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Research Paper Review

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Body Mass Index, Exercise Capacity, and Mortality Risk in Male Veterans With Hypertension

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ABSTRACT

Background

Overweight and obesity are associated with increased risk of chronic diseases and mortality. Exercise capacity is inversely associated with mortality risk. However, little is known on the interaction between fitness, fatness, and mortality risk in hypertensive individuals. Thus, we assessed the interaction between exercise capacity, fatness, and all-cause mortality in hypertensive males.

Methods

A graded exercise test was performed in 4,183 hypertensive veterans (mean age ± s.d.; 63.3 ± 10.5 years) at the Veterans Affairs Medical Center, Washington, DC. We defined three body weight categories based on body mass index (BMI): normal weight (BMI <25); overweight (BMI 25–29.9); and obese (BMI ≥30); and three fitness categories based on peak metabolic equivalents (METs) achieved: low-fit (≤5 METs); moderate-fit (5.1–7.5 MET); and high-fit (>7.5 METs).

Results

During a median follow-up period of 7.2 years, there were 1,000 deaths. The association between exercise capacity and mortality risk was strong, inverse, and graded. For each 1-MET increase in exercise capacity the adjusted risk was 20% for normal weight, 12% for overweight, and 25% for obese ($P < 0.001$). When compared to normal weight but unfit individuals, mortality risks were 60% lower in the overweight/high-fit and 78% lower in the obese/high-fit individuals ($P < 0.001$).

Conclusions

Increased exercise capacity is associated with lower mortality risk in hypertensive males regardless of BMI. The risk for overweight and obese but fit individuals was significantly lower when compared to normal weight but unfit. These findings suggest that in older hypertensive men, it may be healthier to be fit regardless of standard BMI category than unfit and normal weight.

ANALYSIS

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Background Information

It is well known in the medical and fitness communities that being overweight or obese is associated with a higher risk of chronic disease and/or premature death (1). In addition to this, cardiovascular fitness is inversely correlated with cardiovascular mortality and all-cause mortality (2). The authors of this study sought to examine the exclusivity of these two statements by studying the association between BMI levels and all-cause mortality and the influence of exercise capacity on this association. This study was performed in a population of middle-aged and older hypertensive veteran men suffering from cardiovascular disease.

PERTINENT RESULTS

Within the body mass index categories, age, resting systolic blood pressure, the presence of CVD and smoking were progressively lowered when moving from normal BMI rage (18.5-24.9 kg/m^2) to a high BMI category (>30 kg/m^2) – no explanation was given to determine why this relationship was present. However, the prevalence of type 2 diabetes, dyslipidemia and the utilization of insulin for the treatment of diabetes were progressively higher when moving from a normal BMI category to a high BMI category.

With regard to fitness categories, one's age, resting systolic blood pressure, presence of CVD, smoking, type 2 diabetes and dyslipidemia were progressively lower when moving from the lowest fitness category to the highest fitness category. Surprisingly, the use of antihypertensive medications was progressively higher when moving to from the lowest to the highest fitness category.

Generally, for every 1-MET (see below for a definition of METs) increase scored on the Bruce Protocol (predicting VO_2Max), the risk of mortality decreased by 17% (Hazard Ratio [HR]: 0.83). Specifically, a 1-MET increase in fitness level was associated with a 20% decrease in mortality risk in the lowest BMI category, a 12% decrease in the overweight BMI category and a 25% decrease in those classified as obese.

The relative risk of mortality in each BMI category progressively lowered as one's level of exercise

capacity increased. The individuals with an exercise capacity between 5.1-7.5 METs or > 7.5 METs who also had a BMI of 18.5-24.9 kg/m^2 scored hazard ratios of .61 and .36, respectively. Similarly, those of the same fitness level who fell within a BMI category of 25-29.9 kg/m^2 had hazard ratios of .64 and .44 respectively, while those with a BMI >30 kg/m^2 had hazard ratios of .53 and .28 respectively. *This means that mortality risk was similar in the low-fit individuals regardless of their BMI category classification and that moderate-to-high fit individuals realized a significant reduction in mortality risk regardless of their BMI category.*

CLINICAL APPLICATION & CONCLUSIONS

Exercise capacity and fitness level are predictive of all-cause mortality amongst hypertensive individuals after adjusting for cardiac medications and traditional cardiovascular factors. Mortality risk decreases by an average 17% for every 1-MET increase (which corresponds to an increase in oxygen consumption of approximately 3.5 mL/kg/min) in exercise capacity. Specifically, individuals within a normal BMI category but have higher fitness levels have a 20% decrease in all-cause mortality risk, while obese but fit individuals have a 25% decrease in all-cause mortality risk.

For moderate and highly fit individuals, there was a 39% and 64% decrease in mortality risk for those falling within the normal BMI category, respectively; a 36% and 56% decrease for those within the overweight category, and a 47% and 72% decrease for those in the obese BMI category.

These results suggest that increased exercise capacity decreases mortality risk in hypertensive individuals. In other words, *fitness is more important than fatness in predicting the mortality risk of individuals suffering from hypertension*. Fit obese and overweight patients have a lower mortality risk than individuals that are unfit with a normal weight. These results are graduated as well, as even a moderate fitness level lowers the risk of all-cause mortality in older hypertensive men, despite their respective BMI category.

This level of fitness can be achieved through a daily brisk walk lasting 20-40 minutes, which is a level of activity that can be performed by most middle-aged and older individuals (3,4). Walking requires little instruction and cost, and has little risk of cardiac complication, making it an easily implemented exercise intervention for hypertensive individuals at any age or body weight.

STUDY METHODS

From 1986 – 2010, symptom-limited exercise tolerance tests were performed on 12, 000 male veterans residing in the Veterans Affairs Medical Centre in Washington DC. Within this population, the researchers identified 4,363 individuals with a history of hypertension at the time of their exercise test. Those diagnosed with cardiovascular disease were defined as those with a history of myocardial infarction, coronary artery disease found via angriography, coronary vessel angioplasty, bypass surgery, chronic heart failure and/or peripheral vascular disease. Individuals who had a history of an implanted pacemaker, had or developed left bundle branch block during the test, were unable to complete the test or required emergency intervention, were measured as < 18.5 kg/m^2 on the body mass index scale, were diagnosed with AIDS or HIV and those who had impaired chronotropic responses were excluded from the study. Four-thousand and eighty-three males with a history of hypertension of either Caucasian or African-American decent were included.

Body weight and height were measured in each individual. BMI was calculated using the standard formula: weight(kg)/height(m) 2. The standard Bruce Protocol was used to determine cardiovascular exercise capacity. During the test, the researchers recorded exercise time and peak workload (measured in metabolic equivalents, or METs). The researchers defined one MET as the energy expended at rest, equivalent to approximately 3.5 mL of oxygen/kg/minute. Workload is calculated as a multiple of resting – thus 6 METs is 6x 1 MET (6 times resting), which is approximately 21 mL/kg/min (6 x 3.5). (Side note: the description of workload in METs is commonly used in experimentation and practice. This gives the practitioner a relatively accurate estimation of what volume of oxygen is being consumed during an exercise test or activity, and can enable them to prescribe exercise based on a percentage of one's maximal oxygen uptake or VO_2 max. METs correlate well with heart rate reserve, calculated using the Karvonen method for determining exercise intensity ((HRmax - HRrest) × % intensity) + HRrest), but not with calculating exercise intensity utilizing a simple percentage of maximum heart rate. For more information, check out the *American College of Sports Medicine's Guidelines for Exercise Testing and Prescription, 2009*. Trainers should be aware of this method of describing exercise intensity and capacity).

In this case, exercise capacity was recorded in METs and was estimated based on an equation for the interpretation of the Bruce Protocol established in the literature. During the test, participants were asked to exercise until volitional fatigue. Medications were not changed. Prior to the examination, supine resting heart rate and blood pressure were assessed after 5 minutes of rest. Exercise blood pressure was recorded during the second minute of each exercise stage, at peak exercise and during the first, third and fifth minutes of recovery in the supine position.

All subjects were classified into three BMI categories: 18.5-24.9 kg/m^2 (normal weight), 25-29.9 kg/m^2 (overweight) and ?30 kg/m^2 (obese). Three fitness categories were also created based on their maximal volitional MET level during the Bruce Protocol: ? 5 (could only work less than 5x resting – lowest fitness category), between 5.1-7 METs (moderate fitness category) and > 7.5 METs (highest fitness category). BMI and fitness categories were combined to form nine additional groups: normal weight/low fit, low weight/moderate fit, normal weight/high fit, moderate weight/low fit, moderate weight/moderate fit, moderate weight/high fit, high weight/low fit, high weight/moderate fit and high weight/high fit. The reference group was normal weight/low fit.

Death rates were recorded from the Veterans Affairs Beneficiary Identification and Record Locator System File. All statistical analyses were adjusted for age, resting blood pressure, all hypertensive medications, history of smoking, history or cardiovascular disease, diabetes and dyslipidemia.

STUDY STRENGTHS / WEAKNESSES

Weaknesses

- Utilized epidemiological data, not prospective.
- Retrospective study
- Only veteran males – no female data
- Only BMI was recorded, which gives no indication of the distribution of weight.
- BMI was only recorded at baseline, which limits the evaluation of changes during the follow-up period in BMI and/or fitness and its impact on all-cause mortality. This study only studied the

association of an initial BMI and fitness level on one's mortality throughout their lifespan.
- Not enough extremely lean or morbidly obese individuals were included in the study population.
- A causal relationship cannot be inferred because of the study design.

Strengths

- A large participant population was studied.
- The authors utilized a widely accepted and incredibly valid measurement of exercise capacity (Bruce Protocol) that is tailored for the cardiac population.
- Novel way of grouping the participants to find new statistical data to add to the pool of fitness and training research

Additional References

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