The MasQsano Method. Detection of unknown cardiac diseases in health screening for athletes

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doi: 10.18176/archmeddeporte.00143

Received: 26/10/2022
Accepted: 06/03/2023

Summary

The sports medical examination is considered a starting point for any athlete before taking up physical or sporting activity. Its main objective is to detect pathologies that could put your life at risk and those that, once corrected, can enhance physical performance. This is why it must be carried out by a multidisciplinary health team with expertise in the area. In this way, it is important to review the scientific evidence and learn directly about the health status of a group of adult and child athletes, their incidence of cardiovascular diseases and the role of nursing in their application. This study evaluated a sample of 7340 athletes aged between 3 and 17 years, composed of 1693 females and 5647 males, who underwent a sports medical examination, according to a registered and previously established protocol in sports clubs in 2 Spanish provinces with the support of nursing staff during the year 2021. Of these, a total of 112 cases of cardiac pathologies were obtained, of which 54% were known to have a cardiac pathology and 64% were unknown. Of this group of unknown cardiac pathologies, 5.9% of the cases required surgical intervention, 21.1% are under review and 73% were discharged. The total number of cases with unknown cardiac pathologies represents 0.70% of the sample. The fundamental role of nursing in the application of this protocol was also determined.

Key words:
Sudden death. Electrocardiography. Physical examination. Athletic perfomance. Disease prevention.

Método MasQsano. Detección de enfermedades cardiacas no conocidas en reconocimientos médicos deportivos

Resumen

El reconocimiento médico deportivo es considerado como un punto de partida para cualquier deportista antes de incorporarse a la actividad física o deportiva. Su objetivo principal es la detección de patologías que pudieran poner en riesgo su vida y aquellas que una vez corregidas pueden potenciar el rendimiento físico. Es por ello por lo que debe realizarse por un equipo de salud multidisciplinario experto en el área. De esta manera, resulta importante revisar la evidencia científica y conocer directamente el estado de salud de un grupo de adultos y niños deportistas, su incidencia de enfermedades cardiovasculares y el rol de la enfermería en su aplicación. Este estudio, evaluó una muestra de 7.340 deportistas con edades comprendidas entre los 3 y 17 años, compuesta de 1.693 femeninos y 5.647 masculinos, a los cuales se les realizó el reconocimiento médico deportivo, de acuerdo con un protocolo registrado y establecido previamente en los clubes deportivos de 2 provincias españolas con el apoyo del personal de enfermería durante el año 2021. De estos, se obtuvo un total de 112 casos de patologías cardiacas, de los cuales el 54% tenía conocimiento de patología cardiaca y el 64% no era conocido. De este grupo de patologías cardíacas no conocidas, el 5,9% de los casos requirió intervención quirúrgica, el 21,1% se encuentra en revisión y el 73% fue dado de alta. El total de casos con patologías cardíacas no conocida representa un 0,70% de la muestra. Así mismo, se determinó el rol fundamental de enfermería en la aplicación de este protocolo.

Palabras clave:
Muerte súbita. Electrocardiografía. Examen físico. Rendimiento atlético. Prevención de enfermedades.

2nd Second Prize SEMED Research Awards 2022

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Introduction

There are numerous benefits to be gained from participating in sports. When approaching the topic in terms of population health, a surprising improvement can be seen over time; not only at a cardiovascular, respiratory or organic level but also mentally and socially[1]. Athletes are considered a paradigm of health and wellbeing, the ultimate reflection of maximum performance and unwavering health, except in those cases of acute or sports injuries and those caused by overexertion[2]. For that reason, health screening for athletes is viewed as a great first step for any athlete intending to resume physical activity or sport. Its main goal is to detect pathologies that could potentially jeopardise the health of the athlete and those that could enhance physical performance[3] once corrected. Health screening for athletes is currently regulated in Spain under Spanish Royal Decree 41/2009. This Commission rules on the need for health screening in those sports where it is deemed necessary for improved prevention of the risks to athletes based on the characteristics of the sport in question, the effort required and other physical and environmental conditions. Currently in Andalusia, those sports are football, basketball, handball and volleyball.

Current European and Spanish guidelines recommend the use of electrocardiograms during health screening in sport prior to participation because they offer a high detection rate for cardiac diseases[4-6]. These cardiac diseases can lead to the sudden death of an athlete if not detected in time. However, due to the similarity between certain findings from an electrocardiogram associated with physiological adaptation to physical training and certain cardiac disorders, interpreting an electrocardiogram in athletes is usually quite a challenge[7]. Cases of sudden death in athletes are uncommon but have such a strong impact on the sports and medical communities, as well as on spectators and relatives obviously, that the main strategy is to prevent them through health screening for athletes[3].

The main purpose of this article is to identify the prevalence of cardiac irregularities in athletes aged 3-17 in the provinces of Granada and Almería in 2021. The secondary goals are to assess the overall health of athletes in general, to monitor those athletes with cardiac pathologies and to determine the characteristics of those pathologies.

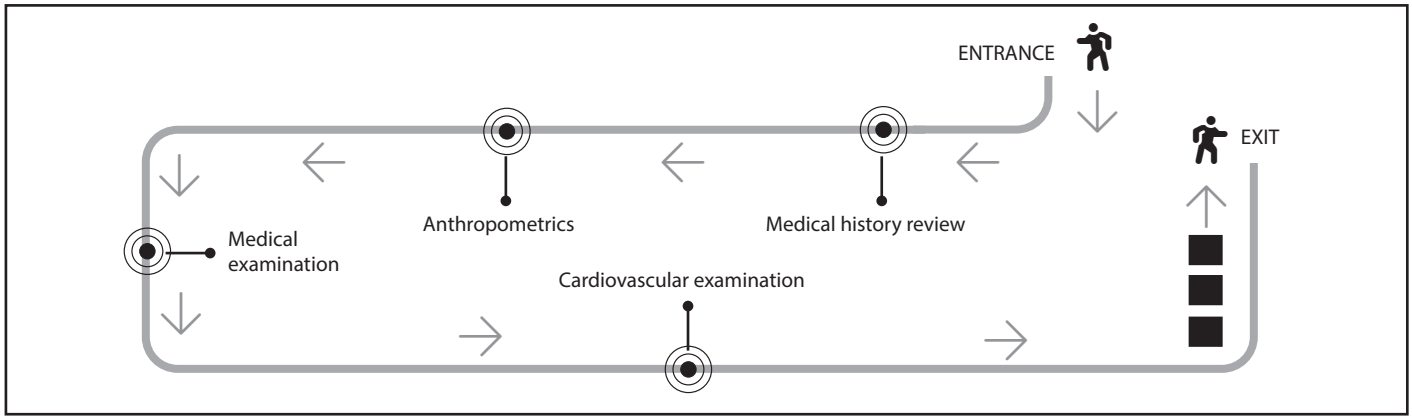
Material and method

A descriptive observational study of a group of athletes subject to pre-competition compulsory health screening for athletes at a sports medical examination company, MasQsano Salud y Deporte S.L.P. The sample consisted of 7,340 athletes aged between 3 and 17, inclusive, from clubs in Almería and Granada. The sports in question were football, basketball, athletics, indoor football, handball, volleyball, rugby and swimming. The clubs ranged from municipal sports academies that introduce children to sport to clubs engaged in advanced or technical training for semi-professional athletes competing at regional or national levels. The criteria for inclusion in the study were: athletes aged 3-17 who received health screening for athletes at MásQsano between June and November 2021. The criteria for exclusion were: Athletes aged 3-17 who received health screening for athletes at MásQsano between June and November not suffering from a prior cardiac pathology and athletes aged 3-17 who received health screening for athletes at MásQsano between June and November suffering from a prior cardiac pathology. The main variables for the study are: presence of previous cardiac diseases, known family history, irregularities defined in the international criteria for the interpretation of electrocardiograms on athletes and the presence of anomalies in the cardiac auscultation. The secondary variables are: sex, age, heart rate, blood pressure and sport.

The method used begins by sending each athlete a form to fill in, which must be checked and signed by an adult. These forms provide information on data protection. The examination circuit consists of four stations, with a different professional at each one. The first station reviews the clinical history of the athlete, with a particular focus on personal and family backgrounds. This is conducted by nursing staff. The athlete then undergoes an anthropometric assessment, with measurements of weight, height, body mass, abdominal circumference, upper limb girth, upper and lower limb segments. A static footprint analysis is also performed using a podoscope, and the ankles, knees and back are examined. Finally, visual acuity is assessed using the Snellen[8] chart. The tests at this station can be performed by a physiotherapist or nursing staff. The third station involves a complete medical examination. It encompasses osteoarticular assessment, cardiopulmonary auscultation, neurological assessment, peripheral pulse palpation, dermatology and general assessment of all the organs. The tests at this station are exclusively performed by a doctor specialising in sports medicine. Finally, a cardiovascular examination is performed at the fourth station using a digital electrocardiogram and by monitoring vital signs (Figure 1). The medical history review, the anthropometric assessment and cardiovascular examination are all performed by nursing staff. Their role is therefore essential in the health screening process because these professionals are responsible for conducting an educational interview regarding the various pathologies detected, providing advice on the practise of sport and following up with those athletes who require assessment by other specialists. The electrocardiogram (ECG) is checked by a sports medicine doctor or, otherwise, a community medicine doctor with experience in sports health screening. Furthermore, the 2017 international criteria for electrocardiographic interpretation in athletes[9] were applied. Any ECG results revealing a discrepancy are assessed by an independent cardiologist and were resolved with a consensual reading. Athletes in whom a previously unknown cardiac pathology is detected are contacted by the nursing staff, who recommend to the athlete – or to the parents or legal guardians in the case of a minor – that they be seen by a cardiologist via the public health system. The approximate wait before being seen by a cardiologist can vary between two to four weeks.

The method is based on guidelines from the European Society of Cardiology (ESC), which recommends a method that includes a review

Figure 1. The MasQsano medical health screenings for athletes method.



of the medical history, a physical examination and an electrocardiogram at rest[3]. A search was therefore performed in the online PubMed, Web of Science, Scopus and Google Scholar databases, up to June 2022. The study was approved by the provincial ethical research committee of Almería.

The results are presented as the average + standard deviation for the normally distributed continuous variables and as percentages for the categorical variables. The quantitative variables were analysed using the Student's t-test for normal distribution or the Mann–Whitney U test for non-normal distribution. The level of significance was set at $p < 0.05$. The statistical analyses were conducted in SPSS Statistics 24.0.

Results

The results from this assessment revealed 52 cases of cardiac pathologies that were previously unknown to the athlete in question (0.69% of the sample), with an average age of 10.8 + 4.2 standard deviation. The median was 11 years old and the mode was 17 years old, as shown in Table 1. The most common gender among the athletes in whom cardiac pathologies were found was male (71.4%), the rest being women (28.6%), as shown in Table 2.

The most commonly practised sport among the athletes with cardiac pathology was football, which was also the most common among all the athletes included in the study (Tables 3 and 4).

Furthermore, there were 60 cases of cardiac pathologies that were already known to the athletes in question (0.82% of the sample); i.e. they were already aware of their diagnosis (repolarisation disorder in 9.2%, heart murmurs in 75.4% and left ventricular hypertrophy in 15.4%).

Of the group with previously unknown cardiac pathologies (n = 52), 5.7% of the cases (n = 3) required surgical intervention, 21.1% are undergoing regular monitoring (n = 11) and 73% (n = 38) were discharged (Figure 2).

Nonetheless, and despite the main objective for this research being to identify the prevalence of cardiac pathologies in adult and

Table 1. Age of the athletes in whom a cardiac pathology was detected.

N Valid	**56**
Average	10.8
Median	11
Mode	17
Standard deviation	4.206

Table 2. Gender of the athletes in whom a cardiac pathology was detected.

	Frequency	Percentage	Valid percentage	Cumulative percentage
Female	16	28.6	28.6	28.6
Male	40	71.4	71.4	100
Total	56	100	100	

Table 3. Sports practised by the athletes with detected cardiac pathology.

	Frequency	Percentage	Valid percentage	Cumulative
Football	38	67.9	67.9	67.9
Basketball	12	21.4	21.4	89.3
Handball	2	3.6	3.6	92.9
Volleyball	1	1.8	1.8	94.6
Rugby	1	1.8	1.8	96.4
Athletics	1	1.8	1.8	98.2
Swimming	1	1.8	1.8	100
Indoor football	0	0	0	100
Total	56	100	100	

child athletes, the total number of cases with cardiac pathologies only represents 1.52% of the total sample: athletes with previously known and unknown cardiac pathologies. A total of 8,268 referrals were made, with the same athlete potentially being referred to several specialists. The largest number of referrals was to nutrition (38.47%, n = 3,220), followed by podiatry (29.04%, n = 2,431), physiotherapy (20.58%, n = 1,723), ophthalmology (5.72%, n = 479), dermatology (3.62%, n = 303) and radiology (1.21% n = 102), as well as those already known cardiology cases (1.33%, n = 112) (Figure 3).

Table 4. Total number of health screenings conducted per sport.

	Number of health checks	Percentage	Valid percentage	Accumulative percentage
Football	3,667	49.95	49.95	49.95
Basketball	1,439	19.6	19.6	69.55
Handball	790	10.76	10.76	80.31
Volleyball	695	9.46	9.46	89.77
Rugby	370	5.04	5.04	94.81
Athletics	150	2.04	2.04	96.85
Swimming	130	1.77	1.77	98.66
Indoor football	99	1.34	1.34	99.96
Total	7,340	100	100	

Figure 2. Trend in detected cardiac pathologies.

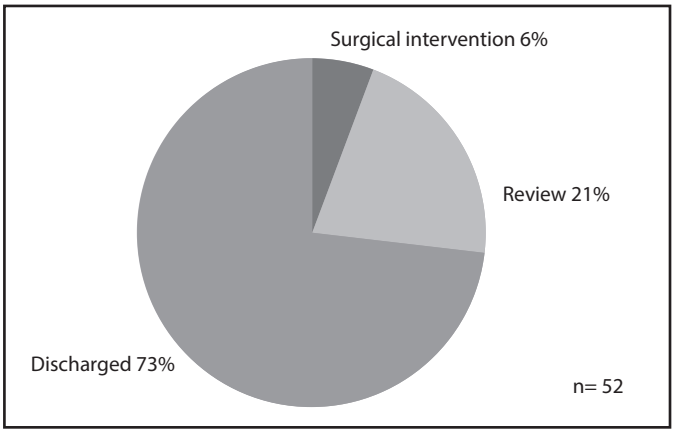
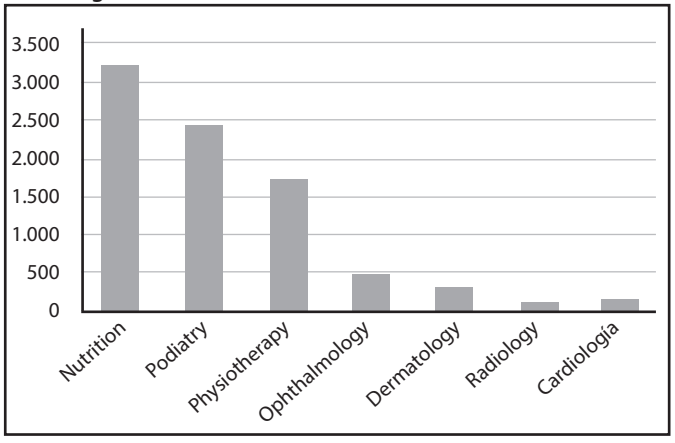


Figure 3. Referral to specialists of athletes subject to the health screening.



Under the 2017 international criteria for electrocardiographic interpretation in athletes[9], cases of previously unknown pathologies were referred to cardiology, revealing T wave inversion in 43%, ventricular pre-excitation in 21%, ventricular extrasystoles in 22%, supraventricular tachycardia in 7% and right bundle branch block in 7% (Figure 4).

Furthermore, this health screening for athletes enabled a decision on whether or not to suspend sports activity in the sample subject to study. As a result, among the sample referred to cardiology for a previously unknown pathology (n = 52), 61% continued practising their sports activity after being discharged by cardiology, 22% had to suspend the practise of sport temporarily until studies could be completed and subsequently resumed the practise of sport, and 17% had to permanently stop practising the sport for which the screening was conducted.

It was also possible to further define the characteristics of the group (n = 112) that was referred to cardiology specialists. It was found that 83.92% consisted of male athletes and 16.07% female athletes, with the largest age group being that of 0-5 years (20.1%), followed by over-18s (15.17%), 8-9 years (12.5%), 14-15 years (11.6%) and 16-18 years (9.82%). Of this sample, 92.22% are right-handed and 7.78% left-handed.

For the anthropometric assessment, the Body Mass Index was used to classify nutritional condition. To classify said weight problems in the athletes from the total sample (n = 7,430), the base cut-off point criteria proposed by the WHO International Obesity Task Force (IOTF) were used for the various weight situations in children and teenagers by age and gender from 5 to 19 years, with such cut-off points as (<18.5 kg/m^2 (underweight); 18.5 kg/m^2 (normal); 25 kg/m^2 (overweight) and 30 kg/m^2 (obese) in adults10. The average for the sample overall was 17.64 ± 1.51 kg/m^2.

Figure 4. Classification of the athletes according to the 2017 international criteria for electrocardiographic interpretation in athletes.

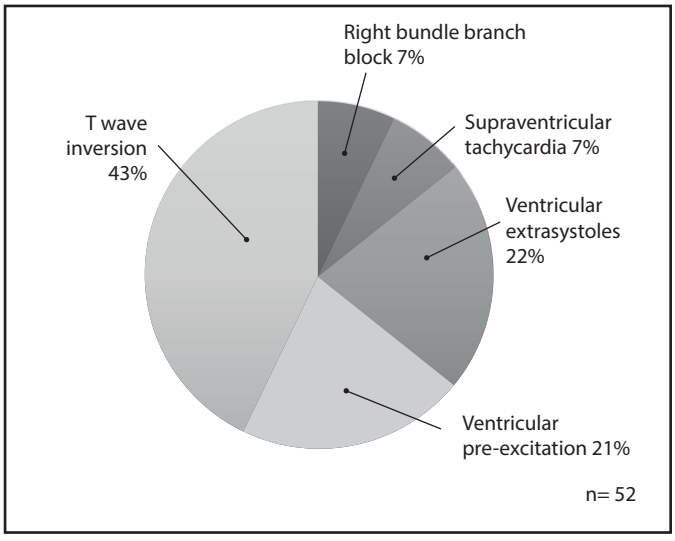
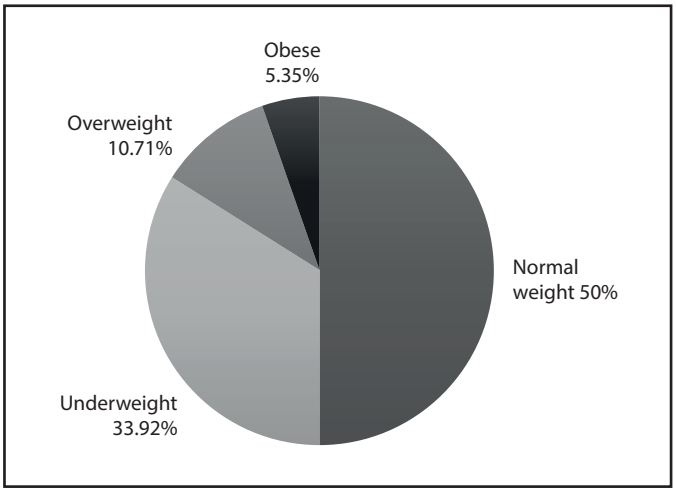


Figure 5. Classification of the BMI of the athletes subject to the health screening.



From the assessment, 50% appeared to be within normal ranges, 33.92% underweight, 10.71% overweight and only 5.35% obese (Figure 5).

Discussion

EThis study was conducted using the MasQsano health screening for athletes method, which can be said to follow the guidelines from the European Society of Cardiology (ESC), which recommends a method that includes a review of the medical history, a physical examination and an ECG at rest[3]. This was adapted to the population being assessed given that, in the case of assessments on groups or teams of athletes, Moreno[11] states that this can be organised into a series of stations with other professionals, such as nursing staff and physiotherapists, among others, lending support to create a method that is entirely valid for the detection of cardiac risks and pathologies in athletes that can contribute to Sudden Cardiac Death (SCD).

Asif and Drezner[12] believe that health screening for athletes that includes an ECG offers an additional benefit of being better able to identify diseases, and the modern ECG interpretation standards specifically applicable to athletes that are used by experienced doctors provide low false positive rates, thus improving profitability and preserving sensitivity. The ECG has shown itself to be a key tool for detecting the main cause of SCD: hypertrophic cardiomyopathy. However, it can be costly for many countries and is therefore not considered a compulsory part of the preventive protocol[13].

Evidence has shown that, if athletes are assessed using these advanced protocols, they can potentially improve their health and safety during sports events and that they should be considered best practice in high-risk athletes whenever sports cardiology supervision and infrastructure are easily available[14].

A low percentage of athletes with cardiac pathologies was found during the course of this research, highlighting the importance of this type of assessment given that it represents a challenge for public health, the league or club, the athlete and their relatives. The majority of these anomalies are treatable hereditary cardiac disorders, but ones that can give the athlete a certain predisposition to SCD, mainly via ventricular arrhythmia[13]. With that in mind, the Spanish Sports Medicine Society (FEMEDE) highlights the need for health screening that can help to determine sports aptitude prior to commencing the practise of sport in all kinds of athletes, especially those with a history of having suffered from a disease, regardless of the level of impact[3].

Furthermore, this corroborates the statements by Moreno[13] on the possible scenarios in health screening for athletes in which there may be an absence of pathologies, the presence of minor or moderate irregularities potentially giving the athlete a predisposition to future injuries or that pose a risk, pathologies that restrict the practise of sport because they pose a risk to life although not requiring the immediate suspension of physical activity and the presence of pathologies that recommend against all forms of physical activity either temporarily or permanently. However, factors may be found in the assessments that might appear to be a cardiac problem but are actually various structural and functional adaptations within the heart that enable the generation of a large and sustained increase in cardiac output and/or a blood pressure increase. The scope to which these physiological remodelling markers manifest in the surface ECG is governed by various factors and certain athletes show electrical and structural changes that overlay those observed in the cardiomyopathy and ion channel diseases, which are recognised causes of sudden cardiac death in young and adult athletes[14].

A limitation was encountered in the poor availability of clinical studies demonstrating the effectiveness of health screening for athletes, as well as studies focused on the pathologies found when conducting these assessments.

Similarly, the important work of both medical and nursing healthcare professionals should be recognised in the detection of cardiac pathologies and in the prevention of SCD given that their role in these procedures ranges from the educational to supervising the equipment, proper organisation for conducting the assessment and offering the necessary advice to athletes[12]. Furthermore, in the presence of already diagnosed pathologies[15], they must guide athletes on the precautionary measures to apply during training and competition, and on switching to a different sport if necessary[14].

In conclusion, this study found a 1.52% prevalence of cardiac pathologies in a sample of 7,430 athletes aged 3-17 in the provinces of Granada and Almería in 2021, but only 0.69% of the total from the sample were previously unknown. This allows us to conclude that the MasQsano method applied to conduct the health screening for athletes at an early age is effective at assessing health conditions and determining the presence of cardiac pathologies.

Furthermore, a general health assessment was also conducted on the athletes. Those athletes with cardiac pathologies were monitored

to reveal their development over time and the characteristics of those athletes who were referred to cardiology were defined.

Conducting European-style health screening for athletes that includes ECG assessment complements the medical evaluation and facilitates the detection of cardiac pathologies that may require anything between regular medical attention and the definitive or permanent suspension of sports activity depending on the level of risk posed to the life of the athlete.

Conflict of interest

The authors declare no conflict of interest whatsoever.

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