Increasing Obesity among Male Workers in Japan: 1992–1997

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Abstract

Objective: To examine changes in the Body Mass Index (BMI) and in the prevalence of obesity among male Japanese workers after five years.

Design: Follow-up study, based on data from annual health checkups performed at workplaces.

Subjects and Methods: We had access to the data for a total of 63,951 male workers aged 20 through 54 years in 1992 who were examined in both 1992 and 1997. In quinquennial cohorts, we compared the findings for mean BMI and the prevalence of obesity in 1992 with the findings in 1997.

Results: Between 1992 and 1997, in all cohorts the mean BMI increased significantly. For each adjacent cohort pair the mean BMI value in 1997 was significantly higher than in 1992. In 1992, 21.3% of all subjects were obese, increasing by 3.4% after five years to 24.7% in 1997. In the younger 1968–1972 and 1963–1967 cohorts the prevalence of obesity increased by 6.3% during five years. The significant increase in the obesity prevalence was observed from 1992 to 1997 for each age-adjusted cohort.

Conclusions: These results suggest a substantial increase in obesity among male Japanese workers. The notable increase in the prevalence of obesity among young male adults and the general trend toward widespread obesity during five years signal an increasing risk of lifestyle-related diseases.

Key words: BMI, obesity, prevalence, male workers, Japanese

Introduction

Obesity is a commonly prevalent disorder that poses serious health problems, especially in Europe and the U/S/A. It is associated with a greater incidence of hypertension, hypercholesterolemia, diabetes, and certain types of cancer¹.

Recent evidence—collected for the period 1988 to 1994 shows that about 54.9% of adult Americans, aged 20 years or older, were estimated to be overweight or obese (Body Mass Index ≥ 25.0)². Obesity varies depending on the criteria used and the population studied. For example, in Western countries, when obesity is defined as body mass index (BMI) ≥ 25.0 , a prevalence of 10.9%–64.2% has been reported, when BMI ≥ 30.0 the reported prevalence is 4.9%–24.1%. On the other hand, at BMI > 30.0 , in some non-Western countries 1.4%–37.0% of people in the sampled populations are obese^{2–8}. These studies generally suggest an increasing prevalence of obesity, greater mean BMI, and

heavier mean body weight.

In Japan, using data from the National Nutritional Survey, the only cross-sectional nationwide survey⁹, the prevalence of obesity (BMI ≥ 25.0) is estimated to be 24.3% in males⁶. Those most prone to obesity are males aged 55–59 years.

The present study, using a large population sample considered representative of the male workers in Japan, examined the changes in the mean BMI and the prevalence of obesity during five years follow-up.

Subjects and Methods

1. Subjects

We analyzed data obtained from male workers who presented themselves for company health checkups in both 1992 and 1997. In Japan, company employees generally undergo regular annual health checkups at their company or at company-designated clinics. At these annual checkups height and weight are monitored and other medical tests are carried out, such as blood pressure, electrocardiogram, chest X-ray, urine test, and blood tests.

In the present study we collected information from employees working at a total of 1,041 companies of various types and sizes, including a financial institution, a manufacturing enterprise, commercial offices, a transportation company. The smallest company

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Table 1 Mean BMI in 1992 and in 1997 and increase in BMI by birth cohort

Birth cohort	Age at 1992	N	BMI 1992		BMI 1997		paired t-test	Mean increase in BMI
			mean	s.d.	mean	s.d.	t-value	
1968–1972	20–24	4,443	21.86	3.03	22.71	3.23	36.57***	0.85
1963–1967	25–29	6,362	22.43	2.91	23.10	3.05	38.12***	0.67
1958–1962	30–34	6,151	22.91	2.91	23.36	3.01	26.41***	0.45
1953–1957	35–39	10,777	22.97	2.81	23.32	2.86	30.32***	0.35
1948–1952	40–44	14,497	23.07	2.76	23.34	2.81	27.45***	0.27
1943–1947	45–49	11,787	23.04	2.64	23.18	2.67	13.26***	0.14
1938–1942	50–54	9,934	23.10	2.56	23.17	2.62	6.32***	0.07
Total (20–54 y)		63,951	22.89	2.79	23.21	2.85	65.46***	0.32

*** $p < 0.001$. **Fig. 1 Changes in mean BMI between 1992 and 1997 for each quinquennial birth cohort**

employed 4 people while the largest had 10,821 employees. These companies were scattered throughout Japan, without being located in any particular region. In each of the companies more than 90% of employees underwent the health checkups. We had access to the data for a total of 67,084 male workers who were examined in both 1992 and 1997. After excluding 3,133 persons aged less than 20 or 55 or older in 1992, we examined body weight and height for a total of 63,951 adult males.

2. Calculation of BMI

Using standard methods, at the checkups standard height (m) was recorded without shoes and the body weight (kg) was recorded in light-weight indoor clothing. BMI was calculated from these measurements as weight in kilograms divided by the square of the height in meters (kg/m^2).

3. Criteria of obesity

Using the criterion of the Japan Society for the Study of Obesity, a BMI value ≥ 25.0 denoted obesity in the present study. This corresponds to grade 1 of the WHO endorsed tripartite classification of obesity: grade 1, BMI 25.0–29.9; grade 2, BMI 30.0–39.9; and grade 3, BMI ≥ 40.0 ⁽¹⁰⁾. We also chose this value because recent epidemiological studies have revealed a significantly increased prevalence of obesity-related diseases, such as diabetes mellitus, hypertension or hyperlipidaemia, among Japanese adults with BMI values ≥ 25.0 ⁽¹¹⁾.

4. Data analysis

Statistical analysis began by classifying groups into seven quinquennial cohorts. We used the Statistical Package for Social Sciences (SPSS_{v9.0}) to analyze the findings using a computer⁽¹²⁾.

For every quinquennial cohort, we compared the differences in the mean BMI values between in 1992 and in 1997 using the paired *t*-test. We used ANOVA to compare each successive cohort pair. Changes in the prevalence of obesity for every quinquennial cohort and in each adjacent cohort pair were analyzed by the χ^2 square test.

Results

Table 1 shows the number in each cohort, the mean and the standard deviation values for BMI in 1992 and 1997. The total and cohort increases in mean BMI are also shown. The mean BMI of the total subjects increased $0.32 \text{ kg}/\text{m}^2$ during the following five years. The mean BMI of the 1968–1972 birth cohort increased $0.85 \text{ kg}/\text{m}^2$ during the five-year period. Paired *t*-test values show significant increases in mean BMI in all birth cohorts from 1992 to 1997. The cohort-specific results are illustrated in Figure 1. Each line presents the change in mean BMI from 1992 to 1997 for each

Table 2 Comparison of mean BMI for each adjacent cohort pair

Age range	BMI 1992	BMI 1997	ANOVA
	mean (birth cohort)	mean (birth cohort)	F value
25–29	22.43 (1963–1967)	22.71 (1968–1972)	22.51***
30–34	22.91 (1958–1962)	23.10 (1963–1967)	12.12**
35–39	22.97 (1953–1957)	23.36 (1958–1962)	70.16***
40–44	23.07 (1948–1952)	23.32 (1953–1957)	47.71***
45–49	23.04 (1943–1947)	23.34 (1948–1952)	78.56***
50–54	23.10 (1938–1942)	23.18 (1943–1947)	5.063*
25–54	22.97	23.25	233.4***

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$.

Table 3 Prevalence of obesity in quinquennial cohorts

Birth cohort	Age at 1992	Obesity prevalence (%)		χ square	Increase in obesity prevalence (%)
		1992	1997		
1968–1972	20–24	13.4	19.7	63.52***	6.3
1963–1967	25–29	17.0	23.3	76.62***	6.3
1958–1962	30–34	21.8	26.3	33.91***	4.5
1953–1957	35–39	22.5	26.1	39.16***	3.6
1948–1952	40–44	22.8	26.2	44.92***	3.4
1943–1947	45–49	22.4	24.1	9.60**	1.7
1938–1942	50–54	22.5	24.0	9.09**	1.5
Total (20–54 y)		21.3	24.7	211.6***	3.4

Obesity; BMI $\geq$ 25.0 ** $p<0.01$, *** $p<0.001$.

quinquennial cohort. The rate of the mean BMI increase was steeper for younger birth cohorts. The 1963–1967 birth cohort, when they were in their early 30's at 1997, had approximately the same mean BMI as the 1948–1952 birth cohort, when they were in their early 40's at 1992.

Table 2 shows comparative findings for adjacent cohorts to contrast the age-adjusted mean BMI in 1992 and 1997. From the results of ANOVA a significant difference was observed between each successive birth cohort pair.

Table 3 gives the prevalence of obesity in 1992 and 1997 for the total sample and quinquennial cohorts. In 1992, 21.3% of all subjects were obese (BMI value $\geq$ 25.0), rising by 3.4% to 24.7% in 1997. The younger 1968–1972 and 1963–1967 cohorts recorded the highest rate of increase (6.3%) in the prevalence of obesity during the five-year period. The younger the cohort, the higher the rate of increase (Figure 2). The prevalence of obesity was significantly increased in all birth cohorts by the χ square test.

Table 4 details the comparison of obesity prevalence in 1992

and 1997 for age-adjusted cohorts. The significant increase with obesity prevalence was observed for each adjacent cohort pair. While the highest obesity prevalence was observed in subjects in their early 40's in 1992, the highest obesity prevalence occurred in subjects in their late 30's in 1997 (Table 4, Figure 2).

Discussion

There have been many cross-sectional studies about the BMI and the prevalence of obesity in Japanese populations^{6,13,14}. In the present study, many male workers (63,951 subjects aged 20 through 54 years at 1992) were followed up for five years to examine changes in the BMI and the prevalence of obesity. Kaido et al. observed that obesity prevalence became higher as age advanced in all birth cohorts among Japanese males¹⁴. The sample used in that study consisted of 2,430 subjects in one industrial factory. The present study is the first that shows the increasing obesity among male workers using a large sample considered

Fig. 2 Changes in prevalence of obesity between 1992 and 1997 for each quinquennial birth cohort**Table 4** Comparison of obesity prevalence for each adjacent cohort pair

Age range	Obesity prevalence 1992		Obesity prevalence 1997		χ square
		(birth cohort)		(birth cohort)	
25–29	17.0	(1963–1967)	19.7	(1968–1972)	12.19***
30–34	21.8	(1958–1962)	23.3	(1963–1967)	3.849*
35–39	22.5	(1953–1957)	26.3	(1958–1962)	31.31***
40–44	22.8	(1948–1952)	26.1	(1953–1957)	36.58***
45–49	22.4	(1943–1947)	26.2	(1948–1952)	50.42***
50–54	22.5	(1938–1942)	24.1	(1943–1947)	7.884**
25–54	21.9		24.9		139.4***

Obesity; BMI $\geq$ 25.0 * $p<0.05$, ** $p<0.01$, *** $p<0.001$.

representative of the Japanese population by five-years follow-up.

The main finding in the present study is that the mean BMI and the prevalence of obesity increased in every birth cohort during the five years follow-up. The results from the cross-sectional analyses showed that the highest prevalence of obesity is observed in subjects in their early 40's in 1992 and late 30's in 1997 and then slowly decreases after those years. The longitudinal analyses, however, confirmed that all birth cohorts showed a significant increase in their mean BMI and the prevalence of obesity.

Another significant finding in the present study is that the younger the cohort, the higher was the rate of increase in obesity. The BMI value increased with age from their twenties to early forties: this age effect was apparent in both 1992 and in 1997. For all cohorts we found significant increases between 1992 and 1997 both in the mean BMI and the prevalence of obesity. However, the increases both in the mean BMI and the prevalence of obesity for the 1968–1972 and 1963–1967 cohorts were particularly high. Yoshiike et al. reported that the highest BMI and prevalence of obesity ($\text{BMI} \geq 25.0$) occurred in males aged 55 to 59 years from the information collected by the National Nutrition Survey carried out in 1990–1994⁶⁾. The National Nutritional Survey carried out in 1998 reported that the highest BMI was observed in males aged 40 to 49 years old. In the present study the highest BMI in the 1992 screening was observed in subjects aged 50 to 54 years old and the highest prevalence of obesity was shown in subjects aged 40 to 44 years old. However, both the highest BMI and the highest prevalence of obesity were confirmed in males aged 35 to 39 years old in the 1997 screening. The present study showed a trend toward increasing obesity among younger males.

We also found evidence of a period effect, with a significant

increase in the mean BMI values for each adjacent cohort pair during five years. The significant increase in the obesity prevalence was also observed for each successive cohort pair. The mean BMI in males aged 25 to 54 years old increased by 0.28 kg/m^2 during the five years observation. Recently, Jacobsen et al. published a 20-year follow up study (the Tromso Study, 1974–1994) in Norway¹⁵⁾. The age-adjusted (25–49 years) mean BMI increased by 1 kg/m^2 in males between 1974 and 1994/1995. In the U/S/A, the prevalence of overweight and obesity has increased in the last 30 years^{2,16,17)}. The mean BMI of 20–74 year-old males was 25.0 kg/m^2 at the first National Health Examination Survey (NHESI, 1960–1962) and became 26.3 kg/m^2 at the third National Health and Nutrition Examination Survey (NHANES III, 1988–1991). In the present study, the rate of increase in the mean BMI was almost equal to these findings, but the prevalence of obesity in Japanese males was clearly low compared with European and American populations.

An increase in BMI and obesity may be due to changes in lifestyle, such as overeating, stressful work conditions, and lack of exercise. The present study describes the changes in BMI and obesity prevalence of Japanese male workers. More studies are needed to clarify the relations between the increasing BMI and lifestyle factors to prevent obesity-related diseases.

We have studied the changes in BMI and obesity prevalence of a large population during a five-year period. The present findings document a substantial increase in obesity among male Japanese workers and corroborate the findings of previous studies that showed notable increases in obesity^{2,6,15–17)}. The increasing prevalence of obesity among young male adults and the whole trend toward widespread obesity during the five-year study period suggest an increasing risk of lifestyle-related diseases.

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