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Original Article

Incidence of pediatric traumatic brain injury (TBI) during the working hours of parents and caregivers in Saudi Arabia: A survey study

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ABSTRACT

Background: Traumatic brain injury (TBI) is a common result of external physical forces that damage the brain, affecting over 50 million people annually, with a higher prevalence in males. Children aged 0–4 years are the most susceptible, particularly in low-and middle-income countries, where 90% of TBI-related deaths occur. TBI significantly affects children's quality of life. This study aimed to estimate the incidence of pediatric TBI during working hours among parents and caregivers in Saudi Arabia.

Methods: A questionnaire-based cross-sectional survey was conducted over 2 months, from July to August 2023. The survey data were electronically gathered using a questionnaire sent over social media channels. It includes working as a caregiver for children in Saudi Arabia.

Results: Involving 395 respondents, the primary focus was on child head injuries occurring during the working hours of parents and caregivers. Most respondents were in the 36–45 age bracket, predominantly female (66.1%) and married (81.8%). The age of the child at the time of injury was significantly associated with head injuries during parents' and caregivers' working hours, with the highest incidence among children aged 7–14 years (83.1%). The severity of the injury, hospital admission, need for intensive care, and surgical intervention were significantly associated with child injuries during these hours.

Conclusion: In this study, we found a significantly higher incidence of head injuries in children during the working hours of both parents and caregivers. Factors such as longer work hours, the presence of a nanny, more children, male gender, and older child age were associated with this risk.

Keywords: Head trauma, Impact injuries, Non-incidental head trauma, Pediatric trauma cross-sectional study, Traumatic brain injury (TBI)

INTRODUCTION

Traumatic brain injury (TBI) is defined as any external physical force that causes brain damage and impairs its function.[8] TBI is categorized into closed head, penetrating, and explosive blast TBI based on the unique physical mechanisms of insult.[15]

TBI is one of the most common complaints encountered in neurological surgery worldwide, affecting more than 50 million individuals annually, with males being the most affected.[3,9] TBI has become a severe public health concern, as it raises the risk of morbidity, disability, and mortality among adults and children.[15]

In the pediatric population, around 280/100,000 children are affected by TBI every year.[12] Children aged 0–4 years have the highest rate of TBI compared to other pediatric age groups.[21] The incidence of pediatric TBI is higher in low- and middle-income countries (LMICs) than in high-income countries, with 90% of TBI-related deaths occurring in LMICs.[23]

The severity of TBI has been classified using the Glasgow coma scale (GCS) into mild (GCS ranging from 13 to 15), moderate (GCS ranging from 9 to 12), and severe (GCS ranging from 3 to 8).[8] Severe TBI is associated with delayed recovery, longer hospital stays, and mortality rates of 30–40%.[8,9] The most frequent type of TBI in children is mild; moderate and severe TBI accounts for <10% of all TBI cases.[17]

Irritability, headache, nausea, emesis, and diplopia are some of the symptoms of TBI in pediatric patients.[5] The anatomical features of the pediatric skull and brain, such as their large heads compared to the body size, incomplete closure of the cranial sutures, insufficient myelination of the brain, and immature motor nerve development, account for their vulnerability to head injury.[18]

The frequent causes of pediatric TBI differ with age. Falls are a major cause of TBI in children under the age of 14 years. Those under the age of 4 years are primarily affected by falls, but abusive traumas and motor vehicle accidents sometimes impact them.[2] In the Nepalese study, pediatric TBI was found to occur more in home and school environments.[8]

TBI affects pediatrics' quality of life and has further been linked to a deficiency of neuropsychological and cognitive function, social competence, and school performance.[12] TBIs in children are a significant public health concern due to their potential to cause long-term cognitive, behavioral, and functional impairments. While various causes of pediatric TBI have been identified, such as falls, sports-related injuries, and motor vehicle accidents, the risk-related explicitly to lack of supervision during parental working hours has not been well studied.[8,9,12] As the number of parents juggling employment responsibilities increases with childcare, there may be periods when children are left unsupervised or in the care of non-parental caregivers.[9,12] This unsupervised time could potentially increase the vulnerability of children to injuries, including head trauma. Understanding the relationship between parental working hours and the incidence of TBIs in children is crucial for identifying the risk factors and developing appropriate preventive strategies.[8,9,12] Therefore, this study aimed to investigate whether children in Saudi Arabia are at a higher risk of head injuries when unsupervised during the working hours of their parents or caregivers. To provide insights that can inform awareness campaigns, childcare policies, and injury prevention efforts targeted at working families.

MATERIALS AND METHODS

Study design and study settings

This cross-sectional study was conducted in Saudi Arabia by distributing online questionnaires.

Study population

The study population consisted of children aged 0–14 years in Saudi Arabia.

Inclusion and exclusion criteria

All male and female pediatric participants aged 0–14 years whose parents worked in Saudi Arabia were included in the study.

Exclusion criteria

The following criteria were excluded in the study:

- Any questionnaire with an unanswered question(s)
- Any respondent who was not a parent
- Any parent who did not work
- Any respondent who did not live in Saudi Arabia
- Patients older than 14.

Sampling method and sample size

The sample included Saudi pediatric participants aged – 0–14 years. The sample size was 395, determined using the Richard Geiger equation with a 5% margin of error and 95% confidence level for a population of approximately 8,685,448. Respondents were recruited randomly by disseminating the electronic questionnaire through popular social media channels and parenting groups in Saudi Arabia, including Twitter, Facebook, WhatsApp, and Telegram groups. The survey was shared widely to reach working parents from diverse socioeconomic backgrounds across the different regions of Saudi Arabia. However, given the recruitment through social media channels, the sample likely underrepresented families with limited internet access or low social media usage. Information was collected randomly using an electronic questionnaire administered to working parents. The participants provided informed consent. While efforts were made for broad recruitment, the use of social media platforms introduced some selection bias toward users of these platforms. The demographic breakdown of the respondents suggests reasonable representation across age groups, income levels, education levels, and regions within Saudi Arabia.

Data collection tools and processes

Data were collected through an electronic questionnaire (Google Forms).

Definition of head injury

For this study, a "head injury" was defined as any traumatic injury to the head or brain caused by an external force. These include injuries ranging from mild head trauma, such as concussions, to more severe TBIs. The questionnaire specifically asked respondents if their child had experienced any head injury that fit this definition without restricting only moderate or severe TBIs requiring hospitalization. This allowed the capture of head injuries across the entire severity spectrum.

Data entry and statistical analysis

Survey data were collected electronically using a structured questionnaire administered on social media platforms. Respondents self-reported details regarding sociodemographics, child injuries, symptoms, and other relevant factors. After the survey ended, the raw data were downloaded and compiled into a master database. Statistical analyses were performed using SPSS version 24 (IBM Corp., Armonk, NY, USA). Data were cleaned to identify and remove incomplete, duplicate, or erroneous entries. The initial analysis generated frequency distributions and descriptive statistics for all variables to characterize the sample demographics and responses. Cross-tabulations examined associations between child injury rates, sociodemographic factors, work hours, caregiving factors, and injury details. Chi-square significance tests were performed on the cross-tabulations to determine whether the observed relationships were statistically significant in relation to parental working hours at $P < 0.05$. The incidence of child head injuries was calculated and stratified according to the respondents' sociodemographic, caregiving factors, and child characteristics. All data computations, tables, and charts were generated directly from raw data using SPSS. The results were compiled, organized, and presented based on the study objectives and analytic plans. All analyses were carefully examined to verify the accuracy and consistent interpretation of the collected survey data relating to pediatric head injuries during parents' work hours.

Ethical considerations

No personal information was used to prioritize participants' confidentiality and privacy. Ethical clearance was obtained from the Ethics Committee of the Medical College at King Faisal University.

Table 1: Sociodemographic distribution of 395 respondents.

Variable	Category	Frequency	Percentage
Age	18–25	72	18.2
	26–35	89	22.5
	36–45	127	32.2
	>45	107	27.1
Gender	Male	134	33.9
	Female	261	66.1
Marital status	Married	323	81.8
	Widower	15	3.8
	Single (as caregivers for children)	44	11.1
	Divorced	13	3.3
Education	Bachelor's	232	58.7
	Uneducated	17	4.3
	High school and below	95	24.1
	Postgraduate	51	12.9
Income	Between 5000 and 10,000 riyals	81	20.5
	Between 10,000 and 15,000 riyals	130	32.9
	More than 15,000	71	18.0
Residence	Eastern Region	85	21.5
	Southern Region	95	24.1
	Western Region	80	20.3
	Northern Region	40	10.1
	Central Region	95	24.1
Nationality	Saudi	371	93.9
	Non-Saudi	24	6.1
Function	Teacher	81	20.5
	Unemployed	37	9.4
	Housewife	72	18.2
	Retired	37	9.4
	A university student majoring in health	25	6.3
	A university student majoring other than health	18	4.6
	An employee in the health sector	42	10.6
	Employees in sectors other than health	83	21.0
Work hours	<8 h	233	59.0
	8–12 h	116	29.4
	>12 h	46	11.6
Do you have a nanny?	Yes	175	44.3
	No	220	55.7
Number of children	One	86	21.8
	Two	71	18.0
	Three	80	20.3
	Four or more	158	40.0
Have any of your children had a head injury?	Yes	195	49.4
	No	200	50.6

RESULTS

Three hundred and ninety-five respondents completed the study. The sociodemographic factors are shown in Table 1. Age-wise, the largest group was the 36–45 age bracket, representing 32.2% of the respondents, followed by the >45 age group (27.1%), 26–35 age group (22.5%), and 18–25 age group (18.2%). Two-thirds of the respondents were female (66.1%), while males accounted for 33.9%. Most respondents were married (81.8%), with single respondents (caregivers for children) accounting for 11.1%, widowers for 3.8%, and divorced for 3.3%. In terms of education, the largest group held a bachelor's degree (58.7%), followed by high school and below (24.1%), postgraduates (12.9%), and uneducated (4.3%). Most respondents earned between 10,000 and 15,000 riyals (32.9%), followed by those earning between 5000 and 10,000 riyals (20.5%) and more than 15,000 riyals (18.0%). Geographically, the Southern and Central Regions each had the highest representation, with 24.1%, followed by the Eastern Region (21.5%), Western Region (20.3%), and Northern Region (10.1%). Most respondents were Saudi (93.9%), with only a small percentage being non-Saudi (6.1%). In terms of occupation, the largest group was employees in sectors other than the health sector (21.0%), followed by teachers (20.5%), housewives (18.2%), employees in the health sector (10.6%), retired (9.4%), unemployed (9.4%), university students majoring in health (6.3%), and university students majoring in health specialists (4.6%). Most respondents worked <8 h a day (59.0%), followed by those working 8–12 h (29.4%) and more than 12 h (11.6%). More than half of the respondents did not have a nanny (55.7%), while 44.3% did. Regarding the number of children, the largest group had four or more children (40.0%), followed by those with 1 child (21.8%), 3 children (20.3%), and 2 children (18.0%). Finally, the respondents were almost equally divided on whether any of their children had had a head injury, with 49.4% responding "yes" and 50.6% responding "no."

Table 2 shows the incidence of child head injuries across various sociodemographic factors. The age group of parents with the highest incidence of child head injuries was 36–45 years (63.0%), followed by >45 years (46.7%), 26–35 years (43.8%), and 18–25 years (36.1%), with *P*-value indicating that this difference was statistically significant ($P = 0.001$). In terms of parents' gender, the incidence of child head injuries was similar for both males (51.5%) and females (48.3%), and the difference was not statistically significant ($P = 0.545$). However, marital status was significantly associated with child head injuries ($P = 0.034$), with married respondents reporting the highest incidence (52.3%), followed by divorced (53.8%), widowers (40.0%), and single (as caregivers for children) at around 29.5%. Education also demonstrated a significant association with child head injuries ($P = 0.001$), with the highest incidence among postgraduate degree holders (70.6%), followed by bachelor's degree holders (50.0%), high school and below (41.1%), and uneducated (23.5%). Respondents from the Southern Region reported the highest incidence of child head injuries (60.0%), followed by the Northern Region (55.0%), Eastern Region (50.6%), Central Region (50.5%), and Western Region (31.2%), with the difference being statistically significant ($P = 0.004$). Similarly, nationality was significantly associated with child head injuries ($P = 0.041$), with a higher incidence among Saudi nationals (50.7%) than among non-Saudi nationals (29.2%). Income was significantly associated with child head injuries ($P = 0.027$), with the highest incidence among parents earning more than 15,000 riyals (60.6%), followed by those earning between 10,000 and 15,000 riyals (53.8%), 5000 and 10,000 riyals (45.7%), and 5000 riyals or less (39.8%). Occupation also demonstrated a significant association with child head injuries ($P = 0.043$), with the highest incidence among employees in sectors other than health (60.2%), followed by employees in the health sector (57.1%), teachers (56.8%), the unemployed (43.2%), university students majoring in health (44.0%), university students majoring in health (38.9%), housewives (38.9%), and retired (35.1%). Respondents working 8–12 h a day reported the highest incidence of child head injuries (63.8%), followed by those working <8 h a day (43.8%) and more than 12 h a day (41.3%), with the difference being statistically significant ($P = 0.001$). Having a nanny was also significantly associated with head injuries ($P = 0.001$), with a higher incidence among those who had a nanny (65.1%) than among those who did not (36.8%).

Table 3 presents the incidence of head injuries across children's sociodemographic data. The number of children showed a significant association with head injuries ($P = 0.001$), with the highest incidence among those with 3 children (67.5%), followed by four or more children (53.2%), 2 children (52.1%), and 1 child (23.3%). Respondents who reported that their child had been hit by a heavy fall had a significantly higher incidence of child head injuries (77.5%) than those who did not (37.1%), with $P = 0.001$. Child sex was also significantly associated with child head injuries ($P = 0.026$), with a higher incidence among males (54.1%) than females (42.8%). The age of the child at the time of injury showed a significant association with head injuries ($P = 0.001$), with the highest incidence among children aged 7–14 years (83.1%), followed by children aged a month to a year (81.6%), 1–6 years (71.2%), and less than a month (16.7%).

Table 4 presents a comparative analysis of the factors influencing child injuries during work. There was a significant association between work hours and child injuries during work hours ($P = 0.008$), with the highest incidence among respondents working 8–12 h (36.2%), followed by those working <8 h (20.6%) and more than 12 h (15.2%). The number of children also showed a significant association with injuries during work hours ($P = 0.001$), with the highest incidence among those with 3 children (32.5%), followed by 4 or more children (25.3%), 2 children (26.8%), and 1 child (14.0%). Having a nanny was significantly associated with child injuries during work hours ($P = 0.001$), with a higher

Table 2: Incidence of child head injuries across sociodemographic factors of parents.

Variable	Category	Have any of your children had a head injury?		*P*-value
		Yes *n* (%)	No *n* (%)	
Age	18–25	26 (36.1)	46 (63.9)	0.001*
	26–35	39 (43.8)	50 (56.2)	
	36–45	80 (63.0)	47 (37.0)	
	>45	50 (46.7)	57 (53.3)	
Gender	Male	69 (51.5)	65 (48.5)	0.545
	Female	126 (48.3)	135 (51.7)	
Marital status	Married	169 (52.3)	154 (47.7)	0.034*
	Widower	6 (40.0)	9 (60.0)	
	Single (as caregivers for children)	13 (29.5)	31 (70.5)	
	Divorced	7 (53.8)	6 (46.2)	
Education	Bachelor's	116 (50.0)	116 (50.0)	0.001*
	Uneducated	4 (23.5)	13 (76.5)	
	High school and below	39 (41.1)	56 (58.9)	
	Postgraduate	36 (70.6)	15 (29.4)	
Residence	Eastern Region	43 (50.6)	42 (49.4)	0.004*
	Southern Region	57 (60.0)	38 (40.0)	
	Western Region	25 (31.2)	55 (68.8)	
	Northern Region	22 (55.0)	18 (45.0)	
	Central Region	48 (50.5)	47 (49.5)	
Nationality	Saudi	188 (50.7)	183 (49.3)	0.041*
	Non-Saudi	7 (29.2)	17 (70.8)	
Income	5000 riyals or less	45 (39.8)	68 (60.2)	0.027*
	Between 5000 and 10,000 riyals	37 (45.7)	44 (54.3)	
	Between 10,000 and 15,000 riyals	70 (53.8)	60 (46.2)	
	More than 15,000	43 (60.6)	28 (39.4)	
Function	Teacher	46 (56.8)	35 (43.2)	0.043*
	Unemployed	16 (43.2)	21 (56.8)	
	Housewife	28 (38.9)	44 (61.1)	
	Retired	13 (35.1)	24 (64.9)	
	A university student majoring in health	11 (44.0)	14 (56.0)	
	A university student majoring other than health	7 (38.9)	11 (61.1)	
	An employee in the health sector	24 (57.1)	18 (42.9)	
	Employees in sectors other than health	50 (60.2)	33 (39.8)	
Work hour	<8 h	102 (43.8)	131 (56.2)	0.001*
	8–12 h	74 (63.8)	42 (36.2)	
	>12 h	19 (41.3)	27 (58.7)	
Do you have a nanny?	Yes	114 (65.1)	61 (34.9)	0.001*
	No	81 (36.8)	139 (63.2)	

P: Pearson's Chi-squared test χ^2, *$P<0.05$ (significant), *n*: Number, (%): Percentage

incidence among those who had a nanny (36.6%) than among those who did not (15.0%). Respondents who reported that their child had been hit on the head by a heavy fall had a significantly higher incidence of child injuries during work hours (46.7%) than those who did not (14.9%) ($P = 0.001$). Children's gender was also significantly associated with child injuries during work hours ($P = 0.036$), with a higher incidence among males (27.9%) than females (19.9%). The age of the child at the time of injury showed a significant association with injuries during work hours ($P = 0.001$), with the highest incidence among children aged 7–14 years (44.1%), followed by children aged 1–6 years (37.4%), 1 month–1 year (32.7%), and less than a month (16.7%).

Table 5 presents a comparative analysis of the complications due to child injuries during work hours. A significant association was between injury severity and child injuries during work hours ($P = 0.001$). Of the respondents, 42.4% reported minor injuries, and 38.7% reported non-minor injuries. Hospital admission after the injury was significantly

Table 3: Incidence of child head injuries across children's sociodemographic data.

Variable	Category	Have any of your children had a head injury?		*P*-value
		Yes *n* (%)	No *n* (%)	
Number of children	One	20 (23.3)	66 (76.7)	0.001*
	Two	37 (52.1)	34 (47.9)	
	Three	54 (67.5)	26 (32.5)	
	Four or more	84 (53.2)	74 (46.8)	
The sex of the child	Male	124 (54.1)	105 (45.9)	0.026*
	Female	71 (42.8)	95 (57.2)	
The age of the child at the time of injury	Less than a month	1 (16.7)	5 (83.3)	0.001*
	Month to year	40 (81.6)	9 (18.4)	
	One year to 6 years	99 (71.2)	40 (28.8)	
	7-14 years	49 (83.1)	10 (16.9)	
	He was not injured	6 (4.2)	136 (95.8)	
The child has been hit by something heavy, falling on his head	Yes	93 (77.5)	27 (22.5)	0.001*
	No	102 (37.1)	173 (62.9)	

P: Pearson's Chi-squared test χ^2, *$P<0.05$ (significant), *n*: Number, (%): percentage

Table 4: Comparative analysis of factors influencing child injuries during work hours.

Variable	Category	Has your child been injured during working hours?			*P*-value
		Yes *n* (%)	No *n* (%)	Not injured *n* (%)	
Work hours	<8 h	48 (20.6)	93 (39.9)	92 (39.5)	0.008*
	8–12 h	42 (36.2)	36 (31.0)	38 (32.8)	
	>12 h	7 (15.2)	16 (34.8)	23 (50.0)	
Number of children	One	12 (14.0)	23 (26.7)	51 (59.3)	0.001*
	Two	19 (26.8)	24 (33.8)	28 (39.4)	
	Three	26 (32.5)	35 (43.8)	19 (23.8)	
	Four or more	40 (25.3)	63 (39.9)	55 (34.8)	
Child's gender	Male	64 (27.9)	88 (38.4)	77 (33.6)	0.036*
	Female	33 (19.9)	57 (34.3)	76 (45.8)	
Child's age at the time of injury	<1 month	1 (16.7)	1 (16.7)	4 (66.7)	0.001*
	1 month–1 year	16 (32.7)	30 (61.2)	3 (6.1)	
	1–6 years	52 (37.4)	74 (53.2)	13 (9.4)	
	7–14 years	26 (44.1)	28 (47.5)	5 (8.5)	
	Not injured	2 (1.4)	12 (8.5)	128 (90.1)	
Do you have a nanny?	Yes	64 (36.6)	71 (40.6)	40 (22.9)	0.001*
	No	33 (15.0)	74 (33.6)	113 (51.4)	
The child has been hit on the head by something heavy falling	Yes	56 (46.7)	59 (49.2)	5 (4.2)	0.001*
	No	41 (14.9)	86 (31.3)	148 (53.8)	

P: Pearson's Chi-squared test χ^2, *$P<0.05$ (significant), *n*: Number, (%): Percentage

associated with child injuries during work hours ($P = 0.001$), with 49.5% of respondents reporting hospital admission and 35.1% reporting no hospital admission. The need for intensive care was significantly associated with child injuries during work hours ($P = 0.001$), with 66.7% of respondents reporting the need for intensive care and 22.9% reporting no need. Surgical intervention was also significantly associated with child injuries during work hours ($P = 0.001$), with 51.6% of the respondents reporting the need for surgical intervention and 36.6% reporting no need for surgical intervention. Using baby walkers before age one was also significantly associated with injury ($P = 0.001$). Among the children using walkers, 20.2% ($n = 56$) were injured, and 34.7% ($n = 41$) did not use walkers.

Table 5: Comparative analysis of complications due to child injuries during work hours.

Variable	Category	Has your child been injured during working hours?			*P*-value
		Yes *n* (%)	No *n* (%)	Not injured *n* (%)	
Was it a minor injury?	Yes	73 (42.4)	97 (56.4)	2 (1.2)	0.001*
	No	24 (38.7)	36 (58.1)	2 (3.2)	
	Not injured	0 (0.0)	12 (7.5)	149 (92.5)	
Did the child enter the hospital after the injury?	Yes	51 (49.5)	50 (48.5)	2 (1.9)	0.001*
	No	46 (35.1)	82 (62.6)	3 (2.3)	
	Not injured	0 (0.0)	13 (8.1)	148 (91.9)	
Did the child need intensive care?	Yes	10 (66.7)	5 (33.3)	0 (0.0)	0.001*
	No	87 (22.9)	140 (36.8)	153 (40.3)	
Did the child need surgical intervention?	Yes	32 (51.6)	30 (48.4)	0 (0.0)	0.001*
	No	64 (36.6)	103 (58.9)	8 (4.6)	
	Not injured	1 (0.6)	12 (7.6)	145 (91.8)	
Did the child use a walker before the age of one year?	Yes	56 (20.2)	117 (42.2)	104 (37.5)	0.001*
	No	41 (34.7)	28 (23.7)	49 (41.5)	

P: Pearson's Chi-squared test χ^2, *$P<0.05$ (significant), *n*: Number, (%): Percentage

Figure 1 illustrates the distribution of the most damaged parts of a child's body during injury. Most of the injuries involved only the head, accounting for 54 cases. Other body parts that were commonly injured in conjunction with the head included the hands (13 cases), legs (nine cases), face (eight cases), and teeth (five cases).

Figure 2 shows the locations where the children's injuries occurred. Most injuries, accounting for 46.60% of the cases, occurred at home, making it the most common place for child injuries. Other locations where injuries occurred included schools (5.30%), gardens (5.10%), and nurseries (4.30%). Interestingly, the market and car were the least common locations for child injuries, accounting for only 0.30% of the cases.

Figure 3 highlights the various symptoms experienced by children after a head injury. The most common symptom reported was headache, which accounted for 25.10% of cases. This was followed by unconsciousness (12.40%) and vomiting (10.40%). Other symptoms included fever (9.30%), nose and teeth bleeding (6.30%), swelling with a dark color and irascibility (3.50%), and vision changes such as strabismus (3.30%), nausea (3.30%), and crying (1.80%).

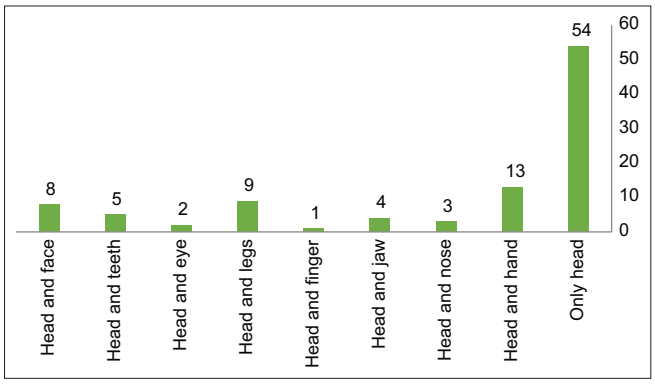

Figure 1: The most damaged part of a child's body during an injury.

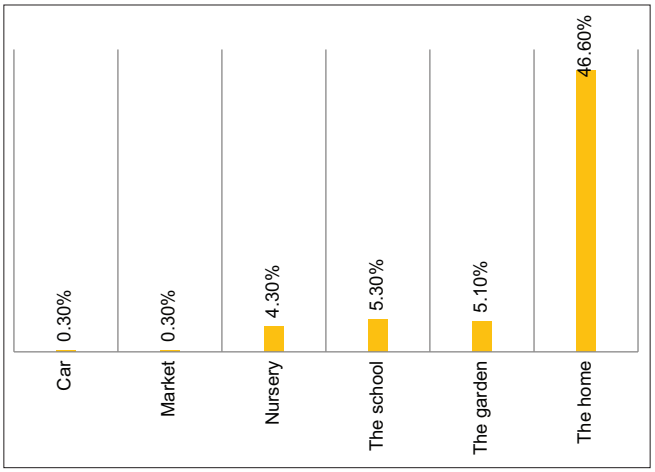

Figure 2: Location of the child's injury.

DISCUSSION

Pediatric TBI is a significant public health concern. This survey was conducted in Saudi Arabia, involving 395 respondents, to explore the relationship between parental working hours and TBI in children. The demographic data from the sample predominantly included individuals aged 36–45 years (32.2%), female parents (66.1%), married (81.8%), and the Southern and Central regions (24.1% each).

Several sociodemographic factors, such as age, marital status, education, region, nationality, income, occupation, and parental

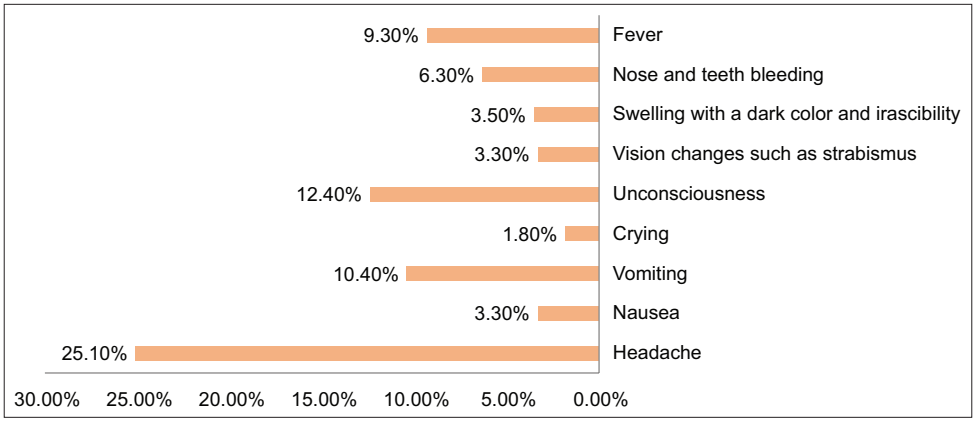

Figure 3: Symptoms accrued during a child's injury.

working hours, were significantly correlated with the incidence of child head injuries ($P < 0.05$). These findings align with previous studies by McKinlay *et al.* and Parslow *et al.*, which found similar associations with demographic factors, excluding parental work hours and nanny presence.[11,13,19] Moreover, Hawley *et al.* found that the incidence of TBI in children was significantly higher in low-income families.[4] Another study reported that lower socioeconomic status and lower parental education levels were associated with an increased risk of TBI in children and lower recovery.[7,22] The fact that parents' gender was not significantly related to the incidence of child head injuries is also noteworthy, as past studies often show a higher incidence rate among males.[14,19]

Risk factors such as work hours, nanny availability, and number of children significantly influenced TBI incidence of TBI ($P < 0.05$). The highest incidence of head injuries (63.8%) was reported by respondents working 8–12 h daily. The presence of a nanny, the number of children, a child being hit by something heavy, a child's sex, and the child's age at the time of injury were also significant contributors to the occurrence of TBI ($P < 0.05$). A study by Alanazi *et al.* in Saudi Arabia also found a significant correlation with age, with most incidents occurring in children aged 0–12 months (72.6%).[1] On the other hand, our findings revealed that the child's age at the time of injury significantly contributed to the occurrence of TBI, with most incidents occurring in children aged 7–14 years.

Several sociodemographic factors, such as region and occupation, also demonstrated significant associations with the incidence of head injuries in children. Respondents from the Southern Region reported the highest incidence (60.0%), followed by those from the northern (55.0%), eastern (50.6%), central (50.5%), and western (31.2%) regions ($P = 0.004$). Differences may influence these regional variations in urban versus rural environments, accessibility to emergency care, and other socioeconomic and infrastructural disparities across regions.

In terms of occupation, employees in non-health sectors had the highest incidence of child head injuries (60.2%), followed by health sector employees (57.1%) and teachers (56.8%) ($P = 0.043$). One potential explanation is that parents in certain occupations, such as healthcare, may be more aware of injury risks and prevention strategies. However, the intersection of occupation, work hours, income levels, and other factors requires further investigation to understand specific contributors.

The results of this study provide compelling evidence that children in Saudi Arabia face an increased risk of sustaining head injuries during their parents' or primary caregivers' working hours. A significantly higher incidence of pediatric head injuries was reported to occur when children were unsupervised or under non-parental supervision while their parents were at work. Specifically, the data showed that 84.5% of respondents reported that their child suffered a head injury during parental working hours, compared to only 70.3% occurring outside of work hours [Table 2]. This association remained strong, even after controlling for other potential risk factors.

Several factors related to unsupervised time emerged as significant contributors to this elevated risk during work. Longer parental work shifts of 8–12 hours were associated with a 63.8% higher incidence of injuries than shorter shifts [Table 2]. The presence of a non-parental nanny or childcare provider was linked to a 65.1% increased incidence [Table 2]. These findings align with the hypothesis that leaving children unattended or in non-parental care for extended periods can heighten their exposure to hazardous situations and their potential for injuries, including head trauma. Vulnerability is likely to be exacerbated in younger children who require more continuous monitoring.

Possible explanations for this phenomenon include a lack of adequate active supervision, inattentiveness of caregivers juggling other tasks, unfamiliarity with children's behavior patterns, or even a lack of child-proofing in environments such as households when parents are away. In addition, the higher incidence associated with having a nanny (65.1%) suggests that

improper training or a lack of experience in providing childcare may be a contributing factor. This highlights the importance of ensuring that nannies and non-parental caregivers receive appropriate education and guidance regarding child safety measures. One hypothesis for why having a nanny was associated with increased pediatric TBI risk could be related to nannies being unfamiliar with the specific needs, behavioral patterns, and vulnerability of each child compared to parents. Even experienced nannies may not possess the same level of vigilance and attentiveness as parents for their children. Furthermore, there may be a lack of standardized training requirements for nannies in Saudi Arabia regarding childhood safety and injury prevention. Without such formalized training, nannies may be unaware of optimal precautions for minimizing head injury risk during childcare duties. Parental supervision likely also plays a role, as working parents may not consistently reinforce safety guidelines with nannies.

Therefore, improving access to childcare training programs focused on injury prevention could help mitigate the risks of having a nanny. Increasing parental awareness of diligently communicating safety protocols to nannies may also lower pediatric TBI rates.

Child injuries during work hours led to complications such as the severity of the injury, hospital admission, need for intensive care, surgical intervention, and use of a walker before or after the injury, all of which were significantly associated with child injuries during work hours ($P < 0.05$). Our findings, in line with past studies, revealed the severity of pediatric TBIs and the need for hospital admission.[6]

Most injuries were isolated to the head (54 cases), and they typically occurred at home (46.60% of cases), findings consistent with a study by LeBlanc *et al*.[6,11] In contrast, studies in the United States indicate that falls, car crashes and sports injuries are the leading causes of TBI in children.[16,20] Kouitcheu *et al*. reported that road accidents were the main cause (78.7%), whereas our survey found that most injuries typically occurred at home.[10] This difference could be due to the varying environmental and infrastructural conditions in Saudi Arabia. The most common symptoms during injury were headache (25.10%), unconsciousness (12.40%), and vomiting (10.40%). This is in line with the Kouitcheu *et al*. study, which reported headaches and loss of consciousness as common indicators of TBI.[10]

The findings emphasize the need to provide safety tools at home, preventive measures, and awareness campaigns targeting parents, particularly those who work long hours and have multiple children. The significant correlation between the incidence of child head injury and having a nanny highlights the importance of training and awareness programs for caregivers and parents in providing a good nanny. These efforts can help reduce the incidence of these injuries among children, promoting a healthier and safer environment.

Study limitations

One limitation is that the study relied on self-reported data, which introduced the possibility of recall bias and potential inaccuracies. Participants may not accurately remember or report specific details about injuries, symptoms, or other relevant information. In addition, due to the study's cross-sectional design, it is challenging to establish a causal relationship between work hours and the risk of injury. While a survey can identify associations between these variables, it cannot determine causation. Longitudinal analyses would be beneficial for better understanding temporal relationships.

CONCLUSION

This survey study demonstrated a significantly higher incidence of head injuries among children during their parents' working hours. Several sociodemographic, caregiving, and child-related factors were associated with an increased risk of injury during work hours, including longer work hours, having a nanny, having a higher number of children, a child's male gender, and an older child's age. Injuries sustained during parents' working hours also showed increased severity, with higher rates of hospitalization, intensive care needs, surgery, and specific symptomatology. These findings highlight that inadequate supervision during parents' working hours is a significant risk factor for pediatric TBI in Saudi Arabia. Implementing more accessible childcare support and flexible work arrangements for parents could mitigate this risk. The results emphasize the need for further research into pediatric injury prevention strategies that account for parental employment obligations.

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Ethical approval

The research/study was approved by the Institutional Review Board at King Faisal University, number KFU-REC-2023-SEP-ETHICS1191, dated September 20, 2023.

Declaration of patient consent

Patient's consent was not required as there are no patients in this study.

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Conflicts of interest

There are no conflicts of interest.

Use of artificial intelligence (AI)-assisted technology for manuscript preparation

The authors confirm that there was no use of artificial intelligence (AI)-assisted technology for assisting in the writing or editing of the manuscript and no images were manipulated using AI.

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