Sudden Death during Sport Activities: A Malaysian Perspective

O.P. Murty¹, Anshoo Agarwal², Kanageshwarri A/P N.S.Murugiah¹, Siti Nurzawani Abdul Rahman¹, Nor Syuhada Binti din Mustafaha¹, Kamarul Ariffin Abu Bakar¹

¹, University Malaya, ²UITM MARA, Department of Pathology, Malaysia

Correspondence:
Dr. O.P. Murty
Professor Forensic Pathology, UITM, Malaysia
Email: dropmurty@yahoo.co.in

Abstract

This is a retrospective study of sports related deaths on the human bodies brought for autopsy in the last 10 years (from 1995-2005) at University Malaya Medical Center (UMMC), Kuala Lumpur. The objective of this study was to know the cause of death, manner of death, ethnicity, food habits, timings of incident, number of cases and other related information like history of metabolic disorders or any other underlying diseases. All cases were analyzed in relation to age, gender, race, causes of death, type of sport activities and victim’s profile. The present study included those subjects who had died either during playing or immediately after it. Our results showed the most common age group affected in such sports related sudden deaths to be ranging between 40 – 49 years and the least affected were between 0 – 9 years of age. Out of 44 cases reanalyzed, 33 were male and 1 was female. Among the ethnic group, most of the subjects were Chinese (45.45 %) followed by Malays (20.45%). This study also showed that 80% of the deaths were caused by ischemic heart disease IHD (50%) or coronary heart disease CAD (30%). Deaths were seen to be more in the subjects above 30 years of age which could be associated with the associated risk factors related to ageing. A significant number of deaths were observed while playing badminton and jogging. No serious need for mass screening was felt as the numbers of cases each year were not significant and they were isolated incidents. Although, there are few basic preventive measures like cardiac screening, lipid profile, avoidance of stressful working conditions which can be easily adopted to decrease loss of life. Incidence may decrease with recreational and health maintaining activities, but absolute prevention may still not be possible.

Key Words: Sudden death; Sports activities; Causes of death; Types of sport activities; Family history; Risk Factors.

Introduction:

Sudden death is defined as “an abrupt unexpected death of pathological or idiopathic cause, in which death occurs within 1 to 12 hours of onset of symptoms” (1, 2). The majority of sudden deaths in this study occurred during or immediately after exercise (game, conditioning, training, etc). Autopsy is most often the only means in making a definitive diagnosis and for determination of the cause of sudden death.

Sports are often regarded as a part of lifestyle owing to the widely held perception that it bettered health and life in whole. The possibility of those indulge in sports to be susceptible to sudden death often seems to be ironic and counter intuitive. Nevertheless, such sudden catastrophes continue to occur, usually in the absence of prior symptoms.

Attempts to understand the causes of such events regularly revolve around cardiac aetiology and to certain extend other causes. However, studies regarding these events are not as extensive as in the western regions in which the causative factors may vary given the diverse environment, cultural, social, economical and climacteric factors.

In this study, consideration of subjects was based on the following criteria (3):
- Individuals that participated in organized competitive sports
- Individuals that exercised regularly and vigorously
- Physically conditioned persons, e.g. military personnel

Individuals that lead a sedentary lifestyle and exercise infrequently were also included in this study as the circumstances indicate that these subjects were in some points close to the sporting events that led to sudden death. Fortunately, sudden death associated with sports is rare. Its exact prevalence is unknown, since there is no national or regional database to track deaths in these individuals. The largest available studies estimate the risk among high school and collegiate (who are active in sports)
to be between 1 per 100,000 and 1 per 300,000 each year (4, 5, 6). An estimated 50 to 100 cases occur in the United States annually (5, 7). It is worthwhile noting that sudden death is about five times more common in males than in females (4). The incidence increases in persons over 35 years of age, largely because of the increasing prevalence of atherosclerotic heart disease. Estimates of the incidence in the older population of joggers or people who exercise vigorously range from 1 per 15,000 to 1 per 18,000 (8, 9).

Sports related death will always be an emotive topic, for it suggests that sports may not prevent the development of heart disease and may actually increase the likelihood of dying suddenly during exercise. Past researches more often than not lay emphasis on cardiac causes of sudden deaths. In this study a broader outlook was adopted to ascertain as many causes and may also serve as an accentuate to the current view of cardiac causes being the major cause of sudden deaths in sports.

**Methodology:**

This study was conducted retrospectively from the period of 1995 to 2005. Data was obtained from Forensic Pathology Unit, Department of Pathology, Faculty of Medicine, University Malaya, and Kuala Lumpur.

The relevant data were reviewed, and registered in the database and analyzed using SPSS programme covering age, sex, ethnicity, types of sport activities done during collapse, causes of death, and other risk factors. Cross tabulations were performed and significant results were tabulated and charted. Comparisons were made with the relevant past researches and any patterns, similarities or dissimilarities were observed and interpreted. The results were again discussed among group members. Literature search was done again to identify any relevance to other studies. Finally significant results were presented.

**Results:**

Table 1: Age and sex distribution of sudden deaths during sport activities

<table>
<thead>
<tr>
<th>Age</th>
<th>Male</th>
<th>Female</th>
<th>Total</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>0-9</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>2.27</td>
</tr>
<tr>
<td>10-19</td>
<td>3</td>
<td>3</td>
<td>6</td>
<td>6.82</td>
</tr>
<tr>
<td>20-29</td>
<td>4</td>
<td>4</td>
<td>8</td>
<td>9.09</td>
</tr>
<tr>
<td>30-39</td>
<td>5</td>
<td>5</td>
<td>10</td>
<td>11.36</td>
</tr>
<tr>
<td>40-49</td>
<td>17</td>
<td>17</td>
<td>34</td>
<td>38.64</td>
</tr>
<tr>
<td>50-59</td>
<td>14</td>
<td>14</td>
<td>28</td>
<td>31.82</td>
</tr>
<tr>
<td>Total</td>
<td>43</td>
<td>1</td>
<td>44</td>
<td>100</td>
</tr>
</tbody>
</table>

From Table 1, we observed that the highest numbers of victims were in the age group of 40-49 years, with total of 17 deaths (38.64%), followed by 50-59 years old age group with 14 deaths (31.82%). The minimum numbers of deaths were recorded in age between 0-9 with only 1 case (2.27%).

43 subjects were male and only 1 was female. Amongst the male victims, most of them were in the age group 40-49 year (38.64%), followed by 31.82% subjects between 50-59 years of age. The female victim was from the age group 0-9 years.

Figure 1: Distribution of different ethnic groups in sports related deaths

In our study, Chinese accounted for the most number of deaths during sport activities with a total number of 21 cases (47.72%) reported in past ten years. Amongst the Chinese, 20 victims were males while only 1 was female. Malays formed the second largest groups of sports related deaths with total of 9 cases (20.45%), and all were males. This was followed by the Indian and Others with each contributing to the same number of cases which was
7. Others included Sikh, non-Malaysians such as Europeans and Indonesians. Of the 44 deaths occurred during sport activities between the years 1995 to 2005, the number of cases in each year varied. From the bar chart below (Figure 2), the highest number was in the year 2003 with 9 cases (20.5%), followed by 7 (15.9%) in year 1999, 5 cases or 11.4% in the year of 2002, 2004 and 2005 each. The lowest number of deaths was 2 cases which occurred in the year of 1996 and 1998.

Figure 2: Distribution of number of cases according to years in sports related deaths

<table>
<thead>
<tr>
<th>year of incidence</th>
<th>Count</th>
</tr>
</thead>
<tbody>
<tr>
<td>1996</td>
<td>2</td>
</tr>
<tr>
<td>1997</td>
<td>1</td>
</tr>
<tr>
<td>1998</td>
<td>3</td>
</tr>
<tr>
<td>1999</td>
<td>7</td>
</tr>
<tr>
<td>2000</td>
<td>3</td>
</tr>
<tr>
<td>2001</td>
<td>5</td>
</tr>
<tr>
<td>2002</td>
<td>5</td>
</tr>
<tr>
<td>2003</td>
<td>9</td>
</tr>
<tr>
<td>2004</td>
<td>5</td>
</tr>
<tr>
<td>2005</td>
<td>5</td>
</tr>
</tbody>
</table>

Table 2: Correlation between causes of death and age group distribution of sudden deaths victims during sports activities

<table>
<thead>
<tr>
<th>age</th>
<th>coronary artery disease</th>
<th>acute myocardial infarction</th>
<th>cardiomyopathy</th>
<th>ischemic heart disease</th>
<th>miscellaneous</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>0-9</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>10-19</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>3</td>
</tr>
<tr>
<td>20-29</td>
<td>2</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>4</td>
</tr>
<tr>
<td>30-39</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>2</td>
<td>0</td>
<td>5</td>
</tr>
<tr>
<td>40-49</td>
<td>9</td>
<td>2</td>
<td>0</td>
<td>6</td>
<td>0</td>
<td>17</td>
</tr>
<tr>
<td>50-59</td>
<td>7</td>
<td>1</td>
<td>1</td>
<td>5</td>
<td>0</td>
<td>14</td>
</tr>
<tr>
<td>Total</td>
<td>22</td>
<td>5</td>
<td>2</td>
<td>13</td>
<td>2</td>
<td>44</td>
</tr>
</tbody>
</table>
Figure 3: Distribution of causes of death in sports related sudden deaths as mentioned in the autopsy records.

Figure 3 showed that 22 sports related sudden deaths occurred due to coronary artery disease which actually contributes to the highest number of cases in the past ten years. Out of 44 cases, 13 victims died due to ischemic heart disease. Another 5 victims died of acute myocardial infarction. Cardiomyopathy contributed to 2 cases of the total number. Associated miscellaneous conditions such as Klebsella infection and choking have accounted for 2 deaths.

Figure 4: Correlation between causes of death and the specific sporting activity
Figure 4 depict the relation between deaths and the specific sporting activity. In figure 5, the category 'others' shows only 4 numbers of sudden deaths. Others here include rugby, snooker, squash and playing in water theme park. These activities did not sum up to significant number and presented as isolated cases, often as exclusive cases. 15 deaths occurred while the victims were playing badminton followed by playing football in 6 cases, 4 deaths occurred while jogging and cycling, followed by death during exercising in 3 cases, swimming, 2 deaths each happened while playing tennis, golf and playing hockey.

Figure 6: Distribution of sudden deaths that occurred in cases with associated risk factors

<table>
<thead>
<tr>
<th>Risk Factors</th>
<th>Count</th>
</tr>
</thead>
<tbody>
<tr>
<td>obesity</td>
<td>15</td>
</tr>
<tr>
<td>smoking</td>
<td>6</td>
</tr>
<tr>
<td>family history</td>
<td>2</td>
</tr>
<tr>
<td>alcoholic</td>
<td>4</td>
</tr>
<tr>
<td>underlying dss</td>
<td>4</td>
</tr>
</tbody>
</table>

Figure 5: Distribution of type of sport activities done during collapse

![Graph showing the distribution of type of sport activities done during collapse.](image)
The line graph above concludes that more deaths were seen above the age of 30 years and this may be due to their associated risk factors. Obesity was found to be associated in the highest number of sudden sports related deaths with total of 8 deaths in the age group of 40-49 years.

**Figure 7**: The correlation between smoking and causes of sports related sudden deaths.

![Smoking & Cause of Deaths](image)

Ironically smoking does not seem to influence the number of sudden deaths. The numbers of smokers were less than the non-smokers who died of various causes of sudden deaths during sporting activity except for only 1 case in which cause of death was acute myocardial infarction. Associated miscellaneous conditions such as Kleibsella infection and choking have accounted for 2 deaths and both of them were non-smokers.

**Figure 8**: Correlation between obesity and causes of sports related sudden deaths.

![Obesity & Cause Of Deaths](image)

In our study, we found that the majority of those who died mainly of coronary artery disease were not obese; the number of these cases is 16 compared to 6 cases which were obese. As for cardiomyopathy and miscellaneous causes, none was found to be obese. People who died of acute myocardial infarction and ischemic heart disease were found to be obese with only 1 case more than the non-obese in each cause.
It was found that those who were working in the private sector (e.g., IT personal, manager, and clerk) formed the largest group of victims with the total of 34.09% (15) cases. The second highest group of victims belonged to group where occupation was not known, comprising of 25% (11) cases. This was followed by government sector workers (e.g., forest officer, public health officer) including 8 cases (18.18%). The least number of victims were from self-employed group and students, with the total number 5 deaths in each group.

**Discussion:**
Few limitations were identified in this study. First, the sampling size was small as only 44 cases had been identified for the past ten years. This is mainly due to the small number of sports related deaths documented in this centre where study was undertaken. The number of cases of sudden deaths during sport activities in University Malaya Medical Center from the year 1995 to 2005 varied each year. The observations are difficult to make any final conclusion as our sample size was small and the limited randomization.

The diagnoses of the cases were based on history noted in autopsy records. Most of the cases were brought for autopsy after collapsing on ground suddenly.

Majority of deaths (38.64%) were found in the age group between 40-49 year old, only 1 case was found in the age group between 0-9. Age group above 30 years contributed to the highest number of sudden deaths and many of them had family history of cardiovascular diseases. Furthermore, most of them were overweight and had the habit of smoking and consuming alcoholic beverages. They were also found to have various underlying diseases. The high male to female ratio can be attributed to the fact that males are involved in sport activities more frequently than females. In addition, men are known to be more vigorous and mobile when it comes to physical activities. Generally, males are also at a higher risk of cardiovascular diseases and prone for falling into the habits of smoking and alcoholism. These indirectly put males into the higher risk group. Another possible contributing factor is the higher professional involvement of males in sports which puts them in the higher stress scale. Women on the other hand, to a certain extend, are more likely to be at home.

The data collected was restricted to Petaling Jaya and Kuala Lumpur where a significant portion of the population is Chinese. Malays contributed to the second highest sports related sudden death which was followed by Indians and others.
Individuals who died suddenly during exercise have advanced heart disease of which they were frequently unaware. The commonest forms of heart diseases associated with sudden death during exercise are coronary artery disease and hypertrophic cardiomyopathy (10, 11). Less common cardiac conditions linked to sports related sudden death include anomalous origin of the coronary arteries, aortic rupture associated with Marfan’s syndrome, myocarditis, mitral valve prolapse and various arrhythmias. (10, 11) The incidence of these predisposing diseases in this group of population is extremely low. Detection of some of these conditions in asymptomatic individuals may be difficult, if not impossible. Regular exercise reduces the overall risk of sudden death in those with latent coronary artery disease, yet acutely increases the risk of sudden death during exercise for those with heart disease that predisposes to sudden death. Most of the sports related deaths occurred due to coronary artery diseases, the number being 22 cases, 50% of the total cases. This was followed by ischemic heart diseases and acute myocardial infarction with 13 and 5 cases respectively. Exercise in general, and regular short-term exercise in particular, produces a significant increase in heart rate, contractility of the heart and increase cardiac output and oxygen consumption. Numerous studies showed that regular exercise has multiple health benefits that go beyond increasing fitness (i.e., improvements in lipid profile, weight loss, reduction of insulin resistance and the risk of type 2 diabetes), cardiovascular disease in general, including the risk of myocardial infarction, heart failure, and death caused by cardiovascular disease. The National Institute of Health recommends a goal of 30 minutes of moderate activity every day of the week (12). However systemic training (dynamic, aerobic) or isometric sports (static, power) has been known to increase cardiac mass and dimensions, and trigger structural remodeling in many people. Although the function of the heart remains preserved, extreme alterations in cardiac dimensions have unavoidably raised concern of whether such exercise-related adaptations are truly physiologic, especially when present for the long periods of time. While firm evidence is presently lacking, one cannot exclude with certainty that such extreme ventricular remodeling due to intense conditioning may have adverse consequences over long time periods (13-17). However the more important point is that none of these conditions is caused by exercise. Rather, the evidence is clear that regular exercise acts against the development especially of coronary atherosclerosis. There is also no evidence that exercise accelerates the progression of these other potentially-lethal cardiac conditions. At present the exact mechanism causing exercise-related sudden death in persons with established disease, especially of the coronary arteries, is not known. Whereas plaque rupture or thrombosis is present in up to 95% of sudden cardiac deaths in the general population, the incidence seems to be lower in exercise-related deaths. Thus exercise-induced ischemia or coronary spasm may be involved in exercise-related deaths (18, 19). Others cases of spots related sudden deaths in the present study include death while playing squash, snooker, rugby and playing in water theme park. However, these activities did not sum up to significant number and presented as isolated cases, often as exclusive cases. Badminton on the other hand, showed the highest number of deaths for specific type of sport activities. This may be because of the popularity of the game in Malaysia and is also played by all age groups. Besides that, it is a game where one can play near the house and only requires minimal of 2 persons. However, this does not prove in any way that badminton can cause higher risk of sudden death.

From the risk factors perspectives, it was found that the majority of sudden deaths during sport activities belonged to the category of non-smokers. Since the main cause of death seem to be of cardiac causes, it can be concluded that smokers may not have utilized the maximum cardiovascular potential. Smokers are often associated with challenged fitness level. In most instances, smokers have impaired lung functions that may deter them from utilizing those maximum cardiac potentials. This in turn could have led to higher risk of cardiac related deficiencies in the non smokers as they often excel in their cardiovascular capacities.

Another crucial risk factor is obesity. It was observed that obese people did not contribute much to sudden deaths statistics. This might be because they were less likely to get involved in any sporting activity compared with non-obese group.

As for alcoholism, it is difficult to interpret as the term alcoholic is not well defined. Form the data, we could only find out whether the subjects had any drinking habits or not. No details on the amount, duration and timing of alcohol consumption could be obtained.

In general, it was observed that there were more deaths occurring above the age of 30 years which may be associated with risk factors they had. The risk factors include obesity, smoking and drinking habit, family history of cardiovascular diseases and the underlying diseases of these subjects.
In our study, we found that white collared workers showed a higher incidence of sudden death during sport activities. This may be due to the unhealthy and sedentary living style where one just has to sit in the air-conditioned room all day long and work. The least number of victims were from self-employed group and students with 5 deaths in each group. As for student, most of them have more free time and always get themselves involved in many activities compared to the older generation. This enables them to be active and decreases the chances of them developing risk factors. American Heart Association Recommended as before taking up active sports, person should be screened for: - [10]

- Family History: Any premature sudden or cardiac death.
- Personal History: excessive fatigue; shortness of breath; exertional chest pain or discomfort; heart murmur; systemic hypertension.
- Physical examination: heart auscultation; brachial and femoral pulses.

Therefore, the common concept of “excess of everything is bad” applies here also in avoiding of “intense” physical activity.

Despite the variety of causes of sudden death (SCD), only a few conditions are responsible for most deaths. Population or mass screening is neither economically viable nor practically feasible. More over most sports deaths did not reveal any positive history or identification of causes in many studies. Current data show that we would be doing a woeful job of implementing these standards.[r] Once there is no clue about disease then a small number of obvious and gross cases detectable either on signs and symptoms or ECG can be detected in pre-sports screening. Any athletic participation carries inherent risks and chances of SCD are very remote. Fatal sport-related injuries can result from head and cervical spine trauma, but most sudden deaths in athletes are cardiac in origin.[7,8] The first recorded sudden death of an athlete was that from Pheidippides, a young long distance messenger, in 400 BC, on arrival in Athens, he reported the defeat of the Persian army and then fell dead.[15] According to Reisdorff and Prodinger, the conditions linked to cases of Sudden Cardiac Death, there are more than 20 causes.

**Conclusion:**

Fortunately, the amount of sudden death during sport activities recorded in University Malaya Medial Center from the year 1995 to 2005 is not high and can be considered as a rare event. Despite numerous causes of sudden death, only a few conditions were found to be responsible for most sports related sudden deaths namely coronary heart disease which contributed as much as 50% of the total causes of death. Most young individuals who are involved with sporting activity who eventually succumb to sudden death have no or minimal history of cardiac problems (family or personal) and no symptoms before death (9). Hence, the detection of at-risk individuals poses a significant challenge to the sports medicine team. Population screening by diagnostic testing is not currently economically or practically feasible, but a significant proportion of at-risk individuals can be identified through a thorough history and physical examination.

Although no perfect screening instrument is currently available, a moral and ethical obligation exists for physicians and athletic trainers to ensure that these group of people are assessed in the most prudent and efficient manner available.

When approached by a patient who wishes either to commence exercise or to establish that it is safe for him or her to continue exercising at their present level, the clinician's first responsibility is to rule out the presence of the acute or chronic diseases associated with sudden death. The clinical problem has several challenges as following (20):

- The incidence of such diseases in the exercising population is low with estimated incidences varying from 1 per 10,000 active exercisers to 1 per 200,000 in children and young adults.
- It is extremely difficult to detect some of these latent forms of heart disease. Indeed, some might have a 30-60% non-critical lesion that does not produce ST segment changes or angina during exercise testing.
- Most acute coronary events occur due to rapid progression of disease at sites at which a critical lesion was not previously present. Furthermore, even when latent disease is detected, it is not always possible to differentiate absolutely those with the disease who will die suddenly during exercise from those with the same condition who are not at risk.

It is clear that there are many people with latent heart disease, especially coronary heart disease, who are able to exercise quite safely without the risk of sudden death. However these are to be distinguished on clinical grounds from those at risk of sudden death during exercise has yet to be established. Accordingly a more pragmatic approach would seem justified. The following guidelines probably represent the current consensus (21, 22):

- All persons over 50 years of age should undergo cardiovascular screening before starting any type of exercise program.
- Younger persons (less than 50 years of age) who are either already participating or who wish
to start exercising should first be interviewed for a family history of conditions associated with sudden death and screened for symptoms and clinical signs of cardiovascular disease, and for risk factors for heart disease.

- When either the family history is suggestive, or clinical suspicion is raised, or risk factors such as hypertension, hypercholesterolemia or cigarette smoking are present, subjects should undergo maximal exercise testing for measurement of exercise performance and the electrocardiographic response to exercise. When abnormalities are detected, further specialist cardiological investigation including echocardiography and possibly coronary angiography is indicated.

Though, it is very difficult to avoid such deaths in absolute manner but, precaution can still reduce these to lowest.

References: