

# Educational disparities in the metabolic syndrome in a rapidly changing society—the case of South Korea

Myoung-Hee Kim,<sup>1</sup> Mi-Kyung Kim,<sup>2</sup> Bo Youl Choi<sup>2</sup> and Young-Jeon Shin<sup>2\*</sup>

Accepted 2 August 2005

**Background** Most of the evidence about socioeconomic inequalities in the metabolic syndrome comes from Western industrialized societies. The aim of this study is to examine how the inequalities appear and what could explain them in Korea, a rapidly changing society.

**Methods** We analysed the nationwide survey data of 1998 and 2001 with a sample of 4630 men and 5896 women ( $\geq 25$  years). The subjects were grouped into four birth cohorts based on the historical context: born before 1946, 1946–53, 1954–62, and since 1963. Socioeconomic position was defined by education level: high school graduation or above as the more educated group, and below that as the less educated one. The syndrome was defined according to ATP III criteria using abdominal obesity for Asians. The covariates included family history of diabetes, smoking, drinking, daily physical activity, regular exercise, suicidal ideation, weight change, and carbohydrates intake. The associations were examined by stratified logistic regression models across cohorts and gender.

**Results** Less-educated women had higher prevalence with widening gaps across successive cohorts; the age-adjusted odds ratios of the less-educated group were 1.22 (0.86–1.71), 1.41 (1.01–1.97), 2.50 (1.87–3.35), and 2.64 (1.69–4.14). They hardly changed after covariate adjustment, and remained significant with considerable attenuation after controlling body mass index. However, educational disparities were not observed in men.

**Conclusions** We could observe the complex pattern of disparities in the metabolic syndrome across cohorts and gender. An equity-sensitive health promotion programme to prevent further spread of social inequalities may have beneficial effects on the metabolic syndrome and its components in Korea.

**Keywords** Metabolic syndrome, education, Korea, cohort, gender, inequality

Since Reaven<sup>1</sup> proposed the concept of the metabolic syndrome, it has attracted enormous attention in relation to the risk of morbidity and mortality of coronary heart disease (CHD).<sup>2–4</sup> Some studies suggested that it mediates socioeconomic inequalities in CHD.<sup>5,6</sup> Regarding pathophysiology, two different hypotheses have been put forward; the thrifty genotype

or phenotype hypothesis from an evolutionary perspective,<sup>7–9</sup> and the neuroendocrine hypothesis from a psychosocial perspective.<sup>10–13</sup> While the former focuses on the recent epidemic of the metabolic syndrome worldwide,<sup>14</sup> the latter is mainly concerned with the explanation of socioeconomic inequalities.<sup>5,15,16</sup> So far, most of the evidence about inequalities in the metabolic syndrome has been gathered from Western industrialized societies, and little is known about societies in rapid transition from rural to urban lifestyles.

In this study, we examined how socioeconomic inequalities in the metabolic syndrome appear in South Korea, a society that experienced substantial changes in socioeconomic conditions during the past century.

<sup>1</sup> Department of Preventive Medicine, Eulji University School of Medicine, Daejeon, Republic of Korea

<sup>2</sup> Department of Preventive Medicine, Hanyang University College of Medicine, Seoul, Republic of Korea

\* Corresponding author. Department of Preventive Medicine, Hanyang University College of Medicine, 17 Haengdang-dong, Seongdong-gu, Seoul 133-791, Republic of Korea. E-mail: yshin@hanyang.ac.kr

Using nationwide cross-sectional survey data in South Korea, we posed three questions. First, what are the patterns of socioeconomic inequalities in the metabolic syndrome in Korea? Second, does the pattern vary by birth cohort and gender? Finally, what might explain the observed patterns?

## Methods

### Study population and data collection

Our analyses were based on the 1998 and 2001 National Health and Nutrition Surveys, which were conducted by the Ministry of Health and Welfare.<sup>17,18</sup> The subjects were selected from non-institutionalized civilians by a stratified multistage probability sampling design based on geographic areas, age, and gender groups. The survey was composed of four modules: (i) household questionnaire for sociodemographics and general health status, (ii) individual questionnaire for health behaviours, (iii) 24 h recall diet survey, and (iv) anthropometric and clinical examination. The first three modules were conducted during home visit by the field staff, and the last one was done in local health centres. While the first module was applied to all the households in each sampling unit, sub-samples were selected for the other modules. A total of 16 650 people aged  $\geq 25$  years were selected for the anthropometric and clinical examination, among whom 13 471 people participated (81.0%). A more detailed description of the survey procedure has been published elsewhere.<sup>19,20</sup>

We excluded subjects whose fasting time was  $< 8$  h, or those for whom data were missing on the components of the metabolic syndrome ( $n = 2718$ ), or those who already had diabetes diagnosed by physicians ( $n = 239$ ). Thus the final sample for this analysis was 10 526, with 4630 men and 5896 women.

### Sociodemographic information

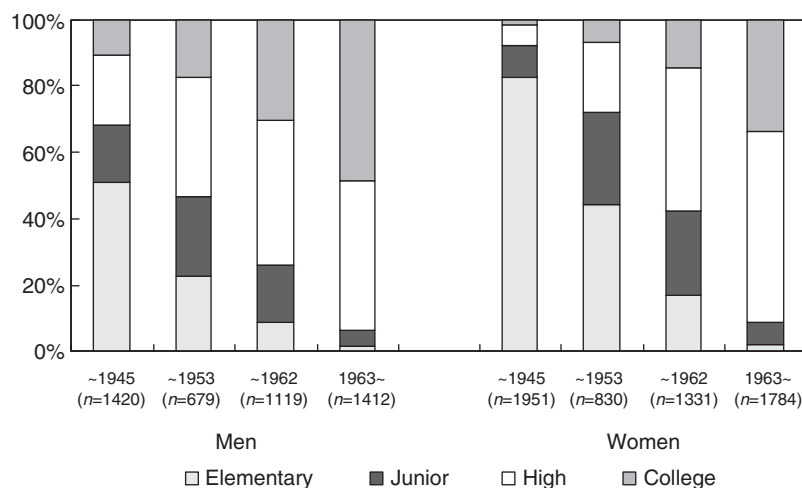
During the past century, Korea has experienced fundamental social changes, such as colonization by Japan followed by the Korean Wars and rapid economic development. Successive generations have, therefore, experienced considerably different living conditions and surroundings. We categorized the subjects into four birth cohorts, according to major social changes in the

Korean history: (i) people born before 1946 when Korea was seriously exploited under an imperial regime, (ii) those born between 1946 and 1953 when the society was devastated owing to political chaos and the Korean Wars, (iii) those born between 1954 and 1962 when post-war reconstruction flourished mainly through international aids, and (iv) those born since 1963 when rapid economic development began under the military dictatorship.

As for socioeconomic position, we examined the feasibility of common used measures such as education, occupation, and income in a preliminary analysis. However, since 8.8% of men and 49.5% women were economically inactive, categorization based on occupation seemed inappropriate. In addition, income was measured by one open-ended question and the median family income per month was found to be  $\sim \$1200$ , only 1.44 times the minimum cost of living in 1999, which raised the question of validity. So we did not include these two measures in our analysis. The Korean education system is composed of elementary school (6 years), junior high school (3 years), high school (3 years), and vocational college (2 or 3 years) or university (4 years). We grouped them into (i) junior high school graduation or below ( $\sim 9$  years) as the less educated group, and (ii) high school graduation or above ( $\sim 10$  years) as the more educated group. The reason for collapsing four different levels into two categories was because of sample size; in fact, there were few women with college graduation born before 1946, or few people with only elementary school graduation among those born since 1963 (Figure 1).

### Case definition

The metabolic syndrome was defined according to the National Cholesterol Education Program Adult Treatment Panel III (ATP III)<sup>21</sup> except for abdominal obesity, for which we used the cut-off value of waist circumference (WC) for Asians.<sup>22</sup> Thus, the syndrome was defined as having three or more components of the following: (i) high blood pressure (BP):  $\geq 130/85$  mm Hg or on current medication; (ii) abdominal obesity: WC  $\geq 90$  cm in men and  $\geq 80$  cm in women; (iii) high triglyceride (TG):  $\geq 150$  mg/dl; (iv) low HDL cholesterol:  $< 40$  mg/dl in men and  $< 50$  mg/dl in women; and (v) high fasting blood sugar (FBS):  $\geq 110$  mg/dl.



**Figure 1** Education status by birth cohort and gender [The differences between cohorts and genders were all statistically significant by the  $\chi^2$  test (all  $P$  values are  $< 0.0001$ )]

### Anthropometric and clinical information

Height, weight, WC, and hip girth were measured with light clothing and no shoes. From height and weight, body mass index (BMI) was calculated, which is highly correlated with WC and also known as a strong predictor for the development of the metabolic syndrome.<sup>23</sup> Systolic and diastolic BP were measured twice using a sphygmomanometer (Baumanometer®) at phase I and V, respectively, and were averaged. Blood samples were obtained through venipuncture in the morning to ensure overnight fasting status, and the subjects were also asked how many hours they had been fasting. The samples were analysed for serum TG, HDL, and FBS (Hitachi-747 autoanalyzer; Hitachi, Japan). In addition, personal history and current medication status for hypertension or diabetes, and family history of chronic illness was determined by self-reports.

### Health behaviour information

Based on the questionnaire, we determined the level of known risk factors for the metabolic syndrome. Family history of diabetes<sup>24</sup> was set as 'yes' or 'no', and smoking status<sup>25,26</sup> as 'current', 'ex-', or 'never' smoker. Drinking behaviour<sup>27</sup> was classified as 'none', 'moderate', or 'heavy'. Heavy drinking corresponded to one bottle or more of Korean whisky (equivalent to 70 g alcohol) for men, and half of a bottle or more for women on a single drinking day. Daily physical activity<sup>28,29</sup> measured by a five-grade scale for intensity based on self-report was categorized into 'sedentary', 'moderate', or 'vigorous' groups. Regular exercise<sup>30–33</sup> was defined as taking exercise for at least 20 min at a time, three times a week, and set as 'yes' or 'no'. Weight change<sup>34</sup> was categorized as 'constant', 'decrease', or 'increase' during the last year. Although psychosocial factors are known to be important risk factors for the metabolic syndrome,<sup>11–13</sup> this survey lacked validated psychometric measures. Hence we used a question on suicidal ideation ('yes' or 'no') in the last year as a proxy for psychosocial distress.

Dietary information was obtained by the single 24 h recall method, and the nutrients were quantified using the Database Management System (Korea Health Industry Development Institute, Seoul). Among various nutrients, refined carbohydrates or the high glycaemic load is known to be associated with the development of the metabolic syndrome.<sup>35–37</sup> However, our data did not include the detailed information of nutritional components, and to date, the nutrition database to provide the glycaemic index is not available in Korea. We used >70% as the cut-off value for high percentage energy from carbohydrate in Korea, because the recommended daily consumption value for percentage energy from carbohydrate by the Korean Nutrition Society<sup>38</sup> ranged from 60 to 70% and because it was not much different from the median value (70.9%), which classified subjects into almost half and half. On the other hand, when we analysed the energy-adjusted carbohydrate intake (continuous variable) by residual method, the relationship with the metabolic syndrome was not found in a preliminary analysis.

### Statistical analysis

We calculated the education-specific prevalence of the metabolic syndrome. In order to consider the potential age difference between education groups within cohorts, we applied the indirect standardization method using the whole sample.

Next we examined the effects of education on prevalence of the metabolic syndrome across birth cohorts, and explored the contribution of known risk factors, using multiple logistic models. In Model 1, only age was adjusted. Model 2 included family history of diabetes (yes or no), smoking (current, ex-, or never), drinking (none, moderate, or heavy), daily physical activity (sedentary, moderate, or vigorous), regular exercise (yes or no), suicidal ideation (yes or no), weight change (constant, decrease, or increase), and high carbohydrate intake (yes or no) as well as age. Finally, in model 3, BMI was added to Model 2.

All analyses were conducted stratified by gender, because previous studies in Korea found that age-specific prevalence of the metabolic syndrome varied significantly by gender<sup>19,20</sup> and education status was also significantly different between gender in preliminary analysis.

For analysis, SAS version 8.1 was used, and statistical significance was determined at the level of 0.05.

## Results

Figure 1 describes the number of study subjects and the educational status by cohort and gender. In general, education level was higher in younger cohorts and men. The differences between cohorts within each gender, and those between genders within each cohort were all statistically significant (all *P* values are <0.0001).

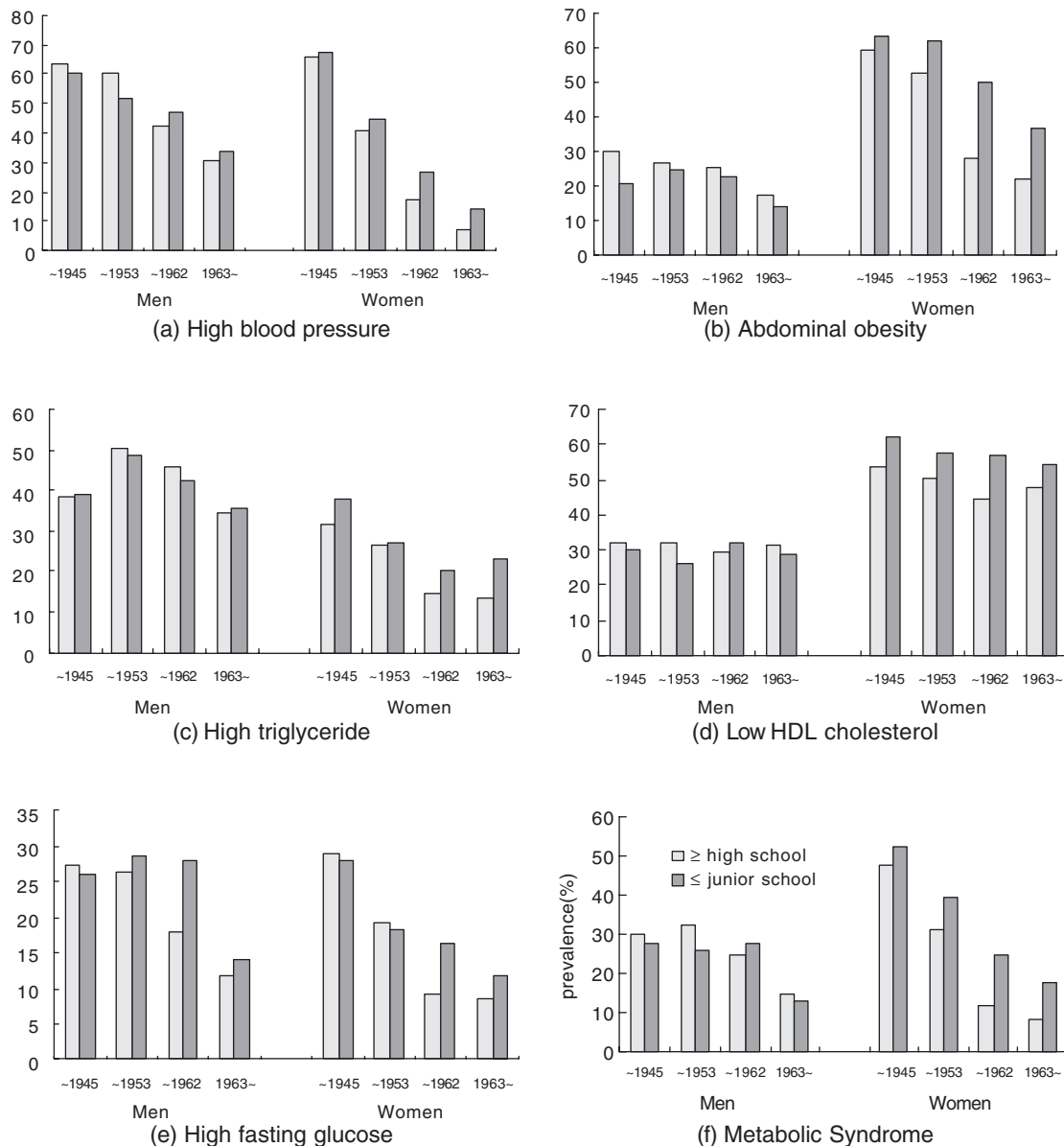
Education-specific prevalence of the metabolic syndrome varied across cohorts and genders. Overall, the older groups had higher prevalence. Prevalence in women was higher than in men in older groups, while this pattern was reversed in younger groups. Among women, the less educated group had higher prevalence, and the gap between education groups increased across successive cohorts. However, no trend was observed among men (Table 1). As for the component of the metabolic syndrome, patterns similar to those found in the metabolic syndrome were observed among women. On the other hand, among men, gaps across education were found only in the prevalence of high BP and high FBS (Figure 2).

**Table 1** The education-specific prevalence of the metabolic syndrome by birth cohorts and gender

Gender	Birth cohort	Education		Total <sup>b</sup>
		≥ High school <sup>a</sup>	≤ Junior school <sup>a</sup>	
Men	1904–45	30.0	27.7	27.1
	1946–53	32.5	26.1	26.9
	1954–62	24.9	27.3	24.3
	1963–76	14.9	12.9	15.7
	Total	24.2	23.1	22.7
Women	1904–45	47.6	52.3	49.0
	1946–53	31.1	39.3	41.4
	1954–62	11.8	24.9	19.2
	1963–76	8.1	17.7	9.9
	Total	24.0	30.7	27.9

<sup>a</sup> Age-standardized by the indirect method using the whole samples.

<sup>b</sup> Age-standardized by the method using the whole population from the census in 2000.



**Figure 2** Education-specific prevalence (age-standardized prevalence by the indirect method) of the metabolic syndrome and its components by birth cohort and gender [Case definition: (a) high BP:  $\geq 130/85$  mm Hg or on current medication; (b) abdominal obesity, WC:  $\geq 90$  cm in men and  $\geq 80$  cm in women; (c) high TG:  $\geq 150$  mg/dl; (d) low HDL cholesterol:  $< 40$  mg/dl in men and  $< 50$  mg/dl in women; (e) high fasting glucose:  $\geq 110$  mg/dl; (f) metabolic syndrome: having three or more components of the above].

The relationships between education and the metabolic syndrome were tested using age-adjusted logistic models (Model 1). There was a statistically significant risk increase in less-educated women, and the effect size became larger across successive cohorts [odds ratios (ORs) 1.22, 1.41, 2.50, and 2.64]. When behavioural risk factors were added (Model 2), the ORs of the less-educated group against the more educated one remained statistically significant, moreover, they were hardly attenuated. Finally, when we added BMI (Model 3), the ORs were largely attenuated, however, they remained statistically significant in the two younger cohorts (Table 2).

We compared the distribution of the behavioural factors between education groups to explore why these factors had little influence on the association between education and the

metabolic syndrome. Family history of diabetes and sedentary lifestyle were consistently more prevalent in the more-educated group. Current smokers were more prevalent in the less-educated group. Although the more educated group tended to take regular exercise, the overall percentage was low. Those with weight increase were significantly more prevalent in the more educated groups except in the two younger female cohorts. Suicidal ideation was more common in the less-educated groups with varying statistical significance across sub-groups. Those with high carbohydrate intake were significantly more prevalent in the less-educated groups across all sub-groups. Obesity was more prevalent in the more-educated men except in the youngest groups, while it was more prevalent among the less-educated women except in the oldest cohort (Table 3).

**Table 2** Covariate-adjusted odds ratios for the metabolic syndrome of the less-educated groups against the more-educated groups

Gender	Birth cohort	OR (95% confidence intervals)		
		Model 1 <sup>a</sup>	Model 2 <sup>b</sup>	Model 3 <sup>c</sup>
Men	1904–45	0.89 (0.69–1.14)	1.17 (0.86–1.59)	1.31 (0.93–1.83)
	1946–53	0.73 (0.52–1.03)	0.74 (0.49–1.13)	0.80 (0.51–1.26)
	1954–62	1.19 (0.87–1.61)	1.18 (0.82–1.71)	1.41 (0.93–2.15)
	1963–76	0.83 (0.45–1.53)	0.95 (0.50–1.83)	0.99 (0.46–2.12)
	Total	0.93 (0.79–1.10)	1.01 (0.83–1.23)	1.12 (0.91–1.39)
Women	1904–45	1.22 (0.86–1.71)	1.60 (1.07–2.39)	1.37 (0.89–2.12)
	1946–53	1.41 (1.01–1.97)	1.55 (1.04–2.31)	1.26 (0.82–1.95)
	1954–62	2.50 (1.87–3.35)	2.44 (1.73–3.43)	1.50 (1.02–2.20)
	1963–76	2.64 (1.69–4.14)	2.85 (1.71–4.73)	1.96 (1.12–3.42)
	Total	2.18 (1.84–2.57)	2.39 (1.98–2.90)	1.56 (1.27–1.92)

<sup>a</sup> Model 1: Only age was adjusted.<sup>b</sup> Model 2: In addition to age, family history of diabetes (yes or no), smoking (current, ex-, or never), drinking (none, moderate, or heavy), daily physical activity (sedentary, moderate, or vigorous), regular exercise (yes or no), suicidal ideation (yes or no), weight change over the last year (constant, decrease, or increase), and high carbohydrate intake >70% of total energy (yes or no) were included.<sup>c</sup> Model 3: BMI (kg/m<sup>2</sup>) was added to Model 2.**Table 3** Distribution of risk factors for the metabolic syndrome by education level

Education <sup>a</sup>	Birth cohort (%)							
	1904–45		1946–53		1954–62		1963–76	
	More	Less	More	Less	More	Less	More	Less
Men								
Family history of diabetes (yes)	6.7	3.5 <sup>b</sup>	7.4	5.4	11.3	9.7	12.9	4.4 <sup>b</sup>
Smoking (current)	49.8	56.0 <sup>b</sup>	61.0	60.2	64.1	70.9	69.7	80.5
Drinking (heavy)	21.4	21.6	35.3	32.2	38.6	35.9	38.6	40.2
Daily activity (sedentary)	57.4	42.1 <sup>b</sup>	40.8	19.1 <sup>b</sup>	42.0	22.0 <sup>b</sup>	48.8	26.4 <sup>b</sup>
Regular exercise (yes)	19.3	6.9 <sup>b</sup>	16.5	7.4 <sup>b</sup>	12.5	7.9 <sup>b</sup>	9.3	10.3
Weight change (increase)	14.7	8.5 <sup>b</sup>	18.2	13.4	23.1	14.8 <sup>b</sup>	32.3	28.7
Suicidal ideation (yes)	15.2	22.4 <sup>b</sup>	14.5	19.1	16.0	18.9	14.1	20.7
Carbohydrate intake >70% of total energy (yes)	50.9	70.4 <sup>b</sup>	40.7	56.0 <sup>b</sup>	37.8	51.3 <sup>b</sup>	37.8	43.0
BMI ≥ 25 kg/m <sup>2</sup> (yes)	28.6	18.9 <sup>b</sup>	33.0	30.8	36.9	30.2 <sup>b</sup>	27.9	25.3
Women								
Family history of diabetes (yes)	19.1	4.9 <sup>b</sup>	15.2	8.0 <sup>b</sup>	14.0	7.5 <sup>b</sup>	13.9	10.7
Smoking (current)	2.2	11.5 <sup>b</sup>	3.2	4.8	3.0	3.8	3.4	5.4
Drinking (heavy)	2.9	2.9	8.6	7.3	8.0	12.4 <sup>b</sup>	11.2	14.3
Daily activity (sedentary)	67.4	56.3 <sup>b</sup>	49.1	33.2 <sup>b</sup>	43.1	32.5 <sup>b</sup>	49.2	36.7 <sup>b</sup>
Regular exercise (yes)	15.9	5.0 <sup>b</sup>	21.3	6.8 <sup>b</sup>	15.0	6.4 <sup>b</sup>	9.1	6.1
Weight change (increase)	25.4	14.3 <sup>b</sup>	41.0	22.2 <sup>b</sup>	35.6	34.4	38.2	39.5
Suicidal ideation (yes)	23.9	32.5 <sup>b</sup>	18.1	32.4 <sup>b</sup>	22.1	27.8 <sup>b</sup>	21.8	25.9
Carbohydrate intake >70% of total energy (yes)	59.2	75.8 <sup>b</sup>	47.2	66.2 <sup>b</sup>	41.7	62.8 <sup>b</sup>	40.7	52.1 <sup>b</sup>
BMI ≥ 25 kg/m <sup>2</sup> (yes)	44.9	36.7	34.2	42.7 <sup>b</sup>	21.3	42.0 <sup>b</sup>	16.4	38.3 <sup>b</sup>

<sup>a</sup> Education level: (i) more: high school graduation or above (~10 years); (ii) less: junior high school graduation or below (~9 years).<sup>b</sup> Statistically significant,  $P < 0.05$  by the  $\chi^2$  test.

## Discussion

This study found that there are socioeconomic inequalities in the metabolic syndrome in Korean women, though not in men. Less-educated women had significantly higher prevalence with widening gaps across successive cohorts. Such inequalities

could not be explained by behavioural risk factors, and they remained significant even after adjustment for BMI.

So far, inequalities in the metabolic syndrome and potential mediating factors have been studied mainly in Western industrialized countries. To our knowledge, this is the first

report on socioeconomic inequalities in the metabolic syndrome among Asian countries. According to Zimmet *et al.*,<sup>14</sup> diabetes and insulin resistance syndrome are rapidly increasing worldwide, especially in non-Western regions. In the case of South Korea, the nationwide prevalence of the metabolic syndrome was estimated as 14.2% in men, and 17.7% in women<sup>19</sup> by the original ATP III criteria,<sup>21</sup> and 22.1 and 27.8%, respectively,<sup>20</sup> by the modified one using the cut-off value of abdominal obesity for Asians.<sup>22</sup> Relatively high prevalence in spite of lean body mass might be explained by the thrifty gene hypotheses.<sup>7–9</sup> However, the previous Korean studies did not report the prevalence by socioeconomic groups<sup>20</sup> and failed to show the educational disparities,<sup>19</sup> which analysed the data using logistic regression without stratification by cohort. It seems that age adjustment considerably set off the effect of education.

Rapid social change has affected the meaning of education; for instance, for women born prior to 1945, the top 20% of educational attainment was equivalent to junior high school graduation. However, it represented the bottom 10% among those born since 1963. Also, the relative position of men and women with the same education differed (Figure 1). This implies that caution is warranted in comparing education groups across time and gender, especially in rapidly changing societies.

What are the reasons for the differences in the inequality pattern of the metabolic syndrome between genders? Although a few studies have included women,<sup>39–41</sup> most studies have reported socioeconomic gradients among men. Moreover, Brunner *et al.*<sup>5</sup> found that the linear gradient across social class was more distinct in men than in women. However, in this study, a clear gradient was observed among women, but not among men. This may be owing to the fact that, in case of men, risk factors such as smoking,<sup>42</sup> suicidal ideation as a proxy for psychosocial distress,<sup>11–13</sup> and high carbohydrate intake<sup>35</sup> were consistently more common in the less-educated groups, while others like family history of diabetes,<sup>24</sup> sedentary lifestyle,<sup>30,34</sup> weight increase,<sup>34</sup> and obesity<sup>43</sup> were far more prevalent in the more-educated groups. It is known that low levels of leisure-time physical activity is associated with the development of the metabolic syndrome<sup>28</sup> and our study showed that men taking regular exercise<sup>31</sup> were more common in the more-educated groups, but the overall proportion was low in both education groups (Table 3). On the other hand, among women, some unfavourable conditions such as family history of diabetes<sup>24</sup> and sedentary lifestyle<sup>30,34</sup> were more prevalent in the more-educated groups similar to men, while obesity, which was highly correlated with abdominal obesity, was significantly associated with low education level (Table 3). To summarize, in the context of the inconsistent pattern of behavioural factors between education groups, the obesity differentials gave rise to the gender difference in the pattern of inequalities.

The next question is to explain the widening gaps in women over successive cohorts. One explanation is related to the obesity issue. According to a review paper on the association between socioeconomic position and obesity,<sup>44</sup> a clearly inverse relationship was observed among women but an inconsistent pattern among men in developed societies, while a positive relationship was found in developing societies. The authors argued that some factors like social attitude against obesity, dietary restraint, or declining manual jobs could explain the condition observed among women in developed societies. In our study, the

education gap in general and abdominal obesity became larger across successive cohorts. It seems that as Korean society has moved closer to the Westernized norm, the gap arising from obesity differential has become larger.

Alternatively, one could argue that the actual gap between social groups was not widening but that the change in the relative position of education level *per se* across time brought about this phenomenon. In order to examine this hypothesis, we tried to estimate ORs using a new cut-off for education; we re-defined the less-educated women born since 1963 as those who graduated high school or below, making the proportion (66.1%) similar to that of less-educated women (junior school or below) born between 1946 and 1953 (72.2%) (Figure 1). We found that the age-adjusted ORs of the less-educated women born since 1963 decreased from 2.7 times with the original cut-off to two times with the new one, which was still >1.4 times of the less-educated women born between 1946 and 1953. It implies that although the difference could be in part explained by the change in the relative position of education level across time, the gap was actually widening.

Our study has some limitations. First, the analysis was based on cross-sectional survey data, which made it hard to judge temporality. For example, people could have modified their behaviours after being affected by the metabolic syndrome. However, since it is unlikely that the development of the metabolic syndrome could affect the educational achievement, education could be considered as one of determinants of the metabolic syndrome. Second, although the data were obtained from the nationwide surveys, actual samples were rather limited because of response rates, compliance with fasting time, and missing values on the components of the metabolic syndrome. In fact, the participation rate in the health examination of the less-educated group was 86.3% while that of the more-educated group was 77.3%. In this regard, there is a possibility of selection bias. To generalize our results, further studies seem to be replicated from diverse population. Third, we could not disentangle the mix of cohort and age effect; for example, one could argue that the widening gap across successive cohorts was caused by just earlier development of the metabolic syndrome in the less-educated groups or selective survival of the more educated group among older cohorts. To address this issue, studies comparing socioeconomic groups with same age from different cohorts are required. Finally, we could not adequately identify the mediating variables of educational disparities in the metabolic syndrome other than obesity. For instance, although previous studies<sup>5,10,12</sup> have pointed out the role of psychosocial factors in the development of the metabolic syndrome, we used only one item—suicidal ideation as a proxy for psychosocial distress. Also, as for dietary factors, a crude measure of total carbohydrates intake (energy percentage) was used, though refined carbohydrates or the high glycaemic load is known to be more relevant rather than carbohydrates *per se*.<sup>35–37</sup> A more detailed survey seems to be required in Korea to elucidate the potential pathways.

In conclusion, among women, inequalities in the metabolic syndrome are clear and increasing, driven mainly by obesity. However, the pattern is less obvious for men. From an evolutionary perspective,<sup>7</sup> as the economic development advances and the so-called Western lifestyle becomes predominant in Korea, the burden of the metabolic syndrome will

increase in tandem. However, it is unlikely that the burden will be equally shared by all socioeconomic groups; this study showed that the patterns of regular exercise sufficient to overcome the disadvantage of sedentary lifestyle, carbohydrate intake, obesity, and psychosocial distress have been shaped unfavourably for lower social groups, especially in more recent cohorts. An equity-sensitive health promotion programme to prevent further spread of social inequalities may have beneficial effects on the metabolic syndrome and its components.

## Acknowledgements

This study was supported in part by the Bum-Suk Academy Scholarship Foundation in South Korea. The authors wish to thank Dr Ichiro Kawachi for his helpful comments on this manuscript. Myoung-Hee Kim was a recipient of the 2004–05 David E. Bell Fellowship programme at the Harvard Center for Population and Development Studies, during which a substantial part of this paper was written.

## KEY MESSAGES

- So far, inequalities in the metabolic syndrome and potential mediating factors have been studied mainly in Western industrialized countries. We found educational disparities in the metabolic syndrome in women, though not in men based on a nationwide cross-sectional survey in Korea, a rapidly changing Asian society. The gap was widening across successive cohorts, and could not be explained by behavioural risk factors.
- An equity-sensitive health promotion programme to prevent further spread of social inequalities may have beneficial effects on the metabolic syndrome and its components in Korea. Also, further studies to identify the mediating factors are required.

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