Wrzesiński Bartłomiej, Piechocka Edyta, Duda Grzegorz, Wojtczak Paweł. Sudden death amongst people practicing competitive sports (review article). Journal of Education, Health and Sport. 2018;8(02):43-52. eISSN 2391-8306. DOI http://dx.doi.org/10.5281/zenodo.1165406
http://ojs.ukw.edu.pl/index.php/johs/article/view/5251

The journal has had 7 points in Ministry of Science and Higher Education parametric evaluation. Part B item 1223 (26.01.2017).
1223 Journal of Education, Health and Sport eISSN 2391-8306 7

The authors declare that there is no conflict of interests regarding the publication of this paper.
Received: 05.01.2018. Revised: 10.01.2018. Accepted: 04.02.2018.

Sudden death amongst people practicing competitive sports (review article)

Bartłomiej Wrzesiński[1], Edyta Piechocka[1], Grzegorz Duda[1], Paweł Wojtczak[1]

[1]Scientific Circle at the Department of Ergonomics and Physiology of Physical Effort Collegium Medicum UMK, Toruń, Bydgoszcz, Poland

Abstract

Sudden cardiac death is and unexpected cardiac arrest that may occur both during exercise and also an hour after its completion. It most often occurs in young sportsmen under 35 years of age and is usually associated with improperly performed physical activity proceeded by lack of specialized medical examination and research. Natural and cardiac causes are two basic phenomena that lead to cardiac death. As confirmed by Framingham Heart Study, conducted in the eighties of the twentieth century on the population of Americans, natural causes accounted for 13% while cardiac causes accounted for 88% off all. The statistics of the largest centers of sport medicine are presented as follows: Germany – 1 death per 200,000 people practicing sports (total) while United States of America – 1 death per 80,000 people per year. The problem of sudden deaths is an important topic worthy of a deeper and more specific analysis. It should be noted that physical exertion is not is not a direct cause of sudden deaths. Currently the most research concerns professional athletes who have extensive support and knowledge about the exercise they perform. The main problem concerning subject of sudden deaths are not diagnosed hearth defects. <> Additional topic of interest is rarity of medical tests performed by amateur athletes and athletes at the lower levels of competition. Such athletes do not have as extensive knowledge as their experienced idols, which may bring tragic consequences.

Keywords: sudden death, improper physical activity, hypertrophic cardiomyopathy, athletes, competitive sports, amateur sports.

Introduction

Sudden death in the case of physical exertion concerns two situations. First one is the death of the player during physical exertion and the second – death during an hour following physical activity. Rarely and additional research is carried due to the fact that it is virtually unmeasurable. The results of a significant amount of research suggest that prolonged and intensive physical activity may cause pathological changes in cardiovascular system. Extreme cases can result in with sudden cardiac death [1,2,3,4,5,6].

They most often affect people over 35 year of age as well as older people. Its prevalence is estimated at 1:200000 in comparison to the entire population. The main cause are ventricular arrhythmias associated with structural changes in the myocardium or impaired nerve conduction. Changes in athlete's myocardium usually occur when the body is adapted to physical exercise [3,4,5].

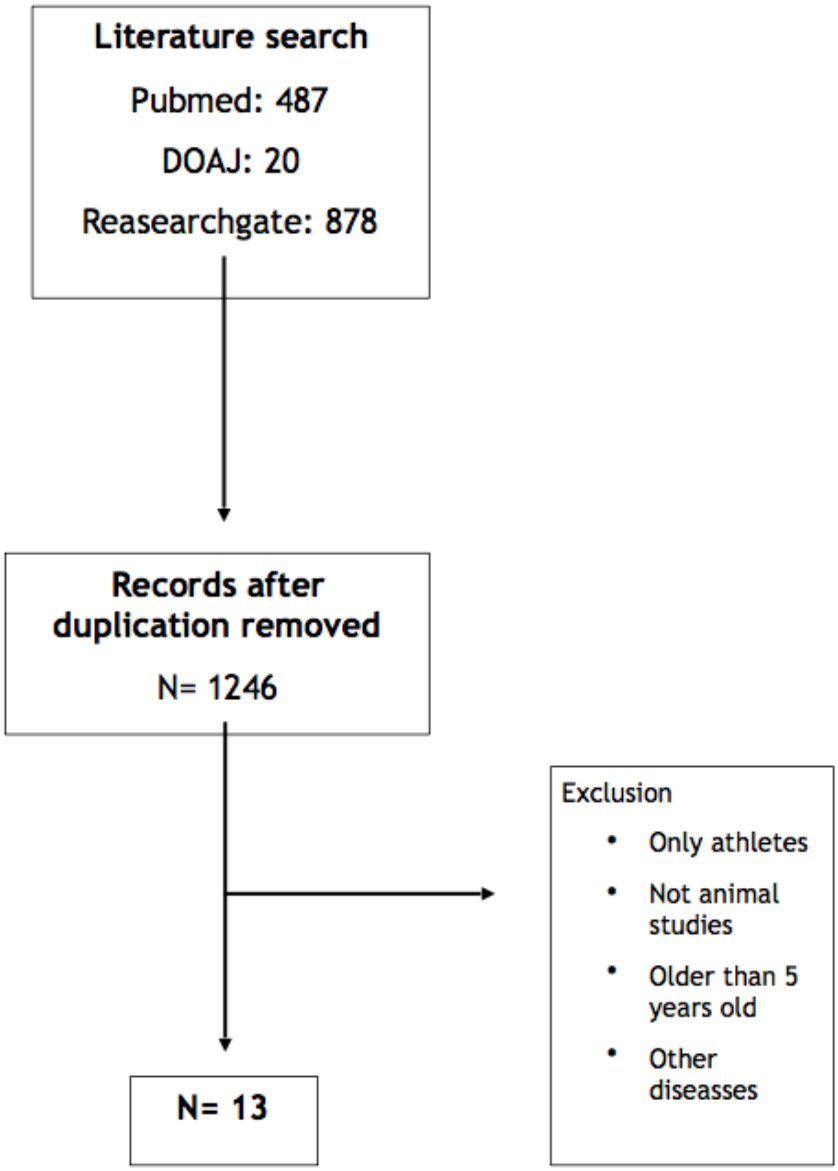
The body adapts in several stages. Initially, the body's renewal processes improve, then muscle movement and function increase. The muscle demand in hemodynamic processes is also decreased. The effects of adaption to physical exert can be observed at around 6-8 hours of physical activity per week, where the hearth rate reaches 160-180 beats per minute [4,5,6].

The main reasons

The immediate cause of most deaths is not physical activity itself, but its adverse effect on pre-existing (usually congenital) pathologies in circulatory system [3]. Specifically hypertrophic cardiomyopathy, coronary anomalies, myocarditis or arithmogenic right ventricular dysplasia. However, in athletes over 39 years of age, the most common cause is failure of cardiovascular system due to coronary heart disease [5,6,7,8,9].

Data Sources

We searched the PubMed, ReasearchGate and DOAJ databases up to May 2017, without language restrictions, for full papers reporting study with the search terms: sudden cardiac death, athletes. Reference lists of the original articles found during research was reviewed manually andcross - checked. A total of 13 articles were identified by these searchers (Figure 1.)


Literature search
Pubmed: 487
DOAJ: 20
Reasearchgate: 878
Records after duplication removed
N= 1246
Exclusion
Only athletes
Not animal studies
Older than 5 years old
Other diseasses
N= 13

Discussion

Author/s	*Experimental group*	*Type of physical exert/discipline*	*Causes of death*
Barry J et al.	*182 causes of sudden death, including 64 athletes.*	*Basketball, football*	*Hypertrophic cardiomyopathy- 21* *Congenital coronary defects- 8* *Coronary arteries atherosclerosis-5* *Aortic atherosclerosis-3* *Arrhythmogenic right ventricular cardiomyopathy*
Kristal Choi et al..	*Athletes with age ranging between 11-31 (death within hour following physical activity)* *69 men* *14 woman*	*Athletic disciplines*	*Hypertrophic cardiomyopathy30%* *Coronary artery anomalies 9%* *Myocardium anomalies 9%*
Barry J et al.	*Young athletes aged from 12 to 18 years, students of sports high school*	*Basketball, wrestling*	*Hypertrophic cardiomyopathy, coronary artery abnormalities, myocarditis, aortic stenosis*
Van Obóz et al.	*126 high school athletes:* *115 men* *11 woman* *36 university athletes:* *31 men* *5 woman*	<>	*Hypertrophic cardiomyopathy, coronary artery abnormalities*
Bruce F et al.	*18 cases of sudden deaths of people ranged between 30 and 64 years of age*	*Boxing, swimming, jogging, basketball, racquetball, softball*	*Atherosclerosis, myocarditis, hypertrophic cardiomyopathy, mitral valve loss*
Corrado Dominico et al.	*Athletes ranging from 12 to 35 years of age, 300 sudden deaths – 55 sportsmen*		*Atherosclerotic lesions, hypertrophic cardiomyopathy, arithmogenic right ventricular cardiomyopathy, congenital coronary artery anomalies, myocarditis, premature syndromes and*

			conduction diseases, ion channel disease, congenital heart disease
S V se Noronha et al	*118 athletes:* *107 men* *11 woman* ≤35 years	*Rugby, football*	*Hypertrophic cardiomyopathy, morphological heart disease, atherosclerotic coronary disease*
Paul Forbes et al	*31 cases of sudden death including:* *29 men (7-57 years)* *2 woman (6-60 years)*	*Running, basketball, swimming, gymnastics, rugby, cycling, skiing, football*	*Acute myocarditis, carotid fibrosis, arithmogenic Right ventricular cardiomyopathy,* *hypertrophic cardiomyopathy*
Anders Gaarsdal Boost et al	*15 athletes ranging from12 to 35 years of age*	*Cycling, aerobics, running, handball, boxing, football*	*Arithmogenic right ventricular cardiomyopathy, myocarditis*
EloiMarijon et al	*Athletes ranging from 15 to 46 years of age (95% of men)*	*Recreational sports, cycling, jogging, football, swimming, basketball, tennis, judo*	*Coronary heart disease, atrial fibrillation, hypertrophic cardiomyopathy*
Erik Ekker Solberg et al	*23 cases of sudden death of people ranged from 17 to 34 years of age:* *22 men* *1 woman*	*Football, running, cycling, handball, skiing, karate, swimming, ice hockey, volleyball*	*Myocarditis, conduction abnormalities, aortic valve stenosis, cardiac rupture, hypertrophic cardiomyopathy, congenital coronary heart disease*
Może. PaźSuàrez-Kier et al	*168 cases of sudden death:* *163 men* *5 woman*	*Running, cycling, tennis, football, basketball, gymnastics*	*CAD, hypertrophic cardiomyopathy (HCM), ACM*
A.Tabib et al	*80 cases of sudden death:* *77 men* *3 woman*	*Rugby, tennis, boxing Swimming, cycling, jogging, football*	*Hypertrophic cardiomyopathy, arrhythmogenic right ventricular cardiomyopathy, aortic stenosis, ventricular septal defect, coronary heart disease, structural abnormalities of the nerve bundle, dilated cardiomyopathy*

Sudden death is one of the most serious effects of cardiovascular disease. The main cause of occurrence are heart defects, the presence of which the person undertaking physical exert is not aware – in this scenario training program is not adapted to this person's body capabilities [4,16,17,20,21,25]. Sudden death is more likely to affect men than woman [4,5,8,9,11,15,16,17,18,19,20,21,22,23,24,25]. Although there is no unambiguous theory explaining this, woman present greater ability to survive selected illnesses, e.g. long QT syndrome, which is probably genetically conditioned. A deep understanding of the diffrences between the sexes may allow to learn the exact relationship [23]. The environment in which man functions, lifestyle and genetic determinants affect the rate of sudden death in the human population. Additional meaning is assigned to the type of cultivated physical discipline, its intensity and conditions, in which it is cultivated (such as temperature, humidity, insolation) [4,19,21]. The reasons of sudden deaths among athletes and people who are not professionally training are based on the same mechanism. The volume the heart needs to pump forces it work at rate to which myocardium is not anatomically designed – heart gets overloaded which may result in cardiac arrest [25]. Athletes in comparison to training amateur people have twice the chance of cardiac arrest. Additionally woman have slightly higher chance than men [5,21]. The type of sport practiced is of great importance, led by sports that require long-term endurance, which stimulates myocardial hypertrophy leading to remodeling [5,17,22]. This is due to loads that are selected during training, less loads cause lesser stimulation of body do adapt, so pathological reconstruction also happens less often. The largest group are cyclists (about 30%), then runners (about 20%) and footballers (about 10%) [22,24]. In an medical interview, about 20% of cases have previously experienced cases of cardiovascular problems or cardiac arrest in family. About 80% of deaths occur during or immediately after exercise. Amongst people with more than 35 years of age the ratio of dying women to men is greater than that of people with less than 35 years of age [4,25]. Most cases are registered between 16 and 35 years of age, this is due to the most frequently undertaken effort in this age group [4].Myocardial hypertrophy should not exceed individual limits. The correct prophylaxis is, therefore, routine medical research to rile out the risks of pathological hypertrophy. Physiological hypertrophy gradually recurs if the workout is interrupted

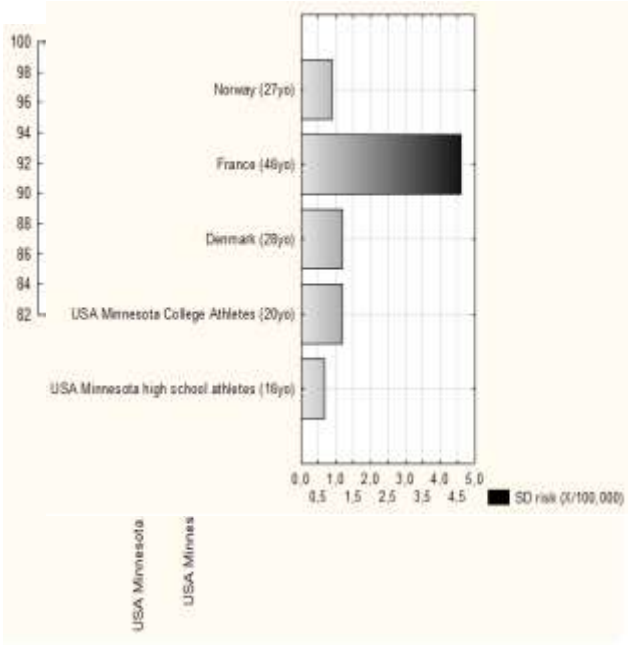


Chart 1. Presents % of men in the experimental group in individual populations (mean age of respondents)

[24]. Unfortunately not all defects are possible to diagnose, about 30% of postmortem testes athletes had defects were detectable during cardiovascular system diagnosis, and about 65% had structural abnormalities [4,16,17]. A relatively large group among student cases of sudden death caused by factors not directly related to sport, such as suicides, drugs, road accidents, drowning or inefficiency on part of the other organs [18].The strategy that allows the greatest possible exclusion of sudden death is imaging of the circulatory system of people undertaking physical activity [16,17,20,22,24,25]. The way to reduce mortality due to cardiac arrest is to popularize a device called an automatic external defibrillator (AED), which in some cases allows reassuming the hearth beating and increasing the chances of getting professional help [22]. It is particularly important to have access to such equipment in places with high traffic [20,22].

Conclusions

Chart 2.Shows mortality per 100,000 people in the experimental group in individual populations (mean age of the subjects)

Sport itself is not a cause of sudden death in sportsmen, however, it is a stimulus that can lead to cardiac arrest in the presence of cardiovascular disease. Often cardiovascular diseases are congenital or acquired defects, but the athlete does not know of their existence. The consequences associated with them affect both professional and amateur athletes. The most serious of those is sudden death, which affects men more often than woman. The risk of death is dramatically increasing after 35 years of age. When it comes to sports, cyclist, runners, and footballers are more exposed. The risk group also includes people with cardiac events in the family (60%). Therefore a systematic medical examination is a very important aspect when practicing sports.

Reference

1. Klukowski K. [Medycyna Sportowa]. Warszawa: Medical Tribune; 2011 (in Polish).
2. Burduk P. Śliwka K, Bloch-Bogusławska E, Burduk PK. [Nagła śmierć a wysiłek fizyczny]. Arch Med Sąd Krym. 1998;XLVIII: 127-133 (in Polish).
3. Maron B.J, Shirani J, Poliac L.C, Mathenge R, Roberts W.C, Mueller F.O. [Sudden death in young competitive athletes]. Clinical, demographic, and pathological profiles. JAMA 1996;276:199-204.
4. Noronha S. V, Shorma S, Papadakis M, Desai S, Whyte G, Sheppard M. N, [Etiology of sudden cardiac death in athletes in the United Kingdom a pathological study]. Heart 2009, 95: 1409-1414.
5. Corrado D, Basso C, Schiavon M, Thiene G, [Does activity enhance the risk of sudden cardiac death]. Italian Federation of Cardiology, 228-233s, 2006.
6. D'Silva A, Papadakis M, [Sudden Cardiac Death in Athletes]. Rodcliffe Cardiology; 2015, 10(1); 48-53s.
7. D'Silva A, Shorma S,[Exercise the Athlete's Heart and Sudden Cardiac Death]. The Physician and sportsmedicine; 2014, 42(2).
8. Świerkosz Sz, Nowak Z, Pacyna A, [The most common causes of sudden cardiac death in athlete]. Fizjoterapia 2015, 23(4), 55-65(in Polish).
9. Mark S, Link M.S, Mark Estes N.A, [Sudden Cardiac death in the Athlete]. Prog. Cardiovasc Dis 2008, Jul-Aug 51(1) 44-57(in Polish).
10. Wojtasik W, Szulc A, Kołodziejczyk M, Szulc A[Wybrane zagadnienia dotyczące wysiłku fizycznego na organizm człowieka]. Journal of Education, Health and Sport; 2015, 5(10), 350-372s.(in Polish).
11. Kenny A, Shapro L.M, Sudden Cardiac death in athletes, Br Med Bull 1992, Jul; 48(3); 534-45(in Polish).
12. Garcia-Gonzales C, Albaladejo R, Villa. R, Naiarro E [Determining factors of sport injuries in amatour sports in Spain] European Journal of Human Movement; 2017, 33, 137-151s.
13. Wrzosek K, Mamcarz A, Braksator W, [Wybrane problemy kardiologii sportowej] Choroby serca i naczyń 2005, 2(4), 179-186s (in Polish).
14. Krenc Z, [Adaptacyjny przerost lewej komory czy kardiomiopatia przerostowa] Choroby serca i naczyń; 2015, 12(1); 25-34 (in Polish).
15. Barry J, Maron MD, Tammy S, Mans RN, Caleb J.M, Ahluwalia A, Rutten-Ramos S, [Incidence and causes of sudden cardiac death in U.S. Collage Athletes]. Journal of the American college of cardiology 2014, 63(16).
16. Maron B J, Haast S, Ahluwalia A, Ruttan-Ramos S C, [Incidence of cardiovascular sudden deaths in Minnesota high school athletes], Heart Rhythm Society, 2013: 10(3): 374- 377.

17. Camp V, Bloor CM, Mueller FO, Cantu RC, Olson HG,[Nontraumatic sports death in high school and college athlete]. Medicine and Science in sports and exercise 27(5), 1995.

18. Waller B. F, Hawley D. A, Clark M. A, Pless J. E, [Incidence of sudden Athletic Death's Between 1985-1990 in Marion Country, Indiana, Clin. Cardiol]. 15, 851-858 (1992).

19. Fornes P, Lecomte D, [Pathology of Sudden Death During Recreational Sports Activity]. The American Journal of Forensic Medicine and Pathology, 24(1) 9-16, 2003.

20. Holst A G, Winkel B G, Theilade J, Kristensen J B, Thomsen J L, Ottesen G L, Svencksen J H, Haunso S, Prescott E, Tfelt-Hansen J, [Incidence and etiology of sports- related sudden cardiac death in Denmark- Implications for preparticipation screening]. Heart Rhythm 2010: 7(10),. 1365-1371s.

21. Marijon E, Tafflet M, Celermajer D S, Dumas F, Perier M-C, Mustafic H, Toussaint J-F, Desnos M, Rieu M, Benameur N, Storts [Related Sudden Death in the General Population]. Univ of ulster at coleraine, 2015, 672-681s.

22. Solberg E. E, Gjertsen F, Haugstad E, Kolsrud L, [Sudden death in sports among young adults in Norway]. European Society of cardiology, 2010, 17, 337-341s.

23. Suarez-Meir M P, Aguilera B, Rosario M, Mosquera M, Soledad Sanches-de-Leon, [Pathology of Sudden death during recreational sports in Spain]. Forensic Science International 226(2013) 188-196.

24. Tabib A, Mirast A, Taniere P, Loire R, [Undetected cardiac lesions cause unexpected sudden cardiac death during occasional sport activity]. European Heart Journal (1999) 20, 900-903.

25. Reindell H. Das sportherz, geschichlicheEntwichlung und neueAspekte. W: Rost R., Webbering F. (red) Kardiologieim Sport. Deutsche ArtzeVerlag, Koln, 1987.

26. Slattery ML, Jacobs DR Jr, Nichaman [MZLeisure time physical activity and coronary heart disease death]. The US Railroad Study. Circulation. 1989 Feb. 304-11.

27. Basavarajaiah S, Shah A. And Sharma S. [Suddencardiac death in young athletes]. Heart 2007, Mar; 93(3): 287-289.