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Urban and rural Differences in the Prevalence of Gender and Age specific Obesity and related Health Behaviors in Korea

The objective of this study was to discuss the residential difference in gender and age specific prevalence of obesity by body mass index (BMI) and obesity related health behaviors in the Republic of Korea. A total of nationally representative 2,583 men and 3,087 women (age: 20-64 yr) was used as subjects from 1998 National Health and Nutrition Survey. All statistics were calculated using SUDAAN to consider a stratified multistage probability sampling design. The prevalence of obesity (BMI≥25) was significantly different by age, gender and residential areas. Although younger men aged 20-49 yr did not show a residential difference in the prevalence of obesity, men aged 50-64 yr showed differences, highest in big cities and lowest in rural areas. However, in women, a higher prevalence was observed in rural areas compared to urban areas in the younger age group (20-49 yr), but not in the older age group. Residential differences of obesity related health behaviors existed mostly in the older population, but not in the younger population. The urban-rural differences demonstrate the various stages of behavioral transition that Korea is currently undergoing. Therefore, different strategies considering those factors are needed to manage obesity problems in Korea.

Key Words : *Korea; Body Mass Index; Obesity; Health Behavior; Health Care Surveys; Nutrition Surveys; National Survey; Residence Characteristics*

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INTRODUCTION

Obesity is one of the major predictors for heart disease and other chronic diseases including hyperlipidemia, hypertension, atherosclerosis and hyperinsulinemia (1). The prevalence of obesity is increasing rapidly worldwide (2). The principal causes of the increasing obesity problem have known to be sedentary lifestyles and a high-fat and energy rich diet.

Body mass index (BMI) is widely used in the adult population to define overweight and obesity although it is a less ideal method for measuring body fat. The cut off points of 25 kg/m^2 and 30 kg/m^2 have been recognized internationally as definitions of adult overweight and obesity, respectively (3). However, recent studies have shown that Asians have a lower BMI but a higher percentage of body fat than Caucasians at the same BMI (4, 5). Deurenberg et al. also suggested that the relationship between BMI and body fat percentage differs between ethnic groups (6). Therefore, increased health risks associated with obesity appear to occur at a lower BMI in Asians. Several Asian countries and the World Health Organization (WHO) expert panel proposed different cut-off values as overweight (BMI 23-24.9 kg/m^2) and obesity (BMI ≥25 kg/m^2) based on the morbidity of their own population (7-10).

Aging is associated with changes in body composition. Cross-sectional and longitudinal studies suggest an increase in body mass and adiposity with aging despite decreases in energy intake or considerable physical activity especially until the ages of 65-70 yr although the patterns seem to differ by gender (11-13). Those studies reported that men had a progressive body mass gain from early adulthood to late middle age while women had a continuous increase from early adulthood to postmenopause. Nationally representative cross-sectional data showed that the prevalence of obesity by BMI in men increased with aging until 35-45 yr of age, followed by plateau in Japan, but a continuous increase in United States until 65-75 yr of age (14, 15). On the contrary, women's BMI increased continuously as they increased in age for both countries. The BMI started to decrease after 65-75 yr of age in both men and women in those countries.

The economic growth in the Republic of Korea increased markedly over the past several decades. At the same time, Western lifestyles including their diet has been introduced rapidly into the country. In addition, industrialization and growth of the technology sector have led to a decrease in physical activity. As those lifestyles change, obesity has also increasingly become a social problem in Korea (16, 17). A study from the Indian population reported the prevalence of obesity by residential difference, which may reflect the degree of industrialization in a country, and suggested that those urban-rural

differences would be due to the differences in lifestyle factors including physical activity and nutrition by residents (18). However, few studies focused on the distribution of BMI and trends of related health behaviors, especially based on the effect of gender, aging and residential areas in current representative Korean population although certain transition must exist cross-sectionally.

The purpose of this study was to discuss the distribution of BMI and obesity related health behaviors by gender, age and residence in Korea using the data obtained from the 1998 National Health and Nutrition Survey gathered by Ministry of Health and Welfare of Republic of Korea and Korea Institute for Health and Social Affairs in November 1998.

MATERIAIS AND METHODS

Data from the 1998 Korean National Health and Nutrition Survey were used in the study. The survey employed a stratified multistage probability sampling design. A total number of 12,283 Korean households with 39,060 household members participated in the Health Interview Survey. One out of three samples from the Health Interview Survey were selected to conduct a Health Examination and Nutrition Survey (19). Anthropometric data were available for 10, 880 participants aged 10-94 yr. Among those, adults aged 20-64 yr were selected to examine the differences in the trends of obesity and related health behaviors. Subjects over the age of 65 yr were excluded from this analysis because BMI started decreasing after 65 yr of age in Korean women. This may be considered as a reflection of selection survival in the population. Finally, 5,670 were used to analyze the data in this study.

Height and weight were measured based on standard procedures and BMI was calculated by dividing the weight in kilograms by the square of the height in meters.

Dietary intake was assessed by the single 24-hr dietary recall method. Experienced interviewers instructed respondents to recall and describe the foods and beverages consumed over the previous 24 hr. Energy, protein, fat and carbohydrate intake were calculated and reported, and they were also expressed as a percentage of total energy.

Adults aged 20-64 yr were further divided into three groups using a 15-yr age interval, 20-34, 35-49 and 50-64 yr. Residential areas were divided into three categories as big cities, small cities and rural areas. The average BMI and energy, protein, fat and carbohydrate intakes were calculated and compared by age and residential areas in each gender.

After the distribution of BMI was analyzed by original WHO standards for western countries and recent suggestions for Asians by WHO Expert Panel ($BMI \geq 30$ as obesity for westerners, $30 > BMI \geq 25$ as overweight for westerners or obesity for Asians, $25 > BMI \geq 23$ as overweight for Asians, $23 > BMI \geq 18.5$ as normal weight for Asians, $BMI < 18.5$ as underweight for westerners and Asians), the prevalence of obesity using the Asian classification $BMI \geq 25$ was compared by age and region categories in each gender to examine age, gender and residential specific prevalence.

The percentage intake of fat from total energy was classified as >20% of energy from fat and ≤20% of energy from fat. Self-reported alcohol consumption, smoking, exercise, the degree of usual daily activity and weight reduction information were obtained from the questionnaire and the proportions were compared by age and region as well. Alcohol consumption was classified as heavy (heavy drinking once or more than once per month) and non-heavy drinkers (drinking less than once per month or none) from the question "How often do you drink heavily?". Smoking status was classified by the participants' self-report as current versus former or nonsmokers. Exercise was classified as regular (at least 20 min at a time, 3 or more times per week) and non-regular (the rest of them). The degree of daily activity was classified as intense versus non-intense from the question "how intensely can you rate your daily activity?" Information on weight reduction status was classified into the current weight reduction group when the answer was weight reduction from a self-reported question "which weight control do you try?"

Statistical analysis

All statistics were calculated using SUDAAN (version 9.0) to consider the sample design (20). SUDAAN was used to increase the accuracy and validity of results through computing variance estimates and test statistics for a stratified, multistage probability survey design. Variance approximation of Taylor series linearization was used to estimate sampling errors. Sample weights were applied to all analyses to account for the unequal probability of selection, non-coverage and non-response bias from sampling.

Mean and standard errors, which represent variability of the estimates, were reported for BMI, energy, protein, fat and carbohydrate intakes. Two way ANOVAs were performed on BMI and health related behaviors to investigate the main effect of age and residential areas and their interaction, separating men and women. Contrasts by Bonfferoni were used to examine the mean differences by age in each residential area and residential area in each age group. The level of statistical significance was set to 5%. General Linear Model and its contrast by Bonfferoni were used to test the significant difference in the prevalence of BMI and proportion of health behaviors by age and residential areas in each gender.

RESULTS

Means of BMI and energy, protein, fat and carbohydrate intakes

A total of 2,583 men and 3,087 women (20-64 yr of age)

were included in this analysis. The distribution of subjects by age categories and residential areas is presented for Korean men and women in Table 1. Table 2 and 3 show the mean and standard error of BMI and energy, protein, fat and carbohydrate intakes by age and residential areas in Korean men and women. The means of BMI (kg/m^2) by age groups from three residential areas were 22.6-23.9 for men and 21.7-24.8 for women. The average BMI for men was slightly higher than that for women in most age groups, except for those between the ages of 50-64 yr. Mean energy intake ranged from 2,079 to 2,554 kcal for men and 1,679-1,938 kcal for women. The average percentages of energy from fat intake were 12.5-20.3% and 10.9-19.8% for men and women, respectively.

Table 1. Distribution of study subjects by gender, age and region

Age (yr)	Male			Female			Total
	Big city	Small city	Rural area	Big city	Small city	Rural area	
20-34	384	244	252	493	337	276	1,986
35-49	433	269	322	465	305	372	2,164
50-64	230	114	337	262	132	445	1,520
Total	1,047	625	911	1,220	774	1,093	5,670

Data are expressed as number of subjects.

Overall significant age differences were found in BMI, energy and macronutrient intakes in Korean men and women (p<0.05) except carbohydrate intake and the percentage of energy from protein for women. Residential differences were observed by higher fat intake and higher percentage of energy from fat and lower percentage from carbohydrate in urban areas (both big and small cities) compared with rural areas among the entire men. Urban women showed higher BMI and fat intake and higher percentage of energy from protein and fat and lower percentage from carbohydrate. Different patterns of age-specific mean BMI by residential areas existed, presenting a significant interaction of age and residential areas for both men and women (p=0.0025 and p<0.0001, respectively).

In the comparison of the mean levels of BMI and intakes by residential areas in each age group, the BMI in men aged 20-49 yr did not show any difference by residential areas. Men aged 50-64 yr in urban areas had a higher BMI than men in the same age group in rural areas. However, women had different residential patterns from men. Urban women in the 20-34 and 35-49 yr age group showed a lower BMI than that for rural women, on the contrary, urban women aged 50-64 yr showed a higher BMI.

The effects of age on BMI were different in each residential area. In big cities, men aged 35-49 and 50-64 yr showed a

Table 2. Mean and standard error of body mass index and dietary variables by age and region in Korean men (two-way ANOVA)

Variables	Age (yr)	Male			Age effect p value	Residence effect p value	Interaction p value
		Big city	Small city	Rural area			
BMI (kg/m^2)	20-34	22.9±0.16 $^{a,\alpha}$	22.9±0.21 $^{a,\alpha}$	23.1±0.22 $^{a,\alpha}$	<0.0001	0.5820	0.0025
	35-49	23.7±0.14 $^{a,\beta}$	23.9±0.16 $^{a,\beta}$	23.8±0.17 $^{a,\beta}$			
	50-64	23.8±0.18 $^{a,\beta}$	23.4±0.30 $^{a,\alpha,\beta}$	22.6±0.16 $^{b,\alpha}$			
Energy (kcal)	20-34	2,403±51.0 $^{a,\alpha}$	2,462±69.4 $^{a,\alpha}$	2,554±72.5 $^{a,\alpha}$	<0.0001	0.7574	0.0963
	35-49	2,307±43.0 $^{a,\alpha,\beta}$	2,431±56.6 $^{a,\alpha}$	2,319±50.5 $^{a,\alpha}$			
	50-64	2,227±56.8 $^{a,\beta}$	2,114±82.5 $^{a,\beta}$	2,079±47.6 $^{a,\beta}$			
Protein (g)	20-34	92.4±2.7 $^{a,\alpha}$	94.7±3.5 $^{a,\alpha}$	93.1±4.0 $^{a,\alpha}$	0.0003	0.4183	0.0034
	35-49	91.7±2.2 $^{a,\alpha}$	95.4±3.2 $^{a,\alpha}$	89.8±2.8 $^{a,\alpha}$			
	50-64	92.0±3.7 $^{a,\alpha}$	74.6±3.3 $^{b,\beta}$	77.3±3.0 $^{b,\beta}$			
Fat (g)	20-34	54.0±2.1 $^{a,\alpha}$	51.7±2.4 $^{a,\alpha}$	53.5±2.9 $^{a,\alpha}$	<0.0001	0.0401	0.0624
	35-49	46.9±1.6 $^{a,\beta}$	46.9±2.0 $^{a,\alpha}$	41.5±1.8 $^{a,\beta}$			
	50-64	40.8±2.1 $^{a,\gamma}$	34.8±2.7 $^{ab,\beta}$	29.2±1.3 $^{b,\gamma}$			
Carbohydrate (g)	20-34	367±7.9 $^{a,\alpha}$	387±10.1 $^{a,\alpha}$	403±10.6 $^{a,\alpha}$	0.0193	0.3602	0.1507
	35-49	366±7.0 $^{a,\alpha}$	383±7.7 $^{a,\alpha}$	374±8.2 $^{a,\alpha,\beta}$			
	50-64	362±10.2 $^{a,\alpha}$	348±13.9 $^{a,\alpha}$	354±8.5 $^{a,\beta}$			
Protein% of energy	20-34	15.8±0.3 $^{a,\alpha}$	15.7±0.3 $^{a,\alpha}$	14.8±0.3 $^{a,\alpha}$	0.0415	0.0533	0.2554
	35-49	16.3±0.2 $^{a,\alpha}$	16.1±0.3 $^{a,\alpha}$	16.2±0.4 $^{a,\beta}$			
	50-64	16.7±0.5 $^{a,\alpha}$	15.6±0.6 $^{ab,\alpha}$	15.2±0.4 $^{b,\alpha,\beta}$			
Fat% of energy	20-34	20.3±0.5 $^{a,\alpha}$	18.7±0.5 $^{a,\alpha}$	18.2±0.6 $^{a,\alpha}$	<0.0001	<0.0001	0.2056
	35-49	18.1±0.4 $^{a,\beta}$	17.3±0.5 $^{ab,\alpha}$	15.9±0.5 $^{b,\beta}$			
	50-64	16.2±0.6 $^{a,\gamma}$	15.0±0.8 $^{a,\beta}$	12.5±0.4 $^{b,\gamma}$			
CHO*% of energy	20-34	63.9±0.6 $^{a,\alpha}$	65.6±0.6 $^{ab,\alpha}$	67.0±0.8 $^{b,\alpha}$	<0.0001	<0.0001	0.2520
	35-49	65.6±0.6 $^{a,\alpha,\beta}$	66.6±0.7 $^{ab,\alpha,\beta}$	67.9±0.7 $^{b,\alpha}$			
	50-64	67.1±0.8 $^{\alpha,\beta}$	69.2±0.9 $^{\alpha,\beta}$	72.3±0.6 $^{b,\beta}$			

Different superscripts in the same row (a, b, c) and the same column (α, β, γ) indicate significant differences between groups at p<0.05.
(a, b, c: Significantly different among residences in each age group; α, β, γ: Significantly different among age groups in each residence).
*CHO, carbohydrate.

Table 3. Mean and standard error of body mass index and dietary variables by age and region in Korean women (two-way ANOVA)

Variables	Age (yr)	Female			Age effect *p* value	Residence effect *p* value	Interaction *p* value
		Big city	Small city	Rural area			
BMI (kg/m^2)	20-34	21.7±0.15 $^{a,\alpha}$	21.9±0.16 $^{a,\alpha}$	22.6±0.21 $^{b,\alpha}$	<0.0001	0.0003	<0.0001
	35-49	23.3±0.17 $^{a,\beta}$	23.5±0.18 $^{a,\beta}$	24.4±0.17 $^{b,\beta}$			
	50-64	24.8±0.21 $^{a,\gamma}$	24.8±0.28 $^{ab,\gamma}$	23.9±0.16 $^{b,\beta}$			
Energy (kcal)	20-34	1,908±38.0 $^{a,\alpha}$	1,932±42.8 $^{a,\alpha}$	1,931±45.2 $^{a,\alpha}$	<0.0001	0.5665	0.7830
	35-49	1,840±35.6 $^{a,\alpha,\beta}$	1,938±44.8 $^{a,\alpha,\beta}$	1,834±38.3 $^{a,\alpha}$			
	50-64	1,697±45.5 $^{a,\beta}$	1,724±62.7 $^{a,\beta}$	1,679±33.3 $^{a,\beta}$			
Protein (g)	20-34	73.2±2.1 $^{a,\alpha}$	72.3±2.3 $^{a,\alpha,\beta}$	74.9±4.1 $^{a,\alpha}$	0.0379	0.4184	0.1616
	35-49	71.6±2.0 $^{a,\alpha}$	74.1±2.8 $^{a,\alpha}$	67.6±2.1 $^{a,\alpha}$			
	50-64	70.7±4.2 $^{a,\alpha}$	64.2±4.5 $^{ab,\beta}$	59.0±1.7 $^{b,\beta}$			
Fat (g)	20-34	43.7±1.5 $^{a,\alpha}$	42.2±1.5 $^{a,\alpha}$	41.2±1.9 $^{a,\alpha}$	<0.0001	0.0091	0.6660
	35-49	36.7±1.6 $^{a,\beta}$	35.4±1.4 $^{ab,\beta}$	31.1±1.4 $^{b,\beta}$			
	50-64	27.0±1.4 $^{a,\gamma}$	27.6±2.1 $^{a,\gamma}$	21.6±1.0 $^{b,\gamma}$			
Carbohydrate (g)	20-34	308±6.3 $^{a,\alpha}$	319±7.7 $^{a,\alpha}$	325±8.8 $^{a,\alpha}$	0.2332	0.1209	0.8016
	35-49	309±5.8 $^{a,\alpha}$	333±8.1 $^{a,\alpha}$	323±6.8 $^{a,\alpha}$			
	50-64	302±7.2 $^{a,\alpha}$	310±114 $^{a,\alpha}$	312±6.4 $^{a,\alpha}$			
Protein% of energy	20-34	15.1±0.3 $^{a,\alpha}$	14.8±0.3 $^{a,\alpha}$	14.8±0.4 $^{a,\alpha}$	0.5614	0.0250	0.5642
	35-49	15.4±0.3 $^{a,\alpha}$	14.9±0.3 $^{ab,\alpha}$	14.4±0.3 $^{b,\alpha}$			
	50-64	15.2±0.4 $^{a,\alpha}$	14.4±0.5 $^{ab,\alpha}$	13.9±0.3 $^{b,\alpha}$			
Fat% of energy	20-34	19.8±0.4 $^{a,\alpha}$	19.0±0.5 $^{a,\alpha}$	18.1±0.6 $^{a,\alpha}$	<0.0001	<0.0001	0.6099
	35-49	16.7±0.4 $^{a,\beta}$	15.8±0.4 $^{ab,\beta}$	14.3±0.4 $^{b,\beta}$			
	50-64	13.4±0.4 $^{a,\gamma}$	13.7±0.7 $^{a,\beta}$	10.9±0.4 $^{b,\gamma}$			
CHO*% of energy	20-34	65.1±0.5 $^{a,\alpha}$	66.2±0.6 $^{a,\alpha}$	67.2±0.7 $^{a,\alpha}$	<0.0001	<0.0001	0.4555
	35-49	67.9±0.5 $^{a,\beta}$	69.4±0.6 $^{ab,\beta}$	71.3±0.6 $^{b,\beta}$			
	50-64	71.4±0.7 $^{a,\gamma}$	71.9±1.0 $^{a,\beta}$	75.2±0.5 $^{b,\gamma}$			

Different superscripts in the same row (a, b, c) and the same column (α, β, γ) indicate significant differences between groups at $p<0.05$.
(a, b, c: Significantly different among residences in each age group; α, β, γ: Significantly different among age groups in each residence).
*CHO, carbohydrate.

higher BMI than men aged 20-34 yr. Whereas, in small cities and rural areas, BMI of men aged 50-64 yr did not show significant differences from the BMI of men aged 20-34 yr. In women, BMI was the highest for those aged 50-64 yr in urban area, however, BMI in those aged 35-49 yr was higher than those aged 50-64 yr in rural area.

Energy intakes did have age effect, but not residential effect. The older population consumed lower energy in each residential area for both men and women. People aged 50-64 yr had lower protein intakes than those aged 20-49 yr in small cities and rural areas, but those in big cities did not have significantly different protein intakes by age. Carbohydrate intakes were not significantly different according to different age and residential areas except for men living in rural areas. The percentage of energy from fat tended to be higher in younger people and those living in big cities. Younger people aged 20-34 yr, did not show any difference in the energy percentage from fat by residential areas in the current Korean population.

Rates of obesity and other health related behaviors

The age-specific prevalence of overweight and obesity across various age categories is presented in Fig. 1. According to the standard for Asians suggested by WHO Expert Panel (obesity ≥ 25), 22.5% and 15.1% were obese in Korean men and women aged 20-34 yr, respectively. The highest prevalence was found in the 30-49 yr for men and 50-64 yr for women. In the 50-64 yr age group, women showed a much higher prevalence than men (28.6% vs. 41.2%). The prevalence of subjects with BMI ≥ 23 (Asian criteria for overweight and obesity) was 61.4% in men aged 35-49 yr and 67.8% in women aged 50-64 yr, whereas 9.8% (BMI<18.5) of women aged 20-34 yr were underweight.

As shown in Fig. 2, the results revealed that obesity is widely prevalent in the older urban population in both men and women except a higher prevalence in younger rural women compared with younger urban women. The prevalence of obesity was significantly different by age (age effect $p=0.0001$ for men and $p<0.0001$ for women by General Linear Model) and the age-specific prevalence trends of obesity were significantly different by residential areas in both men and women (interaction effect, $p=0.0023$ for men and $p=0.0001$ for women). Among men, the highest prevalence was observed in the 50-64 yr of age in big cities, but in the 35-49 yr of age in small cities and rural areas. However, women showed opposite patterns, the highest prevalence at 50-64 yr in urban areas and at 35-49 yr in rural areas. No residential area difference on prevalence was found in the 20-34 and 35-49 yr of age in men, but a significant difference was observed in the 50-64 yr of age (35, 29 and 17% in big city, small city and rural area,

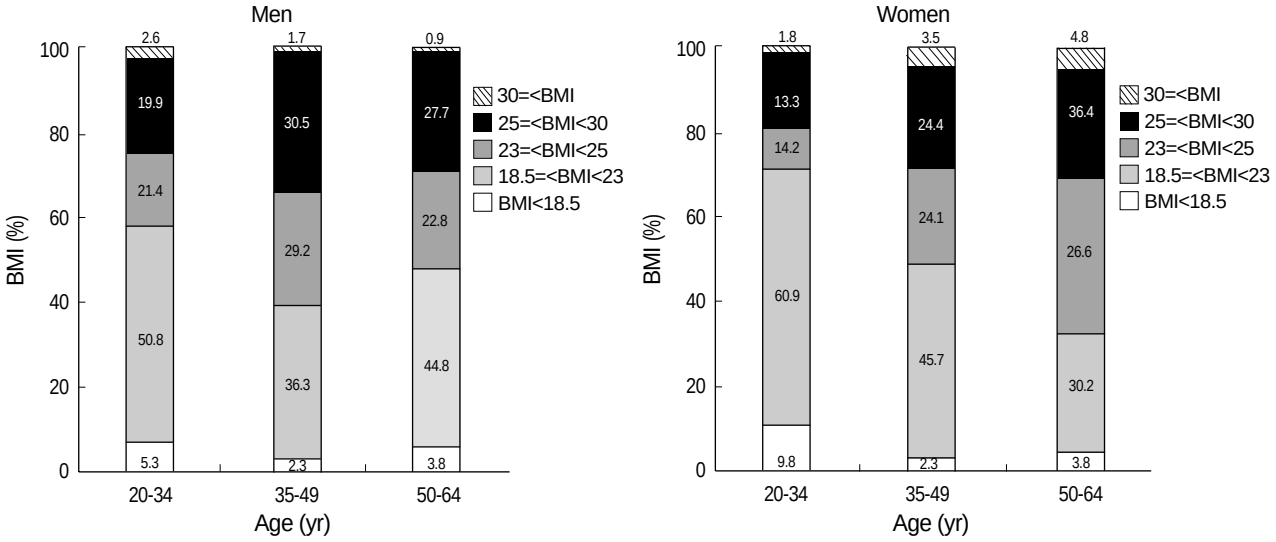

Fig. 1. The distribution of BMI in Korean men and women by age group.

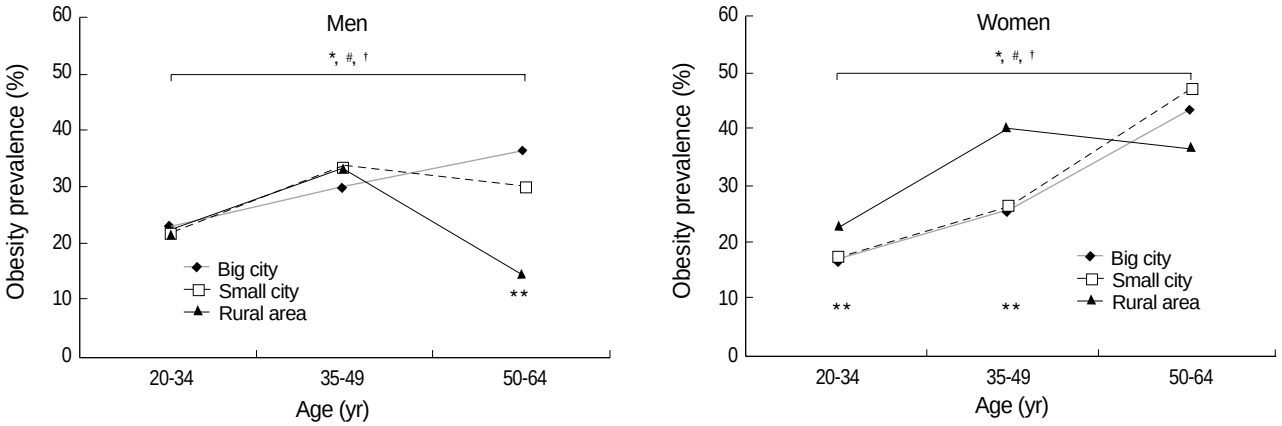

Fig. 2. Prevalence of obesity (BMI ≥ 25) by age and residence in men and women. The 1998 Korean National Health and Nutrition Survey. Result of General Linear Model were as follows: For men, Age effect, p=0.0001; Residence effect, p=0.2986; Age × Residence, p=0.0023; For, women, Age effect, p<0.0001; Residence effect, p=0.0010; Age × Residence, p=0.0001. *significant difference by ages in big city, p<0.05. #significant difference by ages in small city, p<0.05. †significant difference by ages in rural area, p<0.05. **significant difference by residences in each age group, p<0.05

respectively). As with women, the 20-34 and 35-49 yr age group showed a higher prevalence in rural areas than in urban areas.

Age-specific health behaviors by residential areas were only significantly different in exercising, daily activity and weight reduction for men and women (Fig. 3, 4). There was a higher percentage of regular exercising in urban areas than in rural areas in men at the ages of 50-64 yr and in women at 35-64 yr. The proportion of people who self-rated the degree of their activity as intense was the highest in older rural men and women, but the 20-34 yr age group did not show any residential difference. Weight reduction was more popular in the younger age group, especially in women. Almost half of the women in the 20-34 yr of age group tried to lose weight regardless of the residential area. Residential difference in weight reduction existed only in the 50-64 yr age group in men and women. Smoking and alcohol drinking only showed a significant age difference, but not residential difference in any age group. The population rate of eating over 20% energy from fat was significantly lower in the older age group in both men and women. Adults aged 20-34 yr did not show any significant difference in fat intake by residential area, but the 50-64 yr age group showed a lower percentage in rural areas compared to urban areas.

DISCUSSION

The predominant finding of this study was that the prevalence of obesity (BMI ≥ 25) was significantly different by age and residential areas in Korean men and women. Aging seemed to be a significant contributor in the increase of obesity for

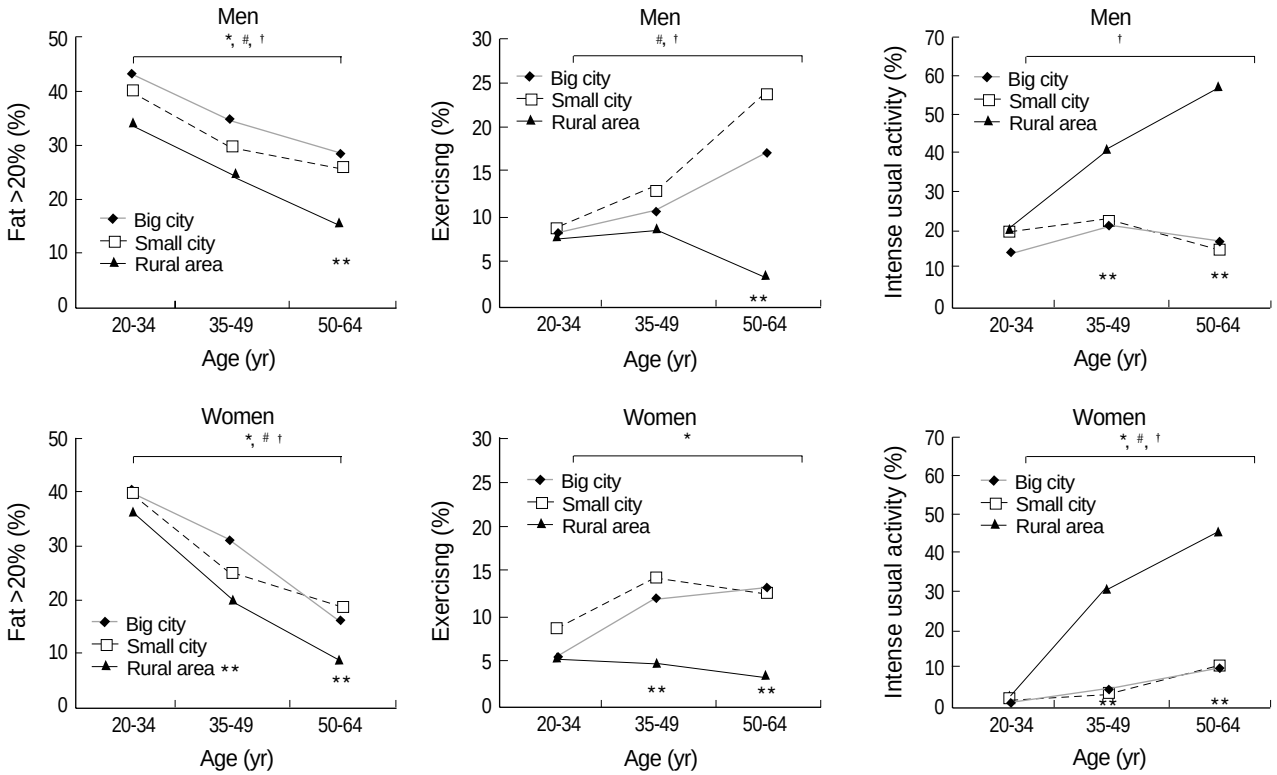

Fig. 3. Fat intakes and exercising and intense usual activities by age and residence in men and women. The 1998 Korean National Health and Nutrition Survey. Result of General Linear Model were as follows: Fat intake: For men, Age effect, $p<0.0001$; Residence effect, $p=0.0005$; Age × Residence, $p=0.7692$; For women, Age effect, $p<0.0001$; Residence effect, $p=0.0081$; Age × Residence, $p=0.3626$. Exercise: For men, Age effect, $p=0.1123$; Residence effect, $p=0.0012$; Age × Residence, $p=0.0006$; For, women, Age effect, $p=0.0049$; Residence effect, $p=0.0003$; Age × Residence, $p=0.0228$. Daily activity: For men, Age effect, $p=0.0009$; Residence effect, $p<0.0001$; Age × Residence, $p<0.0001$; For, women, Age effect, $p<0.0001$; Residence effect, $p<0.0001$; Age × Residence, $p=0.0019$. *significant difference by ages in big city, $p<0.05$. #significant difference by ages in small city, $p<0.05$. †significant difference by ages in rural area, $p<0.05$. **significant difference by residences in each age group, $p<0.05$

both Korean men and women despite the gender difference pattern. This increasing trend by aging in a cross-sectional study was a common phenomenon in other countries as well (9, 21, 22). The 1999-2000 National Health and Nutrition Examination Survey of the U.S.A. showed a continuously increasing prevalence of obesity by aging for men. The 1998 nutrition survey in Japan showed that the prevalence of obesity in men increased to 35-45 yr of age, followed by plateau. On the contrary, women's BMI increased continuously as age increased in both countries.

When the effects of residential areas were considered for obesity trends, these aging effects were different by residential areas in Korea. Although younger people aged 20-49 yr did not show a prevalence difference of obesity by residential areas, people at the ages of 50-64 yr living in urban areas, which are more industrialized, showed the highest prevalence of obesity for men. In rural areas, which usually keep a more traditional lifestyle, men aged 50-64 yr showed the lowest prevalence of obesity. However, in women, these urban-rural effects were applied differently in each age group. In Korean women, a higher prevalence was found in rural areas compared to urban areas in the younger age group (20-49 yr), but not in the older age group.

The urban-rural differences of obesity prevalence in this study demonstrate the various stages of behavioral transition that Korea is currently undergoing, which may be explained by lifestyle and certain social factors. Urban areas had significantly higher rates of people who ate more than 20% energy from fat than rural areas did, especially in older population for both men and women, although age had a greater effect on fat intake than residential areas did. Among lifestyle factors, self-rated usual activity as intense showed the biggest urban-rural differences, which may explain the lower prevalence of obesity in rural older population. The higher exercise rate in urban areas might show that Koreans in urban areas did exercise more in their leisure time than those in rural areas, while non-leisure daily activity level were higher in rural areas. We believe that the industrialized lifestyles including high fat intakes and low usual intense activity led to a high prevalence of obesity, whereas, this higher obesity status combined with higher health concerns got older urban people more involved in exercise.

Higher prevalence of obesity in younger rural Korean women was not explained by lifestyle factors that were analyzed

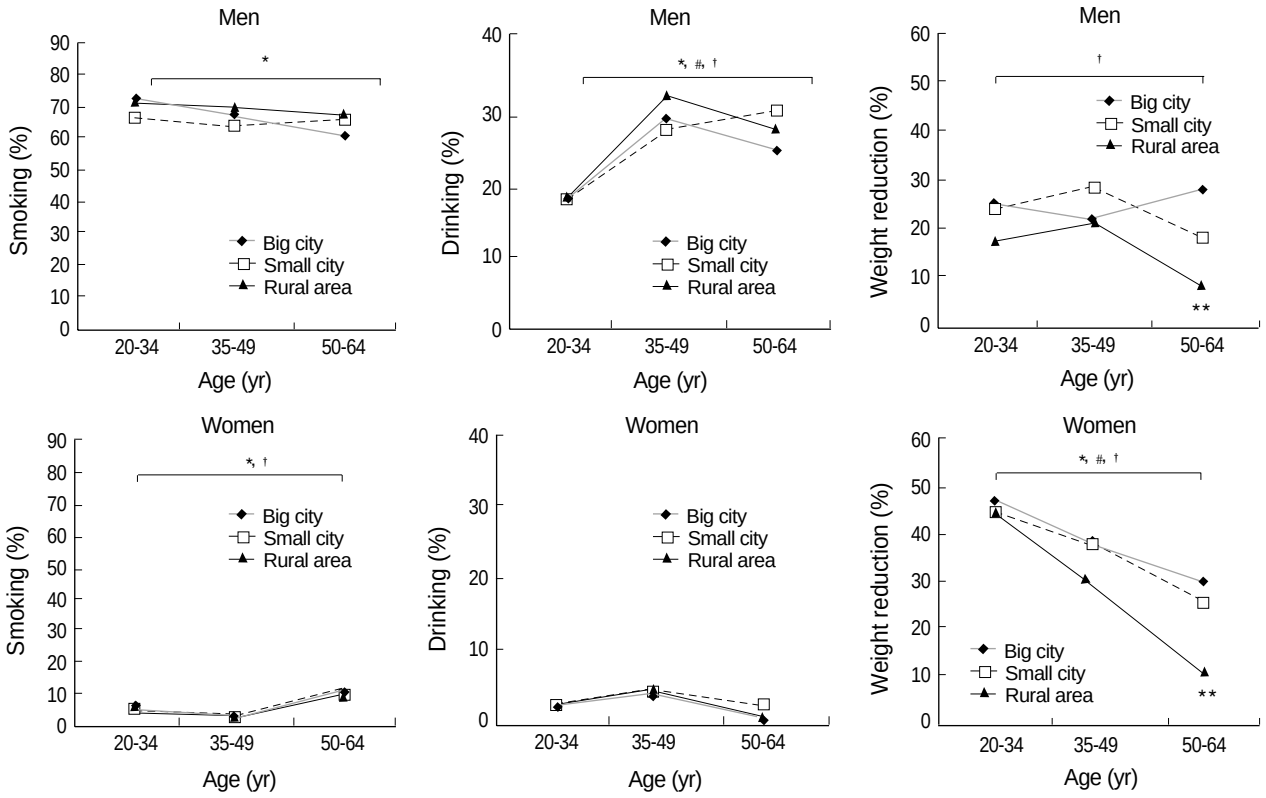

Fig. 4. Smoking, drinking and weight related behaviors by age and residence in men and women. The 1998 Korean National Health and Nutrition Survey. Result of General Linear Model were as follows: Smoke: For men, Age effect, p=0.0024; Residence effect, p=0.2713; Age × Residence, p=0.4968; For, women, Age effect, p=0.0035; Residence effect, p=0.8918; Age × Residence, p=0.9362. Drink: For men, Age effect, p<0.0001; Residence effect, p=0.3813; Age × Residence, p=0.5073; For, women, Age effect, p=0.5402; Residence effect, p=0.8334; Age × Residence, p=0.9605. Weight control to reduce: For men, Age effect, p=0.1047; Residence effect, p=0.0017; Age × Residence, p=0.0052; For, women, Age effect, p<0.0001; Residence effect, p=0.0002; Age × Residence, p=0.0002. *significant difference by ages in big city, p<0.05. #significant difference by ages in small city, p<0.05. †significant difference by ages in rural area, p<0.05. **significant difference by residences in each age group, p<0.05

in this study. We think this may reflect one industrialized trend, having a strong desire to be "thinner" due to social pressure, hence, young urban women showed a lower prevalence of obesity than rural women did (23). However, since we only had information about the rate of weight reduction, and not on the degree of weight control or desire in this study, further research is needed to be conducted. Longitudinal trend analysis on BMI and lifestyle factors in Japan by Yoshiike et al. from 1976-2000 also reported similar obesity trends by residential areas to those of Koreans. They showed a very prominent increasing trend in overweight among males in rural populations and a significant decrease in overweight among females in the metropolitan areas in Japan (14).

Although the overall prevalence of obesity (BMI≥25) in the Korean population is quite low compared with western societies, it reached around one-fourth of Korean adults, which is higher than the prevalence in other Asian countries such as China, the Philippines and Japan (2, 14). A higher prevalence in Korea than even in Japan, a developed country, was a surprising result, which should be taken into consideration for obesity control at national levels.

The strength of this study was that it analyzed a national representative sample obtained from the nationwide health examination survey in Korea (1998). External validity is therefore sufficient to interpret the findings for the general population of Korea. Our study provided variable information about how the distribution of obesity would be characterized in Korea, connected with other studies using this data mostly providing a significant relationship between obesity and metabolic disorders (24-26).

A major limitation of this study would be its cross-sectional nature, suggesting that it does not provide sufficient evidence of causality. Other limitations include the recall bias of the single 24-hr recall method although we used the information for only estimating population means. The reliance on self-reporting answers with undefined self-perceived degree on questions such as "heavy" for alcohol drink and "intense" for usual activity could be also the limitation to interpret our results.

In conclusion, our study revealed that different age-specific trends of obesity coexists depending on residential areas in Korea, especially more in older generation. These urban-rural

differences on obesity might reflect the difference of other health related behaviors such as lifestyle traditions, in which rural residents necessarily impose a more active and traditional lifestyle.

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