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Body composition and development of diabetes: a 15-year follow-up study in a Japanese population

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Study Findings

Following a Japanese population for an extended duration, this study reviewed the association of body composition with the development of diabetes, revealing that diabetes risk differed depending on body fat distribution. It suggested that diabetes risk increases with increase in trunk (abdominal) fat, but that, conversely, an increase in leg fat plays a preventive role against diabetes.

Explanation

The body is composed mainly of fat, muscle, and bone, and dual-energy X-ray absorptiometry (DEXA) examination allows measurement of body composition, including fat mass and lean mass for the body as a whole and for specific regions (trunk, extremities, etc.). This study reviewed the effects of body composition on the development of diabetes in the Adult Health Study (AHS) cohort of A-bomb survivors, which the Radiation Effects Research Foundation (RERF) has followed for an extended duration through biennial health examinations to assess the health status of A-bomb survivors.

1. Study Purpose

Obesity is one of the major risk factors for diabetes, but not all obese people develop the disease. Other than obesity, body composition, such as body fat distribution, is considered to be one of the risk factors associated with diabetes. Only a limited number of studies, however, have investigated the association between body composition and diabetes risk in Japanese and other Asian populations over a long duration in a longitudinal manner. The current study reviewed the effects of body composition on the development of diabetes and determined whether or not these effects differed with presence or absence of obesity.

2. Study Methods

We followed 1,532 diabetes-free subjects aged 48-79 years of age to detect new cases of diabetes until the end of 2011. The subjects had participated in the AHS over the 1994–1996 time period, undergoing whole-body DEXA examination for assessment of body composition.

To review body composition, we used fat mass amount and percentages for the trunk, legs, and arms as an indicator of body fat distribution. We calculated fat mass percentages for the trunk, arms, and legs by dividing that body part's fat mass by total soft tissue mass (i.e., total mass minus bone mass). Furthermore, as an indicator of muscle mass, we used values calculated by dividing appendicular (upper and lower extremities) lean mass (total appendicular mass minus bone and fat mass) by the square of standing height.

The American Diabetes Association (ADA) recommends a body mass index (BMI) cut point of 23 kg/m^2 to identify diabetes risk in Asians, and we therefore defined overweight/obesity as BMI≥23 kg/m^2. Since body composition differs by sex, we analyzed each sex separately, with adjustments performed for BMI, smoking status and alcohol consumption, presence/absence of hypertension and dyslipidemia, baseline age categories, and radiation dose.

3. Study Results

1) Effects of body composition on the development of diabetes

In women, a positive association was suggested between the development of diabetes and trunk fat mass/percentages (the higher the trunk fat mass/percentages, the higher the development of diabetes). However, a significant negative association was observed between leg fat mass/percentages and the development of diabetes. That is, higher leg fat mass/percentages indicated lower diabetes development. An analysis with adjustment for trunk fat percentages (i.e., with trunk fat percentages assumed to be the same) revealed similar results.

In men, separate analyses of trunk fat mass/percentages and leg fat mass/percentages in relation to development of diabetes did not indicate a significant association in either case. However, analysis that took into account trunk/leg fat percentages together revealed a significant positive association between trunk fat percentages and development of diabetes, as well as a significant negative association between leg fat percentages and development of diabetes, as was the case for women.

In both sexes, there was no significant association between development of diabetes and arm fat mass/percentages or appendicular lean mass.

2) Effects of body composition on development of diabetes in relation to the presence or absence of overweight/obesity

Analysis that took into account trunk/leg fat percentages together revealed a significant negative association between leg fat percentages and development of diabetes only in overweight/obese groups (BMI$\geq$23 kg/m^2). However, a large difference in hazard ratios (risk ratios) for development of diabetes was not observed with the presence or absence of obesity. Furthermore, a significant negative association between appendicular lean mass (indicator of muscle mass) and development of diabetes was observed only in non-obese males (BMI<23 kg/m^2).

Study Significance

Development of diabetes was associated positively with trunk fat and negatively with leg fat. Consequently, this study suggested that body composition assessment is one useful method for detection of individuals at high risk for diabetes.

The Radiation Effects Research Foundation has studied A-bomb survivors and their offspring in Hiroshima and Nagasaki for around 70 years. RERF's research achievements are considered the principal scientific basis for radiation risk assessment by the United Nations Scientific Committee on the Effects of Atomic Radiation (UNSCEAR) and for recommendations regarding radiation protection standards by the International Commission on Radiological Protection (ICRP). RERF expresses its profound gratitude to the A-bomb survivors and survivors' offspring for their cooperation in our studies.

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