In 2000 the Japanese Ministry of Health, Labour, and Welfare initiated a new health promotion program, Health Japan 21, in which obesity control is one of the prioritized objectives. For the program’s effective implementation, it is important to enhance individual nutritional education as well as to identify the socioeconomic and environmental factors affecting obesity-related lifestyle habits. This study aimed to investigate the secular changes in dietary and exercise habits between sexes and among four types of residential areas in Japan.

**METHODS:** The datasets of annual national nutrition surveys (1976–2003) were used for the secondary analyses. Data on the dietary and exercise habits of 385,559 persons aged 15 years and older were analyzed. Residential areas were divided into four groups: metropolitan areas, large cities, small cities, and small towns.

**RESULTS:** Similar trends were observed in the proportions of people skipping breakfast and eating out lunch/dinner, with those living in metropolitans having the highest proportions. The secular trend showed that the proportions of people eating dinner out were highest in the early 1990s, which corresponds to the “bubble period” in Japan.

**CONCLUSIONS:** Our findings suggest that dietary habits could be greatly influenced by the country’s economic situation, especially in metropolitan areas. Thus, area-specific population approaches should be enhanced to promote appropriate lifestyle habits, especially for the young to middle-aged.

**KEYWORDS:** overweight, lifestyle behavior, residential area, national nutrition survey, Japan

**INTRODUCTION**

Overweight and obesity, which are defined as abnormal or excessive fat accumulation that may impair health, is now one of the major public health problems in Japan. The nation suffered from a serious food shortage during and after World War II. As Japan achieved economic development, however, the population’s diet and physical activity patterns have greatly changed. Consequently, the nutrition problem gradually shifted from malnutrition to overweight. According to a study that examined the changes in the prevalence of overweight using the datasets of the National Nutrition Survey of Japan from 1976 through 1995, there was an increasing trend in overweight among males of all age groups and females over 60 years of age.

Therefore, in 2000 the Ministry of Health, Labour and Welfare started a new program of health promotion policies and strategies, Health Japan 21, which has 70 goals to be achieved by 2010 in nine areas: nutrition and diet, physical activity and exercise, rest and mental health, tobacco, alcohol, dental health, diabetes, cardiovascular diseases, and cancer. As one of the prioritized objectives in Health Japan 21, various efforts have been made toward obesity control, including enhancement of individual dietary guidance and nutritional education. Yet, the progress has not been sufficient to reach the goals. The midterm evaluation in 2005 showed that the prevalence of being overweight in males aged 20–60 years was 29.0% and that in females aged 40–60 years was 24.6%, whereas the 2010 target values are less than 15% and 20%, respectively. Studies have also indicated, however, that the rapid development of an obesity epidemic in genetically stable populations can be attributed to environmental factors affecting diet or physical activity level. Thus, in order to effectively control obesity, in addition to considering energy intake, other obesity-related lifestyle habits like eating behaviors and physical activity also must be taken into account. Although one of the goals in the area of nutrition and diet of Health Japan 21 is “environment-building to support behavioral change”, few studies have examined how this may be achieved. Thus, the aims of this study was to investigate the secular changes in obesity-related lifestyle habits from 1976 to 2003 between sexes and among types of residential areas in Japan.
Methods

Data Collection in the National Nutrition Survey

The first National Nutrition Survey, Japan (J-NNS) was carried out in Tokyo Metropolitan area in 1945. The Nutrition Improvement Law of 1952 stipulated that the J-NNS be conducted annually. Following the enactment of the Health Promotion Law in 2003, the J-NNS was renamed the National Health and Nutrition Survey. In the annual survey, target populations are selected from the entire national population aged 1 year and over by stratified random sampling; approximately 6000 households in 300 areas are randomly selected from enumerated districts based on the population census. The main components of data collection are household dietary surveys, physical examination (e.g., anthropometry, blood test, physical activity), and a questionnaire on lifestyle habits of the households’ individuals. Of these data, the following variables were included in this study: age, sex, residential area, skipping breakfast, eating lunch out, eating dinner out, alcohol consumption, exercise habits, and physical activity levels.

To consider the differences in socioeconomic background, residential areas are divided into four types, according to the size of municipality of residence: metropolitan areas (≥ 1,000,000 people), large cities (≥ 150,000 people), small cities (≥ 50,000 people), and small towns/villages (< 50,000 people).

Data for skipping breakfast, eating lunch out, and eating dinner out were derived from the dietary survey, as it was regarded that these responses would reflect their usual dietary habits as well. The definitions of “skipping” and “eating out” changed in 2001, after which the former included consuming supplements only or drinks only and the latter included takeaway/delivered meals.

Questions regarding alcohol consumption and exercise habits began to be included in the annual surveys in 1986, and these were asked of subjects aged 20 years and over. If a person drinks more than a bottle of beer (633 mL, or other alcohol equivalent to 23 g ethanol) three times a week, s/he is categorized as a drinker. As for exercise habits, if a person exercises more than twice a week for 30 min or longer over a 1-year period, s/he is regarded as a regular exerciser. The assessment of physical activity started in 1991, by measuring the number of steps per day with pedometer (AS-200, Yamasa Tokei Keiki Co., Ltd.).

Data Sources and Analyses

The datasets of the annual national nutrition surveys (1976–2003) were used, with the permission of the Ministry of Health, Labour, and Welfare. Data for 385,559 persons aged 15 years and over were included in the secondary analyses. As described in the previous section, the numbers of subjects analyzed differ across the variables. Table 1 shows the numbers of study subjects by sex for each variable.

We calculated Body Mass Index (BMI) (kg/m²) using the recorded body weight and height. A cutoff of 25.0 was used to classify overweight individuals (BMI ≥ 25.0 kg/m²) and others, according to the international classification by the World Health Organization (WHO). All the data were tabulated/analyzed using SPSS® for Windows version 11.5.1J (SPSS Inc.). To avoid strong year-to-year fluctuations in the survey results, we calculated overweight prevalence and proportions of each lifestyle habit for six time periods (1976–1980, 1981–1985, 1986–1990, 1991–1995, 1996–2000, and 2001–2003) by sex. These data were further classified by seven age groups and the four types of residential areas. For t-test, p < 0.05 was used as the level of statistical significance.

Results

Data Sources and Analyses

Figures 1a and 1b show the changes in prevalence of overweight by 20-year age group and the residential areas in the six time periods for males and females, respectively. For males, the prevalence of being overweight consistently increased regardless of age group and type of residential area. For those aged 20–59 years, the proportions were highest in small towns and lowest in metropolitan areas. In contrast, there was a decreasing trend in the prevalence of being overweight among females aged 20–59 years, except for those living in small towns. For females aged over 60 years, however, overweight prevalence increased across all types of residential areas.

Changes in Dietary and Exercise Habits

The secular changes in dietary and exercise habits were examined for each lifestyle factor, first by 10-year age group, followed by further analyses by type of residential area focusing on the 20-year age groups who were at risk for each factor.

Dietary Habit (Skipping Breakfast, Eating out for Lunch/Dinner)

As was mentioned in the Methods, the definitions of “skipping” and “eating out” were expanded in 2001 and thereafter. Thus, the secular trends of dietary habits were examined for 1976–2000 only.

Figure 2a shows the secular changes in the proportion of subjects who skipped breakfast according to age group. The proportion was highest in both male and female subjects aged 20–29 years throughout the study period, followed by males aged 30–39 years and females aged 15–19 years. For both males and females less than 50 years old, the proportions were highest in 1991–1995. When the analysis was performed focusing on the age group 20–39 years, there was a large gap between the proportions in metropolitan areas and small towns during 1975–1995, after which this regional difference became less obvious (Figure 2b).
Secular Changes in Lifestyle Behavior in Japan

**Fig. 1a.**
Changes in overweight prevalence among types of residential areas (males)

**Fig. 1b.**
Changes in overweight prevalence among types of residential areas (females)

**Fig. 2a.**
Proportions of the subjects skipping breakfast by age group

*Note: Definition of “Skipping” changed from 2001*
Fig. 2b.
Proportions of the subjects skipping breakfast by residential area
*Note: Definition of “Skipping” changed from 2001*

![Proportions of the subjects skipping breakfast by residential area](image)

Fig. 3a.
Proportions of the subjects eating lunch out by age group
*Note: Definition of “eating out” changed from 2001*

![Proportions of the subjects eating lunch out by age group](image)

Fig. 3b.
Proportions of the subjects eating lunch out by residential area
*Note: Definition of “eating out” changed from 2001*

![Proportions of the subjects eating lunch out by residential area](image)
Secular changes in the proportion of subjects who ate lunch and dinner out are shown in Figures 3a and 4a, respectively, according to age group. There were increasing trends for both lunch and dinner, with the highest proportion in those aged 20–29 years, although the proportions dramatically decreased after 1995. Similar trends were observed in the distributions by type of residential area in the subjects aged 20–39 years: the proportions were highest between 1986 and 1995, with those living in metropolitan areas having the highest proportions (Figure 3b for lunch, Figure 4b for dinner).

**Drinking and Exercise Habits**

Figure 5a shows that the proportions of subjects classified as drinkers remained essentially stable during the study periods, regardless of sex and age group, with the highest proportion in males aged 50–59 years and in females aged 40–49 years. Similarly, when looking at the secular trend in the subjects aged 40–59 years, the proportions remained stable across all types of residential areas (Figure 5b). Among males the proportions of drinkers were highest in small towns and lowest in metropolitan areas, whereas the reverse trend was observed among females.

Among males and females aged 20–49 years, the proportions of those classified as regular exercisers remained relatively low and stable from 1986 to 2003, in contrast to the older subjects (≥ 50 years; Figure 6a). When the data were analyzed by type of residential area focusing on the subjects aged 40–59 years, there was an increasing trend in the proportions of regular exercisers, especially in larger cities (Figure 6b).
Fig. 5a.
Proportions of the subjects classified as "drinker" by age group

Fig. 5b.
Proportions of the subjects classified as "drinker" by residential area

Fig. 6a.
Proportions of the subjects classified as "regular exerciser" by age group
Proportions of the subjects classified as “regular exerciser” by residential area

Fig. 6b.

Fig. 7a.
Mean numbers of steps per day measured using pedometer by age group

Fig. 7b.
Mean numbers of steps per day by residential area
Physical Activity Levels

Mean numbers of daily steps measured using a pedometer, as a proxy of physical activity level, are shown by age group in Figure 7a. Overall, there was an increasing trend in both males and females during the past decade, except for those 70 years or older. When the data were analyzed for subjects aged 40–59 years, the mean values remained essentially stable across all types of residential areas (Figure 7b).

Furthermore, our analysis revealed that physical activity had a highly significant association with BMI. Figure 8 compares the mean numbers of steps between overweight subjects (BMI \( \geq 25.0 \)) and normal-weight subjects (BMI < 25.0) in 2001–2003. Regardless of age group and sex, the subjects with normal BMI walked more than overweight subjects (t-test: \( p < 0.05 \) except males and females aged 15–19 years and females 70 years or over).

Discussion

Although several studies have reported the epidemiology and secular changes of overweight prevalence in Japan,\(^{2,8}\) to our knowledge this is the first study to report the secular changes in lifestyle behaviors and the associations between lifestyle behaviors and overweight using nationally representative samples. As was documented in a previous study for the period 1976–1995,\(^{5}\) there was an increasing trend in overweight prevalence in all male age groups and in elderly women, but a decreasing trend in females less than 50 years old. Our study demonstrated that this trend was consistently observed after 1996 as well, with differences among types of residential areas being expanded.

In this study, similar trends were observed in the proportions of people skipping breakfast and eating out lunch/dinner, with the age group 20–39 years and those living in metropolitan areas having the highest proportion. The secular trend showed that the proportions of people eating out were highest in the early 1990s, and this trend was especially obvious among males in metropolitan areas. Interestingly, this corresponds to the “bubble period” in Japan (1986–1991), which was a time of skyrocketing land and stock prices, leading to the peak of economic boom in the Japanese economy.\(^{9}\) The number of fast food shops and restaurants in the country has dramatically increased since the 1970s.\(^{10}\) Our findings suggest that dietary habits could be greatly influenced by the country’s economic situation, especially in metropolitan areas. Similarly, prevalence of overweight in male greatly increased around bubble period. On the other hand, the association between exercise habit and economic situation was unclear as the data on exercise habit were available after 1986 only. The increasing trend of regular exercisers after 1990, especially among the middle-aged and the elderly, was possibly due to the enhanced national health promotion program. This study also demonstrated that physical activity level (as measured by number of steps per day) was inversely associated with BMI in both male and female. This finding coincides with those of other studies in Japan.\(^{11,12}\)

We recognize the limitations of observational studies. Furthermore, the data for skipping breakfast and eating out lunch/dinner were obtained from dietary surveys (not questionnaires), thus we could not distinguish between subjects who actually have these habits and those who happened to exhibit these behaviors on the day of the dietary survey. Nevertheless, because our findings are based on nationally representative samples, they should have useful policy implications with respect to health promotion of the national population.

The Health Japan 21 program is characterized by a two-pronged approach, where a population approach (to reduce risk factors across the entire population) and a high-risk approach (to prevent disease by reducing the risk to those individuals at a higher risk within the population) are combined.\(^{13}\) To improve one’s lifestyle behavior, it is essential to incorporate the population approach in addition to the high-risk individual approach. Following the initiation of Health Japan 21, the Ministry of Health, Labour, and Welfare established a committee to investigate the possible approaches to improve food environment for health promotion.\(^{13}\) These population approaches are now well incorporated in “Shokuiku,” which started in 2005 following the enactment of “Basic Act on Shokuiku.”\(^{14}\) As for exercise and physical activity; our findings showed that the proportions of people with regular exercise habit increased after 60 years old, though the numbers of steps decreased. With a rapid shift to aging society, there is a growing concern on future health of the current young and middle-aged.

![Fig. 8. Mean numbers of steps: normal vs. overweight (2001-2003)](image_url)

\( p \) value: * < 0.05, ** < 0.01, *** < 0.001
who will become the elderly after the decades. More efforts are therefore required to establish the environment, especially in small towns, to promote regular exercise and physical activity, so that the future elderly will be able to acquire habitual exercise and physical activity after retirement without a difficulty.

Our findings of differential patterns in overweight prevalence as well as in lifestyle behaviors across types of residential areas suggest that the area-specific population approaches should be enhanced to promote appropriate lifestyle behavior for the young and middle aged. In particular, the importance of physical activity should be emphasized.

Acknowledgments

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