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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 ბაზებშიდან.

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. 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.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 საყურადღებო!

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, შემავსებელი და პროცენტული მონაცემები უნდა შეესაბამებოდეს ტექსტში მოყვანილს.

6. ფოტოსურათები უნდა იყოს კონტრასტული; სურათები, ნახაზები, დიაგრამები - დასათაურებული, დანომრილი და სათანადო ადგილას ჩასმული. რენტგენოგრაფიის ფოტოსურათები 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.

აღნიშნული წესების დარღვევის შემთხვევაში სტატიები არ განიხილება.

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Abstract.

Aim: To determine the prevalence and risk stratification profile of cardiovascular abnormalities identified during a two-year structured preparticipation screening programme among pediatric competitive athletes in Adjara, Georgia, and to evaluate its implications for prevention of exercise-related sudden cardiac death.

Material and Methods: A cross-sectional cohort study was conducted over two consecutive athletic seasons (2023–2025) in the Autonomous Republic of Adjara, Georgia. A total of 647 competitive athletes aged 5–17 years were enrolled through organized sports institutions. All participants underwent standardized cardiovascular evaluation comprising structured medical history, physical examination, resting 12-lead electrocardiography interpreted according to international athlete-specific criteria, and transthoracic echocardiography. Detected abnormalities were classified into low-, intermediate-, and high-risk categories for sudden cardiac death in accordance with the 2020 ESC Guidelines on Sports Cardiology and Exercise in Patients with Cardiovascular Disease. Exact 95% confidence intervals were calculated using the Wilson Score method.

Results: Cardiovascular abnormalities were identified in 73 of 647 athletes (11.3%; 95% CI 9.1–14.0%). High-risk conditions requiring specialist cardiology evaluation and individualized, shared decision-making-based sports eligibility assessment were detected in 4 athletes (0.62%; 95% CI 0.24–1.57%), comprising one case of hypertrophic cardiomyopathy and three cases of clinically significant conduction disorders. All four affected individuals were previously asymptomatic. The most prevalent abnormalities were patent foramen ovale (4.02%), mitral valve disease (3.09%), and mitral valve insufficiency (1.85%). The number needed to screen to identify one high-risk condition was 162 athletes.

Conclusions: Structured preparticipation cardiovascular screening in pediatric athletes in Adjara identifies a clinically meaningful burden of previously undetected cardiac pathology, including life-threatening conditions in asymptomatic individuals. The timely detection of high-risk conditions facilitated specialist referral and entry into an individualized, shared decision-making-based sports eligibility process, thereby potentially preventing exercise-related sudden cardiac events in this cohort. These findings provide essential region-specific epidemiological parameters and support the systematic integration of ECG-inclusive cardiovascular screening, aligned with the 2025 AHA/ACC shared decision-making framework, within organized youth sports programmes in Georgia.

Key words. Pediatric athletes, sudden cardiac death, cardiovascular screening, electrocardiography, echocardiography, preparticipation evaluation, sports cardiology, hypertrophic cardiomyopathy, patent foramen ovale, Adjara, Georgia.

Introduction.

Sudden Cardiac Death in Young Athletes as a Public Health Priority:

Sudden cardiac death (SCD) in children and adolescents engaged in competitive sports represents a low-incidence but catastrophically high-impact public health event. Population-based estimates indicate an overall SCD incidence of approximately 0.6 to 6.2 per 100,000 person-years in individuals under 18 years of age, depending on case definition, surveillance methodology, and geographic context [1,2]. Among competitive athletes specifically, incidence estimates range from 1 in 40,000 to 1 in 80,000 athlete-years, with disproportionately higher rates reported among male adolescents and participants in high-intensity sports disciplines [3,4].

Despite its rarity, SCD in young athletes carries consequences far exceeding its numerical frequency. Events typically occur during or immediately after organized sports participation, often in public settings, among individuals who are perceived as healthy and physically fit. The psychological, legal, and institutional repercussions extend to families, sports organizations, healthcare providers, and governing bodies. From a preventive medicine perspective, even rare catastrophic outcomes may justify structured intervention when identifiable preclinical disease is present and when effective detection tools are available [5].

A defining feature of exercise-related SCD in this demographic is that it frequently represents the first clinical manifestation of underlying cardiovascular disease. Structural cardiomyopathies, primary electrical disorders, congenital coronary anomalies, and selected valvular abnormalities collectively account for the majority of exercise-related fatalities. These conditions typically remain clinically silent until the increased sympathetic activity, elevated heart rate, and hemodynamic stress associated with intense physical exertion unmask their arrhythmogenic potential [6].

Evidence from established national screening programmes demonstrates that systematic preparticipation cardiovascular evaluation can identify subclinical disease prior to adverse events. The landmark Italian national screening programme, incorporating routine 12-lead electrocardiography (ECG) as a mandatory component, demonstrated a substantial reduction in SCD incidence among competitive athletes following decades of implementation [7]. This model has profoundly

shaped international policy debate and provided the strongest prospective evidence to date for the preventive value of ECG-inclusive screening.

The 2020 ESC Guidelines Framework:

The 2020 European Society of Cardiology (ESC) Guidelines on Sports Cardiology and Exercise in Patients with Cardiovascular Disease provide the most current and comprehensive international framework for cardiovascular preparticipation evaluation [8]. These guidelines explicitly recommend a preparticipation screening programme encompassing personal and family medical history, physical examination, and resting 12-lead ECG for all competitive athletes. The inclusion of ECG is endorsed based on its superior diagnostic performance relative to history and physical examination alone, particularly for the detection of primary electrical disorders that may not manifest in any structural abnormality detectable by echocardiography.

The 2020 ESC Guidelines further specify risk stratification criteria and sports eligibility recommendations for a broad spectrum of cardiovascular conditions, enabling clinicians to make evidence-based, individualized recommendations that balance participation rights with patient safety. Critically, the guidelines acknowledge that international consensus is not uniform: the American Heart Association continues to endorse a history- and examination-based model, citing concerns related to ECG specificity, downstream testing burden, and cost-effectiveness in the United States context [9]. Nevertheless, the 2020 ESC framework represents the accepted standard in European and broader international sports medicine practice.

Etiological Spectrum of Exercise-Related Cardiac Events:

Sudden cardiac death in pediatric athletes encompasses a heterogeneous group of underlying pathologies with differing prevalence, detectability, and risk profiles [6,10]. Hypertrophic cardiomyopathy (HCM) is among the most frequently identified structural causes of SCD in young athletes, particularly in North American cohorts, where it accounts for approximately one-third of exercise-related fatalities [11]. The arrhythmogenic substrate in HCM — comprising myocardial disarray, interstitial fibrosis, and microvascular dysfunction — predisposes affected individuals to malignant ventricular tachyarrhythmias during exertion, even in the absence of significant outflow tract obstruction [12].

Primary electrical disorders constitute an equally critical etiological category. Clinically significant conduction disorders, including Wolff-Parkinson-White syndrome and other accessory pathway-mediated arrhythmias, may predispose to rapid ventricular rates during atrial arrhythmias and, in extreme cases, ventricular fibrillation [13]. Inherited channelopathies, including long QT syndrome (LQTS) and catecholaminergic polymorphic ventricular tachycardia (CPVT), may precipitate life-threatening arrhythmias in structurally normal hearts and are frequently detectable through careful ECG analysis [14,15].

Structural valvular abnormalities and congenital defects contribute variably to overall risk. Patent foramen ovale (PFO), present in approximately 25% of the general population, carries low direct arrhythmic risk in the context of sports participation, but requires appropriate identification and classification [16]. Mitral valve disease and aortic valve abnormalities may range

from clinically benign variants to hemodynamically significant lesions warranting restriction from high-intensity competitive sports. Distinguishing physiological cardiac adaptation — the so-called 'athlete's heart' — from pathological findings remains a central challenge, addressed systematically by contemporary international ECG interpretation criteria that have significantly improved diagnostic specificity [17,18].

Evidence Gap in Georgia and the Rationale for This Study:

Georgia represents a relevant and informative context within which to establish regional epidemiological data. The country has experienced progressive growth in youth participation in organized competitive sports over the past decade, with football, rugby, basketball, and martial arts disciplines maintaining substantial institutional infrastructure. However, standardized preparticipation cardiovascular screening protocols have not been uniformly implemented at the national or regional level, and no centralized screening registry currently exists [19].

In the absence of region-specific prevalence data, policymakers and sports medicine professionals in Georgia lack empirical foundations necessary for evaluating the proportionality, feasibility, and potential public health impact of structured screening strategies. Prior publication from our group, based on a single cross-sectional cohort of 442 athletes screened in 2025, provided initial evidence that cardiovascular abnormalities occur in this population at rates consistent with international estimates [20]. The present study extends and substantially strengthens this evidence base by reporting findings from a two-year regional screening programme involving 647 pediatric athletes, enabling more robust prevalence estimation and richer characterization of the epidemiological landscape.

Study Objectives.

The primary objective of this study was to determine the prevalence of cardiovascular abnormalities detected during a structured two-year preparticipation cardiovascular screening programme among pediatric competitive athletes aged 5–17 years in Adjara, Georgia.

Secondary objectives were: (1) to classify detected abnormalities according to the 2020 ESC risk stratification framework; (2) to quantify the screening yield for high-risk conditions; (3) to describe the demographic and sport-specific context of the cohort; (4) to compare observed prevalence with international benchmarks; and (5) to evaluate implications for national sports safety and preventive health policy in Georgia.

Materials and Methods.

This study was designed as a cross-sectional cohort screening study, conducted prospectively across two consecutive athletic seasons between 2023 and 2025 in the Autonomous Republic of Adjara, Georgia. Reporting followed the Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) guidelines for observational research [21]. The primary analytical objective was estimation of the point prevalence of cardiovascular abnormalities in a defined population of pediatric competitive athletes. Secondary analyses addressed risk stratification, screening yield, and subgroup characteristics.

Adjara is an autonomous coastal administrative region in western Georgia with an established youth sports infrastructure

encompassing football academies, rugby programmes, basketball clubs, and other organized competitive disciplines. Participants were recruited through organized sports institutions participating in regional competitive programmes during the 2023–2024 and 2024–2025 athletic seasons. A total of 647 athletes fulfilling eligibility criteria were enrolled.

Inclusion criteria were: age 5–17 years; active participation in organized competitive sports with training frequency of at least three sessions per week; and provision of written informed consent by a parent or legal guardian. Exclusion criteria were: previously diagnosed complex congenital heart disease requiring surgical or interventional management; ongoing specialized cardiology follow-up for a known high-risk cardiac condition; and incomplete screening data precluding full assessment.

Screening Protocol:

All participants underwent a standardized cardiovascular evaluation conducted by trained physicians using a structured protocol. The screening comprised four components: (a) structured medical history assessment; (b) physical examination; (c) resting 12-lead electrocardiography; and (d) transthoracic echocardiography.

Medical history was obtained using a structured questionnaire aligned with preparticipation evaluation frameworks recommended by the 2020 ESC Guidelines [8], encompassing exertional chest pain or discomfort, exertional syncope or presyncope, palpitations, unexplained dyspnoea disproportionate to exercise intensity, family history of premature sudden cardiac death, and known familial cardiomyopathy or inherited arrhythmia syndrome.

Physical examination included measurement of resting blood pressure in both arms, cardiac auscultation performed in both supine and standing positions, auscultation for peripheral vascular abnormalities, and clinical assessment for phenotypic features suggestive of connective tissue disorders such as Marfan syndrome. Body height and weight were measured with standardized instruments, and body mass index (BMI) was calculated and classified according to World Health Organization growth reference standards for children and adolescents [22].

Resting 12-lead ECG was performed using standardized electrode positioning and calibration (25 mm/s paper speed, 10 mm/mV amplitude). ECGs were interpreted by a physician trained in athlete-specific ECG evaluation according to the International ECG Criteria for Competitive Athletes (Seattle Criteria as updated in the 2017 international consensus statement) and corroborated with the 2020 ESC Guidelines framework [17,8]. Physiological athletic adaptations, including sinus bradycardia, first-degree atrioventricular block, early repolarization, and voltage criteria for left ventricular hypertrophy in the absence of other abnormalities, were not classified as pathological findings.

Transthoracic echocardiography was performed using two-dimensional and spectral Doppler techniques. Evaluation included measurement of left ventricular wall thickness and chamber dimensions, assessment of valve morphology and function by Doppler and color flow mapping, examination of the interatrial septum with contrast bubble study where indicated, and assessment of right ventricular size and function.

Referral Criteria and Clinical Management Pathway:

A pre-specified referral pathway, aligned with the 2020 ESC risk stratification framework, determined the clinical action taken for each screening outcome. Athletes with a high-risk finding were referred immediately for specialist pediatric cardiology evaluation and were temporarily withheld from competitive training pending completion of diagnostic work-up, consistent with contemporaneous ESC guidance and the subsequent 2025 AHA/ACC scientific statement. Athletes with an intermediate-risk finding were referred for outpatient cardiology follow-up, including further echocardiographic assessment and, where clinically indicated, ambulatory ECG monitoring, but were not restricted from training pending this evaluation. Athletes with a low-risk finding were retained within the screening programme for routine surveillance and scheduled re-evaluation at the subsequent seasonal screening cycle, without formal cardiology referral unless findings progressed on interval assessment. This tiered pathway was intended to concentrate specialist resources on the small proportion of athletes at genuine risk of exercise-related sudden cardiac death while avoiding unnecessary restriction of athletes with benign or low-risk findings.

Definitions and Risk Stratification:

Cardiovascular abnormalities were defined as structural or electrical findings deviating from age-adjusted normative ranges and not attributable to physiological athletic adaptation. Detected abnormalities were classified into three risk categories in accordance with the 2020 ESC Guidelines on Sports Cardiology [8]:

High-risk conditions were defined as those associated with increased probability of malignant arrhythmia or sudden cardiac death during exertion, requiring mandatory specialist cardiology evaluation and individualized sports eligibility assessment. These comprised hypertrophic cardiomyopathy, clinically significant conduction disorders with arrhythmogenic potential (including manifest ventricular pre-excitation and significant atrioventricular conduction anomalies), and inherited channelopathies with pathological ECG features.

Intermediate-risk conditions were defined as structural abnormalities requiring cardiology follow-up but not associated with immediate high arrhythmic risk under standard competitive conditions. These comprised patent foramen ovale and aortic valve disease not meeting criteria for severe stenosis or regurgitation.

Low-risk conditions were defined as findings considered clinically benign in the context of competitive sports participation under regular medical surveillance, including mitral valve disease without significant regurgitation and mild mitral valve insufficiency without functional impairment.

Quality Assurance and Handling of Borderline or False-Positive Findings:

To limit misclassification arising from borderline or equivocal findings, every ECG and echocardiogram flagged as abnormal on initial reading was independently confirmed by a second physician trained in athlete-specific interpretation before being entered into the final dataset. Where initial tracings showed features that could not be confidently distinguished from physiological athletic adaptation, or where echocardiographic

measurements fell close to age-adjusted cut-offs, the athlete underwent repeat evaluation rather than immediate classification. Findings that normalized on repeat testing or were adjudicated as physiological variants by consensus of the reviewing physicians were not counted as cardiovascular abnormalities in the final analysis; only findings confirmed on this two-step process contributed to the prevalence estimates reported here. This approach was intended to minimize both false-positive misclassification, which would inflate apparent prevalence and generate unnecessary downstream referrals, and false-negative misclassification of genuine pathology as physiological adaptation.

Statistical Analysis:

Descriptive statistics were used to characterize the study population. Continuous variables are presented as mean $\pm$ standard deviation (SD). Categorical variables are presented as absolute counts and proportions. Prevalence of cardiovascular abnormalities was calculated as the proportion of affected athletes among all screened participants. Exact 95% confidence intervals for all prevalence estimates were computed using the Wilson Score Interval method, which provides robust coverage probability for proportions across all sample sizes and prevalence levels [23]. The number needed to screen (NNS) to detect one high-risk condition was calculated as the reciprocal of the prevalence of high-risk conditions. All analyses were performed using R statistical software, version 4.4 [24].

Ethical Considerations:

The study was conducted as part of a routine preparticipation cardiovascular screening programme within organized sports institutions. The study protocol was reviewed by the Ethics Committee of the M. Iashvili Mother and Child Center, where this study was conducted, and determined not to require formal independent ethics committee approval, as it involved non-interventional population screening and retrospective analysis of fully anonymized data. All screening procedures conformed to standard clinical practice. Written informed consent was obtained from parents or legal guardians prior to participation, and age-appropriate assent was obtained from participants. All data were fully anonymized prior to analysis. The study was conducted in accordance with the principles of the Declaration of Helsinki.

Results.

A total of 647 pediatric competitive athletes were included in the analysis. The cohort comprised participants from two consecutive athletic seasons (2023–2024 and 2024–2025). Males constituted 86.4% of the cohort ($n = 559$) and females 13.6% ($n = 88$), reflecting the demographic composition of organized competitive sports institutions in Adjara, with football academies representing the predominant recruitment source.

Age ranged from 5 to 17 years. The largest age groups were 13–14 years ($n = 216$; 33.4%) and 11–12 years ($n = 210$; 32.5%), collectively representing 65.9% of the cohort. Children aged 9–10 years comprised 15.6% ($n = 101$), and those aged 7–8 years comprised 11.3% ($n = 73$). Younger (5–6 years) and older (15–17 years) participants represented smaller fractions of the total.

The most prevalent sport was football, accounting for 73.4% of participants ($n = 475$). Rugby ($n = 49$; 7.6%), basketball ($n = 32$; 4.9%), and other disciplines including martial arts, athletics, and swimming accounted for the remainder. Complete demographic and clinical characteristics are presented in Table 1.

Overall Prevalence of Cardiovascular Abnormalities:

Cardiovascular abnormalities were identified in 73 of 647 screened athletes, yielding an overall prevalence of 11.3% (95% CI 9.1–14.0%). The remaining 574 athletes (88.7%) demonstrated no clinically relevant structural or electrical findings on any component of the screening evaluation.

High-risk conditions associated with increased probability of exercise-related sudden cardiac death were detected in 4 athletes, yielding a prevalence of 0.62% (95% CI 0.24–1.57%). All four affected individuals had been entirely asymptomatic prior to screening. The number needed to screen to detect one high-risk condition was 162 athletes. Summary prevalence data are presented in Table 2.

Spectrum of Detected Cardiovascular Abnormalities:

Among the 73 athletes with detected abnormalities, the majority of findings were structural. Patent foramen ovale (PFO) constituted the single most prevalent diagnosis ($n = 26$; 4.02%), followed by mitral valve disease ($n = 20$; 3.09%), mitral valve insufficiency ($n = 12$; 1.85%), aortic valve disease ($n = 11$; 1.70%), clinically significant conduction disorders ($n = 3$; 0.46%), and hypertrophic cardiomyopathy ($n = 1$; 0.15%). The complete distribution of diagnoses with risk classification is presented in Table 3.

Low-risk findings accounted for 32 cases (43.8% of all abnormalities), comprising mitral valve disease and mitral valve insufficiency. Intermediate-risk findings represented 37 cases (50.7%), encompassing PFO and aortic valve disease. High-risk conditions constituted 4 cases (5.5% of abnormalities).

High-Risk Conditions:

Four athletes were identified with high-risk cardiovascular conditions warranting mandatory specialist cardiology referral and individualized sports eligibility assessment per the 2020 ESC Guidelines and, subsequently, the 2025 AHA/ACC scientific statement on competitive sports participation for athletes with cardiovascular abnormalities [8,41].

One athlete was diagnosed with hypertrophic cardiomyopathy based on echocardiographic demonstration of asymmetric septal hypertrophy exceeding the age-adjusted upper limit of normal, in the absence of secondary causes of left ventricular hypertrophy. The affected athlete was male, aged 14 years, and was engaged in competitive football training. No family history of sudden cardiac death was reported at initial screening.

Three athletes were identified with clinically significant conduction disorders on ECG, comprising one case of manifest ventricular pre-excitation consistent with Wolff-Parkinson-White pattern, and two cases of high-degree atrioventricular conduction abnormalities not attributable to physiological vagotonia. These conditions carry established arrhythmogenic risk during high-intensity exercise [13]. All three affected athletes were male, aged between 12 and 15 years, and were engaged in football or rugby.

Table 1. Demographic and Clinical Characteristics of the Study Population (n = 647).

Variable	n	%	95% CI (Wilson)
Total screened	647	100%	—
Male	559	86.4%	83.5–88.8%
Female	88	13.6%	11.2–16.5%
Age 5–6 years	16	2.5%	1.5–4.0%
Age 7–8 years	73	11.3%	9.1–14.0%
Age 9–10 years	101	15.6%	13.0–18.6%
Age 11–12 years	210	32.5%	29.0–36.2%
Age 13–14 years	216	33.4%	29.9–37.1%
Age 15–16 years	26	4.0%	2.8–5.8%
Age 17 years	5	0.8%	0.3–1.8%
Football	475	73.4%	69.9–76.6%
Rugby	49	7.6%	5.8–9.9%
Basketball	32	4.9%	3.5–6.9%
Other sports	91	14.1%	11.6–17.0%

Table 2. Prevalence of Cardiovascular Abnormalities Identified During Screening (n = 647).

Screening Outcome	n	%	95% CI (Wilson)
No abnormality detected	574	88.7%	86.0–90.9%
Any cardiovascular abnormality	73	11.3%	9.1–14.0%
Intermediate-risk condition	37	5.7%	4.1–7.8%
High-risk condition	4	0.62%	0.24–1.57%

Table 3. Distribution and Risk Classification of Cardiovascular Abnormalities (n = 647).

Diagnosis	n	% of total (n=647)	% within abnormalities (n=73)	Risk Category
Mitral valve disease	20	3.09%	27.4%	Low
Mitral valve insufficiency	12	1.85%	16.4%	Low
Patent foramen ovale (PFO)	26	4.02%	35.6%	Intermediate
Aortic valve disease	11	1.70%	15.1%	Intermediate
Conduction disorder	3	0.46%	4.1%	High
Hypertrophic cardiomyopathy (HCM)	1	0.15%	1.4%	High
Total	73	11.28%	100%	—

Table 4. Comparison of Cardiovascular Abnormality Prevalence Across Selected International Screening Cohorts.

Study / Country	n	Screening Method	Overall Prevalence	High-Risk Prevalence
Present study (Georgia)	647	ECG + Echo	11.3% (9.1–14.0%)	0.62% (0.24–1.57%)
Grazioli et al. [25] (Spain)	~3,000	ECG + Echo	~12.5%	~0.5%
Magalski et al. [26] (USA)	~2,500	ECG + Echo	~10.0%	~0.3%
Price et al. [27] (USA)	~5,000	ECG-inclusive	~14.0%	~0.6%
Malhotra et al. [28] (UK)	~11,000	ECG + Echo	~13.8%	~0.4%

All four athletes with high-risk conditions were referred for specialist cardiology evaluation and were temporarily withheld from competitive training pending diagnostic completion and guideline-directed risk reduction therapy, consistent with both the 2020 ESC recommendations applied at the time of screening and the subsequent 2025 AHA/ACC scientific statement, which similarly advises temporary withholding from competition while diagnostic evaluation and risk-reduction measures are completed [8,41]. Final eligibility determinations for these athletes were not framed as one-time disqualification decisions but as the starting point of an individualized shared decision-making process involving the athlete, family, treating cardiologist, and sporting institution, in line with the 2025 AHA/ACC paradigm [41,42]. None of these conditions had been previously identified on any prior medical evaluation.

Age and Sex Distribution of Abnormalities:

High-risk conditions were identified exclusively in male athletes aged 12–15 years. Intermediate-risk findings, particularly PFO, were distributed across both age groups (younger: 5–10 years; older: 11–17 years), consistent with the known prevalence of this variant across pediatric age groups. Low-risk structural findings demonstrated no notable age-specific clustering. Male athletes exhibited a numerically higher rate of detected abnormalities overall, but formal inferential testing for sex-specific differences was not performed given the descriptive nature of the analysis and the marked sex imbalance of the cohort.

Comparison with International Benchmarks:

The observed overall prevalence of cardiovascular abnormalities (11.3%; 95% CI 9.1–14.0%) falls within the

range reported in international screening cohorts utilizing combined ECG and echocardiographic evaluation, where prevalence estimates typically range between 10% and 15% [25,26]. The prevalence of high-risk conditions (0.62%; 95% CI 0.24–1.57%) similarly aligns with international estimates ranging from 0.2% to 0.7% in structured screening programmes [27,28]. These comparisons are summarized in Table 4.

Discussion.

Principal Findings and Clinical Significance:

This two-year regional screening programme provides substantial evidence that structured preparticipation cardiovascular evaluation in pediatric competitive athletes in Adjara, Georgia identifies a clinically meaningful burden of previously unrecognized cardiac pathology. One in nine screened athletes harboured a cardiovascular abnormality; critically, 4 athletes — 1 in every 162 screened — carried high-risk conditions directly associated with exercise-related sudden cardiac death. Each of these four individuals was asymptomatic and had not been previously evaluated or diagnosed.

The clinical importance of these findings cannot be overstated. Hypertrophic cardiomyopathy is the leading identifiable structural cause of SCD in young athletes in North American cohorts and a major cause globally, with the catastrophic arrhythmic event frequently representing its initial manifestation [11,12]. Wolff-Parkinson-White syndrome and significant atrioventricular conduction disorders carry well-documented risk of rapid ventricular conduction and fibrillation during the sympathetic surge accompanying intense physical exertion [13]. Under the 2020 ESC Guidelines framework that informed the risk stratification applied in this study, athletes diagnosed with these conditions require individualized specialist evaluation, with competitive sports eligibility determined on a case-by-case basis incorporating electrophysiological risk stratification [8]. This case-by-case orientation has been substantially reinforced by the 2025 AHA/ACC scientific statement on clinical considerations for competitive sports participation for athletes with cardiovascular abnormalities, which formally supersedes the categorical eligibility/disqualification model of the 2015 statement in favour of a shared decision-making (SDM) paradigm [41]. Under this updated framework, the default response to a high-risk diagnosis such as hypertrophic cardiomyopathy or manifest ventricular pre-excitation is not automatic and permanent disqualification but a structured process of individualized risk assessment, guideline-directed therapy where indicated, and an ongoing dialogue between the athlete (and, in pediatric cases, their family), the treating cardiologist, and the sporting institution, with eligibility decisions revisited longitudinally as risk-modifying treatment, imaging, and electrophysiological data accrue [41,42]. Early identification prior to an adverse event therefore transforms the clinical scenario not only from reactive emergency response to proactive risk management, but also from a one-time eligibility verdict to an iterative, athlete-centred SDM process.

Epidemiological Comparability and Generalizability:

The observed overall prevalence of 11.3% is consistent with international cohorts utilizing combined ECG and

echocardiographic evaluation, as synthesized in recent systematic reviews and referenced cohort studies from Western Europe, North America, and the Middle East [25–28]. The high-risk prevalence of 0.62% similarly falls within the expected range of 0.2–0.7% reported across structured screening programmes. This epidemiological consistency across diverse health system contexts is clinically significant: it indicates that the underlying burden of occult cardiac pathology in pediatric competitive athletes is a relatively stable population-level phenomenon, not confined to high-income or historically screened populations.

The predominance of low-risk and intermediate-risk structural findings — particularly PFO and mitral valve pathology — is also consistent with international data and reflects the expected yield of comprehensive echocardiographic screening. PFO, present in approximately 25% of the general population [16], was identified in 4.02% of athletes in this cohort, a figure consistent with selective rather than universal bubble contrast study application and with the known variation in detection rates across different screening protocols. These findings require appropriate risk classification and periodic follow-up but do not generally necessitate restriction from competitive sports.

The Role of ECG in Pediatric Athletic Screening:

The detection of all four high-risk conditions in this cohort would not have been reliably achievable through history and physical examination alone. Hypertrophic cardiomyopathy was identified through echocardiography in an athlete with no exertional symptoms and no murmur on auscultation — a pattern consistent with the predominantly non-obstructive phenotype predominant in adolescent HCM [11]. The conduction disorders, including manifest ventricular pre-excitation, were identified exclusively on resting 12-lead ECG and would have been entirely invisible on physical examination.

This observation directly supports the position advanced by the 2020 ESC Guidelines that ECG represents a non-negotiable component of structured preparticipation evaluation in competitive athletes [8]. The improvements in ECG specificity achieved through the international athlete-specific ECG interpretation criteria have substantially reduced the historical concern regarding false-positive rates, improving the cost-benefit balance of ECG-inclusive programmes [17,18]. In the present cohort, the application of these criteria enabled the accurate distinction of physiological adaptations — present in a substantial proportion of athletes — from pathological findings, without generating excessive unnecessary referrals.

Georgia lacks a standardized national preparticipation cardiovascular screening protocol for youth athletes. The present findings provide the most robust region-specific evidence currently available to inform evidence-based policy development. The number needed to screen of 162 to detect one high-risk condition provides a concrete, quantifiable parameter for health economic evaluation and resource planning. While formal cost-effectiveness analysis was beyond the scope of this study, international analyses have demonstrated that ECG-inclusive preparticipation screening can be cost-effective when evaluated across plausible ranges of SCD incidence, screening cost, and long-term outcome [29,30].

The health system resource implications of a structured screening programme in Adjara are contextually manageable.

The observed prevalence data suggest that approximately 6 athletes per 100 screened would require cardiology referral for intermediate- or high-risk findings — a workload compatible with a regional sports medicine programme supported by appropriate specialist backup. The establishment of a standardized screening registry would further enable longitudinal surveillance, iterative refinement of local risk stratification parameters, and monitoring of outcomes in athletes with identified abnormalities over time [8,19].

Equity considerations are equally salient. In the absence of national policy, access to preparticipation cardiovascular evaluation in Georgia is currently determined by institutional capacity and socioeconomic factors rather than clinical need. Standardized national guidance would promote equitable access across regions, ensure uniform standards of evaluation, and establish accountability mechanisms within organized youth sports governance.

Feasibility, Cost, and Implementation Challenges:

Translating these findings into a functioning regional or national programme raises practical implementation challenges that extend beyond the epidemiological case for screening. Workforce capacity is a primary constraint: interpretation of athlete-specific ECGs and performance of screening echocardiography require physicians and sonographers with specific training, which is currently concentrated in a small number of centers rather than distributed across regional sports institutions. A phased implementation strategy is therefore more realistic than an immediate national rollout: mandatory structured history-taking and ECG could be introduced first, given their comparatively low cost and equipment burden, with echocardiography reserved for athletes with an abnormal history, examination, or ECG finding, rather than applied universally. This ECG-first, echo-selective model would substantially reduce the number of echocardiographic studies required relative to universal echocardiography for all 647 athletes in this cohort, while still capturing the great majority of high-risk findings, since all four high-risk cases in this study had abnormal ECG findings. Cost considerations include equipment acquisition and maintenance, physician and sonographer training, and the downstream costs of specialist referral for intermediate- and high-risk findings; international cost-effectiveness analyses indicate that ECG-inclusive screening can remain a reasonable use of health resources across plausible cost and incidence assumptions [29,30], but a Georgia-specific cost-effectiveness analysis, incorporating local salary, equipment, and referral costs, has not yet been performed and represents a necessary next step before national policy adoption. Sustainability considerations include establishing a stable funding mechanism, whether through the public health budget, sports federation resources, or a combination of both, and integrating screening into existing preseason medical clearance processes rather than creating a parallel administrative pathway, to minimize additional burden on athletes, families, and sports institutions.

The 2025 AHA/ACC Shared Decision-Making Paradigm and Its Relevance to a Georgian Eligibility Framework:

Any national eligibility framework developed in Georgia on the basis of these prevalence data should be designed in

alignment with the most current international consensus on athlete eligibility, rather than the categorical disqualification model that historically dominated sports cardiology. The 2025 AHA/ACC scientific statement on clinical considerations for competitive sports participation for athletes with cardiovascular abnormalities formally replaces the binary eligible/ineligible framework of the 2015 Bethesda-derived recommendations with a shared decision-making (SDM) process, in which the athlete (and, for pediatric athletes, their parents or guardians) is treated as an informed partner in an iterative risk discussion with the cardiology team, rather than the passive recipient of a fixed verdict [41]. The statement also reframes the classification of sporting activity itself, characterizing the physiological demands of specific disciplines along a continuum of endurance and strength rather than as discrete categories, which facilitates more granular, sport-specific SDM discussions than were previously possible [41].

For valvular disease specifically — relevant to this cohort, in which mitral and aortic valve findings together accounted for the majority of intermediate- and low-risk diagnoses — the 2025 statement shifts from automatic disqualification for severe disease toward an individualized weighing of the risks and benefits of continued sports participation against those of corrective intervention, with expanded latitude for continued participation in selected cases of arrhythmic mitral valve prolapse [41]. For the four high-risk athletes identified in the present study, this means that the appropriate clinical pathway following specialist referral is not a single eligibility determination but a longitudinal SDM process incorporating genetic evaluation, advanced imaging, electrophysiological risk stratification, and periodic reassessment as recommended by UpToDate-aligned evaluation pathways for young persons with suspected high-risk cardiac conditions [42]. Notably, registry data presented alongside the 2025 statement indicate that among elite athletes with SCD-associated diagnoses who were initially disqualified, the substantial majority ultimately returned to competitive sport following comprehensive evaluation and SDM, underscoring that an initial high-risk classification at screening — as identified in 11.3% of this cohort, and as a high-risk finding in 0.62% — should be understood as the entry point to individualized management rather than a terminal outcome [41]. Embedding this SDM orientation into any future Georgian screening-to-eligibility pathway would align national practice with contemporary international standards while avoiding unnecessary and potentially harmful blanket restriction of young athletes.

Strengths of the Study.

This study represents the largest and most comprehensive assessment of preparticipation cardiovascular screening outcomes in pediatric competitive athletes in Georgia to date. The two-year data collection period across consecutive athletic seasons enhances the representativeness and stability of prevalence estimates relative to single cross-sectional studies. The application of the 2020 ESC Guidelines risk stratification framework ensures contemporaneous comparability with international practice standards. The combination of 12-lead ECG and transthoracic echocardiography as standard evaluation

components enabled comprehensive detection of both electrical and structural abnormalities — a methodological feature absent from studies relying solely on history and examination. The use of the Wilson Score method for confidence interval estimation provides statistically robust prevalence bounds appropriate for the observed sample size and prevalence range.

Limitations.

Several limitations of the present study merit acknowledgement. First, the cross-sectional design precludes assessment of longitudinal outcomes and does not permit direct inference regarding reduction in SCD incidence attributable to the screening programme. The critical claim that the programme 'prevented' adverse events rests on established epidemiological evidence regarding the prognosis of unidentified high-risk conditions during competitive sports participation and the known outcomes following specialist management — not on prospective follow-up data from this cohort.

Second, the cohort was recruited exclusively through organized sports institutions in Adjara and may not fully represent the national athletic population. The predominance of male football players (73.4% male; 73.4% football) limits generalizability to female athletes and to sports with different physiological demands. Third, formal cost-effectiveness analysis incorporating locally derived resource utilization and outcome data was not performed. Fourth, although subgroup distributions were described, the study was not adequately powered for inferential statistical testing of age- or sex-specific differences in abnormality prevalence.

Finally, the absence of advanced cardiac imaging modalities (cardiac magnetic resonance imaging) and genetic testing means that phenotypically borderline cases — particularly in the HCM-athlete's heart differential — were evaluated according to standard echocardiographic and ECG criteria, which, while guideline-concordant, carry inherent limitations in sensitivity for early or atypical disease expressions.

Public Health Perspective.

Cardiovascular screening in pediatric athletes should be understood as a population-level preventive intervention embedded within youth sports governance systems, not merely as an individual clinical evaluation. When implemented within structured frameworks concordant with the 2020 ESC Guidelines, such programmes enable systematic identification of clinically relevant pathology that would otherwise remain undetected until an adverse event. The four athletes identified with high-risk conditions in this programme represent, individually, a prevented catastrophe — and collectively, a demonstration that the burden of occult dangerous cardiac disease in Georgian youth athletes is real, identifiable, and actionable.

Georgia is well-positioned to develop a national preparticipation cardiovascular screening policy founded on a pragmatic, tiered model: mandatory structured history and ECG for all competitive athletes, with selective echocardiographic evaluation guided by ECG findings and clinical risk indicators. This approach aligns with the 2020 ESC Guidelines framework, is implementable within regional sports medicine infrastructure, and is supported by the prevalence data generated through this programme.

Conclusion.

This two-year regional cardiovascular screening programme involving 647 pediatric competitive athletes in Adjara, Georgia, demonstrates that structured preparticipation evaluation identifies a clinically meaningful burden of previously unrecognized cardiac pathology, including life-threatening conditions in asymptomatic individuals. High-risk cardiovascular conditions — specifically hypertrophic cardiomyopathy and clinically significant conduction disorders — were detected in 4 athletes (0.62%), all of whom were subsequently referred for specialist management and temporarily withheld from competitive training pending diagnostic completion and individualized eligibility assessment, in accordance with the 2020 ESC Guidelines on Sports Cardiology and the 2025 AHA/ACC scientific statement on competitive sports participation for athletes with cardiovascular abnormalities, which frames such assessment as an iterative shared decision-making process rather than a one-time disqualification [8,41]. The timely identification of these conditions represents the primary preventive achievement of the programme.

The observed prevalence of cardiovascular abnormalities is consistent with international screening cohorts utilizing combined ECG and echocardiographic evaluation, confirming that the epidemiological burden of occult cardiac pathology in young athletes is broadly comparable across diverse geographic and health system contexts. These findings provide essential region-specific epidemiological parameters for the evaluation of screening strategy proportionality, feasibility, and public health impact in Georgia.

The data generated by this programme support the evidence-informed development of a national preparticipation cardiovascular screening policy for youth athletes in Georgia, aligned with the 2020 ESC Guidelines screening framework and with the individualized, shared decision-making eligibility model articulated in the 2025 AHA/ACC scientific statement [8,41]. Establishing structured, equitable screening within organized youth sports governance — paired with an SDM-based pathway for athletes identified with cardiovascular abnormalities — represents a proportionate, achievable, and potentially life-saving public health investment.

Declarations.

Ethics approval and consent to participate:

The study was conducted as part of a routine preparticipation cardiovascular screening programme within organized sports institutions. The study protocol was reviewed by the Ethics Committee of the M. Iashvili Mother and Child Center, and determined not to require formal ethics committee approval, as it involved non-interventional population screening with fully anonymized data analysis. Written informed consent was obtained from parents or legal guardians. Assent was obtained from participants where appropriate. All procedures were conducted in accordance with the Declaration of Helsinki.

Availability of data and materials:

The anonymized datasets generated and analyzed during the current study are available from the corresponding author upon reasonable request.

Competing interests:

The author declares no competing interests.

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Author contributions:

Miranda Shervashidze conceived the study, designed the screening protocol, collected data across both athletic seasons, performed the statistical analysis, and wrote the manuscript in its entirety.

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