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Mitral Valve Prolapse in Athletes: Prevalence, Arrhythmic Associations, and Clinical Implications — A Systematic Review

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ADMINISTRATIVE INFORMATION

Support - N/A.

Review Stage at time of this submission - The review has not yet started.

Conflicts of interest - None declared.

INPLASY registration number: INPLASY202590064

Amendments - This protocol was registered with the International Platform of Registered Systematic Review and Meta-Analysis Protocols (INPLASY) on 16 September 2025 and was last updated on 16 September 2025.

INTRODUCTION

Review question / Objective To perform a systematic review of the literature on mitral valve prolapse (MVP) prevalence among athletes.

Rationale The true burden of MVP in athletes remains uncertain. Studies have reported variable rates across sports disciplines, competitive levels, and geographic regions. The lack of uniform diagnostic definitions, differences in study populations, and the absence of pooled analyses have limited the interpretability of available data. Moreover, while MVP is generally considered compatible with athletic participation, its association with ventricular arrhythmias and SCD in selected cases underscores the need for precise epidemiological characterization in this setting.

Condition being studied Mitral valve prolapse (MVP) is the most frequent valvular abnormality in developed countries, with a prevalence estimated at 2–3% in the general population. It is defined echocardiographically as the systolic billowing of one or both mitral valve leaflets at least 2 mm beyond the plane of the mitral annulus into the left atrium, best visualized in the parasternal long-axis view. Although most individuals with MVP experience a benign clinical course, the disorder has attracted enduring attention because of its potential complications, including mitral regurgitation (MR), infective endocarditis, atrial and ventricular arrhythmias, and, in selected cases, sudden cardiac death (SCD). In particular, a subgroup characterized by bileaflet or myxomatous prolapse, mitral annular disjunction, and complex ventricular arrhythmias has recently been recognized as a distinct arrhythmogenic phenotype with heightened risk of adverse outcomes.

The relevance of MVP extends beyond the general population to athletic cohorts. Regular participation in competitive sports subjects the cardiovascular system to sustained hemodynamic load and adrenergic stimulation, which may amplify

the arrhythmic substrate in susceptible individuals. Although MVP is often detected incidentally during pre-participation cardiovascular screening, its identification in an athlete carries important clinical and medico-legal implications, raising questions regarding eligibility for competition, need for further diagnostic testing, and intensity of follow-up. Concern stems primarily from the potential contribution of MVP to exercise-related SCD, which remains a leading cause of mortality in young athletes.

Accurate assessment of MVP prevalence in athletes is therefore essential to inform clinical practice. However, estimates have historically been inconsistent, largely due to methodological heterogeneity. Earlier echocardiographic investigations, particularly those performed prior to 1999, frequently applied less specific diagnostic criteria based on M-mode or apical four-chamber imaging, leading to overestimation of prevalence. More recent criteria, which account for the saddle-shaped nonplanarity of the mitral annulus, define MVP more strictly as leaflet displacement >2 mm beyond the annulus in the parasternal long-axis view. Adoption of these standards has reduced false positive diagnoses and led to substantially lower prevalence estimates. In a recent systematic review of echocardiographic studies in heterogeneous populations, the pooled prevalence of MVP decreased from 7.8% in studies conducted before 1999 to 2.2% in those performed thereafter.

METHODS

Search strategy We will conduct a comprehensive literature search to identify studies evaluating the prevalence of mitral valve prolapse (MVP) among athletes. The search will be performed in PubMed/MEDLINE, Scopus, and Web of Science from inception through August 2025, without language restrictions. The search terms will include combinations of "mitral valve prolapse," "athletes," "sports," "echocardiography," and "pre-participation screening." Boolean operators and Medical Subject Headings (MeSH) will be applied to maximize sensitivity. In addition, the reference lists of relevant systematic reviews and included studies will be screened manually to identify additional eligible reports.

Participant or population Studies will be considered eligible if they met the following criteria: (1) original research published in peer-reviewed journals; (2) population of competitive or recreational athletes undergoing cardiovascular evaluation; (3) MVP diagnosis based on echocardiography or, in autopsy studies, pathological examination; and (4) report of MVP prevalence or raw numbers allowing calculation. No restriction will be applied on athlete age, sex, type of sport, or competitive level. We will exclude case reports, editorials, narrative reviews, abstracts without sufficient data, and studies in non-athletic populations. When duplicate publications from the same cohort will be identified, the most comprehensive or recent report will be included.

Intervention Studies will be considered eligible if they met the following criteria: (1) original research published in peer-reviewed journals; (2) population of competitive or recreational athletes undergoing cardiovascular evaluation; (3) MVP diagnosis based on echocardiography or, in autopsy studies, pathological examination; and (4) report of MVP prevalence or raw numbers allowing calculation. No restriction will be applied on athlete age, sex, type of sport, or competitive level. We will exclude case reports, editorials, narrative reviews, abstracts without sufficient data, and studies in non-athletic populations. When duplicate publications from the same cohort will be identified, the most comprehensive or recent report will be included.

Comparator N/A.

Study designs to be included Observational Cohort and Cross-Sectional Studies.

Eligibility criteria Studies will be considered eligible if they met the following criteria: (1) original research published in peer-reviewed journals; (2) population of competitive or recreational athletes undergoing cardiovascular evaluation; (3) MVP diagnosis based on echocardiography or, in autopsy studies, pathological examination; and (4) report of MVP prevalence or raw numbers allowing calculation. No restriction will be applied on athlete age, sex, type of sport, or competitive level. We will exclude case reports, editorials, narrative reviews, abstracts without sufficient data, and studies in non-athletic populations. When duplicate publications from the same cohort will be identified, the most comprehensive or recent report will be included.

Information sources We will conduct a comprehensive literature search to identify studies evaluating the prevalence of mitral valve prolapse (MVP) among athletes. The search will be performed in PubMed/MEDLINE, Scopus, and Web of Science from inception through August 2025, without language restrictions. The search terms will include combinations of "mitral valve prolapse," "athletes," "sports,"

"echocardiography," and "pre-participation screening." Boolean operators and Medical Subject Headings (MeSH) will be applied to maximize sensitivity. In addition, the reference lists of relevant systematic reviews and included studies will be screened manually to identify additional eligible reports.

Main outcome(s) By synthesizing evidence from echocardiographic studies performed in sporting populations and contextualizing them within the evolution of diagnostic criteria, the present work aims to provide a reliable estimate of MVP prevalence in athletes.

Additional outcome(s) To assess arrhythmic associations with MVP in athletes.

Quality assessment / Risk of bias analysis The methodological quality of the included studies will be assessed using the National Institutes of Health (NIH) Quality Assessment Tool for Observational Cohort and Cross-Sectional Studies. This instrument evaluates 14 domains, including clarity of the research question, population definition, participation rate, exposure and outcome measures, length of follow-up (if applicable), and adequacy of statistical analyses. Each study will be independently evaluated by the three cardiologists who will extract the data, and judgments will be categorized as good, fair, or poor quality according to NIH guidance.

Strategy of data synthesis Two investigators independently will screen titles and abstracts retrieved from the search to exclude irrelevant records. Full texts will be subsequently assessed for eligibility. Disagreements will be resolved by consensus with a third reviewer. Data extraction will be performed independently by three experienced cardiologists (A.S., M.B., and G.L.N.) in August 2025, using a standardized data collection form. For each study, the following information will be collected: author, year of publication, country, population characteristics (type of sport, sample size, age, sex distribution), study design, diagnostic criteria for MVP, number and prevalence of MVP cases, and presence of arrhythmic complications, including ventricular arrhythmias (VAs) and supraventricular arrhythmias (SVAs). When available, follow-up information and clinical outcomes will also be recorded. Extracted data will be cross-checked for consistency and compiled in a summary table.

Subgroup analysis N/A.

Sensitivity analysis N/A.

Country(ies) involved Italy.

Keywords Athletes; mitral valve prolapse; prevalence; ventricular arrhythmias; modified Haller index.

Contributions of each author

Author 1 - Andrea Sonaglioni - Author 1 will draft the manuscript.
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