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ORIGINAL ARTICLE

Incidence and Impact of Unintentional Childhood Injuries: A Community Based Study in Rural South India

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Abstract
Objective To estimate the incidence of unintentional childhood injuries and to assess the impact of injury during childhood.
Methods This is a cross sectional study, conducted in 13 clusters of a rural block in Vellore. Children were screened by two-stage cluster sampling method by two weeks and three months recall method. The primary caregivers of injured children were administered a questionnaire to assess the impact of the injury.
Results Childhood injury related morbidity was 292.5 per 1000 y. Children between 10 and 14 y (4.6%) and boys (4.5%) had a higher rate of injury. Fall (43.1 %) was the most common cause of injury followed by RTIs (Road Traffic Incidents-27.6%). Work absenteeism for primary caregivers ranged from 1 to 60 (IQR 2–7) days. Sickness absenteeism ranged from 1 to 45 d with a mean of 7.64 (IQR 2–7) days. Half of the children missed school after an injury. The days spent with temporary disability ranged from 1 to 60 d with a mean of 11.79 (IQR 2–7) d and 7.73% had permanent disability.
Conclusions Unintentional childhood injury is a neglected public health problem which leads to sickness absenteeism and disability. Boys and older children are the most common victims of injury. There is a need for establishing state or nationwide injury registries to help understand accurate estimates of disability-adjusted life year (DALY) and loss of productivity.

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Introduction

Unintentional childhood injuries are a major cause of mortality and morbidity among children (upto 18 y) across the globe and contributes to over 875,000 deaths annually. This is equivalent to the deaths caused by measles, diphtheria and polio added together [1, 2]. In India, a nationwide survey based on verbal autopsy revealed an injury related mortality of 302/100,000 live births among under-5 children [3]. A community based study in India revealed a higher mortality rate in rural than urban areas [4]. Childhood Unintentional Injury Surveillance estimated that nearly 50 % of children under 12 y suffered unintentional injuries severe enough to warrant presentation to an emergency room (ER) and had some form of disability [1]. Rivara et al. reported that in the USA, children treated in the ER were more likely to miss school and stay in bed for two or more days compared to children treated in clinics. More than half of the children (55.9%) had some limitation of activity for 2 d or more. The impact of the injury also varied with etiology of injury and age of the child [5]. According to Gofin et al., burns and traffic accidents were associated with a higher proportion of disability. The limitation of activity 6 mo after an injury ranged from 8.3% (due to daily activities) to 19.4% (sports injury) [6]. Childhood injury has severe physical, emotional and financial consequences for children and their families including days of painful medical procedures, disability, permanent brain damage or loss of vital organs. Poor awareness among the public and lack of effective Government surveillance has made unintentional injuries an under-reported public health problem in India. A knowledge of the current epidemiological trends and

consequences of unintentional injuries will help in understanding the burden of the problem and improve prevention strategies. Hence this study was undertaken to estimate the incidence and medical consequences of unintentional injuries among children (0–14 y) in rural Tamil Nadu.

Material and Methods

This is a cross-sectional study conducted by Department of Community Health, Christian Medical College, Vellore, from March to August 2013, in Kaniyambadi Block, Tamil Nadu which has a population of 1,10,646 people. The Department provides health care through CHAD (Community Health And Development) program. The Part Time Community Health Worker (PTCHW) of the program is a trained local midwife serving a population of 1500–2000 and is supervised by a health aide. The Health aide serving a population of 3000–5000, collects data on pregnancies, births, deaths, morbidity, marriages, immunization and reports it to a Public Health Nurse (PHN). The PHN is responsible for a population of 15,000–20,000 and ensures updating of records, regular follow up, detecting health complications and early referral to the hospital, if required. The PHN is supervised by a Postgraduate resident in Community Medicine who looks after a population of 30,000–40,000. The Community Health and Development (CHAD) Hospital serves both as a referral centre for field programs and as a point of primary care. The data obtained for the entire block through this surveillance system is maintained in an electronic database in the Health Information System (HIS) of the department and is reviewed monthly.

An earlier study in this block showed the mean number of events as 0.3/y [7]. The sample size was calculated as 1598 using the formula $4pq/d^2$ with 20% precision and adding design effect of 1.2. Mortality from January 2008 to December 2012 was obtained from the HIS and childhood (0–14 y) unintentional injury related deaths were analyzed. Villages with at least 3 deaths were arranged in alphabetical order and the first 13 villages were chosen. In each village a house-to-house survey of permanent residents was done and the youngest child below 14 y in each household was included. Information was sought from the primary care giver after obtaining informed consent. The primary care giver was asked if the child sustained any injury in the past two weeks or three months and responses were noted in an injury screening form. A pilot tested, translated and back translated, interviewer-administered questionnaire was used to collect data regarding details of injury and events that followed the injury. Injuries were classified as trivial, moderate, major, serious and fatal injuries. This classification was based on Report to UNICEF on the Vietnam multi-center injury [8]. Children with birth injuries, iatrogenic injuries or trivial injuries were excluded. Data was entered in epi-info and analyzed using the statistical package SPSS v.17.0. This study was approved by Ethics Committee of Institutional Review Board.

Results

The study population consisted of 1600 children (80 % of eligible children from all clusters) with almost equal proportion of boys and girls. Majority of children were in the 0–4 y age group (Table 1). The 2 wk recall period group had eighteen children and 3 mo recall period group had fifty eight children with a history of injury. As injuries are hyper-acute events and duration is immaterial, prevalence of injury can be considered as its incidence. The incidence of injury for 1 y was derived from 2 wk and 3 mo recall periods by multiplying with 26 and 4 respectively. Injury related morbidity rate was 292.5 per 1000 person- years [(18/1600) × 26 × 1000] and 145 per 1000 person- years [(58/1600) × 4 × 1000] for 2 wk and 3 mo recall period respectively. Rate of injury in 0–4, 5–9 and 10–14 y was 117, 153 and 173 per 1000 y respectively. The injury rate among boys was 181 per 1000 person- years and among girls was 104 per 1000 person-years. This difference was found to be statistically significant ($p = 0.04$). The 0–4 and 10–14 age group had a higher proportion of injuries than 5–9 y group. However, this difference ($\chi^2 = 9.58$, df = 2, $p = 0.619$) was not statistically significant. Nearly two-third (60.3 %) of the children were alone at the time of injury. Children with primary care givers apart from mothers, had higher rate of injury (89.3%) than children with their mothers (10.3%). This difference was also not statistically significant ($\chi^2 = 0.028$, $p = 0.867$).

Injuries were frequently sustained at home or on the street. The commonest cause of injury was falls (43%), followed by RTIs (27.6%) (Table 2). Majority of RTIs (87.5%) were bicycle or motorcycle related (12.5 %) (Table 3) either while riding (71.4%) or as pillion riders (31%). Nearly two-third (63%) of the injuries in 0–4 age group occurred at home. Majority of them sustained injury to the lower limb (51.7%) or head (27.6%). Most of them (91.4%) had moderate injuries and about 7% had severe injuries leading to disability.

The mean distance from home to the place of treatment was 9 km (IQR 3–8 km). More than half of the children (60.7%) were treated by a private practitioner (Table 4) or in a rural health centre run by a private institution and one-third of them received free treatment in a Government hospital with the duration of treatment ranging from 30 min to 7 d (IQR 30 min – 12 h) with a mean of 18 min. None of them had health insurance. Few children continued to attend school immediately after an injury. Sickness absenteeism varied from 1 to 45 d (Table 5). Mean sickness absenteeism was 7.64 with standard deviation of 10.86 (IQR 2–7) d. Absenteeism from work by primary caregivers in the process of caring for the

Table 1 Age–Gender distribution of injuries

Age in years	Male			Female			Total	*P* value
	No. of children screened	No. of children with injury	% of injured children in each age category	No. of children screened	No. of children with injury	% of injured children in each age category	% of injured children in each category	
0–4	329	12	3.6	318	7	2.2	2.9	0.619
5–9	236	10	4.2	209	7	3.3	3.8	
10–14	273	16	5.8	235	6	2.5	4.3	
Total	838	38	4.5	762	20	2.6	3.6	

injured child ranged 1–60 d with a mean of 10.6 (2–7) d. The mean days spent with temporary disability were 11.79 d (IQR 2–7) d. Four children (7.73%) had permanent disability.

Discussion

The index study revealed an injury morbidity rate of 292.5 per 1000 person-years among children between 0 and 14 y which is lower than that in a study (341.8 per1000 person-years) done 10 y ago in the same block [7]. This difference may be due to either a decreasing trend in the injury rate over the years or recall bias. In the index study, there was a decline in estimated injury rates in three mo recall (145 per 1000 person-years) in comparison with two wk (292.5 per 1000 person-years) recall. It can be concluded that 2 wk recall is a better method to measure injury related morbidity as it is a hyperacute event. This is also evident in existing literature that shorter recall is appropriate for accurate estimation of non-fatal injury rates [9].

Nirgude et al. [10] studied a wider age group (0–18 y) of children in Andhra Pradesh and reported a higher injury rate (307 per 1000 person-years). In 1962, Gordon et al. reported a morbidity of 126.6 per 1000 person-years in the 0–14 y age group [11]. This striking difference in the morbidity rate may be attributed to the fact that he included injuries causing disability for a day or more, whereas in index study, all injuries excluding trivial ones were included. Report to UNICEF on the Vietnam multi-center injury survey revealed an overall non fatal injury rate of 48.18 per 1000 person-years which is much lower than index finding [8].

The present study shows a significantly higher proportion of injuries among boys [4.5% (38/838)] than girls [2.6% (20/762)]. This is in concordance with studies across the globe and India [1, 7, 10, 12]. This may be due to the risk taking behavior and greater independence of boys [13]. Children between 10 and 14 y had a higher injury rate [4.6%,(22/478)] than in the other age groups. This is in concordance with a research from the USA [5]. However, few studies have also reported a bimodal distribution with a higher rate of injury in younger (1–5 y) and older children (10–14 y) [1, 13].

Most of the injuries occurred at home (44.8%) commonly due to falls or burns. Similar observations were made in a study from Pakistan where 85% of injuries occurred at home [14]. In the index study, the commonest anatomical site of

Table 2 Distribution of injuries (n = 58)

Characters	Category	Number	Percentage
Type of injury	Falls	25	43.1
	RTI	16	27.6
	Burns	8	13.8
	Others	9	15.5
Place of injury	Home	26	44.8
	Street	16	27.6
	School	5	8.6
	Highway	5	8.6
	Play ground & Farm	4	6.8
	Others	2	3.4
Anatomical site of injury	Lower Limb	30	51.7
	Head	16	27.6
	Upper Limb	7	12.1
	Rest of the body	5	8.6
Classification of injury	Moderate	53	91.4
	Severe	4	6.9
	Major	1	1.7

RTI Road traffic incident

Table 3 Causes of injury

Type of injury	Causes	Number	Percentage
RTIs (N = 16)	Bicycle related	14	87.5
	Motorcycle related	2	12.5
Falls (N = 25)	On ground level	17	68.0
	Stairs	4	16.0
	Others	4	16.0
Burns (N = 8)	Silencer of the bike	3	37.5
	Hot water & milk	2	25.0
	Others	3	37.5

RTIs Road traffic incidents

Table 4 Place and type of treatment

Categories (n = 56)	Variables	Number	Percentage
Type of treatment	Outpatient care	43	76.8
	Emergency room	9	16.1
	Home & native remedy	2	3.5
	In-patient care	1	1.8
Place of treatment	Private services	34	60.7
	Government services	16	28.5
	Tertiary centre	3	5.3
	Home & native remedy	3	3.5

injury was the lower limb (51.7%). A study in Texas observed that younger children sustained more head injuries while older children sustained more injuries on the lower limbs [15]. Injuries were commonly due to falls (43.1%) and this is in concordance with observations from Aligarh [16] and the earlier study done in Kaniyambadi block [7]. However, western literature reports falls as the second commonest cause after RTIs [1].

In the industrialized world [1] pedestrian injuries are most common in younger children and driver injuries in adolescents, whereas in present study majority were driver injuries (62.5%) followed by occupant injuries (31.3%). Among the injuries with burns, a significant proportion of them were from the silencers of parked motorbikes, mostly at home, when the parents were also at home. This implies poor parental perception of the silencer being a potential hazard to the children.

While three-quarters of children were treated in an outpatient facility, 16% of them reported to the emergency room and only one child required hospital admission. This is in contrast with western studies where one-third of the children presented to the emergency room and a significant proportion of them required hospitalization [15]. Half of the children missed school after an injury. This finding is similar to an

Table 5 Loss of productivity and sickness absenteeism

Categories	No. of days	Number	Percentage
Sickness absenteeism (n = 28)	1–3 d	14	50
	4–5 d	3	10.7
	6–10 d	7	25
	>10 d	4	14.3
Temporary disability (n = 19)	1–5 d	9	47.4
	6–10 d	5	26.3
	>10 d	9	26.3
Total duration of illness (n = 56)	<3 d	21	37.5
	4–5 d	7	12.5
	6–10 d	19	33.9
	>10 d	9	16.1

American study by Rivara et al. which showed 55.9% of the injured children missed school for 1–2 d [5]. Among children who had temporary disability, nearly half of them (47.4%) had disability upto 5 d. Overall, 32.7% of the children reported to have a temporary disability whereas the American study reported that 43% of the children had a disability for seven or more days [5]. In contrast to the present findings, Zaida et al. reported only 10.2% with some form of disability. This may be due to differences in case definition [16]. Four children (6.9%) were likely to have a permanent disability including unilateral blindness. The index study shows higher rates of disability as compared to few others in South Asia [17–21].

It is suggested that prevention strategies should focus on falls and RTIs in rural areas to bring down the morbidity. Ensuring railings for staircases and parapet walls for the terraces can minimize the risk of falls. Safety in the cooking area can prevent burns and scalds leading to disability. Placement of door barriers or enclosures around the playpen using local materials is not a costly intervention. The use of anklets with bells is a simple, effective and affordable way of tracking the child's movements.

The current legislations do not incorporate comprehensive provisions for ensuring safety of the children on the road. For instance, the Motor Vehicles Act, 1988, does not necessitate the use of child restraints in four-wheelers, which can be extremely effective in reducing morbidities and mortalities. Although the act provides regulations for protective headgear for both pillion and driver of two-wheelers, it does not lay down the standards for child helmets, therefore it is hardly implemented vis-a-vis children. Moreover, the power of state government to make amendments to this act has further diluted helmet requirements by specifically excluding children from the category. The Central legislation is completely silent on ensuring safety of children in non-motorised transport, which is the most frequently used mode of transport for thousands of children. The feasibility of implementing initiatives such as "Safe routes to school" in UK and USA and iwalk-iwheel club in Canada need to be looked into by the government as well as by the community. India, like other low-income countries has financial constrains in relation to running different vertical programmes for addressing different public health problems. However, it is time our law makers are sensitive to this issue and ensure the safety of our children. At the same time, increasing awareness among parents in terms of supervision and identification of hazards and risks through health education and multimedia is also the need of the hour. More focused research on hazards and risks in the rural areas and at homes is needed to develop preventive strategies specific to rural India.

There are few limitations of index study. Firstly, the occurrence of injury was determined by a simple question 'Did he/she die from an injury in the 2 wk or 3 mo? There was a possibility of recall bias especially with regard to injuries that did not require medical attention. Secondly, authors could not

record any mortality possibly because of shorter recall period and smaller sample size. Thirdly, since they selected the villages from the top ones that had the highest deaths, it is likely that their study may not be representative of the population. However it does bring out the major issues in childhood injuries by adhering to international guidelines in classifying the injuries and attempting to study beyond injuries and looking at disabilities and other medical consequences in rural India.

Conclusions

Unintentional childhood injuries is a major public health problem which contribute to sickness absenteeism and disability among children in rural parts of India. Boys and older children are the most common victims of injury. There is a need for establishing state or nationwide injury registries to help understand accurate estimates of DALY and loss of productivity.

Contributions LRI: Concepts, design, definition of intellectual content, literature search, experimental studies, data acquisition and analysis, statistical analysis, manuscript preparation and review; AR and AB: Concepts, design, definition of intellectual content, literature search, experimental studies, manuscript review; KG: Concepts, design, definition of intellectual content, literature search, experimental studies, statistical analysis, manuscript review. KG will act as guarantor for the paper.

Compliance with Ethical Standards

Ethical Approval All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards.

Informed Consent Informed consent was obtained from all the individual participants included in the study.

Conflict of Interest None.

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