larger effect (HR = 0.40) between 'morbidly obese' and 'normal' women is found to be non-significant (P = 0.12). Investigation of the relative widths of the hazard ratio confidence intervals for these two comparisons in the authors' figures reveals striking differences in the sample sizes included in the relevant gender by BMI groupings. While the authors do eventually consider BMI as a continuous variable, they curiously restrict it to having a linear effect (results again show a significant increase risk for men, but not for women). This is particularly puzzling as they previously claim a J-shaped association for men (it should be kept in mind, however, that this association is dependent on the categorization selected). It would seem that a smoothing technique such as cubic splining, which requires neither categorization nor an assumption of a linear effect, would have been more appropriate for modeling BMI in the analyses presented. Future research studies should avoid grouping continuous variables into categories, especially if it cannot be demonstrated that such a categorization accurately reflects the relationship between this variable and the specific outcome of interest.

In addition, continuous variables should not be assumed to have a linear effect unless the assumption of linearity can be justified.

References

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The dangers of categorizing BMI: reply

We thank Drs Hamilton and Filardo for their interest in our article examining the association between obesity and cardiovascular events in patients with established coronary disease. They raise valid points regarding the dangers of categorizing continuous variables, such as body mass index (BMI). Our intent, however, was not to examine the association between BMI and cardiovascular events. Our intent was to examine the association between obesity and cardiovascular events, using BMI cut-points as surrogates for obesity categories. The BMI cut-points used are well established and are often used in the clinical setting for diagnostics and therapeutics, hence their clinical relevance. Even so, we do agree that continuous variables should not be assumed to have a linear effect. We did conduct a cubic spline analysis, which provided no additional information than that from the analysis of the five categories of obesity (underweight, normal, overweight, obese, and morbidly obese). With regards to the differences observed between men and women, we acknowledged in our article that the results are limited by the small sample size in women, that the null finding in women requires further study, and that BMI may not be the best measure of obesity in women. With regards to the non-significant, but large strength of association [hazard ratio (HR) = 0.40] between the morbidly obese and normal women, because of the small sample size and greater variability, the confidence interval is quite wide and therefore, the HR could not be precisely estimated. A larger sample of women would have produced a more precisely estimated HR, which may or may not have been similar to the observed HR of 0.40.

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Cardiovascular pre-participation screening of young competitive athletes for prevention of sudden death: proposal for a common European protocol

In May 2005, Corrado et al.1 published a consensus statement of the ESC working groups recommending pre-participation screening of all young, competitive athletes with the aim of preventing SCD. Screening was recommended to follow the Italian model, which includes 12-lead ECG, with screening commencing at age 12–14 and continuing every 2 years until age 35. The recommendation was based on findings that in the Veneto region in Italy, SCD from HCM among screened athletes was less frequent than expected.

A task force appointed by the Danish Society of Cardiology has evaluated the available data and concluded that pre-
participation screening should not be recommended in Denmark.\textsuperscript{2} The task force is of the opinion that ESC recommendations have not dealt adequately with a number of issues of pertinence, as adopted by the WHO when planning a screening programme. These issues include the following.

(i) Research on the effectiveness of pre-participation screening is very limited and relies heavily on Italian studies. The current research data neither supports nor refutes screening.

(ii) A considerable number of healthy athletes will have abnormal ECGs or echocardiograms, which do not quite reach diagnostic criteria for cardiomyopathy (false positive). In addition to exclusion from organized sports, which may have considerable impact on the athletes’ quality of life, abnormal findings would be likely to have implications for employment and life insurance.

(iii) The screening programme does not identify the majority of athletes at risk of SCD (false negative). Although SCD caused by HCM in screened athletes was rare, the screening programme did not prevent SCD caused by other conditions, including ARVC, anomalous coronary arteries, and atherosclerosis.\textsuperscript{3}

(iv) The economic impact and cost-effectiveness of such a policy should be analysed. The Italian data suggest that \(\sim 10\%\) of the entire population should be screened and that \(\sim 9\%\) of the screened athletes need further examinations, mostly involving echocardiography. For most countries, this would imply that the capacity for echocardiography should be significantly increased.

The Danish task force recommends that registration of SCD in the young be improved so that the circumstances around these tragic deaths can be analysed with the aim of reducing the incidence. Possible preventive measures include better awareness among athletes and coaches of symptoms of structural heart disease that may precede SCD, better knowledge of resuscitation in the general population and in the sports environment in particular, better availability of defibrillators at relevant sites, and sensible precautions such as avoidance of strenuous exercise during mild infections, avoidance of dehydration, and so on.

We would warmly welcome a further discussion of the proposed policy.

References


In her letter to the Editor regarding the ESC report on ‘Cardiovascular pre-participation screening of young competitive athletes for prevention of sudden death (SD),’\textsuperscript{1} Dr Prescott on behalf of a Danish task force raised some concerns about efficacy, cost-effectiveness, and feasibility of pre-participation screening and reached the conclusion that it should not be recommended in Denmark.

We acknowledge that the guidelines for implementation of a common European screening program predominantly relied on Italian studies.\textsuperscript{7} However, Italy is the only country in the world where pre-participation evaluation is required by law and a mass-screening program, essentially based on 12-lead ECG, has been the practice for almost 25 years.\textsuperscript{1,2} This population-based and long-term experience has provided compelling evidence of screening efficacy in identifying athletes at risk and in preventing SD. The Italian pre-participation evaluation has been proved to successfully detect athletes with previously undiagnosed hypertrophic cardiomyopathy,\textsuperscript{2,3} which is the most important cause of athletic-field SD in young competitors.\textsuperscript{2} Moreover, during the long-term follow-up, no deaths were recorded among former athletes who were disqualified due to hypertrophic cardiomyopathy, indicating that identification and subsequent clinical management of affected athletes actually improves survival.\textsuperscript{2}

A recent time-trend analysis of cardiovascular SD of young competitive athletes of the Veneto region of Italy over 26 years showed a mortality decline by almost 90\% after implementation of the nationwide pre-participation screening program, whereas the incidence of SD among the unscreened non-athletic population of the same age range did not change significantly.\textsuperscript{5} Mortality reduction in athletes was predominantly due to a lower prevalence over time of SD from cardiomyopathies and paralleled the increased identification through pre-participation screening of athletes with hypertrophic cardiomyopathy and arrhythmogenic right ventricular cardiomyopathy.\textsuperscript{5} All these findings definitively show that pre-participation screening is a life-saving strategy and that the 12-lead ECG is a very sensitive and powerful tool for identification, risk stratification, and management of competitive athletes.

The Italian screening program was made feasible because of the limited cost of first line cardiovascular evaluation in the setting of a mass screening.\textsuperscript{1} The presumed high percentage of false positives, i.e. athletes with a normal heart but positive screening findings, requiring additional testing (mainly an echocardiogram), was actually limited to \(<9\%\) with modest proportional cost impact.\textsuperscript{2,5} We believe that the increase in athletes’ awareness of symptoms that may precede cardiac arrest plays a marginal role in preventing fatalities. SD during sports is most often the first clinical manifestation of an underlying cardiovascular disease, which usually is clinically silent.\textsuperscript{2,5,6} This explains why a screening protocol based solely on the athlete’s history and physical examination (without 12-lead ECG), as used in the USA, is of limited value.\textsuperscript{4}

We agree that the athlete’s disqualification can be associated with an important individual cost in terms of health, contentment, and even future opportunity for professional sports. However, the risk of sudden death