Prolonged exercise should be considered alongside typical symptoms of acute myocardial infarction when evaluating increases in cardiac troponin T

R E Shave, G P Whyte, K George, D C Gaze, P O Collinson

METHODS
Data were collected at the 2002 and 2003 London Marathons. Following local ethics approval, we obtained written informed consent from 72 runners (mean (SD) age 35 (9) years) to participate in the study. On the basis of a self-reported history all participants were apparently healthy, free from cardiovascular disease, and non-medicated. Whole blood samples were drawn, a standard 12 lead ECG was recorded, and standard echocardiography was performed 24 hours before the race and within 30 minutes of race completion. Indices of left ventricular diastolic (ratio of early to late ventricular filling (E:A)) and systolic (end systolic volume–pressure relation) function were calculated. Serum samples were analysed for cTnT with the third generation immunoassay (Roche Diagnostics, Lewes, UK). The assay imprecision was 5.5% at 0.32 μg/l and 5.4% at 6 μg/l and had a detection limit of 0.01 μg/l and an upper limit of 25 μg/l. Data were analysed for normality by the Kolmogorov-Smirnov test. Age, completion time, and functional indices were all normally distributed (p > 0.05). The cTnT data were, however, skewed (p < 0.05), probably because of the large number of samples below the assay detection limit. Owing to the abnormal distribution of the cTnT data, analyses was completed by determining the percentage of subjects with a rise in cTnT above the current suggested AMI cut off (0.05 μg/l) and a number of previously suggested AMI cut offs (0.01, 0.03, and 0.1 μg/l). Pearson correlation coefficients were calculated between increases in cTnT and age, completion time, and indices of left ventricular function.

RESULTS
Mean (SD) completion time of the marathon was 253 (48) minutes. Before the marathon all cTnT samples were below the 0.01 μg/l detection limit of the assay. After race completion 56 subjects (78%) had cTnT concentrations above 0.01 μg/l (range 0.012–0.733 μg/l). Of these, 42 (58%) had concentrations above 0.03 μg/l, 26 (36%) above the current AMI cut off (0.05 μg/l), and eight (11%) above 0.1 μg/l. Figure 1 presents a scatter plot of the positive cTnT samples. No ECG evidence of ischaemia was observed before or after race completion. After completion of the marathon systolic function did not change significantly; however, a significant reduction in E:A (1.7 (0.4) v 1.2 (0.3)) showing altered left ventricular filling was observed (p < 0.05). Increases in cTnT after the marathon were not related to age (r = 0.15), completion time (r = 0.01), or changes in E:A (r = 0.16) (p > 0.05).

DISCUSSION
Within the present study minimally increased serum concentrations above 0.01 μg/l of cTnT were widely observed after marathon running in non-elite runners in the absence of any ECG abnormalities. In addition cTnT concentrations exceeded all or some of the previously examined cTnT cut off criteria. Left ventricular filling was significantly different compared to before the race.

Abbreviations: AMI, acute myocardial infarction; E:A, ratio of early to late ventricular filling; cTnT, cardiac troponin T
after race completion; however, no relation was observed between cTnT rise and altered diastolic filling. The significance of an increased cTnT after prolonged exercise may be confused by clinical findings, such as dyspnoea, chest tightness, and possible ECG abnormalities occasionally observed in athletes after prolonged exercise. Accordingly, caution is advised on the use of cTnT cut-off criteria in the diagnosis of AMI in patients who have recently completed a bout of prolonged exercise. Although not assessed within the present study, previous studies of highly trained athletes suggest that, 24 hours after completion of a prolonged bout of exercise, cardiac troponin concentrations return below the lower limit of detection. Further, previous research indicates that changes in cardiac function following prolonged exercise are also transient.

The aetiology of exercise induced cTnT release and alterations in cardiac function is unclear. However, the widespread increases in cTnT within the present study suggest that the phenomenon is probably physiological. Increased coronary artery shear stress, oxidative stress, and ischaemia have been suggested as potential mechanisms, all of which are mediated by prolonged exercise. The relatively low concentrations of cTnT observed in the present study may result from leakage from the cytosol as opposed to the breakdown of the contractile apparatus. Cytosolic release of cTnT might result from membrane damage propagated by any of the conditions outlined previously. Work is warranted to elucidate further the mechanisms responsible for both exercise induced cTnT release and exercise induced changes in diastolic function. Moreover, the possible long term consequences of exercise induced cTnT release need to be examined. In a clinical setting, elevations in cTnT should be assessed with reference to prolonged exercise as well as typical symptoms of AMI.

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**FROM BMJ JOURNALS**

**Overweight and obesity and weight change in middle aged men: impact on cardiovascular disease and diabetes**

S Goya Wannamethee, A Gerald Shaper, Mary Walker

**Context:** The benefit of weight reduction for cardiovascular disease (CVD) outcomes remains uncertain.

**Objective:** To examine the effects of baseline body mass index on major CVD outcomes and diabetes over a 20 year follow up, and of weight change in the first five years of the subsequent 15 years.

**Design and setting:** A prospective study of British men followed up for 20 years.

**Participants:** Men aged 40–59 years with no diagnosis of CVD or diabetes (n = 7176) of whom 6798 provided full information on weight change five years later.

**Outcome measures:** Major CVD events (fatal and non-fatal myocardial infarction and stroke, angina, “other” CVD deaths) and diabetes.

**Results:** During the 20 year follow up there were 1989 major CVD events and 449 incident cases of diabetes in the 7176 men. Risk of major CVD and diabetes increased significantly with increasing overweight and obesity. During the 15 year follow up, weight gain was associated with increased risk of CVD and diabetes. Weight loss was associated with lower risk of diabetes than the stable group irrespective of initial weight. No significant cardiovascular benefit was seen for weight loss in any men, except possibly in considerably overweight (BMI 27.5–29.9 kg/m²) younger middle aged men (RR = 0.42; 95% CI 0.22 to 0.81).

**Conclusion:** Long term risk of CVD and diabetes increased significantly with increasing overweight and obesity. Weight loss was associated with significant reduction in risk of diabetes but not CVD, except possibly in considerably overweight younger men. Duration and severity of obesity seem to limit the cardiovascular benefits of weight reduction in older men.