Fatal injuries among children under five years in southern provinces (Muthana, Thiqar, Basra,and Misan) of Iraq during 2010-2015

Khitam M. Ali,[1] Abdul Sahib H. Abdul Kareem,[2] F. Lami,[3] Ahmed H. Radi,[4]

ABSTRACT

INTRODUCTION: Child injury is a growing but preventable global public health problem. For every person killed by injury, 30 people are hospitalized and 300 are treated in emergency rooms that may live with varying degrees of disability. Every day >2,000 children die from injuries.

OBJECTIVE: Is to describe the epidemiological characteristics, estimate incidence and identify mechanism of fatal injuries among under five years' children (FIU5) in four south provinces (Basra, Misan, Muthana, and Thiqar), Iraq, 2010-2015..

METHODS: This cross-sectional study was conducted on data obtained from Iraqi Injury Surveillance System. The mortality part of the injury surveillance is a population based involving the coroner offices in four south provinces (Muthana, Thiqar, Basra, and Misan), Iraq. U5 population data were obtained from Ministry of Planning.

RESULTS: The total number of reported FIU5 during this period was 1,022 with an average annual incidence of 24.7/100,000 U5 population (U5P). It represents 22.2% of FIU5 and 1.4% of total fatal injuries of all ages. The incidence of FIU5 increased from 17.1/100,000 U5P in 2010 to 28.7/100,000 U5P in 2015. The male to female ratio of FIU5 was 1.6:1 and 28.9% occurred at the age of two years. About 50.1% occurred at home; 79.1% were unintentional and 63% occurred during 6 am-3pm. The main causes of FI were: Road traffic accidents (22.6%), drowning (19.8%), burn (16.9%), electric shock (9.6%), fall (7.3%) and explosions (2.9%). The highest average incidence was reported in Muthana (54.2/100,000 U5P) and Misan (50.3/100,000 U5P) governorates.

CONCLUSION: The increasing incidence of FI is the tip of the iceberg which indicates that every year thousands of U5 are injured and hundreds end with disability. Public Health officials need to develop a comprehensive program to control injuries among young children particularly the traffic and home injuries. .

Key words: Fatal, Injury, Epidemiology, Under Five, Iraq.

INTRODUCTION

Injury is a growing global public health problem which can be prevented. As well as being a leading cause of mortality-particularly among children and young adults.[1] Injuries and violence are so common that we often accept them as just part of life. But they can be prevented, and their consequences may be reduced.[2] The interval from the appearance of injury to death could be immediate, or as long as months or years.[3]

"Injuries occur when humans are exposed to energy forces that are larger than the body's normal tolerance levels for energy absorption".[4] Injury is caused by acute exposure to physical agents such as mechanical energy, heat, electricity; and chemicals. In some cases, for example drowning, injuries result from the sudden lack of essential agents such as oxygen. About three-fourths of all injuries, including most vehicle crashes, falls, and shootings, are caused by mechanical energy.[5]

In the world's high-income countries, for every person killed by injury, 30 people are hospitalized, and 300 are treated in emergency rooms; even more are treated in other health care facilities. This does not reflect the situation in developing countries, which have

1 MBCHB. Field epidemiologist, Iraqi Cancer Registry Section,Iraqi Cancer Board,Ministry of Health, Baghdad, Iraq.
2 Medical Educationist. National Centre for Training and Human Development, Iraqi MoH, Baghdad, Iraq.
3 Professor of Community Medicine. Departments of Community and Family Medicine, College of Medicine Baghdad University.
4 Operational Centre and Emergency Medicine, Ministry of Health, Iraq.

Corresponding Author: **Khitam M. Ali**, Iraqi Cancer Registry Section, Iraqi Cancer Board, Ministry of Health, Baghdad, Iraq.
E mail: dr.Khetam66@gmail.com.

fewer resources for prevention, treatment, and rehabilitation of injuries.[6]

Worldwide, World Health Organization (WHO) estimated that about 16,000 persons die from injuries every day more than 2000 of them are children. Each year one million deaths among under 18 years result from injuries, about 90% of them due to unintentional injuries.[7]

In the Eastern Mediterranean Region (EMR) half a million people die of injuries every year represented 11% of all regional deaths. Injuries in EMR represent the 2nd highest estimated mortality rate in under 5 years (U5) in the world, after the African region.[8]

This study is conducted to estimate the incidence of fatal injuries in south provinces (Muthana, Thiqar, Basra, and Misan) of Iraq among children less than 5 years of age for the period from 2010 to 2015, and to describe some of the epidemiological characteristics like gender, age group, time model, and mechanism of injury.

METHODS

Settings and study design: A descriptive cross-sectional study was conducted to measure death of children under 5 years due to fatal injuries reported to the Coroner Offices (CO) as a part of Iraqi Injury Surveillance System (IISS) in south provinces of Iraq (Muthana, Thiqar, Basra, and Misan) from 2010 to 2015.

Ethical consideration: A written permission for accessing the data was obtained from Operations Centre Department (OCD) at Ministry of Health (MoH). The information of the injured persons is kept secured and protected and has been used only for the sake of this study.

Definition of the participants and exclusion criteria: Data of all children under 5 years who died as a result of an injury in south provinces of Iraq (Muthana, Thiqar, Basra, and Misan) from 2010 to 2015 were included in this study. Data were extracted from IISS. Sexual assaults were excluded from this analysis

Data collection: Data obtained from the records registries of the IISS, OCD at MoH for the period from 2010 to 2015. The IISS is a central registry system established by MoH in Baghdad in December 2008 as a pilot included only 4 Health Directorates; Baghdad\Rasafa, Basra, Erbil, and Kerbala. From 2010 to 2012 IISS expanded to involved 8 governorates; Baghdad (Rasafa and Karhk), Basra, Erbil, Kerbala, Misan, Anbar, Mosel, and Sulaimaniya. In 2013, all provinces in Iraq have been involved.

Each Iraqi province has a single CO that records the biodata of the fatalities using a standardized surveillance form; a form that was prepared by MoH in English, Arabic and Kurdish languages with support of experts from the WHO and the Centre for Disease Control and Prevention (CDC). All reports would be transferred to the OCD at MoH in Baghdad on monthly bases by Epi-info software.

Procedure: We took a row data of IISS from OCD\MoH for the period from 2010-2015. The data were examined carefully to remove any duplication. For the sake of our study, data of the fatal injuries affecting children under 5 years were only extracted and subjected for analysis. Children under 5 years populations (U5P) in south provinces (Muthana, Thiqar, Basra, and Misan) in Iraq distributed according to age group from 2010 to 2015 were taken from Ministry of Planning (MoP).[9] Due to lack of exact figures of 2014, the number of children of under 5 years in south provinces (Muthana, Thiqar, Basra, and Misan) was estimated by calculating the average number of children under5 years in 2013 and 2015. The number, percentage, trend, and incidence of FIU5 were calculated. From 2010 to 2013 using the data of Basra and Misan only, while from 2014 to 2015 the data of Muthana, Thiqar, Basra, and Misan. The incidence calculated by divided the numbers of injuries over the populations multiply by the constant (100,000).

Statistical analysis: Analysis of data done by using Epi-info and Excel software, and represented in suitable tables and figures.

RESULTS

The total number of fatal injuries under 5 years (FIU5) in south provinces during the period 2010 to 2015 was 1,022. They represented 22.2% of total FIU5 registered in the IISS, see Table 1. The average annual incidence of FIU5

Table 1 | Number of injuries and death of all ages and U5 in Iraq and in the southern provinces according to IISS from 2012-2015*

	In Iraq	In south	Percentages to all Iraq
	No (%)	No (%)	
Number of injuries all ages	558 005 (100)	112 208 (100)	20.1
Number of deaths all ages	69 999 (12.5)	12 029 (10.7)	17.1
Injuries under 5	57 664 (10.3)	8 760 (7.8)	15.2
Fatal injuries under 5	4587 (7.9)	1022 (11.7)	22.3

* Registries of the IISS/ MoH has included data for all four provinces in 2014 and 2015, and for only Basra and Misan from 2010 to 2013.

Table 2 | Distribution of FIU5 in Southern Provinces* according to age and gender 2010-2015.

Demographic features		N (%)	Average Annual Incidence
Gender	Male	641 (62.7)	30\100000 †
	Female	380 (37.1)	18.7\100000 ‡
	Unknown (not specified)	1 (0.09)	---
Age group	0 - < 1 year	103 (10.1)	
	1 - < 2 years	235 (23.1)	
	2 - < 3 years	295 (28.9)	
	3 - < 4 years	223 (21.9)	
	4 - < 5 years	166 (16)	
Total		1022 (100%)	24.7/100000 §

* IISS data for all four provinces in 2014 and 2015, and for only Basra and Misan from 2010 to 2013.
† Under 5 years male population
‡ Under 5 years female population
§ Under 5 years population

in southern provinces from 2010-2015 was 24.7/100,000. The trend of incidence is shown in **figure 1**.

The highest number, percentage and average annual incidence of FIU5 was among males 641 (62.7%) with an incidence ratio of 30/100,000 of U5MP, with a male to female ratio of 1.6:1. The highest number and percentage of FIU5 were among those aged 2 - < 3 years, 295 (28.9%). **See table 2**. The trend incidence was increased among both male and female from 2010 to 2015, **see figure 2**.

The top three causes of FIU5 were traffic accidents 230 (22.6%) followed by drowning 202 (19.8%), then burn 173 (16.9%): with average annual incidence 4.8, 4.1, 3.8/100,000 U5P respectively (**Table 3**). The trend incidence of the top three causes is seen in **figure 3**.

The main place of FIU5 occurs at home 513 (50.1%), on street, high way, or road 253 (24.8%), and in farms and countryside 101 (9.9%) with an average annual incidence of 11.5, 5.7, and 1.9/100,000 U5P respectively, **table 4**. The trend incidence for places of occurrence is seen in **figure 4**.

Regarding the type of intention, the highest number, percentage and the average annual incidence of FIU5 was reported as unintentional injuries 808 (79.1%) with an incidence ratio of 17.5/100,000 U5P, see **table 5**. The trend Incidence is shown in **figure 5**.

The highest distribution of FIU5 was reported in Misan 484 (47.3%) and the lowest in was in Muthana 125 (12.2%), while the highest

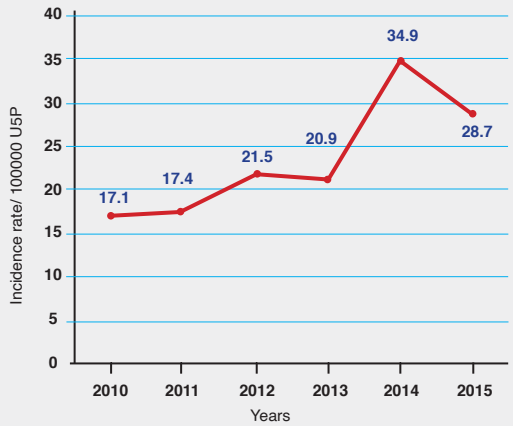

Figure 1 | Trend Incidence of FIU5, in Southern Provinces in Iraq, 2010-2015.

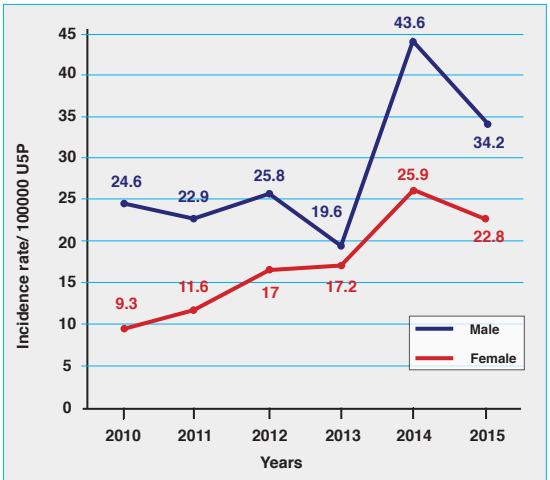

Figure 2 | Trend Incidence of FIU5, in Southern Provinces in Iraq, 2010-2015 according to gender

Table 3 | Mechanisms of FIU5 in southern provinces of Iraq from 2010-2015*, distribution and average annual incidence.

Mechanisms	N (%)	Average Annual Incidence\100000 †
Traffic accidents	230 (22.6)	4.8
Drowning	202 (19.8)	4.1
Burns	173 (16.9)	3.8
Electric injury	99 (9.6)	2.0
Falls	74 (7.3)	1.5
Explosion accidents	30 (2.9)	0.6
Others	214(20.9)	5.4
Total	1022 (100%)	24.7

* IISS data for all four provinces in 2014 and 2015, and for only Basra and Misan from 2010 to 2013.
† Under 5 years population

average incidence was reported in Muthana 54.2/100,000 of Muthana U5P, and the lowest was reported in Basra 8.7/100,000 of Basra U5P, **table 6**. Regarding the time from injury to arrival to a health facility, the majority was brought within the 24 hours of the injury 688 (67.4%), **figure 6**. However, still 167 victims (16.3 %) were brought after 24 hours from the injury.

The vast majority of the victims were brought to a health facility using vehicles other than ambulances 931 (91.1 %), while only 85 victims (8.3 %) were brought by ambulances. Four victims (0.4 %) have been brought by other ways and 2 (0.2 %) were not registered.

It is worth mentioning, that only 948 of the registered FIU5 have been specified at which hour of the day the injury had occurred, others are either missed or left blank in the recording system. Most of FIU5 595 (63%) were happened between 6 am to 3 pm, and 353 (37 %) had happened between 4 pm and 5 am.

Table 4 | Place of occurrence of FIU5 in southern provinces from 2010-2015*, distribution and average annual incidence.

Place of occurrence	N (%)	Average Annual Incidence\100000 †
Home	513 (50.1)	11.5
Street/high way/road	253 (24.8)	5.7
Farm and countryside	101 (9.9)	1.9
Public gathering	5 (0.5)	0.1
Workplace	2 (0.2)	0.05
Others/unknown	148 (14.5)	3.4
Total	1022 (100%)	24.7

* IISS data for all four provinces in 2014 and 2015, and for only Basra and Misan from 2010 to 2013.
† Under 5 years population

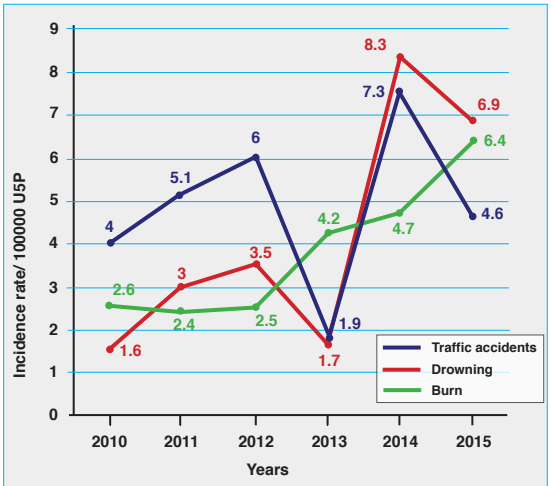

Figure 3 | Trend incidence of top three Causes of FIU5, in Southern Provinces of Iraq, 2010-2015.

DISCUSSION

The current study showed an overall increase in the trend incidence of FIU5 from 2010 to 2014; however, a relative decrease in the incidence was noted in 2015. This trend may be the result of unsafe environment that this age group in living in and the lack of comprehensive injury control and prevention programs. In Canada, a study shows that the trends of unintentional injury related deaths for children aged 0-14 form 2003-2012 decreased by 30%.[10]

The current study showed that the males experienced higher percentage of injuries in comparison to females, with male to female ratio 1.6:1. The trend curve of incidence of fa-

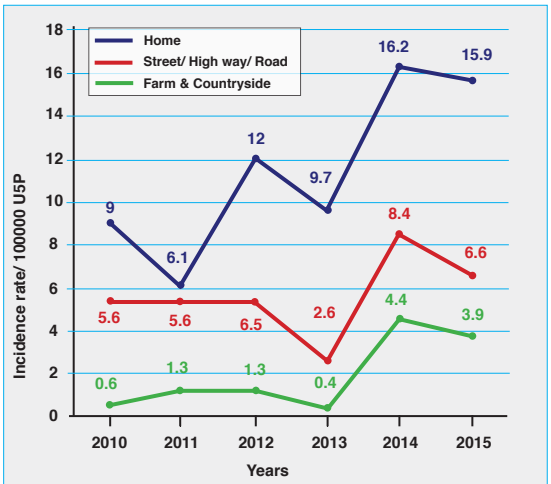

Figure 3 | Trend incidence of top three places of occurrence of FIU5, in Southern Provinces of Iraq, 2010-2015.

Table 5 | Type of intention of FIU5 in southern provinces from 2010-2015*, distribution and average annual Incidence.

Type of intention	N (%)	Average Annual Incidence\100000 †
Unintentional inflected	808 (79.1)	17.5
Intentional inflected	48 (4.6)	1.1
Unknown	166 (16.3)	---
Total	1022 (100%)	24.7

* IISS data for all four provinces in 2014 and 2015, and for only Basra and Misan from 2010 to 2013.
† Under 5 years population

Table 6 | Distribution and average annual incidence of FIU5 in the four southern provinces from 2010-2015*

Provinces	N. (%)	Average Annual Incidence Rate
Misan	484 (47.4%)	50.3/100000 †
Basra	204 (19.9%)	8.7/100000 †
Thiqar	209 (20.4%)	35.9/100000 †
Muthana	125 (12.3%)	54.2/100000 †
Total	1022 (100%)	24.7/100000 †

* IISS data for all four provinces in 2014 and 2015, and for only Basra and Misan from 2010 to 2013.
† Under 5 years population of the relevant province

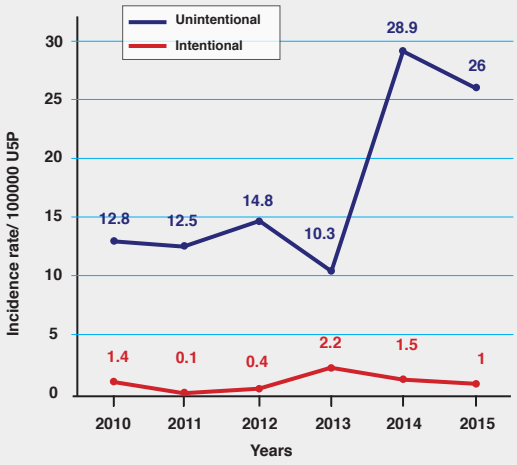

Figure 5 | Trend incidence of FIU5, in Southern Provinces in Iraq, 2010-2015 according to type of intention.

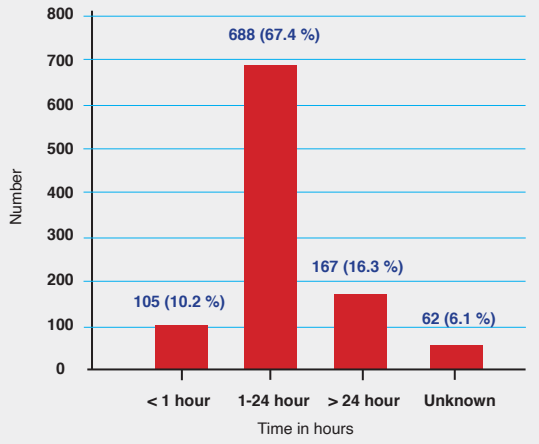

Figure 6 | Time from injury to arrival of FIU5 in Southern Provinces of Iraq, 2010-2015.

tal injuries in both genders showed an overall increase during the studied period with some relative drops, but the drop was more in 2015 for both genders. This gender difference in Iraq may be socio-cultural as girls even during childhood may be more home bounded and less active than boys exposing them to less danger of being victims for injuries. According to the CDC Childhood Injury Report/ USA, males had higher injury death rates than females.[11] Also, in New Hampshire in USA, a study shows that male children under 5 years who died from injuries between 2005 and 2009 outnumbered females 2.3:1.[12] In Eastern Mediterranean Region (EMR) in 2004, the estimation of FIU5 was nearly doubled in boys than in girls.[13] In this study, the incidence of FIU5 was increasing in both gender from 2010-2015 in obvious disagreement with the results from Sweden study that showed about 60 % decline in fatal injuries in both genders below age of 20 years over the period from 1987-2001.[14] The difference in the targeted ages may be a cause for this disagreement.

Our data have shown that children aged 2-3 years are mostly affected by fatal injuries, while those under one year of age are least affected. These results sound logical as former age group is the highly active and energetic while the latter is highly dependent and are always under their parents' close supervision. Two studies from the USA[15] and Scotland[16] have also shown that fatal injuries are more in children less than 1 year comparing to those between 1-4 years.

Regarding the mechanism causing FIU5, the current study showed that the highest number, percentage and incidence, were traffic, drowning, and burn respectively. The incidence of the first three causes of FIU5 has shown that for traffic accidents and drowning the trend curve from 2010-2015 was similarly fluctuated with a relative decline in 2015 after a surge in 2014. While the trend curve for burn has shown a relatively progressive upward

movement. This trend may give us a clue that the family attention about the safety of their children from the injuries occur at home like burn is still low compared to their attention when the children get outside. Rapid urbanization and motorization, lack of appropriate road engineering, and lack of programs of preventing road traffic injury can explain why traffic is the commonest cause of FIU5 in sounthern Iraq. According to the WHO, over 3,400 people die on the world's roads every day and tens of millions of people are injured or disabled every year. Children, pedestrians, cyclists and older people are among the most vulnerable of road users.[17] In the United States, injuries by motor vehicle are a leading cause of death among children.[18] in 2015, 663 children ages 12 years and younger died as occupants in motor vehicle crashes.[19]

In 2004, WHO estimated that 115 boys and 7.4 girls younger than one year/ 100000, and 9.7 boys and 8.3 girls between 1-4 years/ 100,000 died due to road traffic accidents. In Eastern Mediterranean region the estimation of FIU5 due to road traffic was 18.3/100,000 in high-income countries, and 17.4/100,000 in low and middle-income countries.[20] In Germany during the period from 1990-2004, a more than two-thirds decline in fatal injuries of all causes among children under age of 15 years is reported. This decline is true for road traffic, home, and leisure accidents.[21]

For drowning, living near an open source of water as the situation in Iraq prone children for drowning. WHO reported that drowning claimed the life of 360000 people, ranking it as the 3rd cause of death from unintentional injury. The highest rates of death from drowning are among children 1-4 years, followed by children 5-9 years.[22] CDC Childhood Injury Report in the USA has stated that drowning was the leading cause of injury death for those 1 to 4 years of age,[11] and it is the second leading cause of unintentional injury death in children aged 1–14 years. Around 4000 persons died annually from boating and non-boating unintentional downing, and one in five of them were children 14 years and younger.[23, 24] Similarly, in 2014 drowning was also a leading cause of FIU3 in Australia, and accounting for 43 % of FIU4 in Bangladesh.[22] In Eastern Mediterranean Region in 2004, the estimated mortality of all children's drowning in under 1 year of age were 4.8 boys and 7 girls/ 100,000, while it was 11.2 boys and 6.8 girls/ 100,000 for those between 1-4 years.[13]

Regarding burn injuries, the highest percentage of burn in our series may be explained by poverty, overcrowding, lack of proper safety measures, and concomitant presence of medical conditions endangering the child for burn like epilepsy. In 2016, WHO estimated that 265,000 deaths every year are caused by burns and child deaths from burns is 7 times higher in low- and middle-income countries than in high-income countries.[25] In Colombia from 2000 to 2009, a total of 1,197 fatal paediatric injuries related to burn were identified, about 60 % of them were under 5 years of age and almost half of them died before arriving at a health facility.[26] In a systematic review of studies from EMR between 1997 and 2007, burn in under age of 5 years represented 78 % of all childhood burns and 48 % of burn in all ages.[27]

In our data, the main place of FIU5 occurs at home followed by Street/high way/road then farm and countryside. The trend incidence for all above placed increased progressively from 2010-2015. Usually in Iraq, children spend most of their time at home where they may expose to injuries especially when it comes to drowning and burn. Farms are the houses and workplaces at the same time and due to their relatively larger areas comparing to the usual houses, children are paying little attention and playing unsupervised prone them for injuries. According to the CDC, more than 11,000 individuals are estimated to die each year at home from preventable unintentional injuries.[28]

According to WHO In 2004, road traffic injuries accounted for approximately 262 000 child deaths among children and youth aged 0–19 years – almost 30% of all injury deaths among children, there are significant geographic variations, however. In the South-East Asia Region, the proportion of childhood deaths due to road traffic injuries is 1.3%, while in the Americas it is as high as 4.7%. Some 93% of child road deaths occur in low-income and middle-income countries, In South-East Asia, however, the rate is 7.4 per 100 000 population, Global road traffic fatality rates increase with age, Children up to the age of nine years are more likely to be accompanied by parents when they travel, either in vehicles or as pe-

destrians, its around rates 9/ 100 000 children 0f fatal road-traffic injury for both High-income countries and low-income and middle-income countries , while for those (1-5) years its about 3 child /100000 in high income countries and 9 child /100000 for low-income and middle-income countries.[29]

About 80 % of FIU5 in our series is unintentional, and its incidence was increasing from 2010-2015. This is expectable as we are living in an environment with many hazards. Injury and violence is a major killer of children throughout the world, responsible for about 950 000 deaths in children and young people under the age of 18 years each year. Unintentional injuries account for almost 90% of these cases. And that road traffic injuries and drowning together account for nearly half of all child death due to unintentional injury.[30] In the USA during 2000-2006, each year more than 12,000 people under age of 19 years die from unintentional injuries, mostly caused by burns, drowning, and road traffic, makes them the leading cause of mortality among children in the United States.[30]

The highest average annual incidence rate of FIU5 was reported in Muthana followed by Misan, Thiqar, and Basra respectively. Is this a real difference between the provinces? Or it is a due to incomplete or inaccurate registration among different provinces, keeping in mind that not all the four provinces were involved in the IISS before 2014. Anyhow other epidemiological and social studies are needed to unfold the real cause.

Regarding the time of arrival to hospitals since injury, although about 80 % of the victims in our series were brought to health facility within the first 24 hours, only about 10 % of the victims were brought within the first hour. Ignorance, misjudgment about the seriousness of the injury, afraid of legal consequences, or lack of a way of transportation or unavailability of a nearby health care facilities could explain this harmful behaviour. This is not inclusive to our country, A study from England done at a trauma centre for injured children showed that only 30 % of injured children under age of 17 years were brought to the centre within 60 minutes of the injury.[31] It is worth mentioning that the first 60 minutes after injury is usually seen by many trauma experts as the “golden hour” for saving lives.[32] and morbidity and mortality are significantly increased if the time of arriving hospital exceed an hour after an injury.[33, 34] We also found that only less than 10 % of the victims were brought by ambulances, and the vast majority were brought by vehicle other than ambulances. This may occur due to poor knowledge of people about how to contact the ambulances or their believes that ambulances will not come in a short time. In Kampala, Uganda, 2004-2005, a study shows that less than 5% of all injured patients brought to the emergency unit by ambulance.[35]

Our study ha shown that 63 % of FIU5 was reported between 6 am - 3 pm. This is not strange as we expect injuries to occur usually during working hours. In South India a study done in a tertiary care hospital shows that 52% of the injuries occurred between 8 am and 5 pm.[36]

This is a retrospective study based on already existed data of Iraqi Injury Surveillance System (IISS). This system has started initially as a pilot to include only some of Iraqi Provinces. This is why we could not include data of all southern provinces for all the studied period.

CONCLUSION

Injuries are still one of the preventable cause claiming the life of the children under age of 5 years in southern provinces especially at age of two years. Most of the fatal death occur at home during the working hours. The causes FIU5 are many but traffic, drowning, and burn are the leading causes. Although most of the victims were brought to a hospital within the first 24 hours after the injury most of them do so by private vehicle other than the ambulances.

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Abbreviations list: Ante meridiem (**am**), Centres of disease prevention and control (**CDC**), Coroner Offices (**CO**), Eastern Mediterranean Region (**EMR**), Fatal injuries under age of 3 years (**FIU3**), Fatal injuries under age of 4 years (**FIU4**), Fatal injuries under age of 5 years (**FIU5**), Iraqi Injury Surveillance System (**IISS**), Ministry of Health (**MoH**), Ministry of Planning (**MoP**), Operations Centre Department (**OCD**), Post meridiem (**pm**), Under 5 years populations (**U5P**), Under age of 5 years (**U5**), United States of America (**USA**), World Health Organization (**WHO**).

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