Prevalence of cardiovascular risk factors in elite athletes following retiring from competition

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Summary

Introduction: Epidemiological studies show that cardiovascular risk factors (CVRF) increase with age in the general population.
Aim: To study the Cardiovascular Risk Factors (CVRF) in elite athletes who had retired from competitive sports for a minimum of five years prior to participation in the follow-up examination.
Material and method: longitudinal follow-up study in 157 former elite athletes who had sinus bradycardia (n = 157) 122 men and 35 women. Age = 47 ± 5.9 years. Track and field (n = 66 42%) swimming (n = 35 22%) and others (n = 56 36%). To determine the presence of CRF, a structured questionnaire was used at the time of inclusion of the study and in the follow-up. A descriptive analysis was performed depending on whether the variables were qualitative or quantitative and a bivariate analysis in relation to sinus bradycardia and CRF. The results have been compared with data from the general population.
Results: Smoking 9.0% men and 8.6% women versus the general population 30.9% men and 20.5% women; Hypertension 9.8% men and 0% women versus 22.6% and 23.7%; Diabetes Mellitus 2.5% men and 0% women versus 7.6% and 7.9%; Obesity 4.1% men and 0% women versus 15.7% and 14.0%; Hypercholesterolemia 18.2% men and 2.9% women versus 16% of the total in the general population. 85% men and 82.9% women versus 84.5% and 81.1% regularly exercise. 47 (29.9%) performed moderate physical exercise, 32 (20.4%) intense physical exercise, 21 (13.3%) very intense physical exercise.
Conclusion: The majority of elite athletes continue to regularly exercise and their CRF are lower than those of the general population.

Key words:
Cardiovascular risck factor. Physical exercise. Elite athletes

Prevalencia de factores de riesgo cardiovascular en deportistas de élite después de abandonar la competición

Resumen

Introducción: Estudios epidemiológicos muestran que los factores de riesgo cardiovascular (FRCV) aumentan con la edad en la población general.
Objetivo: Estudiar los FRCV en deportistas de élite que habían abandonado la alta competición como mínimo desde hace 5 años.
Material y método: Estudio descriptivo longitudinal de una cohorte de ex–deportistas de élite con bradicardia sinusal extrema (n= 157) 122 hombres y 35 mujeres. Edad= 47 ±5,9 años. Atletismo (n= 66 42%) natación (n=35 22%) y otros (n=56 36%). Para determinar la presencia de FRCV se utilizó un cuestionario estructurado en el momento de inclusión del estudio y en el seguimiento. Se realizó un análisis descriptivo según las variables fueran cualitativas o cuantitativas y un análisis bivariado en relación a la bradicardia sinusal y los FRCV.
Resultados: Se han comparado con datos de la población general. Tabaquismo 9,0% hombres y 8,6% mujeres *versus* población general 30,9% hombres y 20,5% mujeres; Hipertensión arterial 9,8% hombres y 0% mujeres *versus* 22,6% y 23,7%; Diabetes *Mellitus* 2,5% hombres y 0% mujeres *versus* 7,6% y 7,9%; Obesidad 4,1% hombres y 0% mujeres *versus* 15,7% y 14,0%; Hipercolesterolemia 18,2% hombres y 2,9% mujeres *versus* 16% del total en la población general. Practican ejercicio físico regularmente 85% hombres y 82,9% mujeres *versus* 84,5% y 81,1%. 47 (29,9%) realizaban ejercicio físico moderado, 32 (20,4%) ejercicio físico intenso, 21 (13,3%) ejercicio físico muy intenso.
Conclusión: La mayoría de los deportistas de élite continúan realizando ejercicio físico regular y sus FRCV son inferiores a los de la población general.

Palabras clave:
Riesgo cardiovascular. Ejercicio físico. Deportistas élite.

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Introduction

Lifestyle and healthy habits are key to promoting health and preventing cardiovascular diseases and constitute the foundation for athletic performance from an inclusive level right up to top competition.

High intensity training programmes call for the adoption, among other aspects, of changes that affect schedules, specific nutrition, and eliminating toxic elements such as smoking. All this has a direct repercussion on short and long-term health and physical performance.

Giving up top-level competitive sport generates modifications that span from the psychological profile - with reduced stress linked to competition - to flexibility in lifestyle standards. The greatest change is the reduction of hours spent training, which triggers the most important lifestyle variation.

If healthy eating habits and a lack of toxic habits - particularly smoking - are maintained once competition sport is left, and physical exercise is continued at a different level, the probability that the most widespread cardiovascular risk factors (CVRF) such as high blood pressure[1,2], dyslipidaemia or diabetes[3-5] appear, is simply lower, or otherwise, they appear at a more advanced chronological age.

The possibility of comparing CVRF that appear at the start of top-level competition sport with those that appear after at least five years after retiring from competition, enable us to observe if there are any differences in this demographic compared to those observed in the general public with no antecedents of performing regular sport[6].

As our study group is a cohort of athletes subject to the discipline of top-level competition for years, it is of interest to discover if they continue to perform physical exercise, and at what intensity, or if they have become sedentary. We know the indirect estimation of the level of physical activity, objectively, by assessing whether the sinus bradycardia - the most common sign in the electrocardiogram of the athlete - remains the same, has reduced, or is not observed[7]. An electrocardiogram was performed at the start of top-level competition training and currently, having retired from competition.

Material and method

Longitudinal descriptive study of ex-athletes that had participated in top-level competition and that had left competition at least 5 years previously.

Study of the demographic

This group comprises a cohort of 157 ex top-level competition athletes whose initial heart rate electrocardiogram was lower than 50 beats/minute. 122 males (78%) and 35 females (22%) registered between 1960 and 1990 in the Sports Medicine and Health Unit of the Blume Residency, Sant Cugat CAR and Medical Service of the Barcelona Football Club.

The data was collected in a structured questionnaire with information about the initial history and follow-up. It includes information about the type of sport, hours of training per week during competition, years of participation and years past since retiring from competition. Information was also collected about the level of physical exercise that they are performing. Four levels of intensity were established: light (2-3 hours/week), moderate (3-5 hours/week), intense (5-7 hours/week) and very considerable (over 7 hours/week). Family history of cases of cardiovascular disease in first-generation family members, affectation of cardiovascular events, prevalence of CVRF (smoking, high blood pressure, dyslipidaemia, type 1 and 2 diabetes and obesity) and if they are undergoing medical treatment. All the participants underwent an initial electrocardiogram and another at the time of follow-up.

The sporting level was assessed through participation in national and international competitions, as well as by medals won (Table 1).

Information about the general public was collected through the 2018 Catalonia Health Survey[6].

This study was approved by the Hospital de la Santa Creu i Sant Pau ethics committee, and all participants signed the informed consent form.

Statistical analysis

A descriptive analysis was performed for the quantitative variables. For qualitative variables, contingency tables and the Mcnemar test were used. The results of the quantitative variables were presented as average and standard deviation. The paired t-test was used in individual comparisons.

A bivariate analysis was performed and the odds ratio (OR) and 95% confidence interval (95% CI) were calculated for each factor in relation to current bradycardia. The statistical package SPSS® (v 22.0) was used.

Results

A total of 157 ex-elite athletes participated in this study, 122 males and 35 females. The average age of starting competition was 17±4.6 years, and the average age of retirement from competition was 30±7.4 years. The average age at follow-up (current age) is 47±5.9 years. The most frequently practised sport was long-distance running in athletics

Table 1. Sporting history of participants in Spanish and International Championships (1960-1990).

Sporting participations	N
World level medals: gold/silver/bronze	
Olympic Games	2
World championships	8
European championships	27
State level medals: gold/silver/bronze	
Spanish championships	489
Participation in national teams	3,850
World level sporting participation	
World championships	105
Olympic Games	52
European championships	122

(42%), followed by swimming (22%) and others (36%), including football, basketball, volleyball, triathlon, pentathlon, rugby, cycling, judo, sailing and roller hockey. The average number of years participating in top-level competition were 12±7.4, and the average number of hours spent training each week during this time were 19±7.4 per week. Table 1 displays the number of participations in national and international competitions, as well as the number of medals won.

Sinus bradycardia

In accordance with the inclusion criteria, all the participants had a marked sinus bradycardia in the initial electrocardiogram (below 50 beats/minute) and 14% of participants had a heart rate of below 40 beats/second. In the follow-up study, 64% presented sinus bradycardia (below 60 beats/minute) and 18% had marked sinus bradycardia linked to the continuation of more intense physical exercise.

Cardiovascular risk factors

All the CVRF that were assessed at the start and during the follow-up of the study are displayed in Table 2. At the start of the study, 7% of the participants claimed to be smokers, and at follow-up, 8.9% smoked regularly, 5.7% smoked occasionally, and 21.7% were ex-smokers. At the start of the study, one participant (0.6%) had high blood pressure. At the time of follow-up, 12 participants (7.6%) had high blood pressure, of whom 4 took anti-hypertensive medication. None of the participants had diabetes at the start of the study, and 3 had diabetes treated with oral anti-diabetics (OAD) at the time of follow-up. A total of 13 participants (7.6%) at the start of the study had a BMI (body mass index) between 25 and 30 - considered overweight - and none were obese. At the time of follow-up, 49 (31.2%) were overweight, and 10 (6.3%) were obese (BMI >30).

Table 2. Prevalence of CVRF at the start of elite sport (initial) and currently (today).

	Initial		Current	
	N	%	N	%
Smoking	11	7		
Ex-smokers			34	21.7
Irregular smokers				
<1 cigarette/day			9	5.7
Smokers			14	8.9
Hypertension	1	0.6	12	7.6
Medication			4	
Cholesterol	4	2.5	23	14.6
Medication			7	
Diabetes	0	0	3	1.9
OAD Medication		3		
BMI				
Excess weight (BMI ≥25 ≤30)	13	7.6	49	31.2
Obesity (BMI>30)	0	0	10	6.3

IMC: índice de masa corporal; ADO: antidiabéticos orales.

Table 3. Comparison of prevalence of current CVRF of the elite athlete demographic and the CVRF of the general population.

	Ex-athletes (%)	General population (%)
Smoking		
Males	9	30.9
Females	8.6	20.5
High blood pressure		
Males	9.8	22.6
Females	0	23.7
Mellitus diabetes		
Males	2.5	7.6
Females	0	7.9
Obesity		
Males	4.1	15.7
Females	0	14
Hypercholesterolemia		
Males	18.2	16%*
Females	2.9	
Perform regular exercise		
Males	85	84.5
Females	82.9	81.1**

*No difference between males and females; **Result of international physical activity questionnaire (IPAQ - short).

The comparison of the prevalence of CVRF of the ex-athletes with those of the general population, is displayed in Table 3. In terms of smoking, there is a percentage difference for both males and females, as well as in high blood pressure and obesity. The values of hypercholesterolemia among males are similar. However, there is a difference between female ex-athletes and data from the general public. In terms of diabetes, differences can be seen among males and female ex-athletes compared to the general reference demographic.

Physical exercise

Regarding physical exercise, 24 (15.3%) of ex-athletes reported not performing any kind of regular exercise, 33 (21%) performed light activity, 47 (29.9%) moderate exercise, 32 (20.4%) intense activity, and 21 (13.3%) very considerable (Figure 1). The prevalence of sinus bradycardia is significantly higher among ex-athletes that performed higher-intensity physical exercise ($p<0.01$) (Figure 2).

Discussion

The changes in athletes produced through training, particularly of the cardiovascular system, have been studied in the so-called "athlete's heart"[8] context. Since the first references in which the only assessment was performed with an Electrocardiogram and thorax x-ray, to today, when assessments are made using a 24-hour electrocardiogram using the Holter method and image techniques with the echo-cardiogram,

Figure 1. Current physical exercise of ex-elite athletes.

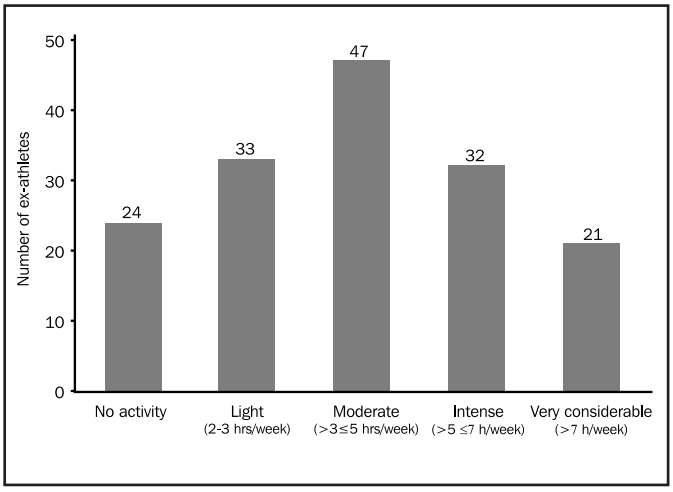
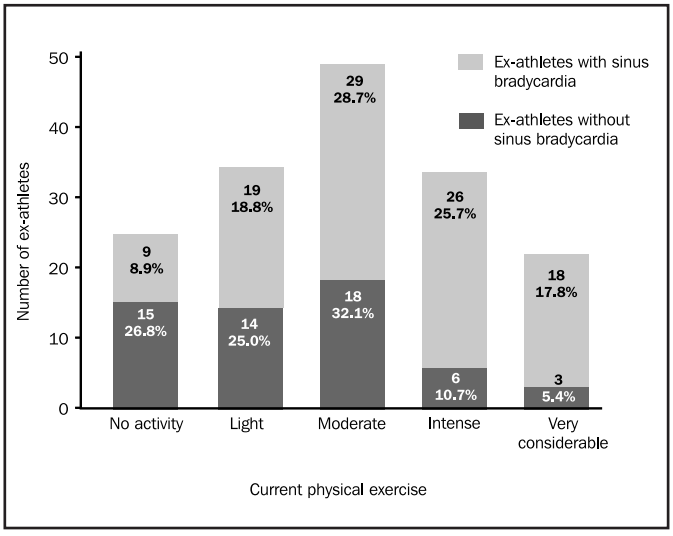


Figure 2. Relationship between current bradycardia and physical exercise.



magnetic nuclear resonance and isotopic nuclear medicine studies, new aspects are being discovered about structural changes, remodelling and function[8-11]. The continuance of physical exercise among ex top-level competition athletes or demographics who have trained for long periods of time, has generated interest in terms of discovering the cardiovascular changes in veteran athletes that have retired from top-level competition[12]. In these cases, in addition to those linked to age, are the appearance of cardiovascular risk factors (CVRF) associated with years, and that levels of training are generally less intense.

Competitive physical exercise has different aspects to consider, including health and sporting performance. Sport is associated with performance, but the foundation of this is a good state of health. For over 50 years, sporting aptitude has been assessed with marked clinical profile criteria, so the history of an athlete was similar to that of patients. The clinical history examination consisted in collecting family and personal data, physical exploration, electrocardiogram and basic analysis.

Currently, reviews have the same profile, which allows for broad information about health and aptitude for competition sport. In the Blume Residence medical centre and in the Sant Cugat CAR, these requisites are fulfilled, which has allowed us to have more information about family antecedents, CVRF such as blood pressure, smoking and plasma lipids. With this data, follow up has been performed on the athletes retired from top-level competition for at least 5 years. The current history provides the same information obtained with the personal interview, structured questionnaire and electrocardiogram. This allows the CVRF to be assessed in the athletes, and for comparison with the general public.

Bibliographic references generally focus on two separate aspects. On the one hand, the modifications that take place through training, and on the other, those observed in veteran athletes that have left top-level competition. Our study was performed on a cohort for whom there is a medical, sporting and analytical history, and knowledge of whether there have been cardiovascular risk factors. After retiring from competition, the presence of CVRF was analysed, as well as if there have been cardiovascular episodes, and the evolution of heart rate, which would be a key general indicator of the continuance of physical exercise or whether the subjects are sedentary, which is a less relevant risk factor.

The physical exercise they perform has been assessed in hours per week, as displayed in Figure 1, and the lowest heart rate is linked to moderate-high levels of activity. This data is consistent enough to be linked to CVRF that alter with physical exercise[1-4].

Studies have been carried out on veteran athletes that have retired from competition but have remained active. Pihl[13] studied active and sedentary athletes and compared them to veteran athletes who performed recreational sport. The CVRF (cholesterol and blood pressure) were lower and were linked to continuing to perform physical activity to date. Along the same line, Melekoglu[14] studied veteran football players, among whom the most active had better controlled CVRF than the least active members. The recommendation is the same as for the general population. Perform regular exercise and as far as possible, under a well-structured training programme.

The prevalence of coronary heart disease increases with age, particularly when there are also CVRF. Physical training causes a remodelling of the coronary arteries, so their diameter is wider, and they are more distensible, increasing the coronary reserve capacity[15].

Mengelkoch[16] has demonstrated that CVRF remain stable and low after a follow-up of 20 years of top-level athletes aged between 60 and 92 years, and who perform regular physical exercise. The recommendations made in primary and secondary cardiovascular disease prevention linked to physical exercise are extremely solid and insist upon method and regularity as basic elements. Optimum results can only be achieved this way. Another study performed on mass-level veteran athletes with lighter levels of training, also revealed that CVRF were lower, and also linked to the continuance of physical exercise to the current day[17], reaching similar conclusions about a broad sample, split into levels of physical exercise, and excluding carriers or those with a family history

of CVRF. The higher the intensity of the physical exercise performed by veteran athletes, the lower the risk of coronary heart disease and heart illnesses linked to maintenance. Sarna[18] carried out a study in Finland with athletes who had participated in at least one top-level competition between 1920 and 1965. For aptitude, they included those who served military service. The follow-up on morbidity, mortality and life expectancy were better and the CVRF were lower than among sedentary groups. The type of exercise, preferentially aerobic and intense, is associated to increases in survival indices[19].

The active recommendation of the medical community in most specialities regarding the practice of physical exercise is due to the evidence of its favourable effects[20]. However, the presence of side-effects cannot be ignored, particularly in high-intensity physical exercise and veterans, which can be prevented or reduced by following indications and the appropriate method.

The results of our study of high-level ex-athletes were obtained by comparing all the initial clinical and CVRF information with that obtained after 5 years, at least, following retirement from competition, despite the challenge of finding said ex-athletes after so many years (Table 2).

The percentage differences with the general public are evident, for both males and females alike (Table 3). In terms of cholesterol, the differences are very slight among men and marked among women.

Regarding obesity in ex-athletes, 7.6% were overweight, whilst today this figure stands at 31%, with 6% obese. In any case, the values are lower than among the general public. Physical exercise level has been linked to the persistence of bradycardia given the close tie between both factors. Figure 2 displays the relationship between the continuation of physical exercise and current sinus bradycardia.

In summary, the study results from a cohort of 157 ex top-level competition athletes, on the one hand reveal the appearance of risk factors association to age, yet on the other, the prevalence is lower than among the general public, and they are physically more active.

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Conflict of interest

The authors claim to have no conflict of interest whatsoever.

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