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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 ВИНИТИ 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 ВИНИТИ РАН-ის მონაცემთა ბაზებში. სტატიების სრული ტექსტი ხელმისაწვდომია EBSCO-ს მონაცემთა ბაზებიდან.

WEBSITE

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
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. Корректура авторам не высылается, 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 compu-ter-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.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 საყურადღებოდ!

რედაქციაში სტატიის წარმოდგენისას საჭიროა დავიცვათ 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. რენტგენოგრამების ფოტოასლები წარმოადგინეთ პოზიტიური გამოსახულებით **tiff** ფორმატში. მიკროფოტოსურათების წარწერებში საჭიროა მიუთითოთ ოკულარის ან ობიექტივის საშუალებით გადიდების ხარისხი, ანათალების შეღებვის 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 ფჩხილებში 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.

აღნიშნული წესების დარღვევის შემთხვევაში სტატიები არ განიხილება.

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METABOLIC DISORDERS IN CHILDREN SUFFERING FROM ACUTE RESPIRATORY VIRAL INFECTIONS (ARVI): COMPLICATIONS AND PREVENTIVE MEASURES

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Abstract.

Objective: A significant research gap exists regarding the association between metabolic disorders and acute respiratory viral infections (ARVIs) in children. This paper aims to investigate the ARVIs associated metabolic complications within the pediatric population.

Methods: The conducted review followed PRISMA 2020 guidelines. To ensure eligibility against defined inclusion criteria (children presenting with acute respiratory viral illness and concomitant metabolic dysfunction; publications spanning 2020 to 2025) and exclusion criteria (non-human studies; individuals over eighteen years of age), manual screening of full-text titles and abstracts was performed. Evaluation of risk of bias was done using the Newcastle-Ottawa Scale (NOS) and the JBI Critical Appraisal Checklist, for the two study designs selected.

Results: Only two studies were finalized for inclusion based on general methodological techniques. The outcomes show that children with recurring ARVIs unveil strong metabolic alterations, characterized by eminent thyroid-stimulating hormone (TSH) concentrations and tapered vitamin D levels.

Conclusion: During the acute phase of viral respiratory infections, research investigation highlights a transient metabolic alteration that does not appear to affect long-term health outcomes. Notably, further exacerbating the infectious period among ARVI patients, metabolic dysfunction increased with age. A higher susceptibility to vitamin D deficiency and TSH elevation was observed in older children, showing an immuno-inflammatory pathways linkage, signifying that metabolic instability in children encourages respiratory infections severity. A critical gap was addressed through the scientific literature study, providing a foundation for future research. Conversely, the small sample size and geographic restrictions do not support specific changes to clinical practice yet.

Key words. Respiratory tract infections, metabolic pathways, children, pulmonary diseases, secondary prevention.

Introduction.

Vital components connected to metabolic syndrome (METS) include deficiencies in vitamin D [1], iron [2], and other essential micronutrients [3], indicating that among children METS may serve as a primary cause of malnutrition, which remains a significant contributor for acute illnesses admissions to intensive care unit (ICU). As a critical indicator of disease progression and the severity of infections, malnutrition is widely recognized including acute respiratory viral infections (ARVIs) [3]. Multiple studies suggest that the clinical outcomes regarding the association between ARVIs and METS [4] could be improved through the replenishment of bodily nutrients. Furthermore, studies determine that poor dietary patterns is a major factor for more than one-fifth of global deaths with chronic diseases such as cardiovascular disorders, cancer, and diabetes being top on the list [5].

It is a complex process to evaluate a child with frequent respiratory infections (FRIs). Physicians must extricate between manageable causes, such as repeated viral infections, and more serious underlying conditions, including immune system abnormalities [6]. A correlation between respiratory distress and individuals who are overweight or obese is identified by current research [7]. In adults, abdominal obesity, increased fasting glucose, and elevated blood pressure as the components of METS demonstrate the strongest links to new-onset respiratory restriction [8]. Remarkably, the development of airflow limitation, chronic lung disease-related events, and respiratory-related mortality all these were associated with the high blood pressure being a singular factor [8]. While some prominent research targets both METS and ARVIs independently, the interconnection where these two conditions intersect remains unclear.

There is a significant lack of robust analysis regarding the recurrence patterns of these abnormalities and associated immune dysfunctions, with various studies individually highlight the derangement of metabolic functions in children with ARVIs. To deal with this, it is essential to focus on these deficiencies. Consequently, from frequent viral respiratory tract infections, significant efforts must be directed toward developing appropriate nutritional support strategies for hospitalized patients suffering [9].

The responsibilities of healthcare professionals have expanded beyond the treatment of acute illnesses to encompass health promotion and disease prevention, including addressing these metabolic associations. In the pediatric population, translating

available evidence into practice should be encouraged to reduce the incidence of ARVI cases, underscoring the necessity and clinical relevance of the present review.

Research Question.

The primary aim of this research is to investigate the metabolic complications in the pediatric population associated with acute respiratory viral infections (ARVIs). This study comprehends the alterations in thyroid profiles, vitamin D deficiency and its subsequent metabolic consequences, thyroid dysfunction, endocrine disturbances, and micronutrient deficiencies that affects the bodily metabolic function.

Literature Review.

Epidemiology of Respiratory Infections in Children.

Among Pediatric population, there are very few recent studies on ARVI and FRI [10] even though hospitalization remains common in this category, primarily triggered by viral pathogens, indicating a recognized priority for addressing this scarcity [11], thereby increasing the clinical burden for this population. Prompting the children into a long-term health disaster, some symptoms range from silent viral replication to mild or severe conditions [11], all due to frequent ARVI [6]. This review with a focus on preventive measures, summarizes pediatric population based recent evidence on the complex role of METS in shaping ARVI disease processes. Still, reflecting a significant pause in this integrated research, most of the research independently focused primarily on ARVI and METS.

Among global populations, viral respiratory infections can spread quickly. High-risk groups typically include children depending on the pathogen while some research studies arrange pediatric results by metabolic situation, or individuals with weakened immune systems, and people with metabolic conditions [12]. The emergence of the significant threat posed by ARVs, highlights severe acute respiratory syndrome (SARS), linked to the coronavirus, and, separately, coronavirus 2019 itself [13], while influencing the severity and clinical features of infection such as replication rate, transmission capability, virulence, and host immune responses [14].

The top-notch clinical variety of ARVIs lacks the evidentiary metabolic alterations under the existent literature research of mentioned Frequent ARVs including rhinovirus [15], respiratory syncytial virus [16], adenovirus [17], coronavirus [18], and influenza virus [18], all associated with pneumonia [19], Acute tonsilitis[20], streptococcal pharyngitis [21], acute laryngitis [22], acute nasopharyngitis [23], acute bronchitis [24] and substantial health control worldwide [25,26].

Pathophysiological Mechanisms Linking Infections to Metabolism.

Many viruses reprogram host cell metabolism at the same time simultaneously weakening antiviral immune defenses by altering gene expression and lipid pathways, which reinforces replication, assembly, and release [27]. These host mechanisms influence the generation of structural components and speeding the energy required for efficient viral production for the intracellular transport and viral multiplication [28]. In a respiratory viral infection, multiple metabolic routes undergo activity changes. Playing a key role in numerous cellular functions, a metabolic regulator namely phosphatidylinositol-3-kinase (PI3K), induces metabolic shifts that occur during viral infection [29,30].

Viral infection can further intensify the severity of metabolic disease while impairing immune responses through disrupting normal immune function [27]. The primary pathways are upregulated during infection, while others may become less active. The affected pathways typically include glycolysis, resulting in nucleotide formation which provides energy and feeds the tricarboxylic acid cycle [12].

Considering a prominent viral influence on various cell signaling and metabolic pathways, rigorousness of viral infection is defined by these virus-host interactions [12]. This research evidently supports biological associations between ARVI and metabolic dysfunction altogether. While mentioned pathways have been thoroughly studied previously, the existing data regarding pediatric populations remain insufficient with recent reliable evidence only for the adult population. However, despite these significant mechanisms identified in these studies, their major methodological limitation is that its inclusion criteria generally exclude participants under the age of eighteen.

Metabolic Disorders Associated with ARVI in Children.

METS prominently influence susceptibility to viral infections and disease outcomes which is now evidently proven from the emerging research [27]. Although comorbidities linked with METS are widely recognized as risk factors for more severe viral illness, relatively very few studies have directly examined how pre-existing metabolic conditions modify the course of acute viral pathogenesis, particularly in young individuals [31]. The limited number of longitudinal follow-up methodologies in these studies reduces the reliability of the findings.

Children and young teens with metabolic syndrome often show milder laboratory changes compared with adults [32]. Although many metabolic markers lie along a continuum of risk, traditional definitions rely on fixed cutoff points, which can create a false dichotomy and may mask critical clinical nuances [33]. A helpful alternative is to treat each metabolic syndrome as a continuous variable and combine its respective z-scores, thereby providing a more accurate representation of overall metabolic risk [27,33]. Previous findings may underestimate the pediatric metabolic pathology due to limited availability.

The most common metabolic disease among older children of Kazakhstan is excessive fat mass and obesity, which is also associated with FRI [34]. This factor of excessive weight among children and teens is also linked with several other metabolic risk factors like thyroid dysregulation [35], micronutrient deficiency [36] like serum Vitamin D insufficiency [37], high Basal metabolic rate (BMR) [35], oxidative stress and inflammation [33] causing it a massive epidemiological crises for viral infections [38-40].

Preventive Measures Targeting Metabolic Indicators.

The majority of research on the FRI focuses on specific metabolic diseases relevant to ARVI. By targeting metabolic indicators, such as addressing micronutrient insufficiencies (e.g., vitamin D, iron, or zinc) [2], through supplementation in the pediatric diet [41,42], this approach has specifically been shown to benefit individuals with FRI. Despite these significant

discoveries, the dosage duration and baseline assessments of dietary nutrition bound the synthesis across research.

For thyroid imbalances [35], many studies have endorsed physical activity among children to target METS conditions such as inappropriate BMR, obesity [35], and insulin resistance, which, in turn, positively influence ARVI [43]. A common vaccine for ACVI, called the influenza virus and Covid virus, is generally recommended for the general population worldwide [27,44]. However, the evidence shows potential; conditions like FRI association with METS need to be researched to develop better preventive measures aligned with child-based strategies and standards.

Gap in Existing Literature.

Despite existing knowledge of the association between METS and ARVI, which poses a potential risk worldwide, evidence linking metabolic pathways to ARVI among children and young teenagers remains lacking. Also, the variances in regional factors and sample sizes limit the overall comparability of the outcomes, as most studies use cross-sectional designs, which prevent causal inference. The primary reason for this gap is that most metabolic and immunological pathway studies are conducted in adults [45], not in the pediatric population, which is a major barrier to exploring the relationship between METS and FRI in the population of interest. This literature review presents a significant challenge in explaining their association, given the lack of data.

Materials and Methods.

Study Design:

Based on the PRISMA 2020 guidelines for search and screening, [46], this study is synthesized systematically however due to limited availability of eligible studies (n=2) and outcome heterogeneity, qualitative analysis was not possible hence the synthesis is presented narratively. A substantial heterogeneity in the literature is identified regarding participants' age ranges, metabolic measurement techniques, ARVIs' definitions, and statistical strategies [47], resulting in a narrative framework preventing a thorough statistical pooling, to synthesize current evidence with meaningful methodological integrity.

Search Strategy:

Given the observational nature of eligible studies and the absence of a uniform comparator, the PEO framework was adopted in place of PICO. The PEO framework based on the population (P) for children aged 1 to 18 years, for exposure (E) ARVIs or FRIs are considered, and lastly any metabolic condition as the outcome (O). A pilot search strategy was developed to increase sensitivity and identify gaps by identifying synonyms and additional keywords for relevant studies. The databases selected for this review are PUBMED [48], Scopus [49], Google Scholar [50], and Cochrane Library [51]. The Boolean operators AND/OR were used to connect the following conceptual search terms: acute respiratory viral infections, metabolic disorders, children, complications, and preventive measures. Filters included English- and Russian-language studies published from 2020 to 2025.

Eligibility Criteria:

Inclusion: The study population mainly includes children aged 1 to 18 years. The primary focus was on children with FRI, particularly viral infections, and on metabolic diseases, including vitamin D insufficiency, thyroid dysfunction, iron deficiency, zinc deficiency, insulin resistance, or glucose intolerance. The Kazakhstan region was also examined, but unfortunately, no studies were found related to this location.

Exclusion: The children who did not have ARVI were not considered. Also, adults aged eighteen years are excluded from the study. Non-human research using animal models was not included. Another exclusion criterion was to nullify the reviews and case reports.

Study Selection Process:

All the records were included in the reference manager and in the Excel file format. All data screening is performed on the Excel file version, where duplicates in each study were removed. Two reviewers independently screened the main titles and abstracts to maintain the accuracy and precision of the review. Full-text screening was performed for eligibility against the inclusion/exclusion criteria using Excel software filters, including conditional formatting. The disagreements were discussed and resolved through evidence-based discussions. The reference list was also examined, and further studies on ARVI and FRI linked to METS were manually searched and hand-cited. A total of 2 studies have been finalized for inclusion in this research review.

Data Extraction Process:

A standardized, structured data extraction list is maintained in an Excel file, capturing study characteristics such as participants' age range, author, citations (including DOI), study design, and metabolic biomarkers measured. Metabolic outcomes were also considered, including Vitamin D serum levels, thyroid values, BMI by age, lipid panel profile, and Micronutrients (iron, zinc, etc.). All data extraction is performed under the guidance of two reviewers to ensure accurate results; with each dataset line carefully compared to ensure the verification process and data reliability.

Risk of Bias (ROB) Assessment:

The final study designs included in this systematic review were observational cohort and cross-sectional studies; therefore, the ROB tools applied were the Newcastle–Ottawa Quality Assessment Scale (NOS) [52] and the Journal of Biomedical Informatics (JBI) Critical Appraisal Checklist [53], respectively.

Results.

The total number of research studies examined for this systematic review is one thousand two hundred and twenty-two. After removing duplicates, 848 report titles and abstracts were screened. After screening and deleting unnecessary reports, some records were also excluded due to the study design, the absence of ARVI and a paediatric population, and review studies. The outcome of the PRISMA flow chart (Figure 1) shows that two eligible studies linked to our designated topic meet the inclusion criteria with cautious results interpretation, making this a systematic review [54]. As the review followed strict PRISMA guidelines, limited eligible studies (n=2) and outcome variability disqualified quantitative synthesis, hence the study findings are presented following a narrative approach.

One included study in this review was manually searched in an online database, while the other was screened from the extracted data file.

Study Findings by Outcome:

Figure 2 illustrates the main characteristics organized and proposed mechanisms linking ARVI according to metabolic abnormalities associated with respiratory illness in children. The two included studies address different metabolic conditions and target separate age-group populations with ARVIs (Figure 2).

Researchers find through a cross-sectional study that low serum Vitamin D levels in children aged from one to five years are associated with two conditions of respiratory illness, namely pneumonia (viral respiratory infection) and ARVI [26]. They compared the Vitamin D levels of a total of 140 children with pneumonia (n=70) and ARVI (n=70), along with low vitamin D levels (<30 ng/mL), 52 children having pneumonia and 38 children with ARVI (statistical significance = $p < 0.05$). Children with normal Vitamin D levels were also compared; these included 18 pneumonia patients and 32 ARI patients. In contrast, another study using an observational cohort found that ARVI patients, including Acute nasopharyngitis (AN), Streptococcal pharyngitis (SP), Acute laryngitis (AL), and Acute bronchitis (AB), also have endocrine-related metabolic disorders [19]. Researchers found that elevated thyroid-stimulating hormone (TSH) levels in children, which are divided into two categories: young children (prepubertal) and older children (pubertal), of mean age 6.79±2.75 among young children and

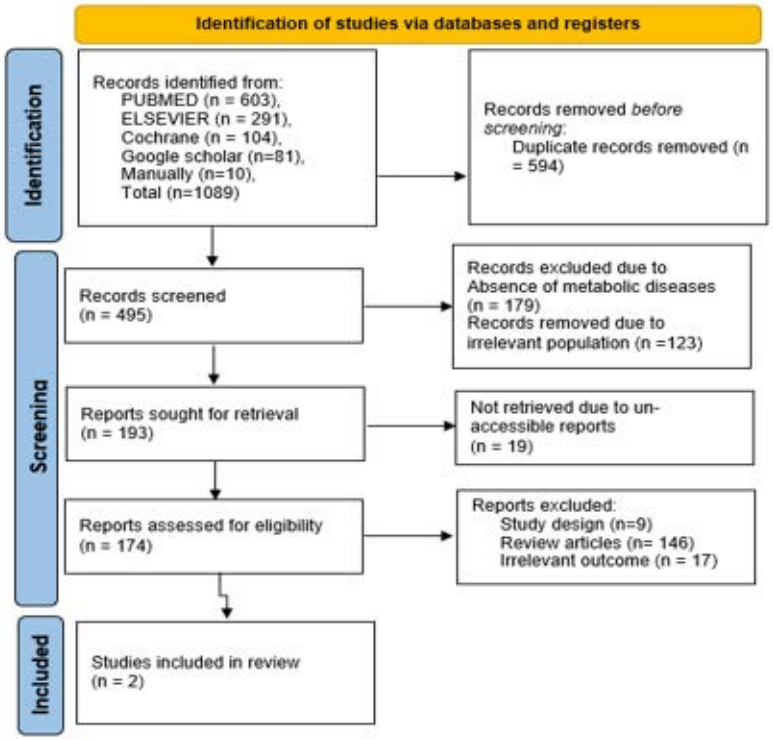

Figure 1. *PRISMA 2020 Flow Diagram Illustrating the Study Selection Process.*

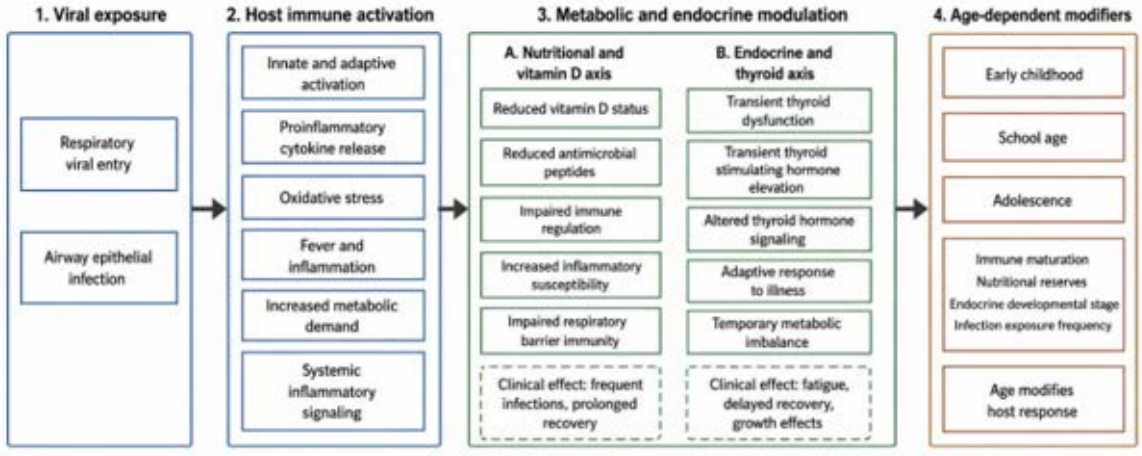

Figure 2. *Proposed mechanisms linking ARVI to different Metabolic Conditions in children.*

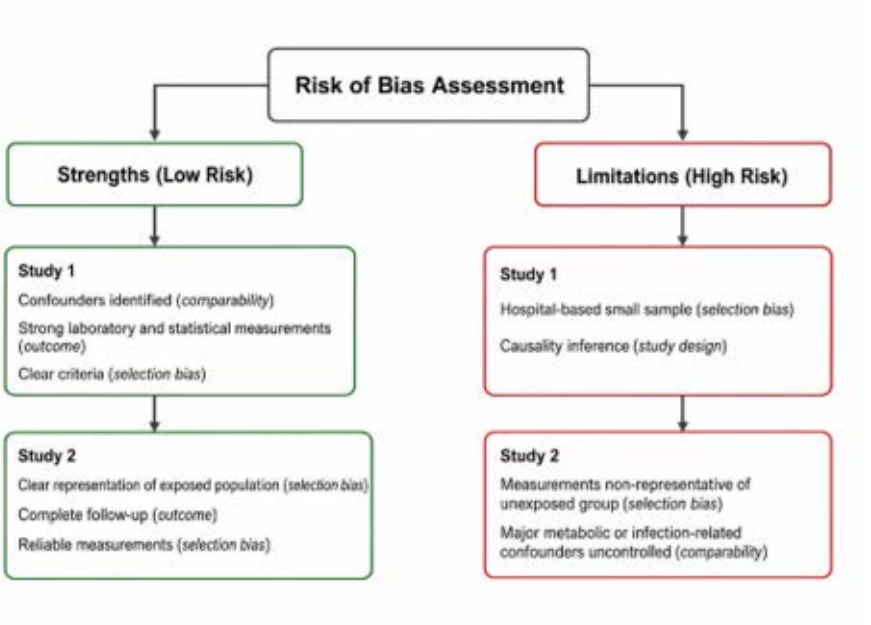

Figure 3. *Risk of Bias Assessment of Overall Result Outcome.*

Table 1. *Statistical Significance of Each Study Included.*

Study	Statistical Significance	Outcomes Measured	Numerical Outcomes
Adamczewska et al. 2021 [19]	p = 0.007 (sample size n= 94)	Thyroid hormone (elevated TSH, normal FT4). Increased TSH levels indicated an association with ARVI	TSH LEVELS -ARVI: 2.88 ± 1.29 vs CONTROL GROUP 2.95 ± 1.16 mIU/L (Non-significant) FT4- ARVI: 1.24 ± 0.08 vs CONTROL GROUP: 1.24 ± 0.11 ng/mL (Non-significant) Elevated TSH- ARVI 5 (6.6%) vs CONTROL GROUP: 4 (22.2%)0.06 TSH (follow-up)-2.93 ± 1.32 → 2.67 ± 1.05 mIU/L
Ayvazyan G et al. 2023 [26]	p < 0.05 (sample size n=140)	Vitamin D deficiency in ARVI patients, Old age shows more deficient children, while breastfeeding positively impacts the children and shows less ARVI condition in them	Not reported

Table 2. *Summary of the included studies.*

Study	Metabolic Measures	Population/ Age/Sample Size	Respiratory Illness	Location	Key Findings	Limitation	Measurement Method	Preventive Implications
Adamczewska et al. 2021 [19]	TSH, FT4, White blood cells, lymphocytes, neutrophils, body temperature, C-reactive protein	Children aged from 2.2-17.5 years (n=94)	ARVIs including AB, AL, AN, AT, SP	Poland	TSH elevation indicates ARVI without affecting FT4. TSH can become normal once the ARVI period is over. Increasing age can be a sign of elevated TSH in ARVI patients	Geographical constraint with no preventive measures taken	ECLIA	None taken
Ayvazyan G et al. 2023 [26]	Vitamin D	Children aged from one to five years (n=140)	ARVI, Pneumonia	Armenia	Vitamin D deficiency indicates ARVI in children. Vitamin D supplementation improves the ARVI condition. Increasing age can reduce vitamin D levels in ARVI patients	Geographical constraint with limited sample size lacking ARVI names	Electrochemil-uminescence (Cobas e411)	Vitamin D supplementation increases immunity through reducing recurrence of ARVIs

Table 3. *ROB Assessment Report on Studies Considered in the Review.*

Study	Study Method Design	RoB Measurement Method	RoB result	Strengths	Limitations
Ayvazyan G et al. 2023 [26]	Cross-Sectional	JBI	Low risk	Cofounders identified, strong lab and statistical measurements, clear criteria	Hospital based samples, inference causality
Adamczewska et al. 2021 [19]	Cohort-type Observational	NOS	Good quality (7 out of 9 stars)- Low risk	Representation of exposed cohort, Complete follow-up, secure measurements,	Uncontrolled cofounder, non-exposed cohort

14.5±1.53 among older ones, were associated with ARVI. Despite both studies finding different metabolic imbalances in infected children, they show a link between the mechanisms of metabolic changes during a respiratory viral infection. In Table 1 study findings stated that the older the child gets the lower the vitamin D levels are found in the children's body having respiratory illness, showing a negative association of age with the Calcidol levels (25-hydroxy vitamin D), However, during the acute phase of the respiratory viral infection, around 10% of children reported extreme TSH levels n=5 (6.6% increased) in young children and n=4 (22.2% increase) in older ones. The effect estimates in the included studies were not consistently reported in a standardized manner, therefore the findings are presented as the availability of data.

This shows that with increasing age, children are more susceptible to metabolic disorders, representing a direct association of age and TSH% increase. After ARVI recovery with more than 2 weeks of follow-up, which reflects a very good outcome measure (Figure 3), thyroid levels decreased after the infection phase in 64 out of 90 individuals (64.9%), regardless of baseline values, and 60% of TSH values became normal. The TSH levels showed a significant difference ($p = 0.007$) between the before and after TSH levels, without any preventive measures. This suggests that the ARVI somehow triggered the TSH levels among children with no underlying hormone imbalance or history of chronic thyroid disease, and the metabolic condition could be reversed if the respiratory illness recovered.

On the other hand, to address the Vitamin D deficiency, both children's groups were prescribed prophylactic Vitamin D supplementation [55], which increased Vitamin D levels among ARVI children (not in pneumonia). This suggests that supplementation with a vitamin D preventive dose could influence ARVI recovery while improving metabolic disease patterns, reducing ARVI and FRI complications [56]. A positive association ($p < 0.05$) is observed between feeding patterns and Vitamin D, with breastfeeding enhancing Vitamin D levels the most compared to non-rational and formula feeding among children with ARVI.

The study also examined complete blood count (White blood cells, lymphocytes, and neutrophils), body temperature, and C-reactive protein, but these parameters did not show any significant change in children with elevated TSH due to ARVI (Table 2).

ROB Assessment:

Both studies followed standard methodological practices for risk-of-bias assessment to improve the accuracy of the systematic reviews (as shown in Table 3). The cross-sectional research, following JBI critical appraisal checklist criteria, is of low risk, with key strengths including strong statistics, efficient measurement of vitamin D, clear inclusion/exclusion criteria, and appropriate cofounders. Cohort-type observational research, following the NOS RoB tool for assessment, is conducted with complete follow-up checks, re-measurements, and clear, objective-based lab outcomes, which are considered a good quality of study, with 7 out of 9 stars.

The limitations of the cohort study design include uncontrolled cofounders, with no independent comparison between the TSH and ARVI groups, which reduces the consistency of this review. Figure 3 shows, collectively, the low- and high-risk factors for bias, highlighting their strengths and limitations for this review. The study designs in both studies limit causal inference, and small sample sizes limit external validation for this review (Figure 3). However, standard laboratory procedures improve the reliability of overall biochemical outcomes (Figure 3).

Summary of Findings for the Included Studies.

The findings of this systematic review are summarized and represented in Table 3. Even though the two studies reviewed here address different temporary metabolic variations, they both have a significant impact on ARVI conditions among children aged 1 to 18 years. Interestingly, with increasing age in children with ARVI, vitamin D levels decrease. Similarly, in older ARVI patients, TSH% levels increase more than in younger patients. Both studies include child age groups with significant differences in metabolic outcomes, and neither one showed long-term complications of metabolic dysfunction among individuals after their recovery phase from the ARVI. A strong characteristic is that metabolic diseases appear to be transient, indicating variability or resolvability after the prevention practices observed in certain groups of individuals. However, preventive measures were taken and observed only for serum vitamin D concentration in children with pneumonia and acute respiratory infections, which limits this review. However, TSH levels returned to normal once the ARVI condition resolved.

Discussion.

This systematic review aims to evaluate the development of ARVIs' association with problems arising in multiple metabolic pathways, resulting in serious disease susceptibility. The results focused on two distinct metabolic dysfunctions, vitamin D deficiency and elevated TSH, both identified biomarkers representing a different physiological and methodological approach. Although these distinct pathways are linked with regulation of immunity, inflammatory signals and response of host cell during acute infection phase. Therefore, these conditions were considered under a wider notion, and their

findings collectively suggest that ARVIs in children can be associated with metabolic alterations on a short-term basis rather than affecting endocrine and nutritional sustainability, somehow reflecting a metabolic host response interconnection between the immunological and inflammatory pathways during a child's infection period.

Many researchers support the idea that recurrent body inflammation at an early age can lead to chronic respiratory conditions later in a child's life, including asthma [6], decreased lung volume and function [57], and increased susceptibility to other viral infections [18,24,58]. While demonstrating a measurable metabolic alteration due to ARVIs, this review highlights that the FRI not only shows exposure to infection [39] but also suggests hidden metabolic vulnerabilities, supporting various previous hypotheses. According to the scientists, underlying metabolic diseases, when identified, reflect the body's inflammation through biochemical consequences [45]. While the mentioned research studies support the findings, neither discusses the transient change in metabolic function during the ARVI phase. Our review indicates a reversible metabolic imbalance in ARVI patients rather than permanent dysfunction, suggesting that ARVI-induced metabolic alterations are mainly reactive rather than chronic, revealing a new pattern.

Another significant finding indicated the age-dependent variability in metabolic functions. Older children who have ARVI showed deficient vitamin D levels and elevated TSH levels, making it a potential factor linked to disease susceptibility among children. Many studies have failed to find age-dependent variability in TSH levels in ARVI patients; researchers, on the other hand, found vitamin D deficiency in younger children with acute respiratory infections, contradicting our findings [59]. Although previous studies note that metabolic conditions differ across a child's developmental periods [8,60], the age-associated variance in ARVI patients has not been critically evaluated in either study.

Lack of Vitamin D is a risk factor among ARVI patients.

There are numerous international studies supporting our research outcomes and critically evaluating the inappropriate calcidol levels during an infection period of a respiratory illness among children [26,37,55,56,61]. Several current studies indicate that vitamin D plays various immunomodulatory roles that influence the likelihood of respiratory tract infections in children, fitting our research findings in the extensive context of existing knowledge [62-64]. Vitamin D influences the immune system by controlling the activity of multiple cells having different functions [65]. Because of these functions, vitamin D is considered a key factor involved in the development of numerous diseases. It also contributes to shaping the adaptive immune response [66]. Thus, this may indicate that lower vitamin D levels indicate their susceptibility role in the ARVIs pathways, proving it as a risk factor mainly in older children suffering from FRIs [62,63]. Contrary to our findings, a systematic study evidently failed to find the link between the ARVIs and low serum Vitamin D levels in a pediatric population [64]. Similarly, another article about acute lower respiratory tract infections did not provide evidence against the connection between serum Vitamin D levels and the infection phase [67].

Thyroid Imbalance as a Risk Factor Among ARVI Patients.

Thyroid hormones influence the development of the respiratory system, including lung volume and airflow, while also regulating the respiratory control centers within the brain [68-76]. Consistent with our findings, a research study documented a severe thyroid hormone imbalance in a 10-year-old child presenting with an ARVI [77], indicating a consistent link between respiratory infections and endocrine pathways, however causal inference cannot be drawn from this limited evidence.

Recently, there has been a renewed focus on the production, metabolism, release, and systemic action of thyroid hormones. This research highlights their therapeutic relevance and the mechanisms linking thyroid activity with immune and inflammatory processes within respiratory infectious pathways [78]. Supporting this theoretical framework, additional research indicates that older children with ARVIs exhibit inflammatory responses associated with thyroid hormone complications [78]. Currently, there is a lack of available literature that contradicts the findings presented in this review.

Preventive Measures Taken to Improve Metabolic Pathways for Better Respiratory Recovery.

Like our findings, a cross-sectional study suggested that a standardized vitamin D dosage reduces the ARVIs in children aged from one to eighteen years. Supporting our findings, another study showed that children with vitamin D levels greater than 800 IU per week had a significantly lower incidence of respiratory infections compared with those with vitamin D levels less than 400 IU per week (60.0%, $p < 0.001$) [63]. It is generally accepted that a minimum serum Vitamin D concentration of about 10 ng/mL is required to support bone mineralization and maintain calcium balance [63].

In this review, thyroid alterations are only temporary during the ARVI phase and require no prevention or supplementation. Unfortunately, very few investigations have reported that high TSH levels are linked to a greater likelihood of respiratory tract infections, leading to unnoticed supplementation suggestions and prevention methods for the pediatric population [79] regarding thyroid imbalance that might help prevent such infections, requiring detailed research in this region and marking a considerable gap in the field.

Strengths.

The strengths of this review are evident in Figure 3. The outcome of this research could be exploratory, supported by various research studies, as the review is internally coherent. The review is based on studies that followed standardized procedures and laboratory assessments to evaluate alterations in relevant metabolic biomarkers, which occur temporarily in the form of micronutrient deficiency and hormonal imbalance, during the infection phase of acute respiratory viral illness. The study included participants using clearly defined inclusion and exclusion criteria to reduce selection bias and provide a crystal-clear representation of the exposed ARVI pediatric population.

Limitations.

The findings are geographically restricted, and a small sample size limits statistical power and number of evidence, making

it a provisional systematic review. Confidence intervals and standardized effects were not reported consistently, which limits study interpretation of précised estimation and external generalizability of the research outcome. A lack of potential confounding variables, such as diet, socioeconomic status, and exposure to natural sunlight, is observed, which are insufficiently controlled. A deviation in age among the groups of children is observed, potentially challenging the collective interpretation of the review. A small number of metabolic disorders limit the scope of this study, and there is a need to evaluate long-term metabolic after-effects over an appropriate follow-up period.

Conclusion.

Finally, this review concludes that the children having metabolic vulnerabilities suggests a possible association with ARVIs which are of significant concern. The metabolic alterations include, specifically, low Vitamin D levels and high TSH, reflecting inflammation in biochemical pathways that restrict immunity, making pediatric populations susceptible to respiratory infections through ARVIs, further complicating the child's health condition and leading to other harmful impacts. The evidence base for this heterogeneous review is minimal and geographically restrictive, making the interpretation of the findings extremely cautious. The final indication of this systematic review suggests short-term metabolic alterations in the pediatric population with ARVI, implying that ARVI can possibly disturb metabolic pathways without permanently altering biochemical markers.

Implications for Clinical Practice and Public Health.

Apart from the substantial burden of pulmonary acute infections and the high prevalence of dysfunctional vitamin D and thyroid levels, the current evidence base remains inadequate within the pediatric population, with no functional articulations in standardized clinical practices or specific public health recommendations consequently. Nonetheless, systematic review based on only two eligible studies with preventive strategies and screening protocols related to vitamin D and thyroid hormones cannot be justified characterized by small sample sizes.

Future Research Recommendations.

Broadening the understanding of metabolic regulation pathways involving focused micro nutritional and endocrine systems for the upcoming research investigations particularly multi-center cohort studies. This will further clarify in children with ARVIs collectively whether these alterations represent a temporary inflammatory response or serve as indicators of severe underlying metabolic conditions

Specifically, available study outcome suggests a possible relationship between ARVI and metabolic conditions but due to limited number of research papers it is not proven on such small scale so a continuation of longitudinal study design is required to formulate a significantly research employing sophisticated nonlinear statistical modeling to observe physiological changes occurring before, during, and after an ARVI outbreak is fundamentally essential to improve the long-term understanding of underlying disease mechanisms among the pediatric population. To achieve an external validity, a more diverse research methodology is critically required which will eventually improve the early diagnosis techniques, more accurate assessment of severe respiratory illness, and better outcome prediction.

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Not applicable.

Authors' contributions.

The research was conducted by Klara Kaldygozova and Maya Maksut. They both primarily drafted the manuscript, prepared radiological images, and performed critical revision of the manuscript. Aigul Sergazina critically revised the manuscript. Gulmira Datkayeva conceived the research and critically revised the manuscript. Sulugaisha Kalen obtained intraoperative imaging and critically revised the manuscript. All authors read and approved the final version of the manuscript.

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Competing interests.

The author declare that they have no competing interests for publication.

Data availability statement.

The raw data supporting the conclusions of this article will be made available by the authors, without undue reservation.

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