Cukierman Bartosz, Gołaszewka Kinga, Matuszczak Ewa, Guszczyn Tomasz, Frankowski Paweł, Maksimowicz Michał, Kwiatkowski Michał, Kwiatkowska Ewelina, Komarowska Marta. Epidemiology of forearm fractures in the population of children and adolescents current data from Podlaskie voivodeship, Poland. Journal of Education, Health and Sport. 2018;8(12):777-784. eISNN 2391-8306. DOI http://dx.doi.org/10.5281/zenodo.2529684
http://ojs.ukw.edu.pl/index.php/johs/article/view/6436
https://pbn.nauka.gov.pl/sedno-webapp/works/894857

The journal has had 7 points in Ministry of Science and Higher Education parametric evaluation. Part B item 1223 (26/01/2017).
1223 Journal of Education, Health and Sport eISSN 2391-8306 7

The authors declare that there is no conflict of interests regarding the publication of this paper.

Received: 02.12.2018. Revised: 20.12.2018. Accepted: 29.12.2018.

Epidemiology of forearm fractures in the population of children and adolescents current data from Podlaskie voivodeship, Poland

Bartosz Cukierman
Deptartament of Pediatric Orthopaedic and Trauma Surgery, The Medical University of Bialystok Children's, Clinical Hospital of L. Zamenhof, Poland.
https://orcid.org/0000-0002-5766-7389; bartoszcukierman@gmail.com

Kinga Gołaszewka
A student of the sixth year of the medical department, Medical University of Bialystok, Poland.
https://orcid.org/0000-0001-8685-5023; kin.golaszewska@gmail.com

Ewa Matuszczak
Deptartament of Pediatric Surgery and Urology, The Medical University of Bialystok Children's, Clinical Hospital of L. Zamenhof, Poland.
https://orcid.org/0000-0003-2425-9589; ewamat@tlen.pl

Tomasz Guszczyn
Deptartament of Pediatric Orthopaedic and Trauma Surgery, The Medical University of Bialystok Children's, Clinical Hospital of L. Zamenhof, Poland.
https://orcid.org/0000-0002-8911-9643; Tombial@mp.pl

Paweł Frankowski
Deptartament of Pediatric Orthopaedic and Trauma Surgery, The Medical University of Bialystok Children's, Clinical Hospital of L. Zamenhof, Poland.
https://orcid.org/0000-0001-7967-5809; pfrankowski91@gmail.com

Michał Maksimowicz
Deptartament of Pediatric Orthopaedic and Trauma Surgery, The Medical University of Bialystok Children's, Clinical Hospital of L. Zamenhof, Poland.
https://orcid.org/0000-0003-3168-2705; michal-maksimiwicz@wp.pl

Michał Kwiatkowski
Deptartament of Pediatric Orthopaedic and Trauma Surgery, The Medical University of Bialystok Children's, Clinical Hospital of L. Zamenhof, Poland.
https://orcid.org/0000-0003-0891-2402; michalkwiatkowski@bialan.pl

Ewelina Kwiatkowska
Deptartament of radiology, The Medical University of Bialystok, Clinical Hospital, Poland.
https://orcid.org/0000-0002-4576-0236; kwiatkowskaewelina1@gmail.com

Marta Komarowska
Deptartament of Pediatric Surgery and Urology, The Medical University of Bialystok Children's, Clinical Hospital of L. Zamenhof, Poland.
https://orcid.org/0000-0002-9671-6542; m.komarowska@vp.pl

ABSTRACT

Background:

Bone fractures in children and adolescents are one of the most common reasons of the orthopedic visits in Poland. Therefore, they are an essential economical and clinical problem in that population. The most frequent is forearm fracture which comprises more than $^{1}/_{3}$ of occurring all fractures. In this work we would like to evaluate the epidemiology of these musculoskeletal injuries in group of young people (aged 0 to 18) in Bialystok and entire Podlaskie voivodeship, focusing specifically on the anatomical location of forearm.

Methods:

The study included population of children and adolescents at the age of 0 to 18 years old from Bialystok city and the entire Podlaskie voivodeship, based on medical records from Paediatric Clinical Hospital in Białystok. This work included period from 1st February 2016 to 31st November 2018. The analysis of the incidence we based on 7 groups of anatomical location of fracture of forearm.

Results:

The work recorded 1.806 new cases of isolated fractures of the forearm in patients up to the age of 18 years. The frequency of occurrence was 0,76/1000/year in general population and 4,38/1000/year in pre-working age population. Higher frequency of fractures has been observed among boys 63,1% whereas in girls only 36,9%. The average age of a child with forearm fracture was 9,74 y.o. The proportions of fractures depending on seasonality showed that the largest number of fractures occurred in the summer (39,9%) and successively: autumn (26,87%), spring (21,88%), winter (11,37%). The most common anatomical location of forearm fracture was the distal radius metaphysis which constituted 47,34% of all fractures and the rarest was isolated fracture of the ulna shaft (1,33%).

Conclusions:

Authors usuly focus in their work exclusively on the fractures of the distal epiphysis of the forearm.
We have evaluated all the fractures of the forearm. In the the published data, there are no clearly

documented reasons or etiopathogenetic conections with bone fragility in the first two decades of life. Further studies are needed to determine the exact causes and possibilities of their elimination or reduction as well as the minimization of consequences.

Keywords: Fractures in children; Forearm; Epidemiology

Introduction :

Musculoskeletal injuries are common and require careful clinical management thus they are an essential economical and clinical issue in population of polish children and youth. Out of all occurring fractures the most frequent are forearm fractures. Involving one or two bones they comprise more than 1/3 of all fractures in young population (from 0 to 18-years-old) [1-3]. Existing date do not explain increasing incidence of that kind of injury [1,4,5]. Treatment methods and the mechanisms of injuries differ between children and adults. Consideration of bone growth potential is the major difference in approach to the treatment of bone injuries in children. In this work, we would like to evaluate the epidemiology of those important fractures in children and adolescents in Bialystok city in Poland, focusing specifically on the anatomical location of forearm.

Study participants and methods:

In the study we included population at the age between 0 and 18 years from Podlaskie voivodeship, specifically Białystok city inhabitants. Our analysis covers period from 1st February 2016 to 31st November 2018. Oficial government data said that our region has 1.186.625 inhabitants in total, including 218.769 those in pre-working age (XII, 2016). Analysed data is based on medical records from Pediatric Clinical Hospital in Białystok. which is the only paediatric hospital in Podlaskie region. All children aged from 0 to 18-years-old from the given region are being treated in Paediatric Hospital in Bialystok. The electronic medical records cover following data: gender, age of a child at the moment of an injury, seasonality of forearm fracture and also fracture location .

The following breakdown of fractures depending on the location were used in the analysis: fracture of the Proximal Epiphysis of the Radius (PR), fracture on the basis of the Proximal Ulna (PU), diaphyseal fracture of the Radius (CR), fracture of the shaft of the Ulna (CU), fracture of the Distal Radius (DR), vertebral fracture of both bones of the forearm (CRU) . We assessed anatomical location in relation to gender and age. Only fractures which were clinically documented and confirmed by radiogram (or in some specific cases confirmed by CT) have been taken into consideration. The specific classification of children forearm fractures such as a 'torus fracture', 'Monteggia fracture', well known 'greenstick fracture' etc. weren’t taken into consideration as they are covered by the division into seven groups listed above.

Amount of all type of fractures	
Fracture of rib(s), sternum and thoracic spine (S22)	**49**
Fracture of lumbar spine and pelvis (S32)	**143**
Fracture of shoulder and upper arm (S42)	**2044**
Fracture of forearm (S52)	**3647**
Fracture at wrist and hand level (S62)	**1496**
Fracture of femur (S72)	**182**
Fracture of lower leg, including ankle (S82)	**1096**
Fracture of foot, except ankle (S92)	**645**
Total amount	**9302**

Tab. 1. Amount of all type of fractures.

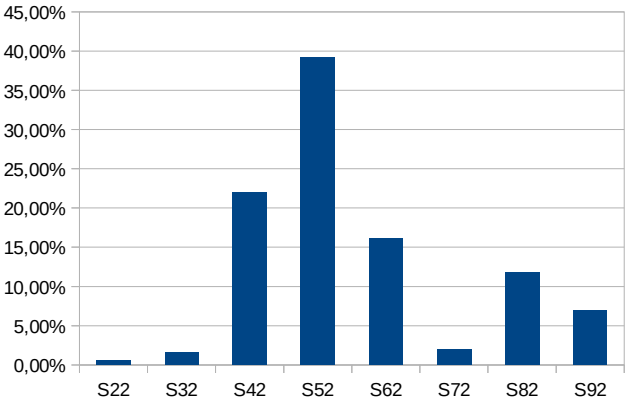


Fig. 1. All tape of fractures (%)

Results:

The study included population of children aged 0 to 18-years-old from Bialystok and the entire Podlaskie voivodeship in period from 1st February 2016 to 31st November 2018. The study recorded 1.806 (0,83% of all 0-18 y.o. Population) new episodes of isolated fractures of the forearm in patients up to the age of 18 years old. The frequency such injuries was 0,76/1000/year in general population and 4,38/1000/year in pre-working age population. 1806 cases was 39,21% of all fractures treated in our hospital (Tab.1 and Fig.1.) The higher frequency of fractures occurred in boys (63,1%) compared to girls (36,9%). The average age of a child with forearm fracture is 9,74 y.o.. For girls 9,01 y.o., and boys 10,17 y.o.. The largest number of fractures occurred in summer (39,9%), in the remaining seasons the incidence of fractures was: winter (11,4%), spring (26,8%), autumn (21,9%). The most common anatomical location of forearm fracture was the the distal radius metaphysis which constituted 47,34% of all fractures and the rarest was isolated fracture of the ulna shaft (1,33%) in frequency. The distribution in gender and anatomical location of forearm fractures shows Table 2.

Anatomical Location of Forearm Fracture	N = 1138 Boys	N = 668 Girls	N = 1806 Total Amount of Fractures
the Base of the Proximal Ulna (PU)	**1,27%**	**0,89%**	**2,16%**
the Proximal Epiphysis of the Radius (PR)	**2,21%**	**1,72%**	**3.93%**
the Shaft of the Ulna (CU)	**0,94%**	**0,39%**	**1,33%**
Diaphyseal of the Radius (CR)	**1,33%**	**0,78%**	**2.11%**
Both Bones of the Forearm (CRU)	**12,51%**	**5,76%**	**18,27%**
the Distal Radius (DR)	**28,85%**	**18,49%**	**47,34%**
the Distal Epiphysis of the Ulna and Radius (DRU)	**8,80%**	**4,71%**	**13,51%**
Total	**63,01%**	**36,99%**	**100,00%**

Tab. 2. The distribution of forearm fractures.

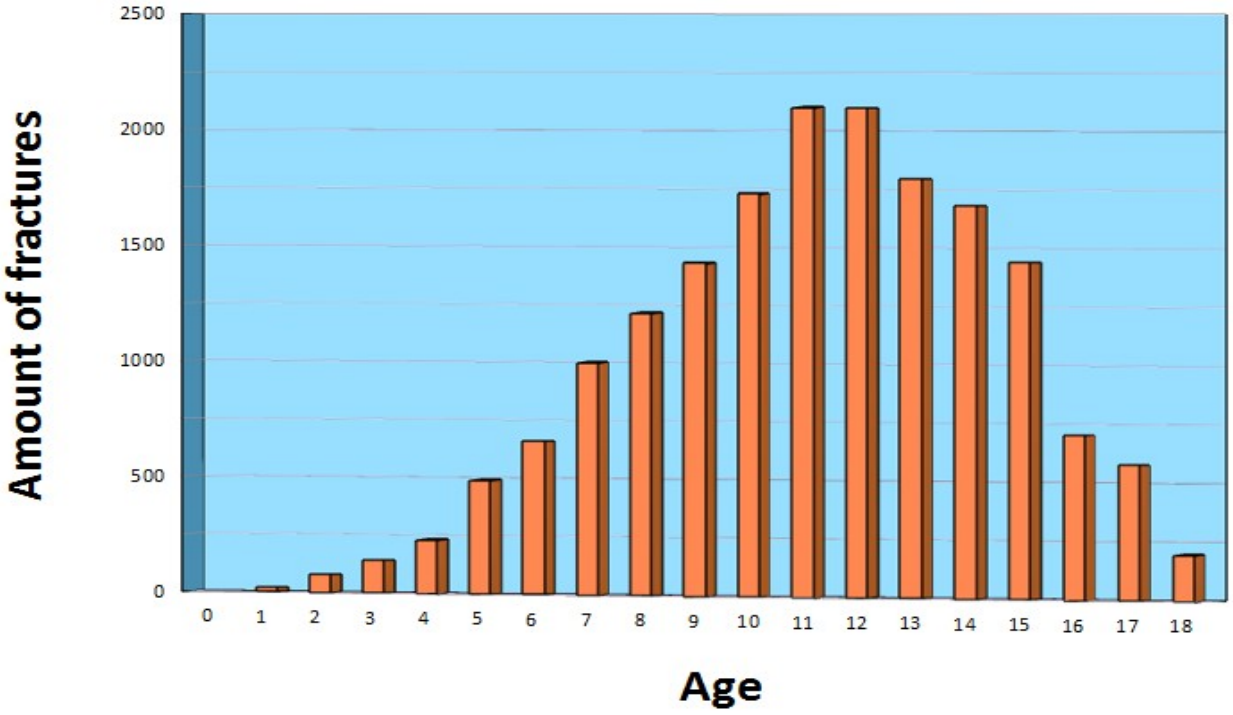
Discussion:

The analysis of the incidence forearm

fractures we based on medical records from Pediatric Clinical Hospital in Białystok which is the only paediatric hospital in the voivodeship. Bialystok is the largest city in north-eastern Poland and the capital of the Podlaskie Voivodeship. Białystok population was 296.628 inhabitants in the end of 2016. The Podlaskie Voivodeship is located at north-eastern region of Poland was inhabited by 1.186.625 at the end of 2016. Białystok is tenth in terms of population, second in population density and 13th position in area in the country.

For our study we have taken into consideration the actual data based only on fractures which were clinically documented and radiologically confirmed. The epidemiological data of Bialystok and north-eastern Polish region population confirm the predominance of forearm fractures in male children and youth. The largest number of forearm fractures in children and adolescents concerns boys - 63,1% of all forearm fractures in data. Other researchers have similar values [12]. The most common anatomical location of forearm fracture was the distal radius metaphysis which constituted 47,34% of all fractures and the rarest was isolated fracture of the ulna shaft (1,33%). The incidence of the forearm fractures goes up over the age of 2 years,

Fig. 2. Average age of fracture (y.o.).



which is associated with the increasing physical activity, the peak of the forearm fractures falls to the period of maturation (Fig. 2). We can observe increasing trend of the forearm fractures in the study age group [2,4,8,9,13,14].

The proportions of most common fractures in childhood depending on seasonality showed that the largest number of fractures occurred in the summer (39,9%). This could be connected with deficiency of vitamin D, higher activity during day and better weather condition in longer term of day in summer. Vitamin D is important for the maintenance of bone health. Low vitamin D levels cause a decrease bone mineral content. The skin production of vitamin D3 in Polish climate is possible from May to

Fig. 2. Average age of fracture (y.o.).

September and only from 10:00 a.m to 15:00

p.m. Therefore, in the remaining months we can observe deficiency of active metabolites of vitamin D. This combined with reduced physical activity form autumn until spring which can result in the reduced mineral density of bones (Bone Mineral Density; BMD) and thus higher risk of fractures [10-15,18].
We can finde researchers that suggest the problems with the osteoarticular system in adulthood are associated with the abnormal accumulation of bone mass during the growth and the positive history of fractures in childhood [11,16,19,20].

Poland lies in the zone of humid continental climate. This climate is also described as a transitional between warm and rainy temperate climate, and a snow-forest boreal climate. Polar, marine and polar-continental air masses have the biggest impact on the climate of Poland, determining it's transitional character. Arctic air masses flow over Poland in winter bringing the weather frosty and sunny, sometimes with heavy snowfall, in spring bringing short-term April-May (often with frost) cooling, so-called cold gardeners. The spring, which extends from March and June, arrives solely in transient weather with a lot of cold, rainy days. Summer - from June to August is characterised by dry sunny weather with thunderstorms. In the early Autumn we have still sunny weather till the period of colder, rainy even sometimes snowy weather in November. The astronomical winter starts 22th December. Winter characterize humid weather with periods of snowstorms and temperature about -20ºC. In last years we observed the shorter and warmer winters than before.
Also, our personal observation suggest that seasonality of the forearm fractures depends on physical activity of our patients. Sunny and warm months allowed them for more risky kind of activity like: football, skateboarding, horse riding ect. More of that we can say that in sunny days (more common in spring and summer) can notice more forearms fracture cases in our hospital.

The analysis indicates that damage to the forearm in boys occurred later in average age of 10,17; while in girls 9,01

The analysis of gender and fracture location is shown in tab. 3

SEX (B – Boys, G – Girls)	Incidence of Fractures Observed in the Anatomical Location							
	PU	PR	CU	CR	CRU	DR	DRU	Total Amount
B	58,97%	56,34%	70,83%	63,16%	68,48%	60,94%	65,16%	1138
G	41,03%	43,66%	29,17%	36,84%	31,52%	39,06%	34,84%	668

Tab. 3. Incidence of Fractures Observed in the Anatomical Location

We distinguish that there is no existence of the special pattern for the anatomical localization of fracture. Boys always present highest number of cases of all kind of fractures [2,5,13,21-23]. We connect that with tendency to more risky activities.

The results are also consistent and indicate the peak incidence of fractures of forearm reaching a maximum at about 11 years. Later for boys and earlier for girls [27].

The epidemiology of fractures in children and adolescents has been the subject of numerous studies. In the published data, there are no obvious reasons or etiopathogenetic links to the bone fragility in the first two decades of life.
However that wasn't goal of that analysis we can say that, fractures in children and adolescents are result of many coexisting factors such as race, age, sex (predominance of boys), biogeographic conditions some physiological and environmental factors, lifestyle or even familial and genetic factors.
A clear cause of fractures in low-energy trauma has not yet been established [24-26].The forearm fractures caused by the direct trauma are often related to the hormonal changes during puberty.

In the light of data shown above, forearm fractures are serious health and economic issue because number of cases.

Further research is necessary to determine the exact causes and possibility of their elimination or reduction of their impact to the general health of population and cost of the health service. It should be strongly emphasized that the causes of fractures are multifactorial and the efforts aimed to improve motion safety, in particular cautious behaviours, are so far the most important.

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