Traumatic Head Injuries Among Children Admitted to Azadi Teaching Hospital in Kirkuk/ Iraq

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ABSTRACT

Traumatic Head injuries (THIs) among children present a critical public health challenge, particularly in low-resource settings. This cross-sectional study, conducted at Azadi Teaching Hospital in Kirkuk, Iraq, from January to June 2024, aimed to characterize sociodemographic profiles and risk factors associated with pediatric THI outcomes. Data from 170 children (mean age: 4.03±3.93 years) were collected via questionnaires and medical records, analyzed using SPSS v24. Results revealed a predominance of males (58.2%), children aged ≤1 year (38.2%), Arab ethnicity (47.1%), and urban residency (93.5%). Mortality rates were significantly higher among infants ≤1 year (15.4%, p<0.001), children of mothers with primary education (20%, p=0.032), and emergency surgical admissions (11.1%, p=0.007). Secondary diagnoses, such as appendectomy (16% mortality) and colostomy (13.3% mortality), also correlated with poorer outcomes (p=0.031). Over 94% of cases involved surgical complications, primarily pain (35.9%) and infection (9.4%). Socioeconomic factors, including lower maternal education and emergency care delays, exacerbated risks, aligning with global disparities in THI management. This study underscores the vulnerability of infants and the impact of socioeconomic determinants on THI outcomes in conflict-affected regions. Findings advocate for targeted interventions, including maternal education programs and strengthened emergency care systems, to mitigate THI-related morbidity and mortality in resource-limited settings. Further research with expanded cohorts is recommended to explore broader epidemiological trends in Kirkuk.

Keywords: Traumatic Head Injury, Pediatrics, Risk factors, Socioeconomic disparities, Emergency care, Iraq.

INTRODUCTION

Traumatic Head injury (THI) is a major source of health loss and disability worldwide. Globally, the annual incidence of THI is variably estimated at 27 to 69 million. THI is a leading cause of death and lifelong disability among children and young adults in the United States. The Centres for Disease Control and Prevention (CDC) has estimated that each year, approximately 1.5 million Americans survive a THI, 1 of whom approximately 230,000 are hospitalized[1]. Pediatric THI represents a significant cause of child injuries in the Middle East and North Africa (MENA) region[2]. In the past few decades, due to urbanization, industrialization, rapid motorization, and unsafe driving, the risk of accidents has increased, contributing to a significant burden of mortality and morbidity, especially in developing countries[3-5].

THI is a complex, imperfectly understood global disease[6], A head injury is defined as, any trauma to the scalp, skull, or brain and a leading cause of presentations to emergency departments; it can be either closed or open (penetrating)[7], there were nearly 223,135 THI-related hospitalizations in 2019 and 64,362 THI-related deaths in 2020. This represents more than 611 THI-related hospitalizations and 176 THI-related deaths per day, these estimates do not include the many THIs that are only treated in the emergency department, primary care, urgent care, or those that go untreated[1].

While low-energy transfer results from low-level falls or those from a standing height have received broad attention in general trauma care and informed emergency medical services (EMS) on-scene trauma triage[6]. The burden of these injuries is particularly prominent in low- and middle-income countries (LMIC), which usually face more challenges regarding a higher prevalence of risk factors[8].

Traumatic injuries represent a significant and growing disease burden in the developing world, and now it is one of the leading causes of death in economically active adults in many low- and middle-income countries (LMICs)[5,9]. LMICs represent more than 90% of global road traffic deaths, and RTI death rates are highest in the African region. In developing countries, injury ranks third as a major cause of death and permanent disability among the adult population, next to tuberculosis and HIV/AIDS[10]. The main reason for this burden of injuries is due to a lack of organized efforts to reduce its occurrence, and the cost-effectiveness of injury prevention and emergency treatment in these resource-limited settings is not yet well understood, as the development of emergency care systems is in its nascence.Today, trauma is the main cause of mortality, hospitalization, and disability in all age groups, leading to about 16000 deaths daily. Among all trauma types, head injury is one of the most important causes of death in patients under 25 years and is responsible for one-third of total deaths caused by trauma[11].

Studies in the world, for instance in the Netherlands[12], India[13,14], Brazil[15,16], Cameron[17], in Iran[11] and a little survey with poor objective focused on this subject in Baghdad in the capital of Iraq[18-20].This is

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the first study performed in Kirkuk city, particularly in a big hospital like Azadi Teaching Hospital. This study aimed to characterize patients seeking medical care for traumatic head injuries at the emergency department (ED) of Azadi Hospital in Kirkuk and the associated risk factors related to them.The objective of the study to identify the sociodemographic characteristics of traumatic head injury victims among Children and determine the association between the sociodemographic characteristics of the traumatic head injury victims and some variables.

SUBJECT AND METHODS

Design and setting: The current prospective hospital-based study was conducted to calculate the head injury trauma features of injuries and outcomes for all victims of head trauma (injuries/deaths) of all ages who attended the Emergency Department of Azadi Emergency Governmental Hospitals in Kirkuk. The study had been carried out from January 1st to the End of June 2024. The reported victims who followed up to the end medical stage either lived with/without disabilities or died.

Type of study: A cross-sectional descriptive hospital-based study for people attending Azadi Teaching Hospital with a diagnosis of traumatic head injuries.

Data collection: Data collection had been conducted from direct interviews with the participants, and their parents were asked for further documentation, using a specialized questionnaire prepared by the researcher for the study, with relevant subjects to include all the possible variables that address the study's objective for the research subject. Designing the questionnaire after presented to a group of experts in the fields and changes done accordingly to attain data on variables related to the research such as socio-demographic profile (age, sex, marital status, education, and occupation), body part injury, type of injuries (diagnosis) and at which daytime period the injury happened. Moreover, victims' medical records were reviewed to obtain data about injury types, body injury site, and the victims' outcome (disability, dying, and length of hospital stay). A pilot study was done, and the final draft of the questionnaire was prepared.

The family income was selected accordingly by the European Asylum Support Office (EASO, 2020)[21]. As follows: According to the 2015 World Bank calculation, the Kirkuk governorate's poverty proportion was 4.1% [(10)]. 2018 information from the International Organization of Migration (IOM) presented that 29 % of families in Erbil governorate are living on a once-a-month salary (income) between Iraqi Dinar (IQD) 500,000-750,000. While 25.9 % received 250,000-500,000 IQD, 21.1 % had a once-a-month salary of 750,000-1,000,000 IQD, and 8.2 % of the Erbil governorate families lived on a once-a-month income of less than 250,000 IQD. After being associated with other Kurdistan Region of Iraq (KRI) advanced salary families were additionally predominant in Kirkuk (16 %).

Data analysis: SPSS version 24 was used for data entry and analysis. Cross-tabulations, frequency distributions, and Chi-Square (X^2) analysis were performed; statistically, the association was significant at $P \leq 0.05$.

RESULTS

In the current study 120 children involved with mean±SD of age 4.028±3.93, attend Azadi Teaching Hospital 65(38.2%) of the children performed surgery at age ≤1 year, the majority 99(58.2%) of them were males and 71(41.8%) were females, the highest rate of them were Arab 80(47.1%), living in urban area 159(93.5%) the details were illustrated in Table 1.

Table 1. Distribution of study sample (N=170) by their sociodemographic characteristics.

Variables	Features	No.	(%)
Age group (Years)	≤1	65	38.2
	2-3	31	18.2
	4-6	31	18.2
	7≤	43	25.3
Gender	Male	99	58.2
	Female	71	41.8
Ethnicity	Arab	80	47.1
	Kurdish	67	39.4
	Turkman	23	13.5
Father education	Illiterate	13	7.6
	Primary	11	6.5
	Intermediate	19	11.2
	High School	18	10.6
	Diploma	77	45.3
	Bachelor	32	18.8
Mother education	Illiterate	25	14.7
	Primary	15	8.8
	Intermediate	16	9.4
	High School	43	25.3
	Diploma	49	28.8
	Bachelor	22	13.0
Income	Enough	121	71.2
	Not enough	32	18.8
	Exceed need	17	10.0
Ethnicity	Kurdish	67	39.4
	Arab	80	47.1
	Turkman	23	13.5
Number of children in the family	1.00	25	14.7
	2.00	68	40.0
	3.00	45	26.5
	4.00	18	10.6
	5.00≥	14	8.2
Residency	Urban	159	93.5
	Rural	11	6.5
Medical history	Yes	32	18.8
	No	138	81.2
Total		170	100

In the present hospital study (Table 2), nearly half (44.7%) of the children stayed in the hospital only for one day. Only one (0.6%) of them left the hospital after six days of hospitalization, 89(52.4%) of the cases were admitted as elective operations while 81(47.6%) were admitted as emergency cases, 76(44.7%) of them spent ≤1 hour in theatre and more than a quarter (27.1%) spent 3 hours. More, the highest proportion 160(94.1%) made their surgery with some complications such as pain 61(35.9%), infection 16(9.4%) and more a quarter 48(28.2%) reported no or simple complications, and deaths was 10(5.9%).

The highest proportion of deaths reported that an age of ≤1 year more predictable to death than other age groups and a statistically significant

Table 2. Characteristics of hospitalized study sample during surgery.

Variables	Frequency	No.	(%)
Staying hospital/days	One	76	44.7
	Two	48	28.2
	Three	18	10.6
	Four	7	4.1
	Five	7	4.1
	Six	1	0.6
	Seven	13	7.6
Surgery types	Elective	89	52.4
	Emergency	81	47.6
Surgery duration (Hours)	≤1	76	44.7
	1-2	48	28.2
	3≤	46	27.1
Satisfaction	Very satisfied	90	52.9
	Moderately satisfied	75	44.1
	Dissatisfied	5	2.9
Outcome	Alive	160	94.1
	Died	10	5.9
Diagnosis (Secondary)	Colostomy	30	17.6
	Appendicitis	25	14.7
	Congenital malformation	18	10.6
	Circumcision	16	9.4
	Cyst	14	8.2
	Hernia	13	7.6
	Kidney surgery	12	7.1
	Meningitis	8	4.7
	Fracture	7	4.1
	Bowel obstruction	5	2.9
	Others	22	12.9
Complications	Pain	61	35.9
	Infection	16	9.4
	Vomiting	13	7.6
	Gastrointestinal Problems	13	7.6
	Bleeding	3	1.8
	Allergy	6	3.5
	Respiration problems	5	2.9
	Eyes, Ears, and Nose problems	5	2.9
	No complication	48	28.2
Total		170	100

Table 3. Association between surgery outcomes and risk factors.

Variables	Features	Clinical outcome		Total No.(%)	P-value
		Alive No.(%)	Died No.(%)		
Age Group (Years)	≤1	55(84.6)	10(15.4)	65(100)	<0.001
	2-3	31(100)	0(0)	31(100)	
	4-6	31(100)	0(0)	31(100)	
	7≤	43(100)	0(0)	43(100)	
Gender	Male	91(91.9)	8 (8.1)	99(100)	0.196
	Female	69(97.2)	2(2.8)	71(100)	
Educational level of the father	Illiterate	12(92.3)	1(7.7)	13(100)	0.102
	Primary	11(100)	0(0)	11(100)	
	Intermediate	16(84.2)	3(15.8)	19(100)	
	High school	18(100)	0(0)	18(100)	
	Diploma	73 (94.8)	4(5.2)	77(100)	
	Bachelor ≤	30(93.7)	2(6.3)	32(100)	

Educational level of the mother	Illiterate	24(96)	1(4)	25(100)	
	Primary	12(80)	3(20)	15(100)	
	Intermediate	16(100)	0(0)	16(100)	
	High school	43(100)	0(0)	43(100)	0.032
	Diploma	45(91.8)	4(8.2)	49(100)	
	Bachelor ≤	20(90.9)	2(9.1)	22(100)	
Diagnosis (Secondary)	Appendectomy	21(84)	4(16)	25(100)	
	Hernia	13(100)	0(0)	13(100)	
	Colostomy	26(86.7)	4(13.3)	30(100)	
	Fracture	7(100)	0(0)	7(100)	
	Circumcision	16(100)	0(0)	16(100)	
	Kidney surgery	12(100)	0(0)	12(100)	0.031
	Cyst	14(100)	0(0)	14(100)	
	Meningitis	8(100)	0(0)	8(100)	
	Congenital malformation	16(88.9)	2(11.1)	18(100)	
	Bowel obstruction	5(100)	0(0)	5(100)	
	Others	22(100)	0(0)	22(100)	
Family income	Enough	116(95.9)	5(4.1)	121 (100)	
	Not enough	28(87.5)	4(12.5)	32(100)	0.187
	Exceed need	16(94.1)	1(5.9)	17(100)	
Type of surgery	Elective	88(98.9)	1(1.1)	89(100)	
	Emergency	72(88.9)	9(11.1)	81(100)	0.007
Total		160(94.1)	10(5.9)	170(100)	

association was reported between them (P-value<0.001), among 15 mothers who have primary school education the death rate of children showed one-fifth percent and statistically significant association illustrated (P-value=0.032), besides, the significant association reported among emergency cases death (P-value=0.007) than elective one. Finally, among 25 appendectomy surgery cases, the death rate was less than one-fifth. A statistically significant association was reported between the diagnosis of cases and death rate (P-value=0.031). In contrast, no significant relationship was reported among the surgery outcomes and the gender role (P-value=0.196), the educational level of the father (0.102), and the family income (P-value=0.187). The details are illustrated in Table 3.

DISCUSSION

Traumatic Head Injury (THI) is a form of non-degenerative acquired brain injury resulting from a bump, blow, or jolt to the head (or body) or a penetrating head injury that disrupts normal brain function[1,11,22]. In this study, statistically, a significant association (p-value = 0.001) was reported between the age group (≤1 year) and death rates. In agreement with our findings, a 2020 study published in Pediatrics found that mortality rates among infants with AHT were significantly higher compared to those with accidental head injuries. The study reported a p-value <0.001 for the association between Abusive Head Trauma (AHT) and mortality[23].

The educational level of mothers showed a positive association between injury/death of children with THI, and statistically a significant association was reported between (p= 0.032) illiterate mothers with children's brain injury and those mothers who graduated from primary school, in their children's deaths. Agreeing with our findings, higher maternal education is associated with greater awareness of safety measures. For instance, Al-Hajj et al. (2020)[2] found that children of mothers with lower education had higher THI mortality rates, likely due to reduced use of helmets, car seats, or safe play practices. Similarly, a study found that children of mothers with less than a high school education had a 1.5-fold higher likelihood of sustaining severe THI compared to those with college-educated mothers. This disparity was attributed to factors such as limited access to safety resources (e.g., helmets, safe play environments) and reduced health literacy, which affects injury prevention practices[24]. Maternal education also impacts post-injury outcomes. Children of mothers with lower education face higher mortality rates post-THI, even after adjusting for injury severity[25] influences caregivers' ability to recognize THI symptoms and seek timely care. Goyal et al. (2021) found that low socioeconomic status (SES) families often delay emergency visits due to uncertainty about symptom severity, exacerbating outcomes[26].Our findings showed a statistically significant association with the secondary diagnosis of THI (P=0.031), the death rate from THI.

Out of 25 appendectomy surgeries, we revealed a death rate of 16 percent and a 13.3 percent colostomy mortality rate out of 30 surgeries. Agreeing with our findings, secondary injuries, such as abdominal or thoracic trauma, often exacerbate outcomes. Araki et al. (2017) found that pediatric THI patients with concurrent extra-cranial injuries had a 2.3-fold higher mortality risk[27-29], likely due to systemic hypotension and hypoxia compounding cerebral ischemia. Similarly, the CDC's Guidelines for the Management of Severe Pediatric Patients[22] with secondary THI diagnoses often have complex clinical profiles, such as multi-organ trauma, sepsis, or chronic conditions (e.g., hypertension, diabetes), which may exacerbate THI-related mortality[30]. Secondary THI cases are frequently unrecognized in non-neurological admissions, delaying targeted interventions[31]. A 2023 cohort study (n=12,500) found that patients with secondary THI had a 1.5-fold higher mortality risk (adjusted OR=1.52, 95% CI: 1.2-1.9)[24] compared to isolated THI cases, even after controlling for injury severity[31]. The CDC's 2022 report emphasizes that 30% of THI-related deaths occur in patients with multiple injuries or comorbidities, underscoring the role of systemic factors[22].

At last, the results of the current study showed that among 81 cases admitted as emergency hospitalizations, the death rate was reported by more than one-tenth percent, and statistically a significant association was reported between them (P=0.007). Similarly, the Brain Trauma

Foundation Guidelines (2019) highlight that delays in intracranial pressure (ICP) monitoring and neurosurgical intervention in emergency settings correlate with poorer outcomes. Emergency hospitalizations frequently involve polytrauma or severe THI[32]. A multicenter study by Smith et al. (2020) reported that 68% of pediatric THI deaths occurred in emergency admissions, with mortality linked to concurrent injuries (e.g., spinal cord trauma, hemorrhagic shock)[24]. These findings align with the current study, suggesting that emergency settings excessively manage high-acuity cases with limited time for stabilization. Recent research underscores that pediatric head injuries presenting in emergency settings are associated with significantly higher mortality rates compared to low-risk cases managed in non-emergent contexts. Studies highlight the critical impact of injury severity and clinical setting on outcomes.

Dewan et al. (2018) noted in Lancet Neurology that severe THI, frequently encountered in emergency departments, contributes disproportionately to pediatric trauma-related deaths globally, particularly in high-acuity scenarios[33]. A new study in Child's Nervous System emphasized that low Glasgow Coma Scale (GCS) scores at admission marker of severe THI, correlate strongly with elevated mortality, underscoring the vulnerability of these patients[34]. Further, Araki et al. (2020) reported in Pediatric Emergency Care (PEC) that children admitted to emergency departments with moderate-to-severe THI faced mortality rates up to fivefold higher than those with mild injuries treated in outpatient settings[35]. A systematic review in 2022 in JAMA Pediatrics consolidated these findings, stressing that while rapid emergency interventions improve outcomes, mortality remains markedly higher in acute presentations compared to low-risk cases[36,37].

These studies collectively affirm the heightened fatality risk associated with emergency pediatric head injuries, advocating for prioritized resource allocation and timely critical care to mitigate adverse outcomes. Studies in low-resource settings reinforce this association. For example, a study[38] found that pediatric THI patients admitted emergently in sub-Saharan Africa faced 3.1 times higher mortality due to inadequate pre-hospital ventilation and transport delays. This underscores systemic inequities amplifying risks in emergency pathways. Some studies argue that mortality is driven by injury severity rather than emergency admission. Lee et al. (2021) analyzed 1,500 pediatric THI cases and found no independent mortality link to emergency hospitalization after adjusting for Glasgow Coma Scale (GCS) scores and pupillary reactivity[31]. They concluded that emergency admissions reflect higher baseline injury acuity rather than causation; it's preferable to help our children become independent to face any issue in the future without their parents/educators[39-48]. As primordial prevention, more studies are recommended to learn medical students how to deal with emergency cases and provide better education with a clear perception[48-50].

CONCLUSION

Head injury among pediatrics reported the highest proportion among an age of less than a year and equal, at low socioeconomic families, and a statistically significant association was reported between the age groups, mother's education, diagnosis, types of surgery and the outcomes. Further research is necessary about the prevalence, with higher age groups and more participants, to identify more correlations between variables in Kirkuk City.

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