of Disease Study 2010. The Lancet 2013; 380(9859): 2095-2128. https://dx.doi.org/10.1016/S0140-6736(12)61728-0
11. Walton-Hayes, L. Pedestrian injuries to young children (EPICgram). California Department of Health Service, Epidemiology and Prevention for Injury Control Branch, 2002 May. Report No. 5. Retrieved from http://www.kidsandcars.org/wp-content/uploads/pdfupload/2002-05-ped-inj-young-children-study.pdf
12. DiMaggio, C. and Durkin, M. Child Pedestrian Injury in an Urban Setting: Descriptive Epidemiology. Academic Emergency Medicine 2002 January; 9(1): 54-62. https://onlinelibrary.wiley.com/doi/pdf/10.1197/aemj.9.1.54
13. Matzopoulos, R., Du Toit, N., Dawad, S. and Van As, S. Assessing the prevention response to child road traffic injuries. In: Van Niekerk, A., Suffla, S. and Seedat, M. (Eds.) Crime, violence and injury prevention in South Africa: Data to action. Cape Town, South Africa: Medical Research Council – University of South Africa, Crime, Violence and Injury Lead Programme, 2008: 14-27.
14. Hotz, G., Kennedy, A., Lutfi, K. and Cohn, S.M. Preventing paediatric pedestrian injuries. Journal of Trauma 2009 May; 66(5): 1492-1499. http://dx.doi.org/10.1097/TA.0b013e31819d9c9b
15. Mabunda, M. M., Swart, L. A. and Seedat, M. Magnitude and categories of pedestrian fatalities in South Africa. Accident, Analysis and Prevention 2008 March; 40(2): 586-593. http://dx.doi.org/10.1016/j.aap.2007.08.019
16. Damsere-Derry, J., Ebel, B. E., Mock, C. N., Afukaar, F. and Donkor, P. Pedestrians injury patterns in Ghana. Accident, Analysis and prevention 2010 July; 42(4): 1080-1088. http://dx.doi.org/10.1016/j.aap.2009.12.016
17. Peng, R. Y. and Bongard, F. S. Pedestrian versus motor vehicle accidents: An analysis of 5000 patients. Journal of the American College of Surgeons 1999 October; 189(4): 343-348. http://www.ncbi.nlm.nih.gov/pubmed/10509458

18. Solaqberu, B.A., Osuoji, R., Ibrahim, N.A., Oludara, M.A., Balogun, R.A., Ajani, A.O., Idowu, O.E., Mustafa, I.A. and Sanni, F.O. Child pedestrian injury and fatality in a developing country. Pediatric Surgery International 2014 June; 30(6): 625-632. http://dx.doi.org/10.1007/s00383-014-3516-8
19. Feng, X.Y., Nah, S.A., Lee, Y.T., Lin, L.C. and Chiang, L.W. Pedestrian injuries in children: who is most at risk? Singapore Medical Journal 2015; 56(11): 618-621. http://dx.doi.org/10.11622/smedj.2015170
20. Woods, W., Sherwood, C., Ivarsson, J., Crandall, J., Orzechowski, K. and Eichelberger, M. A review of pediatric pedestrian injuries at a Level I Trauma centre. Proceedings, 18th International Technical Conference on the Enhanced Safety of Vehicles, DOT HS 809 543; Washington DC, NHTSA. 2003. https://pdfs.semanticscholar.org/80ff/c4deec59dbd574e4d343d625be391e70245b.pdf
21. Byard, R. W., Green, H., James, R. A. and Gilbert, J. D. Pathological features of childhood pedestrian fatalities. The American Journal of Forensic Medicine and Pathology 2000 June; 21(2): 101-106. https://www.ncbi.nlm.nih.gov/pubmed/10871121
22. Walker, P.J., Cass, D.T. Paediatric trauma: urban epidemiology and an analysis of methods for assessing the severity of trauma in 598 injured children. The Australian and New Zeeland Journal of Surgery October 1987; 57(10): 715-722. https://dx.doi.org/10.1111/j.1445-2197.1987.tb01249.x
23. Safe Kids Canada. Child pedestrian injury report 2007-2008. Toronto, Canada: Safe Kids Canada, 2008. Retrieved from http://www.parachutecanada.org/downloads/injurytopics/ChildPed_Report_07:08.pdf
24. Mohan, D., Tiwari, G., Khayesi, M. and Nafukho, F. M. Unit 2: Risk factors for road traffic injuries. In: Road traffic injury prevention: Training manual. Geneva, Switzerland: World Health Organization, 2006: 21-36. http://apps.who.int/iris/handle/10665/43271
25. Mhlanga, M. Investigation of the road safety measures around schools in eThekwini. [MEng minor dissertation]. University of Cape Town, 2018. Retrieved from: https://open.uct.ac.za/handle/11427/29828
26. Thomson, J., Tolmie, A., Foot, H. C. and McLaren B. Child development and the aims of road safety education: A review and analysis. Road Safety Research Report No.1, Department of Transport. United Kingdom, 1996. Retrieved from http://www.cambsdriveiq.co.uk/childev.pdf

27. Crandall, J. R., Bhalla K. S. and Madeley, N. J. Designing road vehicles for pedestrian protection. British Medical Journal 2002 May; 324(7346): 1145-1148. http://dx.doi.org/10.1136/bmj.324.7346.1145
28. Lambert, F. and Venter, C. J. Testing the impact and feasibility of 30km/h speed limit zones at schools. Paper presented at the 34th Annual Southern Africa Transport Conference; Pretoria, 2015. Retrieved from https://repository.up.ac.za/handle/2263/57781

PART C: ADDENDA

INFORMATION FOR AUTHORS

Type of articles considered

The *South African Medical Journa*l (*SAMJ)* no longer limit the articles accepted to those that have 'general medical content' but intends to capture the spectrum of medical and health sciences, grouped by relevance to the country's burdens of disease. This content will include research in the social sciences and economics that is relevant to the medical issues around our burden of disease. Please see 'A new vision for the *SAMJ* – and a call for papers' for a full discussion of the new directions for the *SAMJ*.

The following types of articles are accepted:

- Research
- Reviews
- Clinical trials
- Editorials
- In Practice
- Correspondence
- Obituaries
- Book reviews
- Ad hoc supplements e.g. guidelines

PUBLICATION FEES

All articles published in the *SAMJ* are open access and freely available online upon publication. This is made possible by applying a business model to offset the costs of peer review management, copyediting, design and production, by charging a publication fee of R5 250 (excluding vat) for each research article published. The charge applies only to Research articles submitted after 1 March 2017. The publication fee is standard and does not vary based on length, colour, figures, or other elements.

When submitting a Research article to the *SAMJ*, the submitting author must agree to pay the publication fee should the article be accepted for publication. The

publication fee is payable when the manuscript is editorially accepted and before production commences for publication. The submitting author will be notified that payment is due and given details on the available methods of payment. Prompt payment is advised; the article will not enter production until payment is received. Queries can be directed to claudian@hmpg.co.za.

AUTHORSHIP

Named authors must consent to publication. Authorship should be based on: (*i*) substantial contribution to conceptualisation, design, analysis and interpretation of data; (*ii*) drafting or critical revision of important scientific content; or (*iii*) approval of the version to be published. These conditions must all be met (uniform requirements for manuscripts submitted to biomedical journals; refer to www.icmje.org)

If authors' names are added or deleted after submission of an article, or the order of the names is changed, all authors must agree to this in writing.

Co-authors will be requested to verify their contribution upon submission. Non-verification may lead to delays in the processing of submissions.

Author contributions should be listed/described in the manuscript.

CONFLICT OF INTEREST

Conflicts of interest can derive from any kind of relationship or association that may influence authors' or reviewers' opinions about the subject matter of a paper. The existence of a conflict – whether actual, perceived or potential – does not preclude publication of an article. However, the *SAMJ* aim to ensure that, in such cases, readers have all the information they need to enable them to make an informed assessment about a publication's message and conclusions. It is a requirement that both authors and reviewers declare all sources of support for their research, any personal or financial relationships (including honoraria, speaking fees, gifts received, etc) with relevant individuals or organisations connected to the topic of the paper, and any association with a product or subject that may constitute a real, perceived or potential conflict of interest. If there is any doubt whether a specific relationship constitutes a conflict, the editorial team should be contacted for advice. If a conflict remains undisclosed and is later brought to the attention of the editorial team, it will

be considered a serious issue prompting an investigation with the possibility of retraction.

RESEARCH ETHICS COMMITTEE APPROVAL

Authors must provide evidence of Research Ethics Committee approval of the research where relevant. Ensure the correct, full ethics committee name and reference number is included in the manuscript.

If the study was carried out using data from provincial healthcare facilities or required active data collection through facility visits or staff interviews, approval should be sought from the relevant provincial authorities. For South African authors, please refer to the guidelines for submission to the National Health Research Database. Research involving human subjects must be conducted according to the principles outlined in the Declaration of Helsinki. Please refer to the National Department of Health's guideline on Ethics in Health research: principles, processes and structures to ensure that the appropriate requirements for conducting research have been met, and that the HPCSA's General Ethical Guidelines for Health Researchers have been adhered to.

CLINICAL TRAILS

As per the recommendations published by the International Committee of Medical Journal Editors (ICMJE), clinical trial research is any research that assigns individuals to an intervention, with or without a concurrent comparison/control group to study the cause-and-effect relationship between the intervention and health outcomes. All clinical trials should be registered with the appropriate national clinical trial registry (or any international primary register, if relevant), and the trial registration number should be cited at the end of the abstract. All clinical trial reports must also contain a data sharing statement as per the recommendations of the ICMJE. Statements are to indicate:

- whether individual deidentified participant data will be shared;
- what data in particular will be shared; whether additional, related documents will be available;
- when the data will become available and for how long; by what access criteria data will be shared.

For further details and illustrative examples of data sharing statements see the ICMJE Data Sharing Statements for Clinical Trials.

Since 1 December 2005, all clinical trials conducted in South Africa have been required to be registered in the South African National Clinical Trials Register. It is therefore a requirement that clinical trials be registered in the relevant public trials registry at or before the time of first patient enrolment as a condition for publication. The trial registry name and registration number must be included in the manuscript.

Refer to the general guidelines for all papers for additional requirements with respect to ethics approval, funding, author contributions, etc. The format of original research articles should be followed for reporting of clinical trial results.

Patient Consent

Information that would enable identification of individual patients should not be published in written descriptions, photographs, and pedigrees unless the information is essential for scientific purposes and the patient (or parent or guardian) has given informed written consent for publication and distribution. It is also recommended that the published article is disseminated not only to the involved researchers but also to the patients/participants from whom the data was drawn. Refer to Protection of Research Participants. The signed consent form should be submitted with the manuscript to enable verification by the editorial team.

Other individuals

Any individual who is identifiable in an image must provide written agreement that the image may be used in that context in the *SAMJ.*

COPYRIGHT NOTICE

Material submitted for publication will be accepted provided it has not been published or submitted for publication elsewhere. Please inform the editorial team if the main findings of the paper have been presented at a conference and published in abstract form, to avoid copyright infringement. All research already published as 'Conference proceedings' needs to be substantially re-written, with a new title, a new abstract and new and important results to back up any study before it will be considered for a new publication. The *SAMJ* does not hold itself responsible for statements made by authors.

PREVIOUSLY PUBLISHED IMAGES

If an image/figure has been previously published, permission to reproduce or alter it must be obtained by the authors from the original publisher and the figure legend must give full credit to the original source. This credit should be accompanied by a letter indicating that permission to reproduce the image has been granted to the author/s. This letter should be uploaded as a supplementary file during submission.

PRIVACY STATEMENT

The *SAMJ* is committed to protecting the privacy of its website and submission system users. The names, personal particulars and email addresses entered in the website or submission system will not be made available to third parties without the user's permission or due process. By registering to use the website or submission system, users consent to receive communication from the *SAMJ* or its publisher HMPG on matters relating to the journal or associated publications. Queries with regard to privacy may be directed to publishing@hmpg.co.za.

ETHNIC/RACE CLASSIFICATION

Use of racial or ethnicity classifications in research is fraught with problems. If one chooses to use a research design that involves classification of participants based on race or ethnicity, or discuss issues with reference to such classifications, a detailed rationale should be included, the categories should be defined, and the socioeconomic, cultural and lifestyle variables that may underlie perceived racial disparities should be controlled for. It should also be specified whether race or ethnicity is classified as reported by the patient (self-identifying) or as perceived by the investigators. It is not appropriate to use self-reported or investigator-assigned racial or ethnic categories for genetic studies.

MANUSCRIPT PREPARATION

Preparing an article for anonymous review

To ensure a fair and unbiased review process, all submissions are to include an anonymised version of the manuscript. The exceptions to this are Correspondence, Book reviews and Obituary submissions.

Submitting a manuscript that needs additional blinding can slow down the review process, therefor the following guidelines should be followed:

- An anonymous version should not contain any author, affiliation or particular institutional details that will enable identification.
- Removal of the title page, acknowledgements, contact details, funding grants to a named person, and any running headers of author names.
- Mask self-citations by referring to one's own work in third person.

General article format/layout

Accepted manuscripts that are not in the correct format specified in these guidelines will be returned to the author(s) for correction, which will delay publication.

General:

- Manuscripts must be written in UK English.
- The manuscript must be in Microsoft Word format. Text must be single-spaced, in 12-point Times New Roman font, and contain no unnecessary formatting (such as text in boxes).
- Please make your article concise, even if it is below the word limit.
- Qualifications, ***full*** affiliation (department, school/faculty, institution, city, country) and contact details of ALL authors must be provided in the manuscript and in the online submission process.
- Abbreviations should be spelt out when first used and thereafter used consistently, e.g. 'intravenous (IV)' or 'Department of Health (DoH)'.
- Include sections on Acknowledgements, Conflict of Interest, Author Contributions and Funding sources. If none is applicable, please state 'none'.
- Scientific measurements must be expressed in SI units except blood pressure (mmHg) and haemoglobin (g/dL).

- Litres is denoted with an uppercase L e.g. 'mL' for millilitres.
- Units should be preceded by a space (except for % and ºC), e.g. '40 kg' and '20 cm' but '50%' and '19ºC'.
- Proper symbols should be used e.g. µ not u for micro, a not a for alpha, b not B for beta, etc.
- Numbers should be written as grouped per thousand-units, i.e. 4 000, 22 160.
- Quotes should be placed in single quotation marks: i.e. The respondent stated: '...'
- Round brackets (parentheses) should be used, as opposed to square brackets, which are reserved for denoting concentrations or insertions in direct quotes.

Preparation notes for Research articles

Guideline word limit: 4 000 words

Research articles describe the background, methods, results and conclusions of an original research study. The article should contain the following sections: introduction, methods, results, discussion and conclusion, and should include a structured abstract. The introduction should be concise – no more than three paragraphs – on the background to the research question, and must include references to other relevant published studies that clearly lay out the rationale for conducting the study. Some common reasons for conducting a study are: to fill a gap in the literature, a logical extension of previous work, or to answer an important clinical question. If other papers related to the same study have been published previously, reference must be made to these papers specifically. Study methods must be described in detail to enable replication of the study if needed. Results should describe the study sample as well as the findings from the study itself, but all interpretation of findings must be kept in the discussion section, which should consider primary outcomes first before any secondary or tertiary findings or post-hoc analyses. The conclusion should briefly summarise the main message of the paper and provide recommendations for further study.

Select figures and tables carefully and sparingly. Only figures that adds value to the paper, over and above what is written in the text, should be added to the paper.

Data in the tables and text should not be replicated.

Structured abstract

- The abstract should be 250-400 words, with the following recommended headings:
    - **Background:** why the study is being done and how it relates to other published work.
    - **Objectives:** what the study intends to find out
    - **Methods:** must include study design, number of participants, description of the intervention, primary and secondary outcomes, any specific analyses that were done on the data.
    - **Results:** first sentence must be brief population and sample description; outline the results according to the methods described. Primary outcomes must be described first, even if they are not the most significant findings of the study.
    - **Conclusion:** must be supported by the data, include recommendations for further study/actions.
- The abstract must be complete, accurate and clear, and approved by all authors.
- References should not be included in the abstracts.

Main article

All articles should include the following main sections: Introduction/Background, Methods, Results, Discussion, Conclusions.

The following are additional heading or section options that may appear within these:

- Objectives (within Introduction/Background): a clear statement of the main aim of the study and the major hypothesis tested or research question posed
- Design (within Methods): including factors such as prospective, randomisation, blinding, placebo control, case control, crossover, criterion standards for diagnostic tests, etc.
- Setting (within Methods): level of care, e.g. primary, secondary, number of participating centres.
- Participants (instead of patients or subjects; within Methods): numbers entering and completing the study, sex, age and any other biological, behavioural, social or cultural factors (e.g. smoking status, socioeconomic

group, educational attainment, co-existing disease indicators, etc) that may have an impact on the study results.

- Interventions (within Methods): what, how, when and for how long. Typically for randomised controlled trials, crossover trials, and before and after studies.
- Main outcome measures (within Methods): those as planned in the protocol, and those ultimately measured. Any differences should be explained.

Results

- Description of the population and sample including key characteristics of comparison groups.
- Main results with (for quantitative studies) 95% confidence intervals and the exact level of statistical significance and the number need to treat/harm. Absolute rather than relative risks should be stated when possible.
- Data in tables and text should not be replicated.
- Specify mean and standard deviations e.g.: The mean (SD) birth weight was 2 500 (1 210) g.
- Report findings as per the Methods section. Interpretation of findings should be dealt with under the Discussion section.

Discussion

The discussion must be concise and follow the overall structure – sub-headings are not needed:

- Statement of principal findings
- Strengths and weaknesses of the study
- Contribution to the body of knowledge
- Strengths and weaknesses in relation to other studies
- The meaning of the study – e.g. what this study means to clinicians and policymakers
- Unanswered questions and recommendations for future research

Conclusions

This may be the only section readers look at; therefore it should be written with care. It should also include primary conclusions with their implications and suggestions in terms of areas of further research.

Illustrations/photos/scans

- If illustrations submitted have been published elsewhere, the author(s) should provide consent to republication obtained from the copyright holder.
- Figures must be numbered in Arabic numerals and referred to in the text e.g. '(Fig. 1)'.
- Each figure must have a caption/legend: Fig. 1. Description (any abbreviations in full).
- All images must be of high enough resolution/quality for print.
- All illustrations (graphs, diagrams, charts, etc.) must be in PDF or jpeg form.
- Ensure all graph axes are labelled appropriately, with a heading/description and units (as necessary) indicated. Do not include decimal places if not necessary e.g. 0; 1.0; 2.0; 3.0; 4.0 etc.
- Arrows should be used to show a specific feature on scans or photos.
- Each image must be attached individually as a 'supplementary file' upon submission (not solely embedded in the accompanying manuscript) and named Fig. 1, Fig. 2, etc.

Tables

- Tables should be constructed carefully and simply for intelligible data representation. Unnecessarily complicated tables are discouraged.
- Large tables will generally not be accepted for publication in their entirety. Consider shortening and using the text to highlight specific important sections, or offer a large table as an addendum to the publication, but available in full on request from the author
- Embed/include each table in the manuscript Word file - do not provide separately as supplementary files.
- Number each table in Arabic numerals (Table 1, Table 2, etc.) and refer to consecutively in the text.
- Tables must be cell-based (i.e. not constructed with text boxes or tabs) and editable.
- Each table should have a concise title with column headings and include units where necessary.

- Footnotes must be indicated with consecutive use of the following symbols: * † ‡ § ¶ || then ** †† ‡‡ etc.

References

NB: *Only complete, correctly formatted reference lists in Vancouver style will be accepted. Reference lists must be generated manually and not with the use of reference manager software. Endnotes must* ***not*** *be used.*

- Authors must verify references from original sources.
- Citations should be inserted in the text as superscript numbers between square brackets, e.g. These regulations are endorsed by the World Health Organization,[2] and others.[3,4-6]
- All references should be listed at the end of the article in numerical order of appearance in the Vancouver style (not alphabetical order).
- Approved abbreviations of journal titles must be used; see the List of Journals in Index Medicus.
- Names and initials of all authors should be given; if there are more than six authors, the first three names should be given followed by et al.
- Volume and issue numbers should be given.
- First and last page, in full, should be given e.g.: 1215-1217 **not** 1215-17.
- Wherever possible, references must be accompanied by a digital object identifier (DOI) link). Authors are encouraged to use the DOI lookup service offered by CrossRef:
    - On the Crossref homepage, paste the article title into the 'Metadata search' box.
    - Look for the correct, matching article in the list of results.
    - Click Actions > Cite
    - Alongside 'url =' copy the URL between { }.
    - Provide as follows, e.g.: https://doi.org/10.7196/07294.937.98x

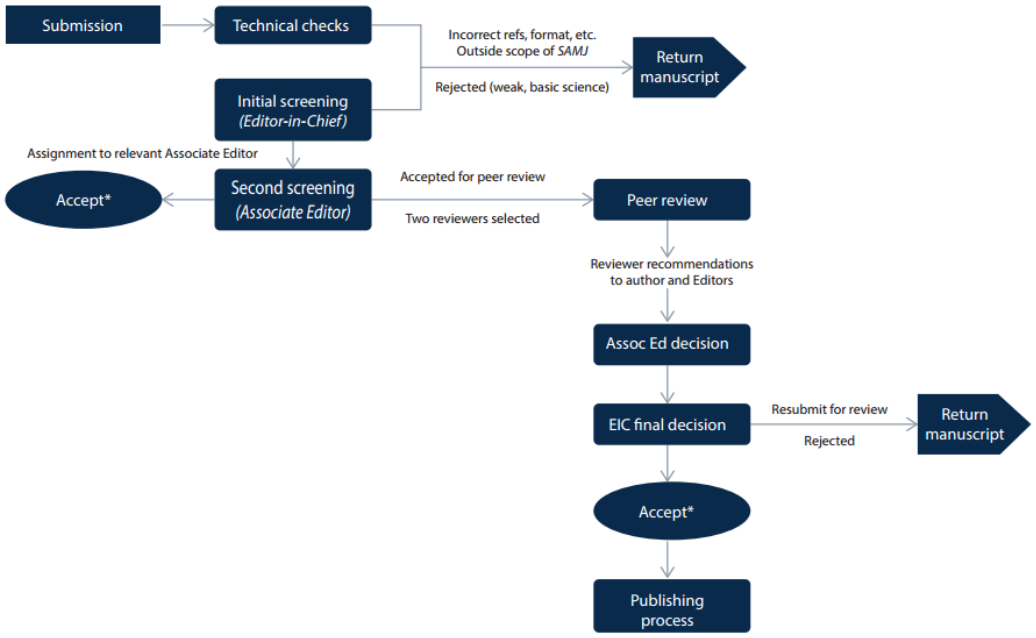
FROM SUBMISSION TO ACCEPTANCE

Submission and peer-review

To submit an article:

- The manuscript must be in line with SAMJ requirements.
- All submissions should be submitted via Editorial Manager www.editorialmanager.com/samj
- The following are required for submission to be complete:
    - Anonymous manuscript (unless otherwise stated)
    - Author Agreement form
    - Manuscript
    - Any supplementary files: figures, datasets, patient consent form, permissions for published images, etc.
- Once the submission has been successfully processed on Editorial Manager, it will undergo a technical check by the Editorial Office before it will be assigned to an editor who will handle the review process. If the author guidelines have not been appropriately followed, the manuscript may be sent back to the author for correcting.

Peer-review process



*Manuscripts accepted at this point are limited to Editorials, Correspondence, Obituaries, Book reviews, Abstracts, CME
**Some minor revisions may be requested

Production process

The following process will follow:

1. An accepted manuscript is passed to a Managing Editor to assign to a copyeditor (CE).
2. The CE copyedits in Word, working on house style, format, spelling/grammar/punctuation, sense and consistency, and preparation for typesetting.
3. If the CE has any author queries, he/she will contact the corresponding author and send them the copyedited Word doc, asking them to solve the queries by means of track changes or comment boxes.
4. The authors are typically asked to respond within 1-3 days. Any comments/changes must be clearly indicated e.g. by means of track changes.
5. The CE will finalise the article and then it will be typeset.
6. Once typeset, the CE will send a PDF of the file to the authors to complete their final check, while simultaneously sending to the 2nd-eye proofreader.
7. The authors are typically asked to complete their final check and sign-off within 1-2 days. No major additional changes can be accommodated at this point.
8. The CE implements the authors' and proofreader's mark-ups, finalises the file, and prepares it for the upcoming issue.

Department Research Council Application

Retrospective review of paediatric patients involved in pedestrian vehicle accidents in the greater Cape Town area.

Introduction

Pedestrian vehicle injuries are a growing public health threat world wide[1].

In Africa, the road traffic death rate for children is almost double that of the rest of the world[2]. In South Africa, pedestrian accidents are the leading cause of injury related deaths in children younger than 15 years[3]. Pedestrians are the highest risk group of road users and tend to suffer more severe injuries than other road users[7].

More information regarding these accidents and the associated injuries may facilitate the development of potential safety measures.

Purpose of the study

The aim of the study is to look at the injury patterns in paediatric pedestrian accidents in different age groups. A comparison will also be done between the injuries sustained by individuals that survive and those that demise, to prognosticate different injury patterns.

The study will look at the demographics of children involved in pedestrian vehicle accidents in the greater Cape Town area. The area where the accident occurred will be documented to identify high risk areas.

Background

There is international and national research looking at various different aspects of pedestrian vehicle accidents. Previous studies have highlighted the general distribution of injuries sustained in paediatric pedestrian accidents[4]. However, the specific types of injuries sustained by child pedestrians in different age groups have

not been researched widely. Only one study could be found. This study was done at the University of Virginia, USA and reviewed the distribution of injury types sustained by paediatric pedestrians involved in road traffic accidents[5].

The high number of paediatric pedestrian accidents in South Africa, including Cape Town, warrants a similar study to be done locally.

Age and low socio-economic circumstances are two of the major risk factors for pedestrian vehicle accidents[6]. Children are more vulnerable because they lack road awareness that is needed to avoid oncoming traffic[6].

Methodology

- Study design: Retrospective review
- Characteristics of the study population: All patients below the age of 13 years that were involved in a pedestrian vehicle accident between 2011 and 2015, and were admitted to Red Cross Children's Hospital (RCCH), as well as those subjects that died and presented to Salt River Mortuary, will be included in the study. During the study period there were approximately 300 children admitted to the Salt River mortuary following fatal pedestrian vehicle accidents. The number of post-accident admissions to RCCH during this period will become clear once the database has been interrogated.
- Recruitment and enrolment: The database at the Division of Forensic Medicine and Toxicology, University of Cape Town, will be interrogated to identify all children that died due to pedestrian vehicle accidents. To identify the patients that were admitted to RCCH for injuries sustained during a pedestrian vehicle accident, the database of Childsafe South Africa will be interrogated. Childsafe South Africa is a non-governmental organisation that maintains a trauma surveillance system based on data captured at RCCH. All of the identified cases will be included in the study for review.
- Research procedures and data collection methods: The data captured in Childsafe South Africa's trauma surveillance system will be interrogated to find all subjects that sustained injuries in pedestrian vehicle accidents and needed admission to RCCH. The data base at the Division of Forensic

Medicine and Toxicology, University of Cape Town, will also be interrogated to find individuals that died from pedestrian vehicle accidents.

- Data safety and monitoring: All collected data will be saved on the personal computer of the principle investigator. No personal information will be recorded for the purpose of the study. This computer is password protected.
- Data analysis: Standard statistical analysis will be performed with the assistance of a qualified statistician.
- Ethical approval: Once DRC approval has been obtained, an application to the Human Research Ethics Committee will be made for approval of the study.

Description of risks and benefits

Due to the retrospective design of the study there will be no risks or benefits for individuals included in the study.

Informed consent process

No informed consent will be required for the study.

Privacy and confidentiality

No personal details of individuals included in the study will be recorded to protect their privacy.

Ethical and Regulatory compliance

The Division of Forensic Medicine and Toxicology “Office Autopsies” data base which will be searched to identify suitable cases and gather some of the data is a registered research repository, with number R036/2014.

The Child Death Review Project data will be used for cases that occurred during 2014-2015. During this time the Project was also a research concern, with number HREC 396/2013. On 1 June 2016 the collection of this data became operational practice and will now be incorporated into the “Office Autopsies” repository.

The registered research number for the Childsafe South Africa's trauma surveillance system will be obtained from Prof Van As (Head of the Trauma Unit at RCCH and National President of Childsafe South Africa) for ethical compliance.

There are no known conflicts of interest of any of the researchers working on the project.

Reimbursement for participation

There will be no reimbursement for participation in the study.

Emergency care and insurance for research-related injuries

Not applicable.

What happens at the end of the study?

The study will form part of a MMed dissertation, and the findings will be published in a peer reviewed journal.

References

1. Peden M. World Report on Road Traffic Injury Prevention: Summary. World Health Organization 2004.
2. McMahon K, Gopalakrishna G, Stevenson M. Road traffic injuries. World report on child injury prevention. World Health Organization, Geneva. 2008: 31-56.
3. Arendse N, Swart LA, van Niekerk A, Van As S. 2 PEDESTRIAN SAFETY.
4. Kong LB, Lekawa M, Navarro RA, McGrath J, Cohen M, Margulies DR, Hiatt JR. Pedestrian-motor vehicle trauma: an analysis of injury profiles by age. Journal of the American College of Surgeons. 1996 Jan; 182(1): 17-23.
5. Woods W, Sherwood C, Ivarsson J, Crandall J, Orzechowski K, Eichelberger M. A review of paediatric pedestrian injuries at a Level 1 trauma centre. In Proceedings, 18th International Technical Conference on the Enhanced Safety of Vehicles, DOT HS 2003 May (Vol. 809, pp. 543).

6. Chakravarthy B, Lotfipour S, Vaca FE. Pedestrian injuries: Emergency care considerations. Western Journal of Emergency Medicine. 2007 Jan 1;8(1).
7. Niebuhr T, Junge M, Rosen E. Pedestrian injury risk and the effect of age. Accident Analysis & Prevention. 2016 Jan 31; 86: 121-8.

HREC852/2016

Retrospective review of paediatric patients involved in pedestrian vehicle accidents in the greater Cape Town area
Data collection sheet 2011 - 2015

Case study number	**No**
Red Cross Hospital number	
Salt River FPS number	
Age	
Sex	
Area of incident	
Day of injury	
Time of injury	

Distribution of injuries by body regions

Head

Soft tissue
Skull fracture
Base of skull fracture
Facial fracture
Intracranial haemorrhage
Brain parenchymal injury
Diffuse axonal injury

Spine

Atlanto-occipital dislocation
Fracture
Spinal cord injury

Chest

Soft tissue
Fractures ribcage
Clavicle fracture
Haemo/pneumothorax
Lung: Laceration, contusion, blood aspiration
Heart: laceration/contusion
Vasculature

Abdomen

Soft tissue
Haemoperitoneum/retroperitoneal haemorrhage
Intestines and mesentery
Diaphragm
Liver
Spleen
Pancreas
Kidney/adrenal
Bladder/ureter
Vasculature

Upper extremity

Soft tissue
Shoulder
Elbow
Humerus
Radius and ulna
Hand/wrist
Vasculature

Lower extremity

Soft tissue
Pelvis
Hip
Femur
Knee
Tibia and fibula
Ankle/foot
Vasculature

mllize001:turnitin[6252].docx

ORIGINALITY REPORT

14%	8%	6%	11%
SIMILARITY INDEX	INTERNET SOURCES	PUBLICATIONS	STUDENT PAPERS

PRIMARY SOURCES

1	open.uct.ac.za Internet Source	1%
2	whqlibdoc.who.int Internet Source	1%
3	"Evidence-Based Emergency Imaging", Springer Science and Business Media LLC, 2018 Publication	1%
4	Submitted to Kwame Nkrumah University of Science and Technology Student Paper	1%
5	Submitted to University of Sydney Student Paper	1%
6	www.saferafrica.eu Internet Source	<1%
7	Submitted to University of Huddersfield Student Paper	<1%
8	www.unicef.org Internet Source	<1%

9	Submitted to Intercollege Student Paper	<1%
10	Submitted to Universiti Teknologi MARA Student Paper	<1%
11	Mary D. Gunnels. "Pedestrian trauma: What types of injury can we expect to see when an injured child arrives?", Journal of Emergency Nursing, 2002 Publication	<1%
12	Submitted to Perdana University Student Paper	<1%
13	J R Crandall. "Designing road vehicles for pedestrian protection", BMJ, 5/11/2002 Publication	<1%
14	Riccardo Rossi, Massimiliano Gastaldi, Francesco Biondi, Claudio Mulatti. "Warning Sound to Affect Perceived Speed in Approaching Roundabouts: Experiments with a Driving Simulator", Procedia - Social and Behavioral Sciences, 2013 Publication	<1%
15	Isaac, Kihurani N., Ashley Van Niekerk, and Arjan Bastiaan Van As. "Child road traffic crash injuries at the Red Cross War Memorial Children's Hospital in Cape Town, South Africa in 1992, 2002 and 2012", International Journal	<1%

	of Injury Control and Safety Promotion, 2014. Publication	
16	Sports Injuries, 2015. Publication	<1%
17	Submitted to University of Leeds Student Paper	<1%
18	Submitted to St Eugene College Student Paper	<1%
19	www.ortoped.fmed.edu.uy Internet Source	<1%
20	Submitted to University of Stellenbosch, South Africa Student Paper	<1%
21	Submitted to Regenesys Business School Student Paper	<1%
22	Submitted to University of Derby Student Paper	<1%
23	ajhpe.org.za Internet Source	<1%
24	issuu.com Internet Source	<1%
25	Submitted to University of East London Student Paper	<1%
26	Submitted to University of South Florida	

	Student Paper	<1%
27	Submitted to Australian National University Student Paper	<1%
28	Submitted to University of Birmingham Student Paper	<1%
29	Huskisson, J. M., and S. Feulbach. "A profile of the socio-demographic background of children admitted with acute diarrhoea to the Red Cross Children's Hospital, Cape Town", Curationis, 1995. Publication	<1%
30	www.mrc.ac.za Internet Source	<1%
31	zambianroadsafety.org Internet Source	<1%
32	"12th European Congress of Trauma and Emergency Surgery", European Journal of Trauma and Emergency Surgery, 2011 Publication	<1%
33	www.umb.edu Internet Source	<1%
34	www.ciht.org.uk Internet Source	<1%
	Submitted to North West University	

35	Student Paper	<1%
36	Submitted to Mahidol University Student Paper	<1%
37	Submitted to Canterbury Christ Church University Student Paper	<1%
38	linknovate.com Internet Source	<1%
39	apps.who.int Internet Source	<1%
40	trepo.tuni.fi Internet Source	<1%
41	www.business-standard.com Internet Source	<1%
42	www.aihw.gov.au Internet Source	<1%
43	Sanford R. Kimmel, John Chessare. "Chapter 17 Selected Problems of Infancy and Childhood", Springer Science and Business Media LLC, 1994 Publication	<1%
44	www.vias-seguras.com Internet Source	<1%

45	rtsa-ims-zambia.co.zm Internet Source	<1%
46	Submitted to Kenyatta University Student Paper	<1%
47	bmcmedethics.biomedcentral.com Internet Source	<1%
48	www.bluechipjournal.co.za Internet Source	<1%
49	losangelescaraccident-attorney.com Internet Source	<1%
50	Hefny, Ashraf F., Hani O. Eid, and Fikri M. Abu-Zidan. "Pedestrian injuries in the United Arab Emirates", International Journal of Injury Control and Safety Promotion, 2014. Publication	<1%
51	Submitted to Laureate Higher Education Group Student Paper	<1%
52	www.deir.qld.gov.au Internet Source	<1%
53	Indian Growth and Development Review, Volume 9, Issue 2 (2016) Publication	<1%
54	www.michelin.ae Internet Source	<1%

55	Submitted to Foundation for Professional Development Student Paper	<1%
56	Sanjay Kumar Singh. "Road Traffic Accidents in India: Issues and Challenges", Transportation Research Procedia, 2017 Publication	<1%
57	www.samj.org.za Internet Source	<1%
58	www.law.utoronto.ca Internet Source	<1%
59	Submitted to Curtin University of Technology Student Paper	<1%
60	Submitted to University of Louisiana, Lafayette Student Paper	<1%
61	www.hpforum.org.nz Internet Source	<1%
62	group.renault.com Internet Source	<1%
63	Submitted to Leeds Metropolitan University Student Paper	<1%
64	ip.bmjjournals.com Internet Source	<1%
65	Submitted to Durban University of Technology	

	Student Paper	<1%
66	blog.limoinsurancedirect.com Internet Source	<1%
67	Submitted to Erasmus University of Rotterdam Student Paper	<1%
68	Submitted to Liverpool John Moores University Student Paper	<1%
69	Submitted to University of Cape Town Student Paper	<1%
70	Submitted to Maastricht School of Management Student Paper	<1%
71	Submitted to University of Newcastle Student Paper	<1%
72	Submitted to University of Newcastle upon Tyne Student Paper	<1%
73	"Trauma and Combat Critical Care in Clinical Practice", Springer Science and Business Media LLC, 2016 Publication	<1%
74	www.chemtrailplanet.com Internet Source	<1%

Exclude quotes	On	Exclude matches	Off
Exclude bibliography	On		

Signature Removed

Dr. L. Liebenberg

UNIVERSITY OF CAPE TOWN
Faculty of Health Sciences
Human Research Ethics Committee

Room E52-24 Old Main Building
Groote Schuur Hospital
Observatory 7925
Telephone [021] 404 7632 • Facsimile [021] 406 6411
Email: nosi.tsame@uct.ac.za
Website: www.health.uct.ac.za/fhs/research/humanethics/forms

10 February 2017

HREC REF: 852/2016

Dr L Liebenberg
Forensic Medicine & Toxicology
Falmouth Building

Dear Dr Liebenberg

PROJECT TITLE: RETROSPECTIVE REVIEW OF PAEDIATRIC PATIENTS INVOLVED IN PEDESTRIAN VEHICLE ACCIDENTS IN THE GREATER CAPE TOWN AREA (MMed-candidate-Dr I Moller)

Thank you for submitting your response letter to the Faculty of Health Sciences Human Research Ethics Committee dated 07 February 2017.

It is a pleasure to inform you that the HREC has **formally approved** the above-mentioned study.

Approval is granted for one year until the 28th February 2018.

Please submit a progress form, using the standardised Annual Report Form if the study continues beyond the approval period. Please submit a Standard Closure form if the study is completed within the approval period.
(Forms can be found on our website: www.health.uct.ac.za/fhs/research/humanethics/forms)

We acknowledge that the student Izelle Moller will be involved in this study.

Please note that for **all** studies approved by the HREC, the principal investigator **must** obtain appropriate institutional approval before the research may occur.

Please quote the HREC REF in all your correspondence.

Please note that the ongoing ethical conduct of the study remains the responsibility of the principal investigator.

Yours sincerely

Signature Removed

PROFESSOR M BLOCKMAN
CHAIRPERSON, FHS HUMAN RESEARCH ETHICS COMMITTEE
Federal Wide Assurance Number: FWA00001637.
Institutional Review Board (IRB) number: IRB0001938

UNIVERSITY OF CAPE TOWN

FACULTY OF HEALTH SCIENCES
Human Research Ethics Committee

HUMAN RESEARCH ETHICS COMMITTEE
22 JAN 2018
HEALTH SCIENCES FACULTY
UNIVERSITY OF CAPE TOWN

FHS017: Annual Progress Report / Renewal

Record Reviews/Audits/Collection of Biological Specimens/Repositories/Databases/Registries

HREC office use only (FWA00001637; IRB00001938)			
This serves as notification of annual approval, including any documentation described below.			
☑ Approved	Annual progress report	Approved until/next renewal date	28/02/2019
☐ Not approved	See attached comments		
Signature Chairperson of the HREC	Signature Removed	Date Signed	23/1/2018

Principal Investigator to complete the following:

1. Protocol information

Date (when submitting this form)	22 January 2018		
HREC REF Number	852/2016	Current Ethics Approval was granted until	28/02/2018
Protocol title	Retrospective review of paediatric patients involved in pedestrian vehicle accidents in the greater Cape Town area.		
Principal Investigator	Dr Linda Liebenberg		
Department / Office Internal Mail Address	Linda.Liebenberg@uct.ac.za		
1.1 Does this protocol receive US Federal funding?		☐ Yes	X No

2. Protocol status (tick ✓)

X	Research-related activities are ongoing
☐	Data collection is complete, data analysis only

Please indicate (in the block below) the titles and HREC reference numbers of any projects currently making use of the Database/registry/repository.

Databases.

Office autopsies (Division of Forensic Medicine and Toxicology) R036/2014 , Child death review (Div For Med and Toxicology) HREC 396/2013 ,

ChildSafeSA – Red Cross Hospital
Copyright © 2018 - Childsafe.

Childsafe is a Campaign by the Child Accident Prevention Foundation of Southern Africa, a member of Safe Kids Worldwide NPO 003-467 /
PBO Number 18/11/13/

3. Protocol summary

Total number of records or specimens collected, reviewed or stored since the original approval	±300
Total number of records or specimens collected, reviewed or stored since last progress report	±150

HUMAN RESEARCH ETHICS COMMITTEE
21 FEB 2019
HEALTH SCIENCES FACULTY
UNIVERSITY OF CAPE TOWN

UNIVERSITY OF CAPE TOWN

FACULTY OF HEALTH SCIENCES
Human Research Ethics Committee

FHS016: Annual Progress Report / Renewal

HREC office use only (FWA00001637; IRB00001938)			
This serves as notification of annual approval, including any documentation described below.			
☑ Approved	Annual progress report	Approved until/next renewal date	28.02.2020
☐ Not approved	See attached comments		
Signature Chairperson of the HREC	Signature Removed	Date Signed	26/02/2019

Comments to PI from the HREC
Please complete the FHS01 for future annual progress reports for this study. many thanks TBurgess

Principal Investigator to complete the following:

1. Protocol information

Date (when submitting this form)	15 February 2019		
HREC REF Number	852/2016	Current Ethics Approval was granted until	28/02/2019
Protocol title	Retrospective review of paediatric patients involved in pedestrian vehicle accidents in the greater Cape Town area.		
Protocol number (if applicable)			
Are there any sub-studies linked to this study?	☐ Yes √ No		
If yes, could you please provide the HREC Ref's for all sub-studies? Note: A separate FHS016 must be submitted for each sub-study.			
Principal Investigator	Dr Linda Liebenberg		
Department / Office Internal Mail Address	Reception at Division Forensic Medicine and Toxicology Entrance 3 Falmouth Building Level 1 UCT Medical School		

1.1 Does this protocol receive US Federal funding?	☐ Yes	√ No

(Note: Please complete the Closure form (FHS010) if the study is completed within the approval period)

HUMAN RESEARCH ETHICS COMMITTEE
21 FEB 2019
HEALTH SCIENCES FACULTY UNIVERSITY OF CAPE TOWN

UNIVERSITY OF CAPE TOWN

FACULTY OF HEALTH SCIENCES
Human Research Ethics Committee

Form FHS006: Protocol Amendment

HREC office use only (FWA00001637; IRB00001938)		
☑ Approved	☑ Type of review: Expedited	☐ Full committee
This serves as notification that all changes and documentation described below are approved.		
Signature Chairperson of the HREC Signature Removed	Date	27/02/2019

Note: All major amendments must include a local **PI Synopsis** justifying the changes for the amendment. Please note that incomplete amendment submissions will not be reviewed.

Comments from the HREC to the Principal Investigator:
Amendment approved subject to appropriate institutional approval being obtained from Red Cross War Memorial Children's Hospital to access the PACS system. Many thanks (Bwps)
Note: The approval of this protocol amendment does not grant annual approval. Please complete the FHS016 / FHS017 form for annual approval at least one month before study expiration.

Principal Investigator to complete the following:

1. Protocol information

Data (when submitting this form)	15 February 2019		
HREC REF Number	852/2016		
Protocol title	Retrospective review of paediatric patients involved in pedestrian vehicle accidents in the greater Cape Town area.		
Protocol number (if applicable)			
Principal Investigator	Dr. Linda Liebenberg		
Department / Office Internal Mail Address	Reception at Division Forensic Medicine and Toxicology Entrance 3 Falmouth Building Level 1 UCT Medical School		
1.1 Is this a major or a minor amendment? (see FHS006hlp) Major (tick box) Minor (tick box)		☐ Major	√ Minor
1.2 Does this protocol receive US Federal funding?		☐ Yes	√ No

Western Cape Government
Health

DR A PARBHOO
Manager: Medical Services
Red Cross War Memorial Children's Hospital
Email: Anita.Parbhoo@westerncape.gov.za
Tel: +27 21 658 5430 Fax: +27 21 658 5006/5166

21 May 2019

Dear, Dr Izelle Maier

RESEARCH: RXH: RCC 186

PROJECT TITLE: RETROSPECTIVE REVIEW OF PAEDIATRIC PATIENTS INVOLVED IN PEDESTRIAN VEHICLE ACCIDENTS IN THE GREATER CAPE TOWN AREA

It is a pleasure to inform you that approval is hereby granted to conduct above-mentioned study at Red Cross War Memorial Children's Hospital.

Yours sincerely.

Signature Removed

DR A PARBHOO
MANAGER: MEDICAL SERVICES