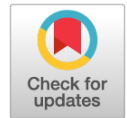


DOI: <https://doi.org/10.17816/PTORS159389>

Journal Article



Trauma rates in children in Saint Petersburg and inpatient trauma care

Alexey G. Baidurashvili, Sergei V. Vissarionov, Anna V. Zaletina, Yuri A. Lapkin, Elena N. Schepina

H. Turner National Medical Research Center for Children's Orthopedics and Trauma Surgery, Saint Petersburg, Russia

BACKGROUND: Increasing rates of childhood trauma, poisoning, and sequelae of environmental exposure not only reduce the quality of life of children and their families but also lead to disability and death. Statistical analysis of childhood trauma data makes it possible to define risk age groups among children and adolescents, identify the causes of the decrease or increase in the rates, estimate the level of medical care, and make necessary management decisions.

AIM: To assess the state of childhood trauma in St. Petersburg and its changes in 5 years (2016–2020) and the provision of inpatient trauma care.

MATERIALS AND METHODS: Data on childhood trauma in St. Petersburg were analyzed based on the analysis of Federal statistical observation forms submitted by the St. Petersburg State Budgetary Institution Medical Center for Information and Analysis, collections of N.N. Priorov National Medical Research Center for Traumatology and Orthopedics of the Ministry of Health of the Russian Federation 'Trauma, orthopedic morbidity, the state of trauma and orthopedic care for the population,' edited by Acad. S.P. Mironov, RAS, and data from the Federal State Statistics Service.

RESULTS: From 2016 to 2019, the frequency of trauma, poisoning, and sequelae of environmental exposure in children of St. Petersburg slightly increased. In 2020, owing to the COVID-19 pandemic, childhood trauma rates decreased, and the most significant decrease in trauma rates was recorded at 32%–36% in adolescents aged 15–17 years. Despite the overall decrease in childhood trauma in 2020, the structure of trauma due to environmental exposure revealed an 81% increase in transport accidents, compared with previous years, and a 39% increase in trauma due to injuries with undetermined intentions. For 5 years, the number of beds was reduced, and by 2020, the provision of trauma, and orthopedic beds for children in St. Petersburg was 1.4 beds per 10 thousand children, which corresponds to the data for Russia.

CONCLUSIONS: The incidence of traumatic injuries slightly increased in children in St. Petersburg, mostly in children aged 0–4 years, and mortality from environmental exposure also increased in adolescence. A correlation was found between the COVID-19 pandemic and a decrease in the number of visits and hospital admissions of children with trauma to medical institutions. Moreover, the incidence of severe, high-energy injuries that require more serious treatment approaches also increased, as evidenced by the annual increase in the number of surgical interventions in children with traumatic injuries. The new form of statistical reporting does not allow us to determine all causes of trauma. The provision of trauma care for children in St. Petersburg remains at an appropriate level.

Keywords: trauma; statistical rates; children.

To cite this article:

Baidurashvili AG, Vissarionov SV, Zaletina AV, Lapkin YuA, Schepina EN. Trauma rates in children in Saint Petersburg and inpatient trauma care. *Pediatric Traumatology, Orthopaedics and Reconstructive Surgery*. 2023;11(2):173–183. DOI: <https://doi.org/10.17816/PTORS159389>

Received: 30.01.2023

Accepted: 20.04.2023

Published: 30.06.2023



УДК 614.8-082.4-053.2(083.41)(470.23)
DOI: <https://doi.org/10.17816/PTORS159389>

Научная статья

Показатели травматизма у детей Санкт-Петербурга и оказание стационарной травматологической помощи

А.Г. Баиндурашвили, С.В. Виссарионов, А.В. Залетина, Ю.А. Лапкин, Е.Н. Щепина

Национальный медицинский исследовательский центр детской травматологии и ортопедии имени Г.И. Турнера, Санкт-Петербург, Россия

Обоснование. Рост показателей травм у детей, отравлений и последствий воздействия внешних причин не просто снижает качество жизни ребенка и семьи в целом, но и приводит к инвалидности и смерти. Анализ статистических данных детского травматизма позволяет выделить возрастные группы риска детей и подростков, уточнить причины снижения или увеличения показателей, оценить уровень оказания медицинской помощи и принять необходимые управленческие решения.

Цель — оценить состояние детского травматизма в Санкт-Петербурге и его динамику за 5 лет с 2016 по 2020 г. и оказание стационарной травматологической помощи.

Материалы и методы. Проанализированы данные травматизма у детей Санкт-Петербурга на основании анализа форм Федерального статистического наблюдения, представленных СПбГБУЗ «МИАЦ», сборников ФГБУ «НМИЦ ТО имени Н.Н. Приорова» Минздрава России «Травматизм, ортопедическая заболеваемость, состояние травматолого-ортопедической помощи населению» под редакцией акад. РАН С.П. Миронова и данных Федеральной службы государственной статистики.

Результаты. На протяжении 4 лет с 2016 по 2019 г. у детей в Санкт-Петербурге наблюдался незначительный рост частоты травм, отравлений и последствий воздействия внешних причин. В 2020 г. на фоне пандемии новой коронавирусной инфекции (COVID-19) показатели детского травматизма уменьшились, наиболее существенное снижение частоты травматизма на 32–36 % зафиксировано у подростков 15–17 лет. Несмотря на общее уменьшение случаев детского травматизма в 2020 г., в структуре травм по внешним причинам выявлены рост транспортных несчастных случаев на 81 % в сравнении с предыдущими годами; рост на 39 % травм вследствие повреждений с неопределенными намерениями. В течение 5 лет наблюдалось сокращение коечного фонда, и к 2020 г. обеспеченность травматолого-ортопедическими койками детского населения Санкт-Петербурга составила 1,4 койки на 10 тыс. детей и соответствует данным по России в целом.

Заключение. Зарегистрирован небольшой рост травматизма у детей Санкт-Петербурга, в основном в возрасте от 0 до 4 лет, а также увеличение смертности вследствие воздействия внешних причин в подростковом возрасте. Выявлена связь между вспышкой COVID-19 и уменьшением числа обращений и госпитализаций детей с травмами в медицинские учреждения города. Отмечен рост тяжелых, высокоэнергетических травм, которые требуют более серьезных подходов к лечению, что подтверждается ежегодным увеличением количества хирургических вмешательств у детей с травматическими повреждениями. Новая форма статистической отчетности не позволяет выяснить все причины возникновения травм. Оказание травматологической помощи детям в Санкт-Петербурге остается на должном уровне.

Ключевые слова: травматизм; статистические показатели; дети.

Как цитировать:

Баиндурашвили А.Г., Виссарионов С.В., Залетина А.В., Лапкин Ю.А., Щепина Е.Н. Показатели травматизма у детей Санкт-Петербурга и оказание стационарной травматологической помощи // Ортопедия, травматология и восстановительная хирургия детского возраста. 2023. Т. 11. № 2. С. 173–183. DOI: <https://doi.org/10.17816/PTORS159389>

BACKGROUND

The health of the pediatric population is best represented by indicators of childhood injuries, childhood disability, and mortality due to injuries [1, 2], which characterize the quality of child care in the family, depending on generally accepted ethical standards of behavior in public places, on the street, and at school, reflecting cases of aggression and violence in the relationship between adults and children, as well as in children's groups. These indicators may reveal the availability and quality of medical care and the efficiency of preventive measures [3–7]. Injuries are often the cause of preterm death, and more than 2,000 children and adolescents worldwide die every day from unintentional injuries [8, 9]. The level of disability as a result of injuries is an important medical and social problem [10–12].

Annually, more than 3 million children in the Russian Federation sustain various injuries. In recent years, the rate of childhood injuries ranges from 100% to 117%.

St. Petersburg is the northernmost and westernmost city with an area of 1439 sq. km and a population of 5,398,064 people (2020), of which 17.5% are children. Its population density is 3751.3 people per sq. km, making it the second among the most densely populated cities in Russia. Over the past 5 years, the pediatric population of St. Petersburg has increased by 125,060 people and reached 947,039 in 2020, including 824,467 children aged 0–14 years (715,923 people in 2016) and 122,572 adolescents aged 15–17 years (106,056 people in 2016) with an equal increase in age groups relative to their initial data.

Intensive traffic, use of rental electric vehicles, and tourists visiting the cultural capital (an average of 8.5 million people annually) lead to increased injury rates, including among children. Studies have shown that the structure and rates of injury in terms of the nature of damage in children in St. Petersburg are significantly higher than those reported nationwide. Most probably, this situation is attributed to the high level of urbanization, overall health of children living under low-insolation conditions, and cold and humid climate, compared with some other regions of the country [13]. The widespread use of electric vehicles (gyroscopes, unicycles, and electric scooters) as means of transportation, particularly in recent years, is an important factor influencing injury rates in children. Naturally, the absolute number of children with various injuries in the regions depends on the total pediatric population in a specific region; however, in addition to the degree of urbanization, the level and quality of diagnostics of injuries are of great importance [14].

The work aimed to assess the childhood injury rates in St. Petersburg, its dynamics over 5 years from 2016 to 2020, and provision of inpatient trauma care.

MATERIALS AND METHODS

Injury rate indicators among pediatric patients in St. Petersburg from 2016 to 2020 were analyzed according to the data of the Medical Center for Information and Analysis. The study used the collections of the N.N. Priorov National Medical Research Center of Traumatology and Orthopaedics of the Ministry of Health of Russia "Injuries, orthopedic morbidity, the state of traumatological and orthopedic care for the population," edited by Acad. RAS S.P. Mironov, which annually analyzes and publishes data on injuries in adults and children in the Russian Federation and for each region separately, as well as data from the Federal State Statistics Service (Rosstat).

In the analysis of the indicators of pediatric injuries in St. Petersburg in 2016–2020, the introduction of restrictive measures aimed at countering the spread of coronavirus infection must be considered. These measures were approved at the level of the federal and regional governments (Decrees of the President of the Russian Federation No. 206, 239, 294; Decree of the Government of St. Petersburg dated March 13, 2020, No. 121 "On measures to prevent the spread of coronavirus disease 2019 (COVID-19) in St. Petersburg" with amendments and additions). Since March 16, 2020, the government of St. Petersburg has been systematically taking measures to prevent the spread of COVID-19 and reduce the risk of infection among its population. Public events were banned, and intramural educational activities were forbidden, including sports training, visits to swimming pools, parks, squares, and gardens. In April 2020, visits to entertainment centers and outdoor playgrounds were banned, and citizens were recommended to stay at home [15].

RESULTS AND DISCUSSION

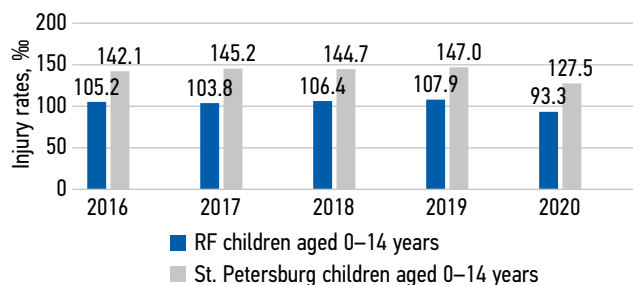
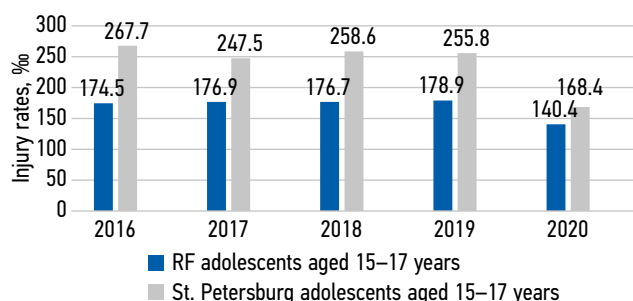
For 2016–2019 in St. Petersburg, according to the information in Statistical Form No. 12, the medical care-seeking rate of children with injuries, trauma, and sequelae of environmental exposure increased, except for 2020. Data on the incidence of injuries, poisoning, and sequelae of environmental exposure in children and adolescents are presented in Table 1.

As shown in Table 1, the largest increase in the level of injuries for 2016–2019 was noted in children aged 0–4 years, i.e., the age at which infants are most dependent on adults for care and nursing. In connection with the increase in injuries in this age group and the decrease in this indicator in 2020 (against the pandemic, when young children and their parents started to spend more time at home), a set of measures must be created, and more attention is needed to prevent and reduce injury rates in pediatric patients, particularly in preschool institutions.

Table 1. Incidence of injuries, poisoning, and sequelae of environmental exposure in children of different age groups for 2016–2020 in St. Petersburg

Years	2016	2017	2018	2019	2020
Aged 0–4 years					
<i>n</i>	24,689	26,434	28,642	29,043	26,105
Per 1 thousand (%)	78.27	79.83	85.82	87.76	80.89
Aged 0–14 years					
<i>n</i>	101,756	109,602	113,527	118,315	105,138
Per 1 thousand (%)	142.13	145.22	144.68	146.93	127.52
Aged 15–17 years					
<i>n</i>	28,394	26,903	29,559	30,395	20,652
Per 1 thousand (%)	267.73	247.55	258.56	255.80	168.4
Aged 0–17 years					
<i>n</i>	130,150	136,505	142,604	148,709	125,790
Per 1 thousand (%)	158.3	158.1	158.6	160.9	132.8

In older children, the injury rate during 2016–2019 did not change significantly, and in 2020, when training began not in school institutions, but remotely, sports clubs were closed, restrictions were imposed on the stay of children outdoors, and the number of traumatic injuries decreased significantly. These data are informative in adolescents aged 15–17 years. The incidence of injuries in these adolescents was nearly 1.5–2 times higher than that in children aged <14 years, but this tended to decrease. In this age group, boys suffer from injuries more often than girls (up to 57% of boys), which may be because boys are more mobile and less cautious than girls.

**Fig. 1.** Dynamics of the injuries in children aged 0–14 years in St. Petersburg and Russia in 2016–2020 (per 1000 population of corresponding age %)**Fig. 2.** Dynamics of the injury rates among adolescents aged 15–17 years in St. Petersburg and Russia in 2016–2020 (per 1000 population of corresponding age %)

For many years, the overall injury rates were the highest in pediatric patients in St. Petersburg compared with those of the Russian Federation.

In St. Petersburg, the highest rates of injuries were detected in the group aged 15–17 years; as a rule, this figure is >1.5 times higher than the national level. St. Petersburg ranks fifth among 22 constituent entities of the Russian Federation, where the injury rates among adolescents exceeded 200.0%. In our opinion, the high rates of pediatric injuries in St. Petersburg compared with similar values throughout Russia are attributed to heavy traffic, a sharp increase in the use of electric vehicles for transport, high availability of trauma and orthopedic care, and maximum population density. Data from a systematic review and meta-analysis of childhood injuries in China and Saudi Arabia from 2000 to 2020 also confirm a trend toward an increase in the number of injuries among children and adolescents with age and a higher risk of injury among boys compared with girls [16, 17]. Thus, work on the precaution and prevention of pediatric injuries must be intensified as much as possible. During the pandemic, when adolescents began to spend more time at home, the number of injuries they had significantly decreased by 32%–36%.

Table 2 presents data on the localization of injuries in pediatric patients in St. Petersburg for 2016–2020 (according to the form of the Federal Statistical Monitoring No. 57).

In accordance with pediatric injury data for 2016–2019, the incidence of neck injuries, chest injuries, thermal and chemical burns, and frostbite gradually decreased, and the incidence of other injuries, taking into account their localization, gradually increased. Every year, wrist and hand injuries (23%) rank first among the sequelae of environmental exposure, ankle and foot injuries (19%) rank second, and head injuries rank third (17%). According to the State Statistical Reporting of the Ministry of Health of

Table 2. Dynamics of the incidence of injuries, taking into account their localization, per 1000 children in St. Petersburg for 2016–2020

Indicator	2016	2017	2018	2019	2020
Injury rates of the pediatric population in the constituent entities of the Russian Federation for the reporting period	158.34	158.1	158.62	160.93	132.82
Head injuries (ICD codes S00–S09)	26.19	27.21	26.69	25.67	22.51
Neck injuries (ICD codes S10–S19)	2.8	2.5	2.33	2.02	1.85
Chest injury (ICD codes S20–S29)	5.94	5.41	5.0	4.87	3.78
Injuries to the abdomen, lower back, lumbar spine, and pelvis (ICD codes S30–S39)	5.91	5.82	4.87	5.64	3.55
Injuries of the shoulder girdle and brachii (ICD codes S40–S49)	9.14	8.2	7.47	8.58	7.23
Elbow and forearm injuries (ICD codes S50–S59)	17.41	16.9	17.51	17.21	15.21
Wrist and hand injuries (ICD codes S60–S69)	33.16	35.9	37.1	36.97	30.63
Injuries of the hip joint and thigh (ICD codes S70–S79)	3.17	2.9	2.82	2.85	2.15
Injuries of the knee and lower leg (ICD codes S80–S89)	17.35	16.63	16.51	16.99	13.3
Injuries of the ankle and foot (ICD codes S90–S99)	28.63	27.85	30.44	31.37	25.04
Injuries involving multiple areas of the body (ICD codes T00–T07)	0.15	0.3	0.35	0.39	0.34
Injury to an unspecified part of the trunk, limb, or body region (ICD codes T08–T14)	2.7	2.67	2.52	2.62	2.28
Consequences of penetration of a foreign body through natural ostia	1.2	1.23	1.24	1.45	0.96
Thermal and chemical burns (ICD codes T20–T32)	3.45	3.3	2.87	2.2	2.2
Frostbite	0.1	0.05	0.06	0.04	0.01
Other and unspecified environmental exposure	0.31	0.42	0.37	0.45	0.82
Consequences of injuries, poisoning, and other sequelae of environmental exposure	0.55	0.72	0.38	1.04	0.82

Table 3. Distribution of injuries in pediatric patients due to environmental exposure in St. Petersburg in 2016–2020

Environmental exposure-related morbidities in pediatric patients	2016	2017	2018	2019	2020
Total injuries	130,150	136,505	142,604	148,709	125,790
Including:					
Other environmental exposure, total	128,673	134,936	140,857	146,909	123,710
Including:					
• Attacks	489	529	566	697	533
• Damage with undetermined intent	385	437	513	528	538
• Traffic accidents	584	587	641	555	1005
• Others	19	16	27	20	4

Russia, if the location of injuries on the body in pediatric patients is considered, then the information obtained in this study for St. Petersburg in 2016–2020 indicates the predominance of upper limb injuries over injuries of the lower limbs and other parts of the body in pediatric patients, which coincides with similar indicators for Russia in general. When comparing the distribution of injuries in accordance with localization, the results agree with the findings of studies conducted in China, where upper

limb fractures rank first in pediatric patients and boys predominated over girls in childhood injuries [18].

In 2020, the incidence of all types of injuries decreased, which was due to the pandemic-related restrictions. Based on the data obtained, environmental exposure and circumstances of injuries in pediatric patients were analyzed (Table 3).

At present, estimating the distribution of injuries by type and nature of the damage is impossible because this

Table 4. Indicators of the work of children's specialized trauma 24-h beds in 2016–2020

Indicator	2016	2017	2018	2019	2020
Average number of beds per year	198	190	187	184	154
Patients admitted to the hospital	9645	9410	9016	8822	6348
Average bed-days	6.6	6.6	6.6	6.3	6.4
Bed turnover	48.8	49.4	49.4	48.7	43.0
Bed occupancy	322.8	325.5	322.8	308.2	276.1

Table 5. Distribution of surgical interventions on the musculoskeletal system in pediatric patients in 2016–2020

Type of surgery	2016	2017	2018	2019	2020
TOTAL* surgeries on the musculoskeletal system	18,645 (4140)	20,729 (4414)	22,618 (5222)	23,369 (5745)	21,812 (5442)
• Corrective osteotomies	1137	1245	999	1289	1600
• With pelvic bone injuries	3	0	7	14	4
• With peri- and intra-articular fractures	54	79	54	67	49
• On the spine	543	661	615	608	611
• With congenital dislocation of the hip	457	458	553	505	381
• Amputations and disarticulations	10	3	13	32	81
• Endoprosthesis	45	51	47	58	49
• On the chest wall	122	198	150	197	191

*Number of surgeries using advanced medical care is given in parentheses.

information is not provided in the forms of the Federal Statistical Monitoring. These forms contain information about the structure of pediatric injuries caused by environmental exposure. In injuries grouped by nature and corresponding environmental causes in children aged 0–17 years, the total number of injuries increased from 2016 to 2019, and in 2020, the incidence of injuries decreased by 15%, and transport accidents sharply increased by 81%. Every year, the number of injuries due to undetermined intentions increased in pediatric patients. The complication rates of therapeutic and surgical interventions are still high, except during the pandemic (2016, $n = 17$; 2017, $n = 16$; 2018, $n = 26$; 2019, $n = 18$; 2020, $n = 1$). Along with this, in 2020, only 8 poisoning events with pharmaceutical products, medicines, and biological substances were recorded, which was significantly less than those in previous periods (2016, $n = 17$; 2017, $n = 15$; 2018, $n = 17$; 2019, $n = 18$). In 5 years, disease rates caused by toxic substances decreased (2016, $n = 37$; 2017, $n = 8$; 2018, $n = 14$; 2019, $n = 4$; 2020, $n = 4$).

In St. Petersburg, inpatient trauma care for children is provided at seven medical organizations in the city, including federal centers. In 2020, an average of 154 trauma beds (versus 198 beds in 2016) was available, and by the end of the year, the number of beds was reduced to 135, which was 1.4 beds per 10,000 pediatric patients and was in line with overall Russian data. For more than 5 years, a hospital-replacing form of medical care has been used; annually, 6–8 day hospital beds in the city are used; thus, the workload exceeds 100%, except that during the pandemic in 2020, when

the provision of hospital-replacing care was discontinued. Most probably, the number of such beds should be increased.

Table 4 presents the operation of children's trauma beds in St. Petersburg for 2016–2020.

Along with a decrease in the number of hospitalized pediatric patients in trauma beds, the performance of medical institutions exhibited a downward trend, such as bed turnover and average annual bed occupancy. The decline was most pronounced during the pandemic in 2020. Thus, evaluating the hospital bed capacity at the end of the pandemic appears appropriate because whether the need for hospital beds will increase again could not be ruled out.

Data of the operational activities of St. Petersburg medical organizations in assisting pediatric patients with various musculoskeletal injuries and diseases were analyzed (Table 5).

The vast majority of musculoskeletal system surgeries (90%) were interventions that were not deciphered by official statistical documents. Despite the decreasing number of beds and patients who applied for inpatient trauma care, the total number of musculoskeletal system surgeries is increasing, including the use of advanced medical care. In 2020, the surgical work of organizations in St. Petersburg has slightly decreased. The number of surgeries for peri- and intra-articular fractures and for congenital dislocation of the hip notably decreased. Moreover, the number of corrective osteotomies, amputations, and exarticulations in children increased, whereas the number of surgeries on the spine and chest remained at the same level.

Table 6. Hospitalizations of pediatric patients with burns in St. Petersburg in 2016–2020

Indicators	2016	2017	2018	2019	2020
Total number of children admitted for inpatient treatment:	662	660	600	1326	1153
Including those aged <1 year	144	116	100	223	205
Average bed-days of patients with burns	9.96	9.46	10.05	5.47	4.71

Table 7. Number of pediatric patients with disabilities in St. Petersburg in 2016–2020

Indicators	2016	2017	2018	2019	2020
Total pediatric patients with disability	16,604	16,341	17,143	17,902	18,510
Children with newly diagnosed disabilities including:	1804	1980	1971	2007	1741
• Boys	1093	1178	1249	1289	1060
• Girls	711	802	722	788	681
Children with disability caused by injuries, poisoning, and some other sequelae of environmental exposure (according to ICD-10 codes S00–T98) in total including:	64	64	54	64	65
• Boys	40	38	30	33	37
• Girls	24	26	24	31	28

Pediatric patients with thermal and chemical burns should receive medical care. The majority of burns in children occur following exposure to hot liquids, and most pediatric patients admitted to a specialized hospital have superficial skin damage, which does not require surgical interventions to restore them [19].

Data on hospitalizations of pediatric patients with burns, taking into account their age, are presented in Table 6.

In 2019–2020, the number of hospitalizations of pediatric patients in burn beds increased, and the average duration of inpatient treatment was shortened. In our opinion, to improve the quality of treatment, it must be initiated early in a hospital setting in a cohort of patients with less severe burns.

Distribution of children with disability according to the primary disease that caused such a disability in 2016–2020, among injuries, poisoning, and some other sequelae of environmental exposure, based on the data of the Federal Statistical Monitoring Form No. 19, is presented in Table 7.

The number of all children with disability increased to 18,510 in 2020, and 61% of them were boys. Over the past 4 years, the number of children with a newly established disability has increased; however, in 2020, when the planned activities of the outpatient service were limited by the above-mentioned legal acts, the number of pediatric patients with a newly established disability decreased.

The number of children with disability in accordance with the International Classification of Diseases of the 10th revision (ICD-10) codes (S00–T98: injuries, poisoning, and some other sequelae of environmental exposure) did not change in

over 5 years, and there were more boys than girls. Children who had disability following injuries, poisoning, and some other sequelae of environmental exposure accounted for 0.35% of the total number of all pediatric patients with disability.

As regards pediatric mortality, injury rates rank second in terms of incidence, secondary to the causes of pediatric deaths from certain conditions in the perinatal period. A 5-year analysis of mortality in children aged 0–17 years from environmental exposure, according to the Medical Center for Information and Analysis of the St. Petersburg Health Committee, helped establish the main causes of death in children, namely, injuries with undetermined intent (Table 8).

Pediatric mortality rates per 100,000 pediatric populations in the group aged 0–14 years are significantly lower than those in adolescents aged 15–17 years in 2016–2020. In the analysis of the sex of children who died from environmental exposure, the number of boys was nearly two times higher than that of girls (a total of 379 children died, including 255 boys (67%) of the total number of children who died from environmental exposure). The rate of adolescent mortality from road traffic accidents and accidental non-alcoholic poisoning increased. Children aged 0–14 years die less often from environmental exposure, such as suicide, falls, and accidental suffocation. The opposite situation is noted in adolescents based on the increased mortality rate from environmental exposure, including suicide, transport injuries, non-alcoholic poisoning, and injuries with undetermined intentions.

Table 8. Pediatric mortality rates due to environmental exposure (absolute number/100,000 child population)

Causes of death	2016		2017		2018		2019		2020	
	0–14 years old	15–17 years old	0–14 years old	15–17 years old	0–14 years old	15–17 years old	0–14 years old	15–17 years old	0–14 years old	15–17 years old
Damage with undetermined intent	17/2.4	8/7.5	13/1.7	13/12	19/2.4	22/19.2	11/1.4	14/11.8	12/1.4	16/13
Accidental nonalcoholic poisoning	3/0.4	5/4.7	2/0.2	7/6.4	4/0.5	9/7.9	3/0.4	2/1.7	2/0.2	14/11.4
All traffic injuries	7/1	4/3.8	6/0.8	7/6.4	7/0.9	5/3.5	10/1.2	11/9.3	8/1	6/5
including traffic accidents	6/0.8	2/1.8	6/0.8	2/1.8	6/0.8	4/3.5	9/1.1	6/5	7/0.8	6/5
Accidental drowning	6/0.8	0/0	2/0.3	3/2.8	5/0.6	1/0.9	6/0.7	0/0	5/0.6	3/2.4
Falls	5/0.7	1/0.9	5/0.7	0/0	2/0.2	0/0	2/0.2	0/0	1/0.1	0/0
Accidental chokes	5/0.7	0/0	4/0.5	0/0	1/0.1	1/0.9	1/0.1	1/0.8	0/0	0/0
Suicide	2/0.3	1/0.9	2/0.3	2/1.8	1/0.1	5/4.4	1/0.1	7/5.9	0/0	3/2.4
External causes of death, total	48/6.7	24/22.6	36/4.8	34/31.3	45/5.7	44/38.5	36/4.5	35/29.5	32/3.9	45/36.7

If pediatric mortality from environmental exposure is considered in more detail in the groups aged 0–4 years and 5–14 years, then most of the recorded cases in St. Petersburg are accounted for by the group aged 5–14 years. The literature offers works presenting opposite data. For example, in the 2015 Ethiopian Childhood Injury Study, the majority of deaths from injuries were registered in children aged 0–4 years [20].

The study of the epidemiology of pediatric fractures is of great importance for the development of preventive strategies and depends on the complete and correct registration of injuries at all stages of treatment. An analysis of the information obtained provided true ideas about the causes of injuries [21]. The incidence of fractures in pediatric patients can be reduced through public education, implementation of safety strategies, and government legislation. Healthcare providers and medical specialists, including pediatricians, can play important roles in reducing childhood trauma by participating in child and parent education, research, and programs that promote safe games [22]. Significant savings in human and financial resources will be achieved only if full-fledged investments are placed in the prevention of pediatric injuries [23].

CONCLUSION

An analysis of injury rates among the pediatric population showed that in St. Petersburg over the past 5 years, the number of injuries in pediatric patients insignificantly increased, mainly in those aged 0–4 years, in contrast to adolescents aged 15–17 years, in which these figures tended to decrease. However, the incidence of injuries in adolescents is nearly two times higher than that in pediatric patients aged

<14 years. Notably, the level of severe, high-energy injuries that require more serious treatment approaches, usually advanced, is increasing and is reflected in the duration of the inpatient stage. This finding confirms the annual increase in the number of surgical interventions in pediatric patients with traumatic injuries.

As before, pediatric injuries remain an urgent issue and an important task of national healthcare, and their solution requires special programs. The prolonged presence of this entity in the top five, with the highest rates of childhood and adolescent injuries, is of particular concern in the Russian Federation.

The new form of statistical reporting does not allow for finding out all the causes of injuries. For a qualitative analysis of the causes of injuries and the place and time of their occurrence, information programs must be improved to clarify information about the circumstances of injuries, possibility of more responses from government agencies, and consequently the creation of a healthy and safe environment that will help improve the health of children and adolescents.

Despite an insignificant increase in injuries and the non-increase in the number of children with disability following injuries, poisoning, and some other sequelae of environmental exposure, pediatric mortality from environmental exposure ranks second in the overall pediatric mortality rate and is a “manageable” cause of pediatric death.

Maintaining the continuity between inpatient and outpatient specialized care, rehabilitation, and follow-up of patients with injuries and consequences of traumatic injuries, and preventive measures are prerequisites in reducing pediatric injuries and providing high-level specialized care.

ADDITIONAL INFORMATION

Funding. The study had no external funding.

Conflict of interest. The authors declare no conflict of interest.

Author contributions. A.G. Baidurashvili and S.V. Vissarionov created the study concept and edited the text of the article.

REFERENCES

1. Aynsley-Green A, Barker M, Burr S, et al. Who is speaking for children and adolescents and for their health at policy level. *BMJ*. 2000;321:229–232. DOI: 10.1136/bmj.321.7255.229
2. Baranov AA, Al'bitskii VYu, Namazova-Baranova LS, et al. Sostoyanie zdorov'ya detei v sovremennoi Rossii. Moscow: Pediatr; 2018. (In Russ.)
3. Gordova LD. Sovershenstvovanie kachestva organizatsii i okazaniya meditsinskoi pomoshchi detyam, poluchivshim travmu, s tsel'yu snizheniya ikh invalidizatsii [abstract dissertation]. Moscow; 2020. (In Russ.)
4. World report on child injury prevention. Ed. by M. Peden, K. Oyegbite, J. Ozanne-Smith, et al. Geneva: World Health Organization; 2008.
5. Golovko OV. Child injuries in Orenburg // Sovremennye tendentsii razvitiya nauki i tekhnologii. 2016;(1–3):90–93. (In Russ.)
6. Sullivan KM, Murray KJ, Ake GS. Trauma-Informed care for children in the child welfare system: an initial evaluation of a trauma-informed parenting workshop. *Child Maltreat*. 2016;21(2):147–155. DOI: 10.1177/1077559515615961
7. Baidurashvili SG, Vissarionov SA, Solovyova KS, et al. Child injuries and specialized care for children in a city. *Journal of Pediatric Surgery, Anesthesia and Intensive Care*. 2018;8(2):16–23. (In Russ.) DOI: 10.30946/2219-4061-2018-8-2-16-23
8. ScienceDaily [Internet]. More than 2,000 children die every day from unintentional injury; at least half could be saved [cited 2023 May 25]. Available from: www.sciencedaily.com/releases/2008/12/081210090825.htm
9. Alonso-Fernandez N, Jimenez-Garcia R, Alonso-Fernandez L, et al. Unintentional injuries and associated factors among children and adolescents. An analysis of the Spanish National Health Survey. *Int J Public Health*. 2017;62:961–969. DOI: 10.1007/s00038-017-0950-0
10. Baranov AA, Namazova-Baranova LS, Terletskaia RN, et al. Problems of Children's Disability in Modern Russia. *Annals of the Russian Academy of Medical Sciences*. 2017;72(4):305–312. (In Russ.) DOI: 10.15690/vramn823
11. Peng J, Wheeler K, Groner JI, et al. Undertriage of pediatric major trauma patients in the United States. *Clin Pediatr (Phila)*. 2017;56(9):845–853. DOI: 10.1177/0009922817709553

СПИСОК ЛИТЕРАТУРЫ

1. Aynsley-Green A., Barker M, Burr S., et al. Who is speaking for children and adolescents and for their health at policy level A // *BMJ*. 2000. Vol. 321. P. 229–232. DOI: 10.1136/bmj.321.7255.229
2. Баранов, А.А., Альбицкий В.Ю., Намазова-Баранова Л.С., и др. Состояние здоровья детей в современной России. Москва: ПедиатрЪ, 2018.

A.V. Zaletina, Yu.A. Lapkin, and E.N. Shchepina analyzed the material, studied the literary sources, and wrote the article.

All authors made a significant contribution to the study and preparation of the article and read and approved the final version before its publication.

12. Golubeva TYu. Sovershenstvovanie instrumentariya statisticheskogo nablyudeniya za detskoj invalidnost'yu v Rossiiskoi Federatsii: [abstract dissertation]. Moscow; 2018. (In Russ.)
13. Baidurashvili AG, Zaletina AV, Vissarionov SV, et al. Follow-up care of children with vertebral body compression fractures (evidence from Saint Petersburg). *Genii ortopedii*. 2019;25(4):S.535–540. (In Russ.) DOI 10.18019/1028-4427-2019-25-4-535-540
14. Zaletina AV, Vissarionov SV, Baidurashvili AG, et al. Injuries of the spine and spinal cord in children population. *International journal of applied and fundamental research*. 2017;(12-1):69–73. (In Russ.)
15. Kuptsova OA, Zaletina AV, Vissarionov SV, et al. Trauma rates in children in the period of restrictive measures related to the spread of the new coronavirus infection (COVID-19). *Pediatric Traumatology, Orthopaedics and Reconstructive Surgery*. 2021;9(1):5–16. DOI: 10.17816/PTORS58630
16. Wang Z, Chen H, Yu T, et al. Status of injuries as a public health burden among children and adolescents in China. *Medicine*. 2019;98. DOI: 10.1097/MD.00000000000017671
17. Albedewi H, Al-Saud N, Kashkary A, et al. Epidemiology of childhood injuries in Saudi Arabia: a scoping review. *BMC Pediatr*. 2021;21(1):424. DOI: 10.1186/s12887-021-02886-8
18. Wang H, Feng C, Liu H, et al. Epidemiologic features of traumatic fractures in children and adolescents: a 9-year retrospective study. *Biomed Res Int*. 2019;2019. DOI: 10.1155/2019/8019063
19. Budkevich LI, Soshkina VV, Astamirova TS, et al. Local conservative therapy in children with burns at the stage of specialized medical care. *Russian Journal of Pediatric Surgery, Anesthesia and Intensive Care*. 2019;9(1):86–95. (In Russ.) DOI: 10.30946/2219-4061-2019-9-1-86-95
20. Li Q, Alonge O, Lawhorn C, et al. Child injuries in Ethiopia: a review of the current situation with projections. *PLoS ONE*. 2016;13(3). DOI: 10.1371/journal.pone.0194692
21. Svyatova NV, Vasil'ev SV, Urbanov AYu. Detskii travmatizm. *Uchenye zapiski Kazanskogo filiala Rossiiskogo gosudarstvennogo universiteta pravosudiya*. 2018;14:483–492. (In Russ.)
22. Valerio G, Gallè F, Mancusi C, et al. Pattern of fractures across pediatric age groups: analysis of individual and lifestyle factors. *BMC Public Health*. 2010;10. DOI: 10.1186/1471-2458-10-656
23. Dowd MD, Keenan HT, Bratton SL. Epidemiology and prevention of childhood injuries. *Crit Care Med*. 2002;30(11):S385–S392. DOI: 10.1097/00003246-200211001-00002

5. Головкин, О.В. Актуальные вопросы детского травматизма в г. Оренбурге // *Современные тенденции развития науки и технологий*. 2016. № 1–3. С. 90–93.
6. Sullivan K.M., Murray K.J., Ake G.S. Trauma-Informed care for children in the child welfare system: an initial evaluation of a trauma-informed parenting workshop // *Child. Maltreat.* 2016. Vol. 21. No. 2. P. 147–155. DOI: 10.1177/1077559515615961
7. Баиндурашвили А.Г., Виссарионов С.В., Соловьева К.С., и др. Детский травматизм и оказание специализированной помощи детям в мегаполисе (на примере Санкт-Петербурга) // *Российский вестник детской хирургии, анестезиологии и реаниматологии*. 2018. Т. 8. № 2. С. 17–25. DOI 10.30946/2219-4061-2018-8-2-17-25
8. ScienceDaily [Internet]. More than 2,000 children die every day from unintentional injury; at least half could be saved [дата обращения 25.05.2023]. Доступ по ссылке: www.sciencedaily.com/releases/2008/12/081210090825.htm
9. Alonso-Fernandez N., Jimenez-Garcia R., Alonso-Fernandez L., et al. Unintentional injuries and associated factors among children and adolescents. An analysis of the Spanish National Health Survey // *Int. J. Public Health.* 2017. Vol. 62. No. 9. P. 961–969. DOI: 10.1007/s00038-017-0950-0
10. Баранов А.А., Намазова-Баранова Л.С., Терлецкая Р.Н., и др. Проблемы детской инвалидности в современной России // *Вестник российской академии медицинских наук*. 2017. Т. 72. № 4. С. 305–312.
11. Peng J., Wheeler K., Groner J.I., et al. Undertriage of pediatric major trauma patients in the United States // *Clin. Pediatr. (Phila)*. 2017. Vol. 56. No. 9. P. 845–853. DOI: 10.1177/0009922817709553
12. Голубева Т.Ю. Совершенствование инструментария статистического наблюдения за детской инвалидностью в Российской Федерации: автореф. дис. ... канд. мед. наук. Москва, 2018.
13. Баиндурашвили А.Г., Залетина А.В., Виссарионов С.В., и др. Диспансеризация детей с компрессионными переломами тел позвонков (на примере Санкт-Петербурга) // *Гений ортопедии*. 2019. Т. 25. № 4. DOI: 10.18019/1028-4427-2019-25-4-535-540
14. Залетина А.В., Виссарионов С.В., Баиндурашвили А.Г., и др. Повреждения позвоночника и спинного мозга у детского населения // *Международный журнал прикладных и фундаментальных исследований*. 2017. № 12–1. С. 69–73.
15. Купцова О.А., Залетина А.В., Виссарионов С.В., и др. Показатели травматизма у детей в период ограничительных мероприятий, связанных с распространением новой коронавирусной инфекции (COVID-19) // *Ортопедия, травматология и восстановительная хирургия детского возраста*. 2021. Т. 9. № 1. С. 5–16. DOI: 10.17816/PTORS58630
16. Wang Z., Chen H., Yu T., et al. Status of injuries as a public health burden among children and adolescents in China // *Medicine* 2019. Vol. 98. P. 45. DOI: 10.1097/MD.00000000000017671
17. Albedewi H., Al-Saud N., Kashkary A., et al. Epidemiology of childhood injuries in Saudi Arabia: a scoping review // *BMC Pediatr.* 2021. Vol. 21. No. 1. P. 424. DOI: 10.1186/s12887-021-02886-8
18. Wang H., Feng C., Liu H., et al. Epidemiologic features of traumatic fractures in children and adolescents: a 9-year retrospective study // *Biomed. Res. Int.* 2019. Vol. 2019. DOI: 10.1155/2019/8019063
19. Будкевич Л.И., Сошкина В.В., Астамирова Т.С., и др. Местная консервативная терапия у детей с ожогами на этапе оказания специализированной медицинской помощи // *Российский вестник детской хирургии, анестезиологии и реаниматологии*. 2019. Т. 9. № 1. С. 86–95. DOI: 10.30946/psaic514
20. Li Q., Alonge O., Lawhorn C., et al. Child injuries in Ethiopia: a review of the current situation with projections // *PLoS ONE*. Vol. 13. No. 3. DOI: 10.1371/journal.pone.0194692
21. Святова Н.В., Васильев С.В., Урбанов А.Ю. Детский травматизм // *Ученые записки Казанского филиала Российского государственного университета правосудия*. 2018. Т. 14. С. 483–492.
22. Valerio G., Gallè F., Mancusi C., et al. Pattern of fractures across pediatric age groups: analysis of individual and lifestyle factors // *BMC Public Health*. 2010. Vol. 10. DOI: 10.1186/1471-2458-10-656
23. Dowd M.D., Keenan H.T., Bratton S.L. Epidemiology and prevention of childhood injuries // *Crit. Care Med.* 2002. Vol. 30. No. 11. P. S385–S392. DOI: 10.1097/00003246-200211001-00002

AUTHOR INFORMATION

Alexey G. Baidurashvili, MD, PhD, Dr. Sci. (Med.), Professor, Member of RAS, Honored Doctor of the Russian Federation; ORCID: <https://orcid.org/0000-0001-8123-6944>; Scopus Author ID: 6603212551; eLibrary SPIN: 2153-9050; e-mail: turner011@mail.ru

Sergei V. Vissarionov, MD, PhD, Dr. Sci. (Med.), Professor, Corresponding Member of RAS; ORCID: <https://orcid.org/0000-0003-4235-5048>; ResearcherID: P-8596-2015; Scopus Author ID: 6504128319; eLibrary SPIN: 7125-4930; e-mail: vissarionovs@gmail.com

ОБ АВТОРАХ

Алексей Георгиевич Баиндурашвили, д-р мед. наук, профессор, академик РАН, заслуженный врач РФ; ORCID: <https://orcid.org/0000-0001-8123-6944>; Scopus Author ID: 6603212551; eLibrary SPIN: 2153-9050; e-mail: turner011@mail.ru

Сергей Валентинович Виссарионов, д-р мед. наук, профессор, чл.-корр. РАН; ORCID: <https://orcid.org/0000-0003-4235-5048>; ResearcherID: P-8596-2015; Scopus Author ID: 6504128319; eLibrary SPIN: 7125-4930; e-mail: vissarionovs@gmail.com

*** Anna V. Zaletina**, MD, PhD, Cand. Sci. (Med.);
address: 64-68 Parkovaya str., Pushkin,
Saint Petersburg, 196603, Russia;
ORCID: <https://orcid.org/0000-0002-9838-2777>;
ResearcherID: H-2439-2013;
Scopus Author ID: 57193254848;
eLibrary SPIN: 4955-1830;
e-mail: omoturner@mail.ru

Yuri A. Lapkin, MD, PhD, Cand. Sci. (Med.);
ORCID: <https://orcid.org/0009-0007-9629-7601>;
Scopus Author ID: 57193254731;
eLibrary SPIN: 3283-8887;
e-mail: lapkin1950@mail.ru

Elena N. Schepina, MD, PhD, Cand. Sci. (Med.);
ORCID: <https://orcid.org/0000-0003-1913-1118>;
eLibrary SPIN: 3934-0694;
e-mail: ov-elena@mail.ru

*** Анна Владимировна Залетина**, канд. мед. наук;
адрес: Россия, 196603, Санкт-Петербург,
Пушкин, ул. Парковая, д. 64-68;
ORCID: <https://orcid.org/0000-0002-9838-2777>;
ResearcherID: H-2439-2013;
Scopus Author ID: 57193254848;
eLibrary SPIN: 4955-1830;
e-mail: omoturner@mail.ru

Юрий Алексеевич Лапкин, канд. мед. наук;
ORCID: <https://orcid.org/0009-0007-9629-7601>;
Scopus Author ID: 57193254731;
eLibrary SPIN: 3283-8887;
e-mail: lapkin1950@mail.ru

Елена Николаевна Щепина, канд. мед. наук;
ORCID: <https://orcid.org/0000-0003-1913-1118>;
eLibrary SPIN: 3934-0694;
e-mail: ov-elena@mail.ru

* Corresponding author / Автор, ответственный за переписку