Sudden Death in Sport Before and After Introduction of the Basic Fitness Test

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SUMMARY: This study examines sudden unexpected deaths in relation to strenuous exercise in the five years following the introduction of the Basic Fitness Test viz: 1978-82 and, by comparison with an identical study of the years 1968-77, shows that the annual exercise associated mortality rate rose from 3.5 per 100,000 before the Basic Fitness Test to 4.75 per 100,000 after its introduction. Sudden unexpected death in relation to strenuous exercise is rare, and its incidence has not importantly changed since the introduction of the Basic Fitness Test.

Introduction

Sudden unexpected deaths in apparently healthy young men are highly emotive tragedies. When they occur in relation to strenuous exercise there is a widespread tendency to regard exercise as the precipitant. In 1977 the British army introduced the Basic Fitness Test (BFT), essentially a twice yearly run of three miles in under 30 minutes as a compulsory part of training. This paper examines the mortality associated with strenuous exercise before and after the introduction of the BFT.

Methods

The Central Medical Envelope (F Med 29) held at Stats G(4), Ministry of Defence contains complete and detailed medical records of all serving personnel. The records of all British Army males who died in the five years from 1978 to 1982 were examined to discover those dying suddenly and unexpectedly within 24 hours of strenuous exercise and compared with an identical study of the years 1968-77¹.

In all there were 958 deaths in the five years and records were available in 944 cases (98.5%). Sudden unexpected death is defined as death occurring instantaneously or within 24 hours of the onset of symptoms in apparently healthy men and in whom there was no apparent cause of death. Trauma and heat illness are thus excluded. The validity of the study depends upon the documentation of strenuous exercise in relation to death and, while this is open to error, the dramatic nature of the event suggests that the association is likely to be recorded in most cases.

Moreover, since the methodology for the years 1978-82 is identical to that for 1968-77, comparison of the two periods is likely to be valid.

Results

In the 10 years prior to the BFT there were 56 sudden unexpected deaths within 24 hours of strenuous exercise in 1.6 million man-years, giving an annual incidence of 3.5 per 100,000. In the five years thereafter there were 38 such deaths in 800,000 man-years, an annual incidence of 4.75 per 100,000. Table I shows the atheromatous, and Table II the non-atheromatous causes of exercise associated deaths in the decade before, and Tables III and IV the same parameters respectively in the five years after the introduction of the BFT.

These data are summarised in Table V.

Discussion

It is immediately apparent that sudden unexpected death in relation to strenuous exercise is a rare event and that its incidence has not importantly altered since the introduction of the BFT. This introduction coincided with an upsurge of interest in physical exercise generally in the United Kingdom. If the association of strenuous exercise with sudden death were random, and no good evidence has yet been produced to show that it is not, then the increase in time spent exercising would be sufficient to cause the slight increase in mortality.

The contribution of the BFT itself is difficult to evaluate; only two fatalities were recorded on the test. However while deaths associated with other exercises

Table I
Atheromatous causes of sudden death. 1968–77

No.	Age	Activity	Thrombus	Worst vessel	General state of vessels
1	33	Rugby	Yes	LMS occluded at 1.5 cm	
2	23	Waterskiing	Yes	LMS occluded	Severe
3	35	3 mile run	Yes	LAD occluded at 2 cm	No other abnormality
4	34	Brawling	Yes	LAD occluded at 2 cm	Severe in Cx
5	26	Route March	Yes	LAD occluded at 1 cm	Severe in LAD
6	43	Training run	Yes	LAD occluded	Severe
7	29	Climbing	Yes	LAD occluded	Severe
8	35	Football	Yes	LAD occluded	RCA occluded
9	50	Lawnmowing	Yes	LAD occluded	RCA occluded
10	43	Basketball	Yes	LAD occluded	
11	35	Circuit training	Yes	LAD & Cx occluded	Multiple areas 90% stenosis
12	35	Water polo	Yes	Cx occluded	
13	39	3 mile run	Yes	Cx occluded	Severe
14	40	Football	Yes	Cx occluded	Severe
15	25	Football	Yes	RCA occluded at 1 cm	
16	25	Brawling	Yes (old)	LMS occluded	
17	34	Rugby	No	LAD occluded by atheroma	Moderate in RCA
18	35	Climbing	No	LAD occluded by atheroma	Severe
19	41	Football	No	LAD occluded by atheroma	Severe
20	42	Cycling	No	LMS pinpoint stenosis	Severe in RCA
21	37	Marching	No	LMS pinhole stenosis	Severe
22	45	Running	No	LAD pinhole stenosis	Moderate RCA & Cx
23	31	Training run	No	LMS 80% stenosis	
24	34	Running	No	LAD severe atheroma	Severe Cx
25	30	Training run	No	LAD severe atheroma	Severe Cx
26	36	3 mile run	No	LAD origin severe atheroma	
27	35	Cycling	No	LAD severe atheroma	Severe Cx & RCA
28	36	Football	No	Generally severe	Generally severe
29	32	Cross-country run	No	Generally severe	Generally severe
30	34	Rugby	No	Moderate atheroma	Generally moderate
31	36	Cycling	No	Moderate atheroma	Massive old scar
32	53	Lawnmowing		Necropsy details not available	
33	46	Pushing car		Necropsy details not available	
34	41	Weightlifting		Necropsy details not available	
35	49	Tennis		Necropsy details not carried out	

LMS – left main stem coronary artery
 LAD – left anterior descending coronary artery
 Cx – circumflex coronary artery
 RCA – right coronary artery

Table II
Non-atheromatous causes of sudden death. 1968–77

No	Age	Activity	Cause of death
1	22	Loading truck	SAH – right middle cerebral artery aneurysm
2	35	Carrying friend	SAH – left anterior cerebral artery aneurysm
3	26	Brawling	SAH – posterior communicating artery aneurysm
4	30	Marching	SAH – no aneurysm found at post mortem
5	15	Brawling	SAH – no aneurysm found at post mortem
6	21	Football	SAH – no necropsy
7	31	Football	SAH – no necropsy
8	53	Sexual intercourse	SAH – no necropsy
9	29	Electrocuted while changing light bulbs	SAH – no necropsy
10	19	Pushing vehicle	SAH – no necropsy
11	20	Sprinting	Distal coronary artery atresia
12	17	Unspecified	Hypoplastic coronary arteries and heart
13	20	Physical training	Ectopic origin of left coronary artery from right coronary cusp
14	19	3 mile run	Ectopic origin of left coronary artery from right coronary cusp
15	35	Unspecified	Aortic dissection in patient with undiagnosed Marfan's syndrome
16	17	7-a-side rugby	Myopericarditis with normal coronary arteries
17	19	Running	Endocarditis with normal coronary arteries
18	21	'Training run'	Bronchopneumonia with normal coronary arteries. Myocardial histopathology report not available
19	29	Hockey	No cause found. Normal coronary arteries. Myocardial histology not available
20	19	10 mile march	No cause found. Normal coronary arteries and myocardial histology
21	19	4 mile run	No cause found. Normal coronary arteries and myocardial histology

SAH = subarachnoid haemorrhage

Table III
Atheromatous causes of sudden death. 1978–82

No.	Age	Activity	Thrombus	Worst vessel	General state of coronary arteries
1	29	Jogging	Yes	RCA occluded at 2 cms	LAD almost occluded in middle third, Cx narrowed to a slit
2	47	Badminton	Yes	RCA occluded	LAD 60% stenosis
3	33	BFT	Yes	Cx occluded	Hypoplastic LCA with moderate atheroma in LAD, RCA large calibre, patent
4	29	BFT	Yes	RCA occluded	Hypoplastic Cx and LAD (75% reduction in calibre)
5	38	Jogging	Yes	RCA occluded	LAD almost occluded by atheroma
6	36	Football	No	Old occlusion LAD	RCA pinhole stenosis, Cx severe
7	28	Football	No	LAD less than pinhole	RCA 70% stenosis at 1.5 cms

8	35	3 mile run	No	RCA severe stenosis	Severe atheroma of Cx and LAD
9	29	Loading stores	No	Cx almost occluded	LAD not found, RCA normal
10	38	Running	No	LMS severe calcified stenosis at 1 cm	RCA severely stenosed at 3 cms, LAD grossly stenosed
11	33	Running	No	RCA severely narrowed at 2 cms	LAD severely narrowed at 2 cms, smaller plaque in Cx at 1 cm
12	41	Running	No	LAD grossly narrow at 1 cm	Patchy atheroma throughout
13	34	2 mile run	No	Generally severe	All 3 CA's show well marked atheroma
14	43	Jogging	No	Generally severe	Severe patchy occlusions in the main stems, extensive myofibrosis
15	26	Football	No	Severe ostial stenosed	Both CA's show pinpoint stenoses in several places
16	42	Basketball	No	Both ostia stenoses	Cx and LAD narrowed and calcified
17	36	Jogging	No	Ill defined	Fresh mid septum
18	34	Hockey	No data	No data	Death recorded as due to CHD
19	39	Hockey	No data	No data	Death recorded as due to CHD
20	37	Running	No data	No data	Death recorded as due to CHD

RCA – right coronary artery
LAD – left anterior descending coronary artery
Cx – circumflex coronary artery

LMS – left main stem coronary artery
BFT – basic fitness test
CHD – coronary heart disease

Table IV
Non-atheromatous causes of sudden death. 1978–82

No	Age	Activity	Cause of death	Remarks
1	17	Swimming	SAH	Aneurysm ACA
2	34	Coitus	SAH	Aneurysm LPCA
3	16	Training run	CVA	Occlusion R carotid artery
4	22	Training run	HOCM	IVS 3.0 cms, PW 1.8 cms
5	31	Basketball	?HOCM	IVS 2.3 cms
6	22	Tug of war	?HOCM	IVS 2.2 cms, histology non-specific
7	26	2½ mile run	COCM	
8	21	Football	Coronary anomaly	Hypoplastic CA
9	19	Training run	Coronary anomaly	Cx arose from R sinus of Valsalva passing round and to R of aorta
10	16	Boxing	Asphyxia	Inhalation of vomit
11	24	Training run	Bronchopneumonia	
12	20	Training run	Asthma	
13	31	Rugby	Unknown	Widely scarred IVS, CA normal
14	26	Rugby	Unknown	Mild atheroma in CA
15	21	Rugby	No data	
16	17	1½ mile run	No data	
17	39	Jogging	No data	
18	?	Jogging	No data	

SAH – subarachnoid hemorrhage
ACA – anterior communicating artery
LPCA – left posterior communicating artery
CVA – cerebrovascular accident
HOCM – hypertrophic obstructive cardiomyopathy

IVS – interventricular septum
PW – posterior wall of the myocardium
COCM – Congestive (dilated) cardiomyopathy
CA – Coronary arteries
Cx – Circumflex coronary artery

Table V
Summary of Deaths Associated with Running

Pre 1977	Number	Rate per 100,000 man years
Associated with Running	15	0.94
Associated with other Exercise	41	2.56
Total	56	3.50
Post 1977		
Associated with Running	21	2.62
Associated with other Exercise	17	2.12
Total	35	4.75

have declined marginally from 2.56 per 100,000 man-years to 2.12 per 100,000 man-years, the increase in deaths associated with running from 0.94 per 100,000 man-years to 2.62 per 100,000 man-years, is probably due to the increased interest in jogging in the Army, which has followed civilian trends and no doubt been reinforced by the introduction of the BFT.

REFERENCE

1. LYNCH, P. Soldiers, sport and sudden death. *Lancet* 1980; 1: 1253-7.

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