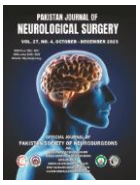

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Original Article

Head Injury Due to Fall from Heights in Pediatric Population of a Middle Resource Country

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ABSTRACT

Objective: One of the serious concerns for public health is unintentional injuries**.** Falls rank as the second most common cause of unintentional injury deaths globally, after injuries sustained in transportation accidents. The study's goals were to check the mechanisms and severity of the head injury from falls among children.

Materials and Methods: A non-randomized retrospective study was conducted and children aged 0 – 12 years (n = 228) undergoing cranial CT guidance for head injury were enrolled. All patients were treated under the supervision of the neurosurgery department. Detailed radiological evaluation was done and recorded on specialized proforma.

Results: Among the enrolled patients, mild head injury was noted in 49.1% of children while moderate head injury was noted among 40.4% of children. A total of 72 (31.6%) patients had skull fractures, of which 12 (5.3%) had a thin underlying subdural hemorrhage. Four cases of extradural hemorrhage complicated a skull fracture, and eight cases of isolated Subdural hemorrhage (SDH) were observed without a skull fracture. Of those 48 (21%), radiologically evident diffuse axonal injuries were present, and each of them included high-force injury mechanisms.

Conclusion: When children sustain minor trauma, skull fractures, and focal SDH are rather common, although most of the time there are no long-term neurological effects. On the other hand, patients with an equally severe cause of injury were the only ones who experienced diffuse brain injury with significant neurological disability that followed.

Keywords: Head injury, Trauma, Craniocerebral damage, unintentional falls.

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INTRODUCTION

Children's emergency room visits due to injuries are primarily caused by unintentional falls in children. Children frequently sustain head traumas, most of which do not result in radiologically obvious craniocerebral damage. Childhood accidental brain injuries are common in the United States, accounting for about 50,000 hospital stays and 650,000 ER visits annually.[1] The spectrum of intracranial patterns associated with fall injuries ranges from clinically benign to deadly. The majority of cross-sectional imaging results for infant domestic head injuries show either a simple skull fracture focal SDH or normal scans. There are rarely any substantial clinical or neurological consequences in pediatric instances. Only in cases of unintentional head trauma involving severe forces in children.[2]

Falls rank as the second most common cause of unintentional injury deaths globally, after injuries sustained in transportation accidents. Children's head injuries were most commonly caused by inadvertent falls. There are insufficient initiatives aimed at preventing childhood injuries that offer interventions and education to attempt and lower the number of these injuries in our nation.[3]

By taking preventive actions, effective national and local preventive programs can lessen the impact. Thanks to successful local initiatives, these public health campaigns decreased kid window falls by up to 96% within the first ten years of implementation.[4]

In the youngest demographic, unintentional pediatric falls continue to be a major source of head injuries, medical morbidity, and costs to the healthcare system despite these attempts to prevent injuries. Unintentional falls in kids under five years old resulted in more ER visits, which raised the costs associated with treating pediatric fall-related injuries.[5,6]

When dealing with children and adolescents, it is important to obtain a thorough case history that will clarify the type of injury we are dealing with, the height from which the child fell, the floor's characteristics (carpet or not), the child's initial state of consciousness (crying or not), and the beginning and occurrence of apnea. It's critical to determine how things happened: Has the child's condition become better, more stable, or worse? Has anyone puked recently? Have the seizures that are late manifested? Abuse may be indicated whenever the case history is insufficient to explain neurologic symptoms. The Glasgow Coma Scale (GCS) is a grading system used to quantify the state of consciousness. It's a helpful tool that needs to be handled with precision and caution.[7]

Neurologic examination in the initial months consists of palpating the fontanelles and sutures, looking for changes in postural tone or clonus, and checking for the existence of primitive reflexes (e.g., Moro reaction). Paleness, tachycardia, and vomiting are among the incredibly common vegetative symptoms following a brain concussion. Monitoring vital signs such as consciousness, spontaneous breathing, blood pressure, heart rate, and, if necessary, an eye fundoscopy, is crucial. Hypotension rarely results from head trauma; instead, it should be presumed that blood loss from head trauma, long bone fracture, or linear neurocranium fracture in children under one year of age, are the likely causes. Hypotension following a spinal cord injury is also possible.[8]

MATERIALS & METHODS

Study Design & Setting

This is a non-randomized retrospective study conducted on patients admitted to the Neurosurgery unit of a tertiary care hospital (The Children's Hospital and The Institute of Child Health) in Multan from June 2021 to May 2023. Non-probability purposive sampling was done to recruit the patients. Before beginning the

investigation, institutional ethical committee permission was obtained. Informed consent was taken from the guardians of all the patients assuring confidentiality and describing the procedure, risk, and objectives of the study to the patient.

Inclusion Criteria

Children aged 0 – 12 undergoing cranial CT guidance for head injury were enrolled in the study. A total of 228 patients were enrolled in the study.

Exclusion Criteria

Patients having suicidal and homicidal falls.

Data Analysis

All patients were treated under the supervision of the neurosurgery department. Detailed radiological evaluation was done and recorded on specialized proforma. The SPSS software, version 25, was used to enter and analyze the data. For the qualitative research variables, percentages and frequencies were computed. The quantitative data variables were subjected to the computation of means and standard deviations.

RESULTS

Population

The majority of patients presented were urban (68%). In our study, 59.6% of patients in the 1–5-year age group had head injuries. These patients were younger (Table 1).

Severity of Head Injury

Among the enrolled patients, mild head injury was noted in 49.1% of children while moderate head injury was noted among 40.4% of children (Table 2). Patients with extra-axial bleeding with mass effect, post-traumatic convulsions, or radiologically visible brain parenchymal damage were the only ones with a GCS of 10 or lower. who, at presentation, exhibited diffuse hypoxic-ischemic injury. 10.5% of patients had severe head injuries, and the (accidental) mode of injury involved significant translational, deceleration, and acceleration forces. Patients in the 5–12 age range had more serious brain injuries 16 out of 24.

Table 1: Age distribution.

Age Group	Frequency	Percent
<1y	24	10.5
1-5Y	**136**	**59.6**
5-12Y	68	29.8
Total	228	100.0

Table 2: Severity of Head Injury.

Age Group	Severity of Head Injury			Total
	Mild	Moderate	Severe	
<1 y	16	8	0	24
1-5 Y	68	60	8	136
5-12 Y	28	24	16	68
Total	112 (49.1%)	92 (40.4%)	24 (10.5%)	228 (100%)

Mechanisms of Head Injury

Of the total cases, 228,188 (82.5%) reported falls, Road traffic Accidents 36 (15.8%). impact by a blunt object during a quarrel (1.8%) (Table 3).

Table 3: Mechanisms of head injury.

Mechanism of Injury	Frequency	Percent
Falls	188	82.5
Quarrel	4	1.8
Road traffic accidents	36	15.8
Total	228	100.0

CT Scan Findings and Skull Fracture Details

A total of 72 (31.6%) patients had skull fractures, of which 12 (5.3%) had thin underlying subdural hemorrhage (SDH). Four cases of extradural hemorrhage complicated a skull fracture, and eight cases of isolated Subdural hemorrhage (SDH) were observed without a skull fracture. Of those 48 (21%), radiologically evident diffuse axonal injuries were present (Table 4).

Table 4: The distribution of injuries shown by the CT scan.

CT Findings	Frequency	Percent
Cerebral Edema	32	14.0
Concussion	16	7.0
DAI	48	21.1
EDH	12	5.3
Fracture	72	31.6
Fracture with underlying contusion	12	5.3
Fracture with underlying EDH	4	1.8
Fracture with underlying SDH	12	5.3
Normal	4	1.8
Pneumocephalus	4	1.8
S.A.H	4	1.8
SDH	8	3.5
Total	228	100.0

Key: Subdural hemorrhage: SDH, Subarachnoid hemorrhage: SAH, extradural hemorrhage: EDH, diffuse axonal injuries: DAI.

DISCUSSION

Young children regularly experience pediatric falls, which can result in hospital-acquired injuries. Our research demonstrates the range of serious injuries that can result from falls. Young age, male sex, and poor socioeconomic position were revealed to be consistent risk factors for fall injuries among children aged 0 to 6 years in a previous systematic analysis.[9] In a similar vein, the bulk of the kids who had fallen in our study were boys. Many of these falls resulted in mild head injuries even though the majority were from low heights, necessitating surgical treatments. It was discovered that younger children, notably those between the ages of 1 and 5, had the most serious fall-related injuries and the most severe head injuries. Due to their patterns of injuries, children aged 1 to 5 also required the greatest number of neuro-imaging and neuro-surgical treatments.[10]

Children can often roll over at 4 – 5 months, sit up at 6 months, pull themselves up to a standing posture at 9 months, begin to walk at 12 months and run or climb stairs at 18 months, depending on their age. Older children in our study had a higher risk of falling from steps or the same level. Given that older kids are more mobile on their own and are more likely to fall when running, tripping, or stumbling, this conclusion makes sense. On the other hand, due to their reliant mobility, smaller children were more likely to fall multiple levels when they were dropped from a caregiver's arms or placed incorrectly on surfaces throughout the house.[11]

While major injuries and neurological aftereffects are uncommon, children frequently get head traumas. According to Warrington et al, there is less than a 1% chance of a major injury in falls involving children under the age of six months (21 patients out of 3357 in the research sample).[12] According to contemporary estimates, the likelihood of a fatal injury resulting from a shortfall is less than one in a million. The height of the fall, the location of impact with the head, the kind of surface being hit, and the velocity at which the surface is contacted are the variables that affect the probability and distribution of brain damage in children.[13]

A brief or focused point of contact permits a very brief force application, resulting in a shorter duration of brain deformation and a lower risk of developing DAI; further focused brain parenchymal damage related to the fracture site may be experienced. Infants' strongly adhered dura to the inner table explains why extradural hemorrhage is quite uncommon. As is the case with shaking injuries, diffuse SDH can arise only

from inertial forces; on the other hand, localized SDHs are more frequently linked to impact injuries about the fracture or impact site. sixteenth results of localized SDH underlying fractures in our sample, where the accidental head injury was most frequently represented by brief falls, can be explained by these pathological and anatomical findings. There has only been one instance of extradural hemorrhage, and skull fractures are rarely linked to either parenchymal or DAI hemorrhage. [14]

Research has attempted to describe the radiological results connected to head trauma. In a population of children aged one to five, a single focus of cerebral hemorrhage/skull fracture was found to be more prevalent. It is now established that the appearance of SDH on CT scans is not a reliable indication of hemorrhage.[15] Almost every SDH in our case series appeared as a narrow, homogeneously hyperdense rim directly below the fracture site. Accidental trauma instances can show posterior interhemispheric SDH. Only two cases of posterior fossa SDH were observed in conjunction with occipital fractures, which occurred after direct trauma without any indication of distant injury.[16]

The amount of height required to cause a significant or even fatal head injury in a newborn or neonate has been hotly debated in the literature.[17,18] In our investigation, the height range from which newborns can fall without suffering radiologically visible harm (apart from scalp swelling) was 1 to 6 m. The sole damage incurred in low-height fall instances was a misaligned fracture of the skull without any concomitant cerebral hemorrhage. Falls into hard surfaces were the mechanisms that were documented. Higher-level falls (1.5–6 m in our study) likewise produced a wide range of results, ranging from widespread axonal injury and cerebral hemorrhage to minimal harm or scalp puffiness.[19,20]

The findings validate the results of previous research that show low-level falls have a generally benign outcome and offer insight into the impact of such injuries in early life. Not all low-level fall head injuries will be reported to the authorities by the medical community.[21]

The minimal incidence of intracranial damage is radiologically visible in our investigation. The tendency for our study population to experience any kind of intracranial injury, primarily SDH, indicates that early in life, the transnational forces linked to low-level/velocity impact trauma are well tolerated.[22]

CONCLUSION

One of the main concerns for children is falling from a height, which results in head injuries and impairments every year. Of the children taken to the hospital, the majority had mild head injuries from falls. The most common causes of fractured skulls were infants falling from a caregiver's arms, newborn products, windows, walls, and attics. When the object from which a person has fallen is known, these data help with both prevention and estimating the risk of significant harm.

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Additional Information

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Human Subjects: Consent was obtained by all patients/participants in this study.
Conflicts of Interest:
In compliance with the ICMJE uniform disclosure form, all authors declare the following:
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AUTHORS CONTRIBUTIONS

Sr.#	Author's Full Name	Intellectual Contribution to Paper in Terms of:
1.	Iqbal Ahmad	1. Study design and methodology.
2.	Muhammad Hassan Raza	2. Paper writing.
3.	Adnan Qasim	3. Data collection and calculations.
4.	Shakeel Ahmad	4. Analysis of data and interpretation of results.
5.	Eram Abbas	5. Literature review and referencing.
6.	Sheraz Ahmad	6. Editing and quality insurer.
7.	Muhammad Kashif Chishti	7. Editing and quality insurer.