

# GEORGIAN MEDICAL NEWS

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ЕЖЕМЕСЯЧНЫЙ НАУЧНЫЙ ЖУРНАЛ

Медицинские новости Грузии  
საქართველოს სამედიცინო სიახლენი

## GEORGIAN MEDICAL NEWS

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**GMN: Georgian Medical News** is peer-reviewed, published monthly journal committed to promoting the science and art of medicine and the betterment of public health, published by the GMN Editorial Board since 1994. GMN carries original scientific articles on medicine, biology and pharmacy, which are of experimental, theoretical and practical character; publishes original research, reviews, commentaries, editorials, essays, medical news, and correspondence in English and Russian.

GMN is indexed in MEDLINE, SCOPUS, PubMed and VINITI Russian Academy of Sciences. The full text content is available through EBSCO databases.

**GMN: Медицинские новости Грузии** - ежемесячный рецензируемый научный журнал, издаётся Редакционной коллегией с 1994 года на русском и английском языках в целях поддержки медицинской науки и улучшения здравоохранения. В журнале публикуются оригинальные научные статьи в области медицины, биологии и фармации, статьи обзорного характера, научные сообщения, новости медицины и здравоохранения. Журнал индексируется в MEDLINE, отражён в базе данных SCOPUS, PubMed и ВИНТИ РАН. Полнотекстовые статьи журнала доступны через БД EBSCO.

**GMN: Georgian Medical News** – საქართველოს სამედიცინო სიახლენი – არის ყოველთვიური სამეცნიერო სამედიცინო რეცენზირებადი ჟურნალი, გამოიცემა 1994 წლიდან, წარმოადგენს სარედაქციო კოლეგიისა და აშშ-ის მეცნიერების, განათლების, ინდუსტრიის, ხელოვნებისა და ბუნებისმეტყველების საერთაშორისო აკადემიის ერთობლივ გამოცემას. GMN-ში რუსულ და ინგლისურ ენებზე ქვეყნდება ექსპერიმენტული, თეორიული და პრაქტიკული ხასიათის ორიგინალური სამეცნიერო სტატიები მედიცინის, ბიოლოგიისა და ფარმაციის სფეროში, მიმოხილვითი ხასიათის სტატიები.

ჟურნალი ინდექსირებულია MEDLINE-ის საერთაშორისო სისტემაში, ასახულია SCOPUS-ის, PubMed-ის და ВИНТИ РАН-ის მონაცემთა ბაზებში. სტატიების სრული ტექსტი ხელმისაწვდომია EBSCO-ს მონაცემთა ბაზებიდან.

### WEBSITE

[www.geomednews.com](http://www.geomednews.com)

## К СВЕДЕНИЮ АВТОРОВ!

При направлении статьи в редакцию необходимо соблюдать следующие правила:

1. Статья должна быть представлена в двух экземплярах, на русском или английском языках, напечатанная через **полтора интервала на одной стороне стандартного листа с шириной левого поля в три сантиметра**. Используемый компьютерный шрифт для текста на русском и английском языках - **Times New Roman (Кириллица)**, для текста на грузинском языке следует использовать **AcadNusx**. Размер шрифта - **12**. К рукописи, напечатанной на компьютере, должен быть приложен CD со статьей.

2. Размер статьи должен быть не менее десяти и не более двадцати страниц машинописи, включая указатель литературы и резюме на английском, русском и грузинском языках.

3. В статье должны быть освещены актуальность данного материала, методы и результаты исследования и их обсуждение.

При представлении в печать научных экспериментальных работ авторы должны указывать вид и количество экспериментальных животных, применявшиеся методы обезболивания и усыпления (в ходе острых опытов).

4. К статье должны быть приложены краткое (на полстраницы) резюме на английском, русском и грузинском языках (включающее следующие разделы: цель исследования, материал и методы, результаты и заключение) и список ключевых слов (key words).

5. Таблицы необходимо представлять в печатной форме. Фотокопии не принимаются. **Все цифровые, итоговые и процентные данные в таблицах должны соответствовать таковым в тексте статьи**. Таблицы и графики должны быть озаглавлены.

6. Фотографии должны быть контрастными, фотокопии с рентгенограмм - в позитивном изображении. Рисунки, чертежи и диаграммы следует озаглавить, пронумеровать и вставить в соответствующее место текста **в tiff формате**.

В подписях к микрофотографиям следует указывать степень увеличения через окуляр или объектив и метод окраски или импрегнации срезов.

7. Фамилии отечественных авторов приводятся в оригинальной транскрипции.

8. При оформлении и направлении статей в журнал МНГ просим авторов соблюдать правила, изложенные в «Единых требованиях к рукописям, представляемым в биомедицинские журналы», принятых Международным комитетом редакторов медицинских журналов - <http://www.spinesurgery.ru/files/publish.pdf> и [http://www.nlm.nih.gov/bsd/uniform\\_requirements.html](http://www.nlm.nih.gov/bsd/uniform_requirements.html) В конце каждой оригинальной статьи приводится библиографический список. В список литературы включаются все материалы, на которые имеются ссылки в тексте. Список составляется в алфавитном порядке и нумеруется. Литературный источник приводится на языке оригинала. В списке литературы сначала приводятся работы, написанные знаками грузинского алфавита, затем кириллицей и латиницей. Ссылки на цитируемые работы в тексте статьи даются в квадратных скобках в виде номера, соответствующего номеру данной работы в списке литературы. Большинство цитированных источников должны быть за последние 5-7 лет.

9. Для получения права на публикацию статья должна иметь от руководителя работы или учреждения визу и сопроводительное отношение, написанные или напечатанные на бланке и заверенные подписью и печатью.

10. В конце статьи должны быть подписи всех авторов, полностью приведены их фамилии, имена и отчества, указаны служебный и домашний номера телефонов и адреса или иные координаты. Количество авторов (соавторов) не должно превышать пяти человек.

11. Редакция оставляет за собой право сокращать и исправлять статьи. Корректур авторам не высылаются, вся работа и сверка проводится по авторскому оригиналу.

12. Недопустимо направление в редакцию работ, представленных к печати в иных издательствах или опубликованных в других изданиях.

**При нарушении указанных правил статьи не рассматриваются.**

## REQUIREMENTS

Please note, materials submitted to the Editorial Office Staff are supposed to meet the following requirements:

1. Articles must be provided with a double copy, in English or Russian languages and typed or computer-printed on a single side of standard typing paper, with the left margin of 3 centimeters width, and 1.5 spacing between the lines, typeface - **Times New Roman (Cyrillic)**, print size - 12 (referring to Georgian and Russian materials). With computer-printed texts please enclose a CD carrying the same file titled with Latin symbols.

2. Size of the article, including index and resume in English, Russian and Georgian languages must be at least 10 pages and not exceed the limit of 20 pages of typed or computer-printed text.

3. Submitted material must include a coverage of a topical subject, research methods, results, and review.

Authors of the scientific-research works must indicate the number of experimental biological species drawn in, list the employed methods of anesthetization and soporific means used during acute tests.

4. Articles must have a short (half page) abstract in English, Russian and Georgian (including the following sections: aim of study, material and methods, results and conclusions) and a list of key words.

5. Tables must be presented in an original typed or computer-printed form, instead of a photocopied version. **Numbers, totals, percentile data on the tables must coincide with those in the texts of the articles.** Tables and graphs must be headed.

6. Photographs are required to be contrasted and must be submitted with doubles. Please number each photograph with a pencil on its back, indicate author's name, title of the article (short version), and mark out its top and bottom parts. Drawings must be accurate, drafts and diagrams drawn in Indian ink (or black ink). Photocopies of the X-ray photographs must be presented in a positive image in **tiff format**.

Accurately numbered subtitles for each illustration must be listed on a separate sheet of paper. In the subtitles for the microphotographs please indicate the ocular and objective lens magnification power, method of coloring or impregnation of the microscopic sections (preparations).

7. Please indicate last names, first and middle initials of the native authors, present names and initials of the foreign authors in the transcription of the original language, enclose in parenthesis corresponding number under which the author is listed in the reference materials.

8. Please follow guidance offered to authors by The International Committee of Medical Journal Editors guidance in its Uniform Requirements for Manuscripts Submitted to Biomedical Journals publication available online at: [http://www.nlm.nih.gov/bsd/uniform\\_requirements.html](http://www.nlm.nih.gov/bsd/uniform_requirements.html)  
[http://www.icmje.org/urm\\_full.pdf](http://www.icmje.org/urm_full.pdf)

In GMN style for each work cited in the text, a bibliographic reference is given, and this is located at the end of the article under the title "References". All references cited in the text must be listed. The list of references should be arranged alphabetically and then numbered. References are numbered in the text [numbers in square brackets] and in the reference list and numbers are repeated throughout the text as needed. The bibliographic description is given in the language of publication (citations in Georgian script are followed by Cyrillic and Latin).

9. To obtain the rights of publication articles must be accompanied by a visa from the project instructor or the establishment, where the work has been performed, and a reference letter, both written or typed on a special signed form, certified by a stamp or a seal.

10. Articles must be signed by all of the authors at the end, and they must be provided with a list of full names, office and home phone numbers and addresses or other non-office locations where the authors could be reached. The number of the authors (co-authors) must not exceed the limit of 5 people.

11. Editorial Staff reserves the rights to cut down in size and correct the articles. Proof-sheets are not sent out to the authors. The entire editorial and collation work is performed according to the author's original text.

12. Sending in the works that have already been assigned to the press by other Editorial Staffs or have been printed by other publishers is not permissible.

**Articles that Fail to Meet the Aforementioned  
Requirements are not Assigned to be Reviewed.**

## ავტორთა საქურაღებოლ!

რედაქციაში სტატიის წარმოდგენისას საჭიროა დაიცვათ შემდეგი წესები:

1. სტატია უნდა წარმოადგინოთ 2 ცალად, რუსულ ან ინგლისურ ენებზე დაბეჭდილი სტანდარტული ფურცლის 1 გვერდზე, 3 სმ სიგანის მარცხენა ველისა და სტრიქონებს შორის 1,5 ინტერვალის დაცვით. გამოყენებული კომპიუტერული შრიფტი რუსულ და ინგლისურენოვან ტექსტებში - **Times New Roman (Кириллица)**, ხოლო ქართულენოვან ტექსტში საჭიროა გამოვიყენოთ **AcadNusx**. შრიფტის ზომა – 12. სტატიას თან უნდა ახლდეს CD სტატიით.

2. სტატიის მოცულობა არ უნდა შეადგენდეს 10 გვერდზე ნაკლებს და 20 გვერდზე მეტს ლიტერატურის სიის და რეზიუმეების (ინგლისურ, რუსულ და ქართულ ენებზე) ჩათვლით.

3. სტატიაში საჭიროა გაშუქდეს: საკითხის აქტუალობა; კვლევის მიზანი; საკვლევი მასალა და გამოყენებული მეთოდები; მიღებული შედეგები და მათი განსჯა. ექსპერიმენტული ხასიათის სტატიების წარმოდგენისას ავტორებმა უნდა მიუთითონ საექსპერიმენტო ცხოველების სახეობა და რაოდენობა; გაუტკივარებისა და დაძინების მეთოდები (მწვავე ცდების პირობებში).

4. სტატიას თან უნდა ახლდეს რეზიუმე ინგლისურ, რუსულ და ქართულ ენებზე არანაკლებ ნახევარი გვერდის მოცულობისა (სათაურის, ავტორების, დაწესებულების მითითებით და უნდა შეიცავდეს შემდეგ განყოფილებებს: მიზანი, მასალა და მეთოდები, შედეგები და დასკვნები; ტექსტუალური ნაწილი არ უნდა იყოს 15 სტრიქონზე ნაკლები) და საკვანძო სიტყვების ჩამონათვალი (key words).

5. ცხრილები საჭიროა წარმოადგინოთ ნაბეჭდი სახით. ყველა ციფრული, შემაჯამებელი და პროცენტული მონაცემები უნდა შეესაბამებოდეს ტექსტში მოყვანილს.

6. ფოტოსურათები უნდა იყოს კონტრასტული; სურათები, ნახაზები, დიაგრამები - დასათაურებული, დანომრილი და სათანადო ადგილას ჩასმული. რენტგენოგრაფიების ფოტოასლები წარმოადგინეთ პოზიტიური გამოსახულებით **tiff** ფორმატში. მიკროფოტოსურათების წარწერებში საჭიროა მიუთითოთ ოკულარის ან ობიექტივის საშუალებით გადიდების ხარისხი, ანათალების შედეგების ან იმპრეგნაციის მეთოდი და აღნიშნოთ სურათის ზედა და ქვედა ნაწილები.

7. სამამულო ავტორების გვარები სტატიაში აღინიშნება ინიციალების თანდართვით, უცხოურისა – უცხოური ტრანსკრიპციით.

8. სტატიას თან უნდა ახლდეს ავტორის მიერ გამოყენებული სამამულო და უცხოური შრომების ბიბლიოგრაფიული სია (ბოლო 5-8 წლის სიღრმით). ანბანური წყობით წარმოდგენილ ბიბლიოგრაფიულ სიაში მიუთითეთ ჯერ სამამულო, შემდეგ უცხოელი ავტორები (გვარი, ინიციალები, სტატიის სათაური, ჟურნალის დასახელება, გამოცემის ადგილი, წელი, ჟურნალის №, პირველი და ბოლო გვერდები). მონოგრაფიის შემთხვევაში მიუთითეთ გამოცემის წელი, ადგილი და გვერდების საერთო რაოდენობა. ტექსტში კვადრატულ ფხიხლებში უნდა მიუთითოთ ავტორის შესაბამისი N ლიტერატურის სიის მიხედვით. მიზანშეწონილია, რომ ციტირებული წყაროების უმეტესი ნაწილი იყოს 5-6 წლის სიღრმის.

9. სტატიას თან უნდა ახლდეს: ა) დაწესებულების ან სამეცნიერო ხელმძღვანელის წარდგინება, დამოწმებული ხელმოწერითა და ბეჭდით; ბ) დარგის სპეციალისტის დამოწმებული რეცენზია, რომელშიც მითითებული იქნება საკითხის აქტუალობა, მასალის საკმაობა, მეთოდის სანდოობა, შედეგების სამეცნიერო-პრაქტიკული მნიშვნელობა.

10. სტატიის ბოლოს საჭიროა ყველა ავტორის ხელმოწერა, რომელთა რაოდენობა არ უნდა აღემატებოდეს 5-ს.

11. რედაქცია იტოვებს უფლებას შეასწოროს სტატია. ტექსტზე მუშაობა და შეჯერება ხდება საავტორო ორიგინალის მიხედვით.

12. დაუშვებელია რედაქციაში ისეთი სტატიის წარდგენა, რომელიც დასაბეჭდად წარდგენილი იყო სხვა რედაქციაში ან გამოქვეყნებული იყო სხვა გამოცემებში.

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## THE OCCURRENCE OF SPORTS INJURIES AMONG PRE-ADOLESCENTS

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### Abstract.

Preschool children's harmonious development, cognitive and communicative abilities are enhanced through physical activities in sports, yet sports training and competition pose a risk of injury to children aged three to seven years due to their physiological and psychological features. Although sports injuries in preschool children are not common, they can be undesirable and unavoidable, and fortunately, these injuries are usually reversible. This review article presents data on the physiological features of the developing musculoskeletal system and its relationship to sports injuries in children, which together determine the nature of children's sports injuries.

We also present a classification of sports injuries among preschool children, based on the literature, which considers the type, location, and severity of the trauma as estimated by the duration of mandatory missed practice.

**Key words.** Excessive load, high-intensity training, epiphyseal injuries, apophysis, spondylolysis, spondylolisthesis, preschool-aged children.

### Introduction.

Physical activity plays a significant role in the well-being of children. Developing a sports exercise program tailored to preschoolers' age characteristics contributes to their harmonious physical, psychomotor, and intellectual development [1]. Preschool children's physical activity should be three hours per day, and 5% to 50% of them follow this requirement. In other words, at least 5-50% of pre-adolescents receive the minimum amount of physical activity [2-4].

The duration of the physical activity, the well-being of the child and its contribution to a balanced development are the determining factors for the long-term health benefits that sport activities offer to children [5-8].

Currently, an increasing number of children participate in sports, both professionally and for additional training. Sport can provide both enjoyment and promote health and personal development for children under the age of 5. However, introducing a competitive aspect may alter this dynamic. Unfortunately, this regimen inevitably increases the likelihood of injury. In order to excel in a specific sport, numerous children commence training as early as 2.5 years old [9]. As a result, aspiring young athletes may train more frequently and intensively, ignoring breaks, in their pursuit of success. An undesirable but inevitable consequence of such a training process is an increase in injury risk.

### Materials and Methods.

#### • Information Sources

A literature review was conducted by searching for appropriate Russian and English language articles in electronic databases such as eLIBRARY, Google Scholar, PubMed, and references in the found articles.

#### • Literature search strategy

Search terms included: «physical activity of children AND injuries», «physical activity of pre-adolescents», «sports injuries among pre-adolescent», «preschoolers' physical activity level AND injuries», «classifications of sports injuries AND children\pre-adolescents\preschoolers», «incidence of sports-related injuries AND preschool children\ children\pre-adolescents», «musculoskeletal system growth AND sports injuries in children», «bone injuries during preschool years».

#### • Eligibility Criteria

The following criteria were used to select articles for inclusion in the analysis:

- Articles with a publication date no earlier than 1993.
- The article discusses classifications of sports injuries in pre-adolescents.
- The article describes the correlation between musculoskeletal system growth and sports injuries in children.
- The article discusses the types of injuries most common to preschool children due to the immaturity of the nervous system, reflexes, and musculoskeletal system.
- The article describes occurrence of various sports injuries among pre-adolescents.

The work of the analysis of the studies was carried out independently by two operators and consisted of several steps.

1. Reviewing the title abstract of the article. Determining whether the data were relevant to the topic of the study.

2. Reading the full text of the material and using the information provided in it for the analysis (Figure 1).

### Results.

159 publications were reviewed; 16 were from the PubMed database, 27 were from Elibrary, 116 were from the Google

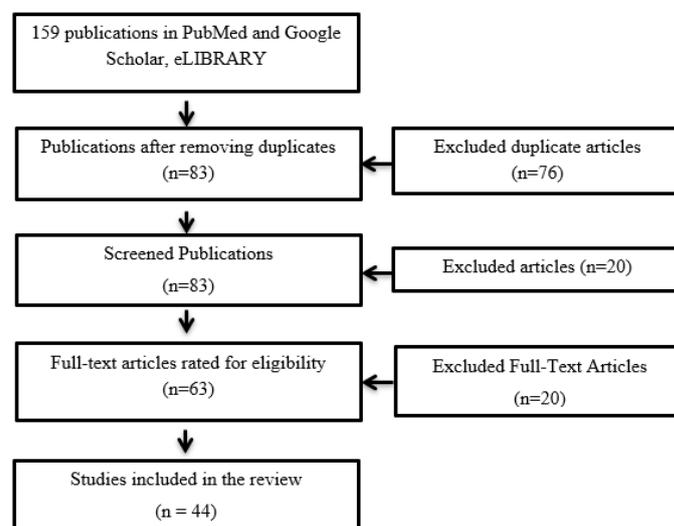


Figure 1. Article selection process.

Scholar. The final number has become 44 after selection according to the inclusion criteria. The included studies described classifications of sports injuries in preschoolers, incidence of sports-related injuries and musculoskeletal system growth in children.

## Discussion.

### 1. Factors associated with preschool sport-related injuries. Physical activity level.

As more children participate in organized sports and specialize in specific sports at an early age, the prevalence of sports-related injuries in children is increasing. Children are susceptible to experiencing acute traumatic injuries during both training and competition, as well as chronic injuries resulting from excessive stress on the musculoskeletal system. The most common childhood injuries are likely to occur during so-called critical periods of development (3-7 years) due to the nervous system's instability in children. Some children may exhibit unwarranted aggression towards their peers or rivals, which can increase the risk of injury in sports.

It is very difficult, if not impossible, to determine the true incidence of sports-related injuries in preschool children. Published studies vary significantly in populations, methodology, and types and severity of injuries sustained. Additionally, due to the varied criteria used to define injury, comparing statistical reports can pose difficulties and should be interpreted with caution [10, 11]. However, despite all the above limits it can be stated that in average 10% of injuries in pre-schoolers admitted to the pediatric clinic are related to sports injuries, particularly those associated with increased sports loads. The summary structure of child traumatism by nature of injuries according to the literature review is presented in Table 1.

**Table 1.** Distribution of sports traumas among nosological forms due to literature review.

Localization	Frequency
Fracture of the skull bones	0.5-1%
Fracture of upper limb bones	11-30%
Fracture of lower limb bones	1.4-18%
Fracture of the spine	0,5-2,5%
Sprains, strains	15-50%
Injuries to internal organs	0,1%
Other	2,5%

Approximately 30 million children participate in organized sports each year in the United States. Despite the growing awareness of sports participation risks, young athletes continue to experience increased rates of overuse injuries. The specific mechanisms of injury in young athletes are diverse and vary by sport, level of fitness, and bone health, with growing bones being the most vulnerable structure susceptible to injury [12].

Moreover, preschoolers' physical activity level is influenced by socio-environmental, socio-cognitive, and individual factors [13]. Italian researchers examined how different types of exertion impact immediate and delayed attention in elementary school children. The study grouped the children according to the intensity of their training: cognitive load (school program lesson), physical load (traditional physical education lesson),

and mixed cognitive and physical load (coordinated physical education lesson). The physical education lesson was designed to combine physical exertion and mental challenges, requiring students to complete movement-based problem-solving tasks that involve precise timing, estimations, production, and spatial adjustments. To assess the impact of the lesson on attention, an attention test was conducted on the students before and after the lesson (at 0 and 50 minutes). The study revealed that the attention performance of preschool children was significantly influenced by load type ( $P < 0.0001$ ), time ( $P < 0.0001$ ), and the interaction of load type with time ( $P < 0.0001$ ). Effect sizes ranged from medium (0.039) to large (0.437). In conclusion, a change in load type has several positive effects on the attention level of preschool children [1].

Environmental factors play a crucial role in preschoolers' health. Research has demonstrated a positive correlation between outdoor playtime and physical activity level. However, spending more time outdoors also increases the likelihood of injuries [14].

### 2. Classification of sports injuries.

Different classifications of sports injuries in children are used by authors: [15]

- I. According to the type of injury
  - 1) soft tissue contusions, muscle stretching, ligament sprains.
  - 2) bone fractures and joint dislocations.
  - 3) cuts, lacerations.
  - 4) concussion, craniocerebral trauma.
  - 5) dental injuries.
  - 6) other (includes injuries of internal organs).
- II. By topography
  - 1) head, face, ear, eyes, nose (head, face).
  - 2) neck, spine.
  - 3) shoulder.
  - 4) upper extremities.
  - 5) wrist, hand, fingers.
  - 6) chest, abdomen, rib cage (trunk).
  - 7) lower extremities, excluding the knee and ankle.
  - 8) knee.
  - 9) ankle joint.
  - 10) foot.
  - 11) other (includes injuries to internal organs).
- III. According to the time of missed training as a result of injury: [16, 17]
  - 1) 1-7 days (minor).
  - 2) 8-21 days (moderate).
  - 3) more than 21 days (severe injury resulting in permanent disability).

Objective evaluation is key in assessing sports injuries in children. Sports injuries in children can result from excessive strain on the developing body, which is accompanied by pain. Depending on the severity of pain experienced, such injuries can be classified into three stages:

- Stage 1 - post-activity pain.
- Stage 2 - pain during physical activity without impacting functioning (the child can continue participating in activities).
- Stage 3 - pain during physical activity lasting all day, affecting functioning (activities may need to be reduced or discontinued).

Stage 4 - indicates pain during all physical activities and impairment of even the most fundamental musculoskeletal functions [18].

### 3. Distribution of child sports injuries by gender and localization.

Research shows that boys are more prone to sports injuries, which tend to be more severe than those sustained by girls. The likelihood of injury is higher in contact or jumping sports. Sports injuries in children under 10 years old are nonspecific, including contusions, mild ligament sprains, and limb fractures. Most commonly, they are growth plate or plastic fractures. Sports-related ligament or muscle injuries, as well as spinal or head injuries, are infrequent in the young athlete [19].

However, in preschool children, the musculoskeletal system undergoes active growth, including bone formation such as growth plate, epiphyseal-apophyseal complex, and periosteum, while the muscular framework is actively forming [20,21].

Bones, muscles, and tendons grow at different rates, often creating undue pressure on secondary ossification centers, particularly during periods of rapid growth and when performing intensive sports activities. Diagnostic radiographs may show microfractures, inflammatory scarring, and areas of ossification. Typically, early-stage injuries can be reversed if the underlying repetitive action, which cause trauma, is stopped [18].

#### a. Epiphyseal and apophyseal injuries.

The unique feature of bone injuries during preschool years is the damage to the growth plates, where growth of tubular bones occurs (epiphyseal plates) and apophyses (sites of muscle-tendon unit attachment) [22,23]. Epiphyseal injuries can occur in sports that involve prolonged compression of tendons resulting in damage to apophyses due to traction forces. Differences in growth rates between epiphyses and apophyses as well as between bone and muscle pose risks for apophyseal injuries. Such divergent growth rates may cause relative musculotendinous inflexibility and increased traction on the apophyses, thereby contributing to apophyseal injuries [24,25].

The apophyses themselves act as a "minoris resistentiae" (an area of lesser resistance to loading) and several mechanisms are responsible for this condition. Among these mechanisms are the following key factors:

- 1) When bones grow in length, they create high tension on the surrounding muscles, leading to an imbalance and significant shortening of the musculovascular equivalent.

- 2) The decrease in mechanical stability can be attributed to an increase in the release of somatotrophic hormones during growth.

- 3) The ossification nucleus interrupts and redirects the flowing tendon collagen fiber bundles. Thus, the ossification nucleus within the tendon itself also alters the biomechanical stability of the tendon.

The musculoskeletal system's growing structures can be organized according to a stability "hierarchy". The growing cartilage zone of the apophysis and epiphysis is the least stable, while tendons, muscles, and ligaments are the most stable. Therefore, apophyses and epiphyses are among the most vulnerable structures in children [26].

#### b. Physiological loading benefits and drawbacks.

In children, bones and muscles exhibit greater elasticity and

a faster healing rate [27]. With the increase of bone stiffness and decrease of impact resistance, sudden overloading of young athletes can result in bone flexion or deflection. Physiological loading benefits the skeleton, but overloading can result in severe joint damage. Low-intensity exercise can promote bone growth, while high-intensity exercise can hinder it [28].

There are adaptive changes to physical activity, and until puberty, muscle strength is significantly alike for girls and boys. Injuries related to sports in preschoolers are mainly concentrated in bones and soft tissues, and as the skeleton develops, injuries can lead to progressive and irreversible effects. Sports injuries that result in disruption of growth plate formation can cause differences in limb length, angular deformity, altered joint mechanics, and even long-term disability [29].

Repetitive microtrauma can lead to bone damage, which in turn causes dissecting osteochondritis, a localized lesion of unclear origin that involves the separation of articular cartilage and subchondral bone. Although most cases of dissecting osteochondritis resolve without complications, lesions that do not heal after surgery or a reduced period of repetitive impact loading may result in degenerative changes in adulthood [30].

#### c. Growth center injuries.

Injuries to the growth center can have long-term consequences and can impact the normal growth and development of a child. Studies have reported changes that are linked with stress loading such as muscle enlargement, osteochondritis, and radiologic enlargement of the proximal growth plate of the humerus. It has been observed that symptom relief can be achieved by stopping physical activity or ensuring adequate rest [29].

#### d. The most common sports injuries in preschool children.

Lower extremity injuries commonly occur in runners, as well as athletes involved in soccer, tennis, baseball (especially catchers), and gymnastics. Intense exercise in children may result in premature closure of the growth plate, and distal exercise stress reactions have been reported in between 10% and 85% of athletes [22,30].

Additionally, children typically produce more heat relative to their body weight, have a lower sweating capacity, and tend to drink less than adults. As a result, they are more likely than adults to suffer from heat exhaustion, especially in hot climates. Consequently, there may be an elevated incidence of injury [10].

Injuries in children's sports range from sprains and contusions to death, and certain types of injuries are more common in some types of sports. Spiral fractures of the tibia represent the most frequent type of fracture among children with skiing injuries, while ankle injuries are the most prevalent injury in basketball [31,32].

Let's review the most common sports injuries in preschool children. Injuries tend to occur most often during wrestling (freestyle, classical, etc.) - 30.9%, followed by game sports (soccer, volleyball) - 27.9% and athletics (running, jumping) - 17.6%. Distribution of sports traumas among nosological forms is as follows: fracture of forearm bones accounts for 30.8% of injuries, followed by fracture of clavicle at 14.7%, and apophysiolysis of humerus medial epicondyle at 11.7%. Fracture of hand bones and hemarthrosis of knee joint make up 11.7% and 8.8% of injuries, respectively. Apophysiolysis of anterior superior pelvic axis accounts for 1.4%, while contusion

of cervical spine and hand tendon injury each constitute 2.9% of injuries. 0.5% of cases involved dislocation of the acromial end of the clavicle, 2.9% involved a transcondylar fracture of the humerus, 2.9% involved a fracture of the bones in the foot, 2.9% involved dislocation of the forearm bones, and 0.4% involved partial damage to the biceps brachii. Early onset of physical activity and training resulted in some cases of repeated injuries (1.5%) - apophysiolysis of the medial epicondyle of the shoulder, refracture of the clavicle, and refracture of the forearm can be presented [33].

Dislocations are infrequent prior to growth plate closure, as the growth plate is the most fragile area and often accompanied by soft tissue injuries, specifically impacting the rotator cuff and biceps tendon during a fall. Gymnastics and soccer players commonly experience elbow dislocation [31], which may coincide with fractures of the medial epicondyle of the humerus, radial neck fractures or injury of the median or ulnar nerve. The majority of dislocations in children occur posteriorly or in a posterolateral direction. Active rehabilitation is recommended, but individuals should not return to sports until 8-12 weeks have passed. Knee sprains tend to occur more frequently in later stages of life.

Clavicle fractures are the most common type of injury in contact sports and sports that involve a fall on an outstretched arm or a direct fall on the shoulder. The younger the child, the less deformity due to trauma and fractures in the thick periosteal tube is presented. Older children are more likely to have metaphyseal fractures of the humerus. The mechanism of injury is usually indirect. Suprascapular fractures of the humerus occur as a result of a fall on an outstretched arm. The distal portion of the humerus is most often displaced posteriorly and may involve the growth plate. The injury may involve damage to major blood vessels or nerves. Fractures of the forearm and wrist are also common in outstretched arm falls. All levels of the forearm may be involved, although most fractures occur in the distal third. Some angulation is acceptable in young children. Tibia fractures are the most common fractures in skiing [34]. Ankle twisting injuries that result in fracture in adults have a different mechanism of injury than in the immature skeleton. Ankle fractures in children are minimally displaced. However, open reduction and internal fixation may be required if the articular surface is involved [33,35].

Cervical spine fractures are less common in children than in adults. In preschool children, spinal fractures involve the atlantoaxial or atlantooccipital joints. Small anterior vertebral wedging is normal in children due to incomplete ossification, and spondylolysis up to 2 mm is acceptable in the upper levels of the cervical spine. Sports with a high risk of acute spinal injury include American football, diving, skiing, gymnastics, and trampolining [31,33,36].

Stress fractures are difficult to diagnose and are often associated with training errors [26,36-43]. Endogenous factors such as body size, gender, diet, hormonal status, and anatomical factors are also important but difficult to prove. Stress fractures are more common in girls and in organized sports. Stress fractures of the ulnar epiphysis are common in baseball players, gymnasts, and wrestlers [33,37].

Gymnastics, dancing, football, weightlifting, and running lead to spondylolysis and spondylolisthesis. Spondylolysis is a bony defect of the interarticular bone between the superior and inferior facets of the vertebral body. Spondylolisthesis is a displacement of the upper vertebrae onto the lower vertebrae. Both can be associated with hyperextension and axial loading, as seen with increased incidence in gymnasts (11%), ballerinas, fast cricket players, and inside linemen in American football. This structural abnormality is not always symptomatic. Although spondylolisthesis can be caused by congenital upper facet insufficiency, it is usually acquired. Its incidence increases with age in childhood, especially between the ages of 5 and 7, and reaches 6% in adults. It is thought to be a fatigue stress fracture, although sometimes it is an acute injury. Approximately 70% of spondylolisthesis occur at the L5-S1 level and rarely above the L3 level. They are usually bilateral, but occasionally unilateral, in which case compensatory hypertrophy of the contralateral pedicle may be seen as increased density on plain radiographs. Computer tomography clearly shows the defect in the posterior arch and also delineates any foraminal impingement with bone fragments [21,31,38,39].

The hand is a frequently traumatized body region in children. The most common injuries are fractures, dislocations, amputations, and tendon or nerve injuries. Minor injuries include contusions and superficial wounds. Injuries to the fingers occur in the majority of cases (60.4%), with the remaining 39.6% of cases occurring to the hand. Serious injuries are found in 24.9% and minor injuries in 75.1% of young athletes [40]. Thus, minor contusions, sprains and strains are the most common sports injuries in preschool children.

### **Conclusion.**

Any sport can lead to musculoskeletal injuries. Exercise programs should certainly take into account the biological age of the participants and their physical and psychological immaturity more than their chronological age. Physical injury is an inherent risk of sport and, to some extent, should be considered an unavoidable cost of high-intensity training and competition. However, coaches and parents can minimize the risk of injury by ensuring appropriate selection of sports activities, use of appropriate equipment, adherence to rules, safe playing conditions, and adequate coaching supervision [11,41-44]. Although injuries are common among young athletes, it is important to balance the negative consequences of sports injuries with the many social, psychological, and health benefits associated with a serious commitment to sport.

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**РЕЗЮМЕ**  
**РАСПРОСТРАНЕННОСТЬ СПОРТИВНОГО**  
**ТРАВМАТИЗМА СРЕДИ ДЕТЕЙ ДОШКОЛЬНОГО**  
**ВОЗРАСТА**

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Гармоничное развитие, развитие познавательных и коммуникативных способностей детей дошкольного возраста обеспечивается физическими нагрузками в спорте, однако спортивные тренировки и соревнования в силу своих физиологических и психологических особенностей представляют опасность травматизма для детей в возрасте от трех до семи лет. Хотя спортивные травмы у детей

дошкольного возраста встречаются нечасто, они могут быть нежелательными и неизбежными, и, к счастью, эти травмы обычно обратимы. В обзорной статье представлены данные о физиологических особенностях развивающегося опорно-двигательного аппарата и их взаимосвязи со спортивным травматизмом у детей, которые в совокупности определяют характер детского спортивного травматизма.

Также представлена классификация спортивных травм у детей дошкольного возраста, основанная на литературных данных и учитывающая вид, локализацию и тяжесть травмы, оцениваемую по длительности обязательного пропуска тренировки.

**Ключевые слова:** чрезмерная нагрузка, высокоинтенсивные тренировки, эпифизарные повреждения, апофизы, дошкольники.

რეზიუმე  
 სკოლამდელი ასაკის ბავშვებში სპორტული ტრავმების გავრცელება

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სკოლამდელი ასაკის ბავშვების ჰარმონიული განვითარება, შემეცნებითი და კომუნიკაციური შესაძლებლობების განვითარება უზრუნველყოფილია სპორტში ფიზიკური აქტივობით, თუმცა სპორტული ვარჯიში და შეჯიბრებები, მათი ფიზიოლოგიური და ფსიქოლოგიური მახასიათებლების გამო, წარმოადგენს დაზიანების რისკს სამიდან შვიდ წლამდე ასაკის ბავშვებისთვის. მიუხედავად იმისა, რომ სკოლამდელი ასაკის ბავშვებში სპორტული დაზიანებები იშვიათია, ისინი შეიძლება არასასურველი და გარდაუვალი იყოს და საბედნიეროდ, ეს დაზიანებები ჩვეულებრივ შექცევადია. მიმოხილვის სტატიაში წარმოდგენილია მონაცემები განვითარებადი კუნთოვანი სისტემის ფიზიოლოგიური მახასიათებლებისა და ბავშვებში სპორტულ დაზიანებებთან მათი ურთიერთობის შესახებ, რაც ერთად განსაზღვრავს ბავშვთა სპორტული დაზიანებების ხასიათს.

სკოლამდელი ასაკის ბავშვებში სპორტული დაზიანებების კლასიფიკაცია ასევე წარმოდგენილია ლიტერატურის მონაცემებზე დაყრდნობით და ტრავმის ტიპის, ლოკალიზაციისა და სიმძიმის გათვალისწინებით, რომელიც შეფასებულია სავალდებულო გამოტოვების ტრენინგის ხანგრძლივობით.

საკვანძო სიტყვები: გადაჭარბებული ვარჯიში, მაღალი ინტენსივობის ვარჯიში, ეპიფიზური დაზიანება, აპოფიზიტები, სკოლამდელი ასაკის ბავშვები.