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Do People with Similar Waist Circumference Share Similar Health Risks Irrespective of Height?

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HSIEH, S.D. and YOSHINAGA, H. *Do People with Similar Waist Circumference Share Similar Health Risks Irrespective of Height?* Tohoku J. Exp. Med., 1999, **188** (1), 55-60 —— In order to know whether people of similar waist circumference having similar health risks irrespective of height, comparisons of odds ratios for coronary risk factors and fatty liver by echogram were made between the subjects from the first (short, $\leqq$164.5 cm) and fourth quartiles (tall, $\geqq$172.4 cm) of height from both the third (84.5$\sim<$89 cm) and fourth ($\geqq$89 cm) quartiles of waist circumference from 3117 men (ranging 35-64 years old) who underwent routine health examinations in Tokyo. After adjusting for age, and with tall subjects in the same waist circumference category as reference, the odds ratios were significantly higher for the short people from the third quartile of waist circumference for the risk of hypertension (1.62, 95% CI 1.002-2.63), hyperglycemia (3.34, 1.27-9.95) and fatty liver (2.12, 1.30-3.50). However, there were no significant differences in odds ratios of any risk health risks between short people and tall people from the fourth quartile of waist circumference. Although people of prominently large waist circumferences may have similar health risks of the above items irrespective of height, short people have higher health risks than tall people in the moderately large waist circumference population of Japanese men. ——
waist; height; health risks

Waist circumference has been reported to be a simple anthropometric index for abdominal visceral fat distribution and coronary risk factors by some investigators (Pouliot et al. 1994; Lean et al. 1995). However, various anthropometric predictors of health risks such as body mass index (BMI) (Revicki and Israel 1986), waist-to-hip ratio (Lasson et al. 1984; Kaplan 1989) and waist-to-height ratio (Hsieh and Yoshinaga 1995a, b, c; Lee et al. 1995; Ashwell et al. 1996a, b; Cox et al. 1997) are relative ratios for physique whereas waist circumference is a single value used for health education of obesity without adjustment for different statues. This gives rise to the simple question of whether people with the similar waist circumference share the similar health risks irrespective of height. The

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waist circumferences proposed by the above investigators as indexes for weight control in men are over 90 cm and/or over 100 cm from the study populations of high mean BMI (Pouliot et al. 1994; Lean et al. 1995). It is possible that the people who have such a large waist circumference have the same health risks irrespective of height. However, do people with a moderately large waist circumference also share the similar health risks irrespective of height? To further explore the health risks related to waist circumference at different heights, we compared health risks for blood pressure, lipids, glucose levels and fatty liver in subjects with the similar waist circumference but different heights.

Subjects and Methods

Subjects

The subjects were 3117 adult Japanese men (age: 35-64 years, mean$\pm$S.D., 48.4$\pm$7.0 years) who underwent routine health examinations at Toranomon Hospital between April 1994 and March 1995. Most were government employees and office workers. The examination data of the subjects from the first (short, $\leqq$ 164.5 cm) and fourth quartiles (tall, $\geqq$172.4 cm) of height and from both the third (84.5$\sim<$89 cm) and fourth ($\geqq$89 cm) quartiles of waist circumference were compared.

Measurement

Waist circumference was measured at the level of the umbilicus with the subjects standing and breathing normally (Lasson et al. 1984; Haffner et al. 1987; Hsieh and Yoshinaga 1995a, b, c; Lee et al. 1995). Skinfold thickness was measured at the medial margin of the lower end of the scapula by the skinfold caliper method. Blood was drawn in the fasting state, and blood glucose, serum triglyceride, cholesterol and HDL cholesterol levels were measured by enzymatic methods. Fatty liver was diagnosed by echogram (Osono et al. 1995).

Statistical analysis

Probabilities of significant differences were compared by the Wilcoxon test for quantitative variables and by the chi-square test for proportions. Odds ratios for the health risks of the short subjects with reference to the tall subjects in the same waist circumference category, adjusted by age were also calculated using JMP software from SAS Institute Inc.

Results

Comparisons of the clinical features between the subjects from the first and fourth quartiles of height and from the third quartile of waist circumference

Significantly older age (51.8$\pm$6.2 vs. 45.4$\pm$6.4 years, mean$\pm$S.D., $p<0.001$), higher BMI (24.3$\pm$1.3 vs. 22.9$\pm$1.2 kg/m^2, $p<0.001$), thicker subscapular skinfold thickness (20.1$\pm$4.6 vs. 17.4$\pm$4.7 mm, $p<0.001$), higher prevalence of hyper-

TABLE 1. *Comparisons of the clinical features between the subjects from the first and fourth quartiles of height and from the third quartile of waist circumference*

Height (cm) Waist circumference (cm)	≦164.5 84.5～<89	≧172.4 84.5～<89	p-value
No.	174	204	
Age (year) (mean±S.D.)	51.8±6.2	45.4±6.4	<0.001
Current smoking rate (%)	37.3	34.5	0.5755
Body mass index (kg/m²) (mean±S.D.)	24.3±1.3	22.9±1.2	<0.001
Subscapular skinfold thickness (mm) (mean±S.D.)	20.1±4.6	17.4±4.7	<0.001
Systolic blood pressure ≧140 mmHg and/or Diastolic blood pressure ≧90 mmHg(%)	42.0	26.0	<0.01
Fasting blood glucose ≧100 mg/100 ml (%)	11.5	2.9	<0.001
Triglyceride ≧150 mg/100 ml (%)	28.7	26.0	0.5490
Cholesterol ≧220 mg/100 ml(%)	45.4	36.8	0.0885
HDL-cholesterol <40 mg/100 ml (%)	19.5	17.2	0.5503
Fatty liver (%)	40.2	25.5	<0.01

TABLE 2. *Comparisons of the clinical features between the subjects from the first and fourth quartiles of height and from the fourth quartile of waist circumference*

Height (cm) Waist circumference (cm)	≦164.5 ≧89	≧172.4 ≧89	p-value
No.	137	280	
Age (year) (mean±S.D.)	51.3±7.3	46.6±6.4	<0.001
Current smoking rate (%)	31.4	30.7	0.8730
Body mass index (kg/m²) (mean±S.D.)	26.4±1.7	25.3±2.1	<0.001
Subscapular skinfold thickness (mm) (mean±S.D.)	24.2±6.0	22.4±5.8	<0.01
Systolic blood pressure ≧140 mmHg and/or Diastolic blood pressure ≧90 mmHg (%)	40.9	36.4	0.3804
Fasting blood glucose ≧100 mg/100 ml (%)	14.6	10.4	0.2134
Triglyceride ≧150 mg/100 ml (%)	35.8	36.8	0.8389
Cholesterol ≧220 mg/100 ml (%)	46.7	42.1	0.3771
HDL-cholesterol <40 mg/100 ml (%)	21.1	23.9	0.5273
Fatty liver (%)	55.5	52.5	0.5671

tension (42% vs. 26%, $p<0.001$), hyperglycemia (11.5% vs. 2.9%, $p<0.001$) and fatty liver (40.2% vs. 25.5%, $p<0.01$) were noted in the short group as compared to the tall group (Table 1). On the other hand, there were no significant differences between the two groups for the prevalences of current smoking, hypertriglyceridemia, hypercholesterolemia, or low HDL-cholesterol levels.

TABLE 3. *Comparisons of the odds ratios of coronary risk factors and fatty liver adjusted by age between the subjects from the first and fourth quartiles of height from the third quartile of waist circumference and from the fourth quartile of waist circumference*

Group	Third quartile of waist		Fourth quartile of waist	
Height (cm)	≦164.5	≧172.4	≦164.5	≧172.4
Waist circumference (cm)	84.5～<89	84.5～<89	≧89	≧89
Systolic blood presurre ≧140 mmHg and/or Diastolic blood pressure ≧90 mmHg	1.62 (1.002-2.63)*	1	1.11 (0.71-1.73)	1
Fasting blood glucose ≧100 mg/100 ml	3.34 (1.27-9.95)*	1	1.18 (0.61-2.24)	1
Triglyceride ≧150 mg/100 ml	1.35 (0.81-2.26)	1	1.03 (0.66-1.62)	1
Cholesterol ≧220 mg/100 ml	1.58 (0.99-2.52)	1	1.27 (0.82-1.96)	1
HDL-cholesterol <40 mg/100 ml	1.20 (0.67-2.16)	1	0.90 (0.53-1.50)	1
Fatty liver	2.12 (1.30-3.50)**	1	1.19 (0.77-1.84)	1

*$p<0.05$, **$p<0.01$, compared between the same waist circumference groups.

Comparisons of the clinical features between the subjects from the first and fourth quartiles of height and from the fourth quartile of waist circumference

Significantly older age (51.3±7.3 vs. 46.6±6.4 years, $p<0.001$), higher BMI (26.4±1.7 vs. 25.3±2.1 kg/m^2, $p<0.001$), and thicker subscapular skinfold (24.2±6.0 vs. 22.4±5.8 mm, $p<0.01$) were noted in the short group as compared to the tall group (Table 2). However, there were no significant differences for the prevalences of current smoking, hypertension, hyperglycemia, hypertriglyceridemia, hypercholesterolemia, low HDL cholesterol level and fatty liver.

Comparisons of the odds ratios of coronary risk factors and fatty liver adjusted by age between the subjects from the first and fourth quartiles of height from both the third and fourth quartiles of waist circumference

After adjusting for age, and with tall subjects in the same category of waist circumference as the reference subjects, odds ratios were significantly higher in the short people from the third quartile of waist circumference for the risk of hypertension (1.62, 95% CI 1.002-2.63, $p<0.05$), hyperglycemia (3.34, 1.27-9.95, $p<0.05$) and fatty liver (2.12, 1.30-3.50, $p<0.01$) (Table 3). However, there were no significant differences in the odds ratios of any risk health risks between short people and tall people from the fourth quartile of waist circumference.

Discussion

The people in our study sample rarely met the waist circumference criteria suggested by Western investigators as a guideline for recommending weight loss (Pouliot et al. 1994; Lean et al. 1995), only 2.5% of our examinees had a waist circumference over 98.5 cm and only 10% had a waist circumference over 93 cm. We therefore used the third quartile (84.5～<89 cm) and fourth quartile (≥89 cm) of waist circumference to make the observations. The short groups had a higher BMI and greater skinfold thickness from both of the third and fourth quartiles of waist circumference. Therefore, tall and short groups with similar waist circumferences may not have similar quantities of fat. Obesity is relative: If a short person and a tall person have a similarly large waist circumference, then the degree of obesity of the short person appears to be greater from our study.

After adjusting for age, and with tall subjects of the same category of waist circumference as a reference, the odds ratios were significantly higher in short people from the third quartile of waist circumference for the risk of hypertension, hyperglycemia and fatty liver. However, no significant differences were found in the odds ratios of health risks between short people and tall people from the fourth quartile of waist circumference.

The results corroborate our previous hypothesis that people who have a prominently large waist circumference may have the same needs for reducing waist circumference for health risks irrespective of height. However, short people with a moderately large waist circumference should pay more attention to their physiques than tall people of the similar waist circumference.

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