Pielęgniarstwo Neurologiczne i Neurochirurgiczne
THE JOURNAL OF NEUROLOGICAL AND NEUROSURGICAL NURSING
eISSN 2299-0321 ISSN 2084-8021 www.pnn.wshe.pl **Original**

DOI: 10.15225/PNN.2014.3.3.4

Head Injuries in Children — Quantitative and Qualitative analysis of Cases Regarding Children Reporting at the Hospital Emergency Ward

Urazy głowy u dzieci — analiza ilościowa i jakościowa przypadków dzieci zgłaszających się na Szpitalny Oddział Ratunkowy

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Abstract

Introduction. With the development of civilization, there has been an increase of the percentage of head injuries cases in children. Head injuries are currently the third reason for the death of children under one year of age and first among older children.
Aim. The aim of the study was the qualitative and quantitative analysis of head injuries among children admitted to the Hospital Emergency Ward in Trzebnica in 2010 as well as determination of factors, contributing to head injuries among children.
Material and Methods. The statistical analysis regarded head injuries in children aged 0–18 which were reported to the Hospital Emergency Ward in Trzebnica within the period from January to December 2010. The total number of injuries reported was 315 and involved 118 girls and 197 boys.
Results. The reason for accidents which resulted in children's injuries were most often falls from height (27.0%), falls on the same level (24.4%) and hitting an object (21.6%). The reason for an accident is conditioned on the child's age. The most common reason for injuries in children under 13 is a fall from height (30.8%) or a fall on the same level (28.5%). The accidents took place mainly during the day and in the summer period. In most cases in all age groups damage to epicrenium happened with children under 6 years of age.
Conclusions. Head injuries are associated with age. They more often occur in the youngest group from 0 to 3 years as well as in the group from 13 to 18 years of age. With young children the main reasons are most commonly falls from height as well as falls on the same level. There has been observed an increase of head injuries during the holiday period. **(JNNN 2014;3(3):121–128)**
Key Words: head injuries, children

Streszczenie

Wstęp. Wraz ze wzrostem rozwoju cywilizacyjnego dochodzi do zwiększenia odsetka urazów głowy u dzieci. Urazy głowy są obecnie trzecią przyczyną zgonów u dzieci poniżej pierwszego roku życia i pierwszą wśród starszych dzieci.
Cel. Analiza jakościowa i ilościowa urazów głowy wśród dzieci zgłaszających się do Szpitalnego Oddziału Ratunkowego w Trzebnicy w 2010 r., a także określenie czynników sprzyjających urazom głowy wśród dzieci.
Materiał i metody. Analiza statystyczna dotyczyła urazów głowy wśród dzieci od 0 do 18 roku życia, z jakimi zgłoszono się do Szpitalnego Oddziału Ratunkowego w Trzebnicy w okresie styczeń–grudzień 2010 r. Łączna liczba zgłoszonych urazów wynosiła 315 i dotyczyła 118 dziewczynek i 197 chłopców.
Wyniki. Przyczyną zdarzeń, na skutek których doszło do urazu dziecka, były najczęściej upadki z wysokości (27,0%), upadki na jednym poziomie (24,4%) i uderzenia w przedmiot (21,6%). Przyczyna incydentu zależy istotnie od wieku dziecka. Najczęstszą przyczyną urazów wśród dzieci do 13 roku życia jest upadek z wysokości (30,8%) lub na tym samym poziomie (28,5%). Najczęściej do wystąpienia urazu dochodziło w dzień i w porze letniej. W większości przypadków we wszystkich grupach wiekowych dochodziło do urazów z uszkodzeniem powłok głowy i istotnie częściej zdarzało się to u dzieci w wieku do 6 lat.

Wnioski. Urazy głowy są związane z wiekiem. Częściej występują w grupie najmłodszej od 0 do 3 lat i w grupie od 13 do 18 lat. Wśród małych dzieci przyczyną są głównie upadki z wysokości i upadki na jednym poziomie. Zaobserwowano wzrost ilości urazów głowy w okresie wakacyjnym. **(PNN 2014;3(3):121–128)**
Słowa kluczowe: urazy głowy, dzieci

Introduction

Head injuries are the third biggest reason for the death of children under one year of age and the first one with older children [1]. According to the statistics the number of injuries has been dramatically increasing in the highly developed countries. Each year in the USA approximately one million children suffer from head injuries and in 30 thousand cases the consequences are lasting [2]. With children, head injuries constitute 30% of all injuries whereas in Poland every second child suffers from craniocerebral trauma and requires medical intervention, and at least every tenth is hospitalized [3].

Head damage is a type of damage which is revealed in the physical examination and is accompanied by the occurrence of subcutaneous blood hemorrhages, deformations, injuries as well as liquorrhoea from auditory duct or from the nose. Traumatic brain injury refers to damage to the brain and may occur without external damage and symptoms. In children due to particular construction of the skull and brain and their impact depreciation abilities there more often occur closed injuries prevailed by concussion or contusion symptoms. There are far fewer cases of skull fracture [4].

Bio-mechanism of head injuries depends on whether the force impacts a moving or motionless head. The extent of damage resulting from the injury is conditioned on the place injured. External injuries which may seem dangerous not always result in the damage to brain structures as the bones of the skull reduce the energy of the force which on its way destroys the structures surrounding the brain before reaching the brain itself. Skin as well as subcutaneous tissue may be bruised and broken which may result in damage to the blood vessels and subcutaneous hematoma formation. Next, the skull bones are broken. Skull cover fracture with displacement leads to the so called herniation. Skull base fracture often results in damage to the cerebral dura mater, and in consequence, there occurs rhinorrhea or pneumocele. If there is damage to arterial or venous vessels and the cerebral dura mater retains its continuity, then the epidural hematoma is formed. Damage to vessels of the subdural area or bleeding of brain surface results in the formation of submeningeal bruises. Brain damage means also damage to the nervous system which generates systemic reactions: in particular respiratory and cardiovascular disorders which may ultimately lead to death [4].

The aim of the study was the qualitative and quantitative analysis of head injuries among children admitted to the Hospital Emergency Ward in Trzebnica in 2010 as well as determination of factors, contributing to head injuries among children.

Material and Methods

The study is based on the analysis of medical records: information sheets, in the case of child observation — histories, observation sheets regarding children hospitalized in the Hospital Emergency Ward at the St. Jadwiga Hospital in Trzebnica in the period January–December 2010. The applied research method was a retrospective analysis of records referring to 315 children. In the development of the research material gathered there was made a division of the collectivity depending on the type and seriousness of the head injury as well as on the injury factor. Also the number, age, place of living, location and time of the accident were taken into account. In the course of the analysis there were also considered data regarding the circumstances of the injuries, recognitions according to ICD-10 codes (there were analysed data with codes: S00, S01, S02, S06) as well as further proceeding which included sending the child to the wards of pediatric surgery in Wroclaw, trauma-orthopedic surgery in Trzebnica and neurosurgery in Wroclaw as well as children discharged home with the recommendations of observation at home. In the analysed material there were considered injuries with and without damage done to the epicranium, and also there were applied diagnostic tests.

The data obtained were statistically drawn up using the Excel spreadsheet MS Office 2010 package and summed up by means of statements in the form of tables and graphic illustrations. For the purpose of studying the correlations between quantitative variables there was used χ^2 test. The level of statistical significance $p<0.05$ was adopted.

Results

Children were divided into four age groups:
- group I — age from 0 to 3 years of age — 84 (including 36 girls),
- group II — age from 3 to 6 years of age — 71 (including 30 girls),

- group III — age from 6 to 13 years of age — 66 (including 22girls),
- group IV — age from 13 to 18 years of age — 94 (including 30 girls).

The percentage of girls in the age groups decreased (Figure 1) but it did not differ significantly (p>0.05), which was verified by Pearson's χ^2 test (Table 1).

The percentage of injuries with children living in the city was slightly smaller than with children living in the country but it did not vary significantly in each age group (Table 2, p>0.05).

Accidents, resulting in child's injury most often took place in the playground (35.2%), at home (34.0%) and school (16.2%), and most rarely in the kindergarten (1.9%). The total number of injuries considering the place of their occurrence is illustrated in Figure 2. However, the place of the accident is largely conditioned on the child's age (p<0.0001). Injuries with children under six most often take place at home, children aged 6–13 are most often injured in playgrounds whereas older children are mostly injured at school (Table 3).

The vast majority of events in which the head was injured took place during the day, between 15 and 22 — 53%, and between 7 and 15 — 43.2%. Children aged from 13 to 18 were statistically significantly more often injured (55.3%) between 7 and 15, whereas younger children between 15 and 22 — (59.3%).

The reason for the accidents resulting in the child's injury were falls from height (27.0%), falls on the same level (24.4%) and hitting an object (21.6%). However, the reason for the accident largely depends on the child's age (p<0.0001). The most frequent reason for injuries with children under 13 years of age was the fall from height (30.8%) or on the same level (28.5%).

Most injuries occur in summer (June, July, August). The number of injuries taking place in these months

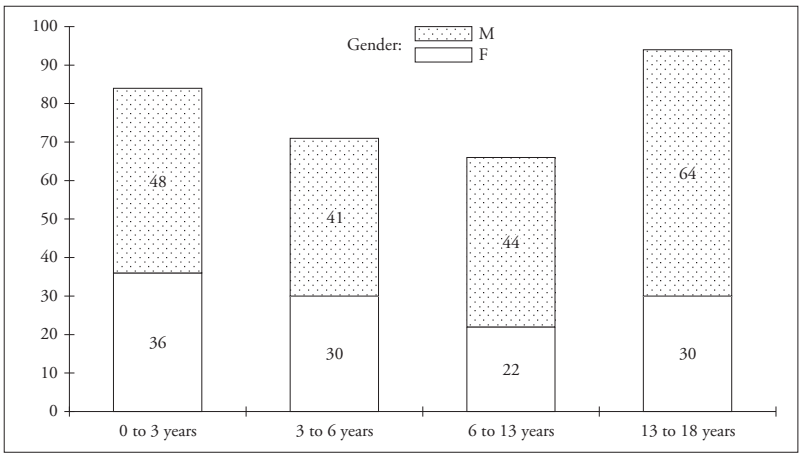

Fig. 1. The structure of injuries in age groups according to the gender criterion

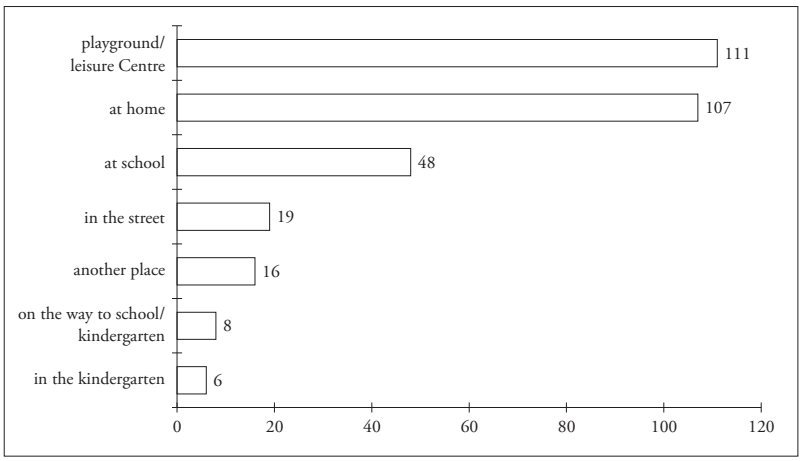

Fig. 2. The number of all analysed injuries in children depending on the location of their occurrence

Table 1. Number (percentage) of injuries in groups differing in age and gender, as well as place of residence of the group studied

Gender	Age group			
	I	II	III	IV
Feminine (F)	36 (42.9%)	30 (42.3%)	22 (33.3%)	30 (31.9%)
Masculine (M)	48 (57.1%)	41 (57.7%)	44 (66.7%)	64 (68.1%)
Total	84	71	66	94
Chi-square test: χ^2=3.454; df=3; p=0.3267				
Place of residence	Age group			
	I	II	III	IV
City	43 (51.2%)	35 (49.3%)	27 (40.9%)	39 (41.5%)
Country	41 (48.8%)	36 (50.7%)	39 (59.1%)	55 (58.5%)
Total	84	71	66	94
Chi-square test: χ^2=2.672; df=3; p=0.4450				

Table 2. Number (percentage) of injuries in groups differing in age and locations, where the head injury took place and in the time of the day

Location of the incident	Age group			
	I	II	III	IV
Playground, leisure centre	29 (34.5%)	28 (39.4%)	27 (40.9%)	27 (28.7%)
At home	48 (57.1%)	32 (45.1%)	11 (16.7%)	16 (17.0%)
In school	0 (0.0%)	0 (0.0%)	16 (24.2%)	32 (34.0%)
In the street	2 (2.4%)	2 (2.8%)	7 (10.6%)	8 (8.5%)
In another place	2 (2.4%)	3 (4.2%)	3 (4.5%)	8 (8.5%)
On the way to school, kindergarten	1 (1.2%)	3 (4.2%)	1 (1.5%)	3 (3.2%)
In the kindergarten	2 (2.4%)	3 (4.2%)	1 (1.5%)	0 (0.0%)
Total	84	71	66	94
Chi-square test: χ^2=96.286; df=18; p<0.0001				
Time of the day	Age group			
	I	II	III	IV
From 7 to 15	34 (40.5%)	26 (36.6%)	24 (36.4%)	52 (55.3%)
From 15 to 22	50 (59.5%)	41 (57.7%)	40 (60.6%)	37 (39.4%)
From 22 to 7	0 (0.0%)	4 (5.6%)	2 (3.0%)	5 (5.3%)
Total	84 (100%)	71 (100%)	66 (100%)	94 (100%)
Chi-square test: χ^2=14.53; df=6; p=0.0242				

Table 3. The reasons for injuries and the reasons for falling from height in the group tested

The reasons for injuries	Age group			
	I	II	III	IV
Fall from height	29 (34.5%)	21 (29.6%)	18 (27.3%)	17 (18.1%)
Fall on the same level	27 (32.1%)	20 (28.2%)	16 (24.2%)	14 (14.9%)
Hittig and object	24 (28.6%)	20 (28.2%)	12 (18.2%)	12 (12.8%)
Beating	0 (0.0%)	3 (4.2%)	8 (12.1%)	27 (28.7%)
Fainting	0 (0.0%)	1 (1.4%)	7 (10.6%)	14 (14.9%)
Hitting with	2 (2.4%)	3 (4.2%)	2 (3.0%)	5 (5.3%)
Another reason	2 (2.4%)	2 (2.8%)	0 (0.0%)	2 (2.1%)
Bitten by a dog	0 (0.0%)	1 (1.4%)	2 (3.0%)	2 (2.1%)
Diving	0 (0.0%)	1 (1.4%)	2 (3.0%)	2 (2.1%)
Total	84 (100%)	71 (100%)	66 (100%)	94 (100%)
Chi-quarter test: χ^2=79,08; df=24; p<0.0001				
Fall from height	Age group			
	I	II	III	IV
Fall off a bike	6 (20.7%)	1 (4.8%)	11 (61.1%)	9 (52.9%)
Falling down the stairs	9 (31.0%)	6 (28.6%)	4 (22.2%)	5 (29.4%)
Fall off the swing	6 (20.7%)	8 (38.1%)	0 (0.0%)	0 (0.0%)
Fall off the motorbike/quad	2 (6.9%)	2 (9.5%)	3 (16.7%)	3 (17.6%)
Fall off the chair	4 (13.8%)	2 (9.5%)	0 (0.0%)	0 (0.0%)
Fall off bunk bed	0 (0.0%)	1 (4.8%)	0 (0.0%)	0 (0.0%)
Fall off a different place	2 (6.9%)	1 (4.8%)	0 (0.0%)	0 (0.0%)
Total	29 (100%)	21 (100%)	18 (100%)	17 (100%)
Chi-quarter test: χ^2=36,94; df=18; p=0.0053				

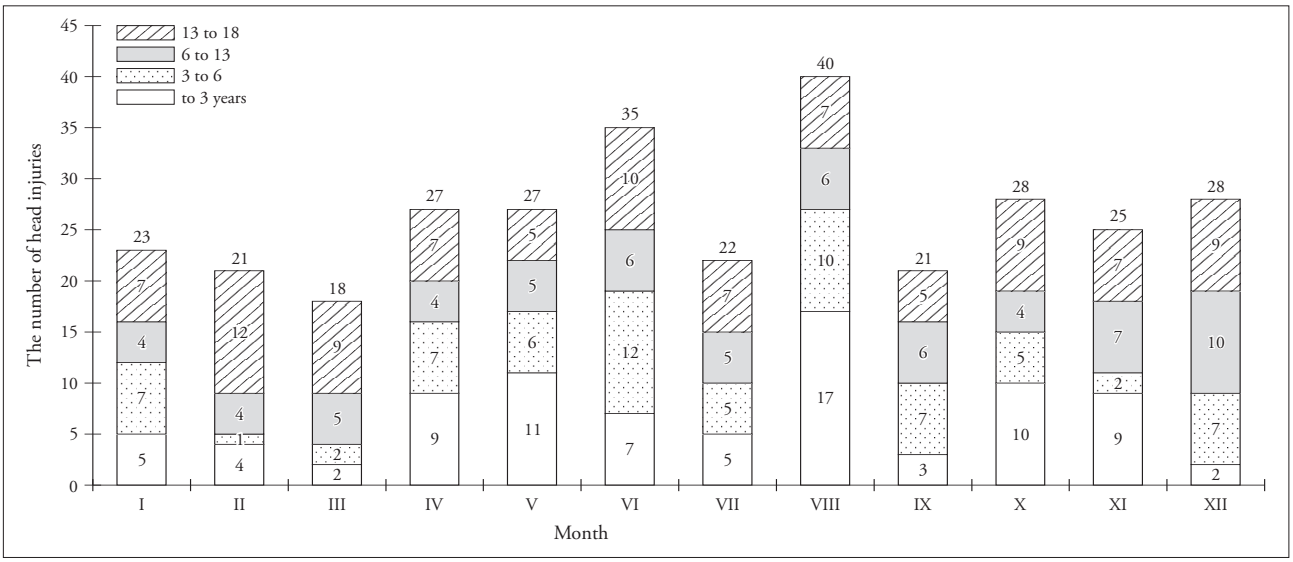

Fig. 3. The number of injuries depending on the season

amounts for 97 which is 30.8% of all injuries. There was no statistically significant correlation between the season and age of the child with head injury (χ^2=45.14; df=33; p=0.077).

In most cases there were head injuries with damage to epicranium and indeed it much more often happened to children under 6 years of age.

The frequency of skull x-rays increased with age. The differences were statistically significant (p<0.0001).

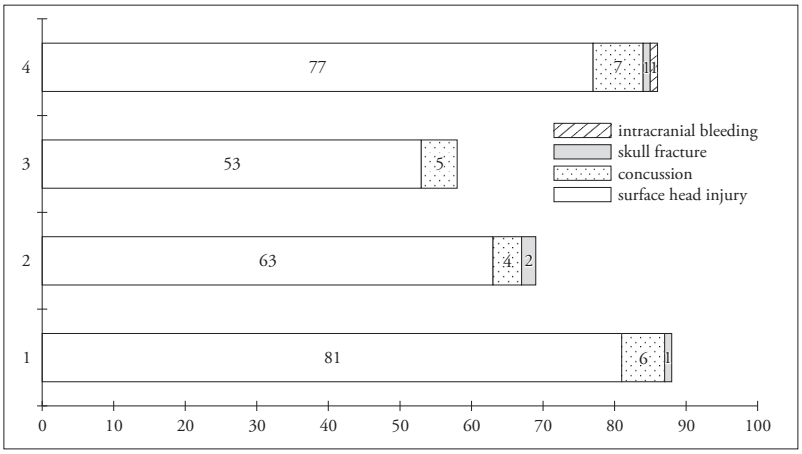

Fig. 4. The number of head injuries according to the diagnosis

Table 4. The number (percentage) of injuries in groups differing in age and diagnosis, type of the injury and diagnosis

Head injuries	Age group			
	I	II	III	IV
Surface head injury	82 (97.62%)	65 (91.55%)	62 (93.94%)	85 (90.43%)
Concussion	1 (1.19%)	3 (4.23%)	4 (6.06%)	7 (7.45%)
Fracture of skull	1 (1.19%)	2 (2.82%)	0 (0.00%)	1 (1.06%)
Intracranial bleeding	0 (0.00%)	0 (0.00%)	0 (0.00%)	1 (1.06%)
Intracranial injury	0 (0.00%)	1 (1.41%)	0 (0.00%)	0 (0.00%)
Total	84 (100.00%)	71 (100.00%)	66 (100.00%)	94 (100.00%)
Type of injury	Age group			
	I	II	III	IV
Without damage to epicranium	18 (21.4%)	18 (25.4%)	24 (42.9%)	35 (40.7%)
With damage to epicranium	66 (78.6%)	53 (74.6%)	32 (57.1%)	51 (59.3%)
Total	84 (100%)	71 (100%)	56 (100%)	86 (100%)
Chi-quarter test: χ^2=11.78; df=3; p=0.0082				
Diagnostics	Age group			Test χ^2
	I n=84	II n=71	III n=66	IV n=94	
Skull x-ray	32 (38.1%)	35 (49.3%)	38 (57.6%)	72 (76.6%)	p<0.0001
CT of the head	0 (0.0%)	1 (1.4%)	1 (1.5%)	4 (4.3%)	p=0.2072

Table 5. The number of children (percentage) in age groups including further proceeding

	Age group				Test χ^2
	I n=84	II n=71	III n=66	IV n=94	
The child discharged from Hospital Emergency Ward home directly after first aid	50 (59.5%)	44 (62.0%)	44 (66.7%)	61 (64.9%)	p=0.8035
The child discharged home after observation at Hospital Emergency Ward	2 (2.4%)	8 (11.3%)	12 (18.2%)	16 (17.0%)	p=0.0075
The child discharged home at parent's request without a permission to be observed	7 (8.3%)	5 (7.0%)	1 (1.5%)	6 (6.4%)	p=0.3464
The child sent to the Child Surgical Ward in Wrocław	25 (29.8%)	14 (19.7%)	9 (13.6%)	5 (5.3%)	p=0.0002
The child sent to the Surgical, Trauma and Orthopaedic Ward in Trzebnica	0 (0.0%)	0 (0.0%)	0 (0.0%)	5 (5.3%)	p=0.0076
The child sent to the Neurosurgical Ward	0 (0.0%)	0 (0.0%)	0 (0.0%)	1 (1.1%)	p=0.5014

There has been observed a statistically significant correlation between the child's age and:

- discharge from hospital after observation at the Hospital Emergency Ward (significantly fewer cases in group age I),
- sending to the Child Surgical Ward in Wrocław (significantly fewer in group IV),
- sending to the Surgical, Trauma and Orthopaedic Ward inTrzebnica (only older children — group IV), (Table 5).

The remaining analysed cases do not depend on the child's age (p>0.05).

Discussion

The authors of articles regarding head injuries draw attention to the factors contributing to head injuries as well as to the need to take preventive measures [3,5,6]. The results of our research are consistent with the data from medical publications. According to literature head injuries are mostly mild, constituting approximately 95% [3,6]. In 2010 315 children reported to the Hospital Emergency Ward in Trzebnica after a head injury. In 93.3% of cases they regarded surface injuries, and in approximately 4.8% of cases concussion; fracture of the skull occurred in 1.27% of cases, whereas intracranial bleeding and other intracranial injuries accounted for 0.36%. In the population studied, most accidents regarded damage to epicranium whern surgical repair of the injury was required, similar results were obtained in other publications.

Traditionally, the children with head injuries underwent radiological examinations. Today, it is still a routine examination at numerous wards in our country regardless of the degree of seriousness of the injury [7]. In the medical literature computed tomography performance is recommended (CT) [8], however in our research regarding children with head injuries, in most cases (63%) the children were discharged home after the injury had been dressed at (HEW) and they did not require such a diagnostics or were sent to a specialist pediatric surgery ward where they were further diagnosed. The 12% remaining were discharged after observation at HEW (Hospital Emergency Ward). There have been 6% of cases when parents at their own request discharged the child without the permission for observation. Fifty-three children were sent to the Pediatric Surgery Ward in Wrocław. One child (15 years old) was sent to the neurosurgical ward with a serious skull-brain injury. Only 5 (1.6%) children were sent to the orthopedic — trauma surgery ward in Trzebnica — this refers only to children from group IV (13–18 year olds) which is related to the biological age, they were patients aged 15–18. 38 (12.06%) children were discharged home after a few-hour observation at HEW with recommendation for further observation at home. The material analysed regards HEW and the early posttraumatic period, a few hours after reporting at HEW, therefore the observation of the child has to be continued at home.

The authors of articles on head injuries draw attention to the head injury factors as well as to the need of taking preventive measures [9]. The factors anlysed in

the article are compliant with world publications, only few differences have been observed.

Male gender favours head injuries, in the material analysed it was 62.5% of cases, however, with younger children in the age group 0–3 and 3–6 the difference is slight whereas in the group of girls aged 13–18 head injuries are decreased considerably.

According to medical publications children living in cities more often suffer from head injuries and accidents more often occur there [10]. In the material analysed, children living in the country more often suffer from head injuries (54.3%) and it is there that accidents more frequently take place (53.3%). It may result from the fact that Trzebnica Municipality, the citizens of which (80 thousand) are the majority of HEW patients, is a municipality located in the rural area, there are only four small towns and one with the population exceeding 10 thousand people. If the research is carried out in big cities, the urban population is in majority.

The events resulting in the child's injury took place mostly at the playground (35.2%), at home (34.0%) and at school (16.2%), most rarely in the kindergarten (1.9%). Injuries with children under 6 most often take place at home, children aged 6–13 suffer from injuries mostly at playgrounds whereas with older children (according to Kalińska-Lipert, Osemlak and partners, 2005) road accidents are the main reason (41%), next the accident happening at home and playground (17.2%) [10]. This might mean that safety on roads regarding children has improved considerably, due to the obligatory use of car sits and belt fastening, also more and more frequently protective helmets are used by cyclists.

The reason for accidents resulting in child's head injury were mostly falls from height (27.0%), falls on one the same level (24.4%) and hitting an object (21.6%). However, the reason for the accident is significantly conditioned on the child's age ($p<0.0001$). The most frequent reason for head injuries in children under 13 years of age was a fall from height (30.8%) or on the same level (28.5%).

Vast majority of accidents resulting in the head injury took place during the day between 15 and 22 — 53.3%, and between 7 and 15 — 43.2%. Children aged from 13 to 18 were more often injured (55.3%) from 7 to 15, whereas younger children in the period from 15 to 22 (59.3%).

Most injuries take place in summer (June, July, August) and amount for 97, which is 30.8% of all injuries. There was no statistically significant correlation observed between the season and age of the child with the head injury.

Conclusions

1. Head injuries are mainly connected with age. In terms of quantity, they most often take place in the youngest group aged from 0 to 3 as well as in the group aged 13 to 18 years of age.
2. Head injury factors are related to age. With small children the reason being falls from height and falls on the same level.
3. The youngest children suffer from surface head injuries (significantly more common with the youngest children). The hard skull-brain injury occurred in the group aged from 3 to 6 as well as above 13 years of age.
4. There has been observed an increase of the number of head injuries in the holiday season: June, July, August.
5. There is a need to educate adults, particularly parents, in the matter of the safety of their wards and proceeding in the case of head injuries in children.

Implications for Nursing Practice

The paper describes issues related to epidemiology of skull-brain injuries in children covered by the Hospital Emergency Ward in Trzebnica. The knowledge of factors contributing to the occurrence of skull-brain injuries with children, as well as diagnostic-therapeutic proceeding with the pediatric patient reporting to the Hospital Emergency Ward in Trzebnica is an important element of the nursing practice. The educational function of the nurse addressed to parents and regarding the period after head injuries is also important.

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Conflict of Interest: None
Funding: None
Author Contributions: Dorota Radlica[A, B, C, D, E], Sylwia Krzemińska[A, C, E, G H], Adriana Borodzicz-Cedro[B, D, F], Marta Arendarczyk[B, F]
(A — Concept and design of research, B — Collection and/or compilation of data, C — Analysis and interpretation of data, D — Statistical Analysis, E — Writing an article, F — Search of the literature, G — Critical article analysis, H — Approval of the final version of the article)
Received: 23.05.2014
Accepted: 26.06.2014