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ORIGINAL ARTICLE

The impact of socioeconomic status on the incidence of metabolic syndrome in a Taiwanese health screening population

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Abstract
Objectives The purpose of this study was to estimate the incidence of metabolic syndrome (MS) in a 5-year follow-up adult population in Taiwan who were examined at the Major Health Screening Center, and to assess possible socioeconomic determinants of the syndrome in this sample.
Methods The longitudinal study included 9,389 adults, aged 35–74 years, who visited the Major Health Screening Center from 1998–2002, and were followed up for 5 years.
Results The 5-year cumulative incidence of MS in this sample was 11.37%, and the weighted incidence was 12.46%; 14.95% for men and 9.89% for women, respectively. After adjustment for behavioral and habits, family history, gender and age, education level was associated with the incidence of MS. With middle school and lower as a baseline, the incidence of MS for high school, junior college, and college and above was OR 0.80, 95% CI 0.64–1.00; OR 0.80, 95% CI 0.62–1.03 and OR 0.65, 95% CI 0.50–0.83, respectively.
Conclusions The standardized cumulative incidence of MS was 12.46%. Lower education level was an important socioeconomic determinant of MS in women.

Keywords Socioeconomic status · Metabolic syndrome · Incidence · Longitudinal study · Taiwan checked-up population

Introduction

Metabolic syndrome (MS) is characterized by multiple cardiovascular risk factors such as central obesity, arterial hypertension, dyslipidemia, and hyperglycemia (Expert Panel on Detection, Evaluation, and Treatment of High Blood Cholesterol in Adults 2001). This syndrome has been documented to increase the risk of type 2 diabetes mellitus (Hanson et al. 2002; Sun et al. 2009) and cardiovascular disease (Mottillo et al. 2010; Wannamethee et al. 2006; He et al. 2006). In Asians, MS is now well recognized as a growing problem, with a suggested ethnic predisposition (Yusuf et al. 2001).

Socioeconomic status (SES) is a measure of access to material and social resources, as well as prestige-based measures that represent a person's status in a social hierarchy. Adult SES is typically measured as educational level, income, or occupation. The Associations between socioeconomic status and MS have been observed in cross-sectional studies (Loucks et al. 2007a, b; Marquezine et al. 2008; Yoo et al. 2010). Most of these studies have been conducted using income and education as measures of SES. However, the cross-sectional data cannot adequately assess the effect of socioeconomic status on the incidence of MS. Longitudinal studies are needed, but only a few reports have been published. For example, the US Coronary Artery Risk Development in Young Adults Study showed that in analyses adjusted for age and covariates, education was significantly inversely associated with the incidence of MS in women but not in men (Carnethon et al. 2004), yet this

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remains controversial (Silventoinen et al. 2005). Further gender-specific investigations should clarify the findings. So, we need to consider the confounders and effect modifiers on the association between SES and MS study; it was reported that the possible confounding factors could be age, gender, married or not and race (Loucks et al. 2007b). In addition, a study showed alcohol and exercise were significant in women, but not in men (Park et al. 2007).

The possible mechanism for the relation between SES and MS could explain that educational level partly reflects the health knowledge, social status and income, and influences the individual behavior and habits. These habits are the important external factors in the development of MS. Gender as a confounder in the SES and MS is possibly because of different education and income levels in men and women (Silventoinen et al. 2005).

The aim of our study is to determine if there is a correlation between the incidence of MS and SES, and mainly describe the incidence of MS according to the SES (e.g. education, income, occupational grade) by conducting a longitudinal analysis of data from the Taiwan Major Longitudinal health-check-up-based Population Database (MJLPD). We hypothesize that SES plays a role in the incidence of MS in individuals with a lower and higher SES. We include an analysis that adjusts for age, gender, behavior and habits and family history of diseases and examine their potential confounding effect in the association between SES and MS.

Methods

Design and data source

The Major Health Screening Center is a membership-oriented private institute with four clinics around the island of Taiwan. These clinics provide periodic health examinations to its members. The total number of individuals screened at these health centers is about 2% of the population of Taiwan. Membership to the program is required. However, a discount in the examination fee is offered for those who come back for repeated examinations in subsequent years. This incentive succeeds in attracting and sustaining a large number of customers. The Taiwan Major Longitudinal health-check-up-based Population Database (MJLPD) has been described in detail elsewhere (Wen et al. 2008; Huang et al. 2008; Sun et al. 2009).The MJLPD database is open for academic research on request.

Study sample and selection of participants

We conducted a longitudinal study of 9,389 participants who underwent a standard health screening conducted at a Major Health Screening Center in Taiwan, from 1998 to 2002. The participants underwent initial health screening examinations. The follow-up was conducted 5 years later. Participants were between 35 and 74 years at the time of recruitment.

We excluded patients who already met the modified National Cholesterol Education Program Adult Treatment Panel III (ATP III) criteria for MS, at baseline (the prevalence of MS in the baseline sample was 14.75%). People receiving antihypertensive and hypoglycemic treatments were also excluded. Finally 9,389 subjects (4,397 males and 4,992 females) were available for analysis.

In our study, MS was defined according to the modified ATP III criteria (Grundy et al. 2005). The diagnosis of MS was made when 3 or more of the following were present: waist circumference $\geq$90 cm in men and $\geq$80 cm in women; fasting glucose $\geq$5.55 mmol/L (100 mg/dL) or use of antidiabetic medication; systolic blood pressure (BP) $\geq$130 mmHg, diastolic BP $\geq$85 mmHg, or use of antihypertensive medication; fasting triglycerides $\geq$1.7 mm/L; and high-density lipoprotein cholesterol (HDL-C) $<$1.0 mm/L in men and $<$1.3 mm/L in women.

The protocol for this research on human subjects was approved by the Review Committee of the Major Health Screening Center.

Measure

Each participant completed a self-administered questionnaire at the time of screening to provide information on demographic and socioeconomic characteristics (including habits such as cigarette smoking and alcohol consumption), and personal and family history of major chronic diseases. With regard to socioeconomic status, the participants were classified into four levels of education, according to the highest attained: middle school or lower, high school, junior college, and college or higher. Individual annual income was divided into three levels: less than 400 thousand, 400–1,600 thousand, and 1,600 thousand and above (New Taiwan dollars) (Wu et al. 2001). Occupation was classified as professional, manual, or others. Professional occupations included government official, teacher, freelancer (e.g., freelance writer, artist) and business, while manual occupations included peasant and worker. Students, homemakers and others were categorized as ‘others’ (Fujishiro et al. 2010; Cesana et al. 2001).

Smoking, drinking, and physical activity status was determined by the self-reported questionnaire. Examinations included a general physical with anthropometric and blood pressure measurements. Using a computerized automercury-sphygmomanometer, Citizen CH-5000 (Citizen, Tokyo, Japan), blood pressure was measured twice on the right arm, with the subject in a sitting position after a 5-min rest. Two measurements were taken at 10-min intervals and the mean of these two readings was used in the analysis.

Every subject was advised to fast for at least 8 h before participating in the health checkup. Overnight fasting blood was collected and analyzed (Hitachi 7150 auto-analyzers, Tokyo, Japan). A more detailed description for a series of biochemical analyses have been documented elsewhere (Wu et al. 2001). The central laboratory at the Major Health Screening Center analyzed all specimens, practicing strict internal and external quality control techniques. The manufacturer (Hitachi) supplied the calibrators used in the measurements.

All participants received questionnaires, but some data were missing: education level (2.1%), income (5.2%), and occupation (2.8%). All other data, such as blood pressure and blood glucose, were almost 99% complete for every individual. Therefore, the incidence and baseline for MS prevalence were minimally affected by missing data.

Statistical analyses

Statistical analysis was performed using SAS for Windows 9.1.3 (SAS Institute, Cary, NC, USA). The data-checking process was conducted at the district office and then at the central laboratory of the Major Health Screening Center. All continuous data were presented as mean ± standard deviation (SD), and categorical data as percentage.

As the study sample was not a random sample of the check-up population, we used the survey procedures (i.e. proc surveyfreq and proc surveylogistic) in SAS to account for the weighting structure by the age and gender of the whole followed up population in order to get more exact outcomes. Each participant was assigned a statistical weight according to the whole followed up subjects and the study subjects' gender and age were adjusted using the procedures. To investigate bivariate associations of MS to socioeconomic characteristics, the Rao–Scott Chi-square test, a design-adjusted version of the Pearson Chi-square test, was computed using 'the surveyfreq procedure' of the SAS statistical software version 9.1.3 (Demnati and Rao 2004; Jiang et al. 2007; SAS Institute Inc. 2004). To assess associations between MS and socioeconomic status, univariate and multivariate logistic regression methods were implemented using 'the surveylogistic procedure'.

Firstly, age, gender, education, income and occupation were put in the univariate model. These variables were reported related to the MS from the literatures. Then the variables that were significant in the univariate analysis were put in the multivariate model. Potential confounders were introduced in sequential steps. Model 2 mainly included only two confounders: age and gender. Next, we considered that age, gender, behavior factors (smoking, drinking status and sport) and family history of diseases were the possible confounding factors in our study, so the third multivariable logistic regression models were computed to determine the presence and magnitude of the association between SES and MS adjusting these factors. A 95% confidence interval (CI) was determined for each risk factor. The interactions between gender, education and income are shown in Figs. 2 and 3. The interaction between education and income was put in the multivariable logistic regression model. A probability (P) value of <0.05 was considered statistically significant.

Results

The incidence of MS by age and gender

Table 1 lists the characteristics at baseline of the sample population according to gender. Men had higher waist circumference, triglycerides, blood pressure, and low-density lipoprotein cholesterol (LDL-C; $P < 0.05$), whereas women had higher HDL-C ($P < 0.05$).

The overall crude cumulative incidence of MS in the 5-year follow-up was 11.37%, and the weighted incidence of MS (adjusted by age and gender of the check-up population) was 12.46%. Gender-specific weighted incidence is 14.95% for men and 9.89% for women (Table 2). The weighted cumulative MS incidence was different between males and females, and this varied significantly in different age groups (Fig. 1). The weighted incidence in males during the 5-year period was higher than in females for the age groups below 50 years. The situation was inversed for those over 50 years of age, i.e., incidence was more prevalent in females than males.

The incidence of MS by age, sex, education, individual annual income and occupation

As shown in Table 2, the incidence of MS was significantly different among subjects with varying gender, education and income (Fig. 2). The highest risk group was middle school and lower, whereas college and higher educated subjects had the lowest risk. Upon further analysis it was observed that the risk of MS decreased with increasing education in females only, whereas in males the risk remained similar, the risk of MS varied with gender and individual annual income (Table 2; Fig. 2). We observed that there was a significant relationship between MS risk and income level for females, but not for males (Table 2; Rao–Scott Chi-square test, surveyfreq, $P < 0.05$). Regarding occupation, as shown in Table 2, higher incidence was observed in non-manual men than women. We also explored the interaction between gender, education and income. Shown as in Fig. 3, the effect of education and income to the incidence of MS was different between two genders ($P < 0.05$). The strength of association appeared to be stronger in women and weaker in men (Table 2).

Table 1 The characteristics of participants without metabolic syndrome at baseline according to gender in the Taiwan Major Longitudinal health-check-up-based Population Database (MJLPD), Taiwan, 1998–2002

	Men	Women	*P* value
N	4,397	4,992	
Age (year)	46.4 ± 9.6	46.6 ± 9.4	0.539
Education (%)			
Middle school and lower	19.5	33.6*	<0.001
High school	19.6	25.8	
Junior college	22.0	18.2	
College and over	38.8	22.4	
Annual income (%)			
400 thousand and lower	20.9	52.2*	<0.001
400–1,600 thousand	69.2	44.8	
1,600 thousand and higher	9.9	3.0	
Occupation (%)			
Professional	62.3	49.1	<0.001
Manual	27.5	8.4	
Others	10.1	42.6	
SBP[a] (mmHg)	120 ± 15	114 ± 17*	<0.001
DBP (mmHg)	74 ± 10	69 ± 10*	<0.001
HDL-C (mg/dL)	48.6 ± 11.8	60.0 ± 14.1*	<0.001
LDL-C (mg/dL)	121.2 ± 31.8	115.0 ± 31.3*	<0.001
FBG[b] (mg/dL)	97.3 ± 15.2	94.1 ± 12.5*	<0.001
TG (mg/dL)	117.0 ± 56.1	86.7 ± 39.7*	<0.001
WC (cm)	80.7 ± 7.1	70.5 ± 6.6*	<0.001
Prevalence at baseline (%)			
WC [≥90 cm (male); ≥80 cm (female)]	9.0	9.4	0.003
FBG[b] (≥5.6 mmol/L)	30.1	19.2*	<0.001
TG (≥1.7 mmol/L)	19.0	6.7*	<0.001
BP (≥130/85 mmHg)	26.9	20.8*	<0.001
HDL-C [<0.9 mmol/L (male), <1.1 (female)]	26.2	24.6*	0.271
Family history of (%)			
Hypertension	34.1	33.5	0.511
Diabetes	21.6	23.0	0.106
Cerebrovascular disease	12.3	11.7	0.404
Cardiovascular disease	13.2	12.4*	0.249

Characteristics of the sample fulfilling inclusion criteria for analysis at baseline; at follow-up contrasting beneficiaries who developed metabolic syndrome or not over 5 years

* *P* value for the difference between two genders. All $P < 0.05$ from *t* test, Wilcoxon nonparametric test and Chi-square or Fisher tests for variables

Table 2 Incidence of the metabolic syndrome according to age, education, income and occupation by gender in the Taiwan Major Longitudinal health-check-up-based Population Database (MJLPD), Taiwan, 1998–2002

Item	Men weight rate (%)	Women weight rate (%)	Total weight rate (%)
Age (year)			
35–39	13.85	3.26	8.22*
40–44	14.63	5.06	9.54*
45–49	13.45	8.23	10.99*
50–54	13.90	14.31	14.07
55–59	16.39	15.82	16.14
60–64	16.44	17.28	16.84
65–69	20.51	27.27	24.25
70–74	20.69	24.44	22.82
Education			
Middle school and lower	16.02	17.49	16.90
High school	17.33	5.67	10.97*
Junior college	15.40	5.63	10.99*
College and higher	12.62	4.05	9.55*
Income			
Low	16.03	12.99	13.97*
Middle	14.44	5.97	11.21*
High	15.57	6.02	13.46*
Occupation			
Professional	15.54	5.62	11.40*
Manual	13.25	11.48	13.14
Others	14.86	13.77	13.99
Total	14.95	9.89	12.46*

Incidence of the metabolic syndrome according to age, education, income and occupation by gender (adjusting the age and gender according to the check-up population)

* Rao-Scott Chi-square test (SURVEYFREQ), $P < 0.05$

Association of socioeconomic status with the risk of MS

Three logistic regression models were employed analyzing the relationship between the socioeconomic factor and MS; the result is shown in Table 3. Model 1 was a univariate analysis. Model 2 was a multivariate analysis, in to which the variables of sex, age, education, income and occupation were introduced. Before constructing model 2, we put age, gender, education, income, occupation and interaction between education and income into the model together; the result revealed that the interaction was not significant. So we did not consider the interaction of education and income in model 2. Model 3 also was a multivariate regression, on the basis of model 2 variables, but also the behavior factors and family history status were included.

The univariate regression analysis revealed that education, income and occupation were the significant factors in the incidence of MS. Lower education level, middle income and "others" occupation were associated with MS (Table 3, model 1).

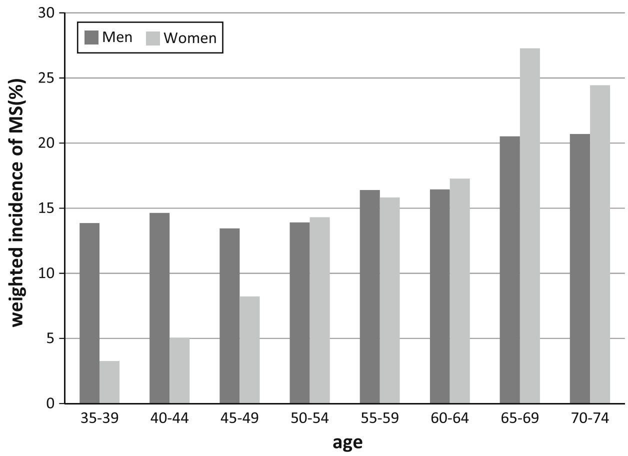

Fig. 1 The weighted incidence of metabolic syndrome (MS) by age and gender in the Taiwan Major Longitudinal health-check-up-based Population Database (MJLPD), Taiwan, 1998–2002

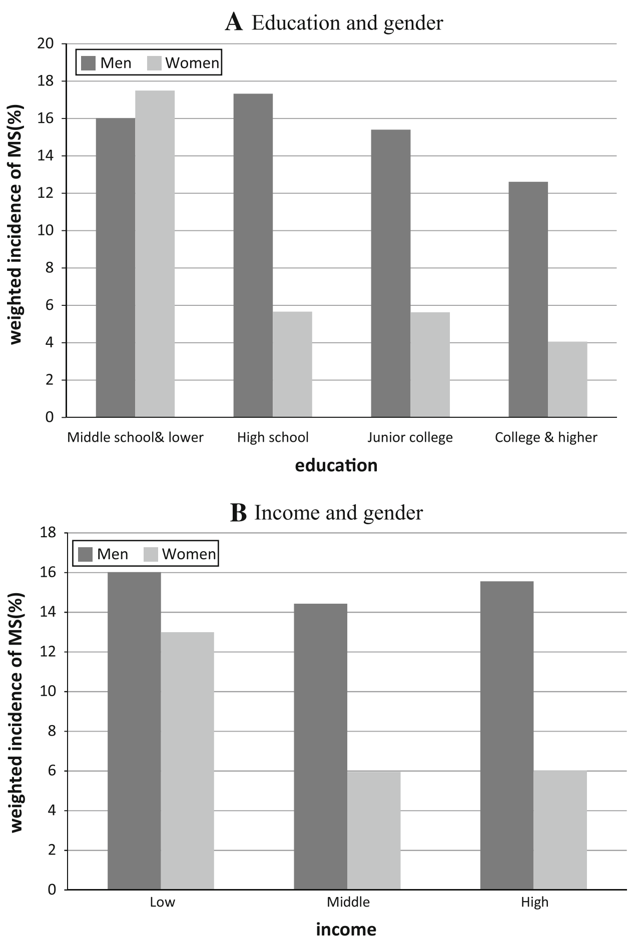

Fig. 2 The weighted incidence of metabolic syndrome (MS) by gender and socioeconomic status (SES, mainly education and income) in the Taiwan Major Longitudinal health-check-up-based Population Database (MJLPD), Taiwan, 1998–2002

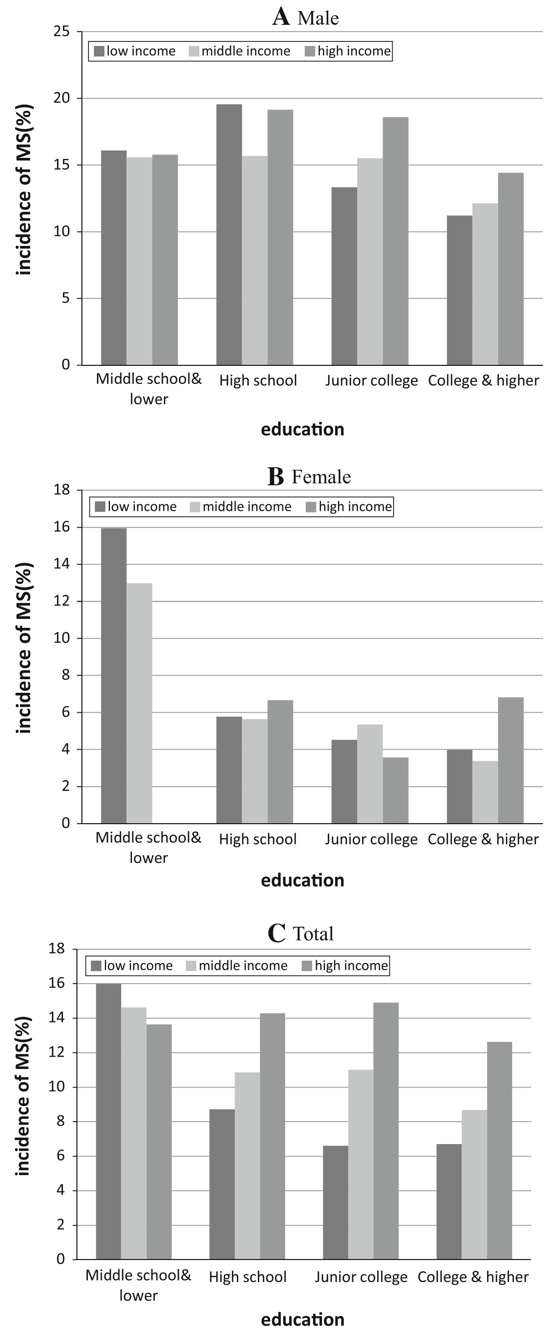

Fig. 3 Incidence of metabolic syndrome (MS) by gender, education and income in the Taiwan Major Longitudinal health-check-up-based Population Database (MJLPD), Taiwan, 1998–2002

The results of the multivariate-adjusted logistic regressions are shown in models 2 and 3 (Table 3). Model 2 was adjusted for age and gender; this model consisted of gender, age, education, individual annual income, and occupation. The odds of MS incidence in men was 1.78 times higher than in women, and age was a risk factor. Among these five factors, when adjusting age, gender, income and occupation, the education level appeared to be

Table 3 The odds ratios (OR) of risk factors of metabolic syndrome by multivariate logistic regression in the Taiwan Major Longitudinal health-check-up-based Population Database (MJLPD), Taiwan, 1998–2002

	Model 1 (univariate)		Model 2 (sex, age, education, income, occupation)		Model 3 (Model 2 + behavior and family history[a])	
	OR (95% CI)	*P* value	OR (95% CI)	*P* value	OR (95% CI)	*P* value
Sex						
Male vs. female	1.60 (1.39–1.85)*	<0.0001	1.78 (1.50–2.11)*	<0.0001	1.63 (1.34–2.00)*	<0.0001
Age (5 years)	1.21 (1.17–1.25)*	<0.0001	1.16 (1.11–1.22)*	<0.0001	1.19 (1.13–1.25)*	<0.0001
Education						
Middle school and lower	1.00*		1.00*		1.00*	
High school	0.61 (0.50–0.73)	0.1778	0.76 (0.62–0.94)	0.9032	0.80 (0.64–1.00)	0.9992
Junior college	0.61 (0.50–0.74)	0.2032	0.77 (0.60–097)	0.9507	0.80 (0.62–1.03)	0.9253
College and above	0.52 (0.43–0.62)	<0.0001	0.60 (0.47–0.75)	0.0002	0.65 (0.50–0.83)	0.0024
Annual income						
<400 thousand	1.00*		1.00		1.00	
400–1,600 thousand	0.77 (0.67–0.90)	0.0060	1.07 (0.89–1.29)	0.4408	1.05 (0.86–1.29)	0.3172
>1,600 thousand	0.96 (0.73–1.26)	0.5261	1.32 (0.96–1.81)	0.0934	1.34 (0.96–1.86)	0.0735
Occupation						
Professional	1.00*		1.00		1.00	
Manual	1.18 (0.98–1.41)	0.6174	0.85 (0.70–1.04)	0.0333	0.86 (0.70–1.07)	0.0427
Others	1.26 (1.07–1.49)	0.0645	1.12 (0.92–1.35)	0.0519	1.16 (0.95–1.41)	0.0352
Drink						
No	–		–		1.00*	
Quit					1.64 (1.13–2.37)	0.0098
Current					1.03 (0.84–1.26)	0.0809
Smoke	–		–			
No					1.00*	0.2393
Quit					0.95 (0.71–1.27)	0.1055
1–3 times/week					0.75 (0.41–1.36)	0.0420
4–5 times/week					1.83 (1.02–3.31)	0.1135
Everyday					1.33 (1.08–1.65)	
Sport	–		–			
No or <1 h/week					1.00*	
1–2 h/week					0.82 (0.67–1.00)	0.0982
3–4 h/week,					0.78 (0.62–0.98)	0.5126
5 h or over/week					0.72 (0.58–0.90)	0.9211
Family history of	–		–			
Hypertension					1.01 (0.86–1.20)	0.8839
Diabetes					1.41 (1.18–1.68)*	0.0001
Cerebrovascular disease					1.25 (1.01–1.54)*	0.0388
Cardiovascular disease					1.21 (0.98–1.50)	0.0763

* $P < 0.05$

[a] Drinking, smoking, sports activity per week, family history of hypertension/cerebrovascular disease were significant in Model 3

protective for the development of MS. We may say that less than 9 years of education was associated with significantly greater odds compared with more than 9 years (Table 3).

The factors analyzed in model 3 were socioeconomic status, behavior factors (such as smoking, drinking, and weekly sports activity), and family history of diseases (particularly hypertension, diabetes, cerebrovascular and cardiovascular disease). In model 3, education, income, and occupation shared a similar result with model 2. With the educational level middle school and lower as a baseline, the incidence of MS for those who had attended high school only was OR 0.80, 95% CI 0.64–1.00, junior college was OR 0.80, 95% CI 0.62–1.03, and college and above was OR 0.65, 95% CI 0.50–0.83. After adjusting age, gender, income, occupation, behavior factors and family history of diseases, the education level appeared to be protective for the development of MS. Besides educational level, drinking, smoking, sport and history of diseases were also significant in the development of MS (Table 3).

Association of socioeconomic status with components of MS

Table 4 shows that abdominal obesity, fast blood glucose, high blood pressure, and low HDL-cholesterol were significant among the different educational levels and income.

Table 5 shows the relation between SES and numbers of MS's components. It was shown that the distribution of numbers about the components of MS was significant among the educational levels and income grades.

Discussion

This study investigated the incidence of MS among an adult population, aged 35 to 74 years, who underwent a standard health screening conducted at the Major Health Screening Center in Taiwan, and analyzed how socioeconomic status influenced MS incidence.

Previous cross-sectional studies found that sex and age were associated with the prevalence of MS (Dallongeville et al. 2005; Perel et al. 2006; Park et al. 2007), and this longitudinal study corroborated those findings. The incidence increased with increasing age in both male and female, but the rate of increase was different for the two groups.

Several studies suggested that MS was associated with socioeconomic status and the association was female specific. A South Korean study showed strong associations between education level in women but not in men (Kim et al. 2005), but in Finland and Britain, little evidence of gender differences was observed (Silventoinen et al. 2005; Perel et al. 2006).

In our study, as an indicator of socioeconomic status education was strongly associated with the incidence of MS. It was clear that education level was a significant factor for developing MS, as shown in univariate and multiple analyses adjusted for age, gender, behavior, and family histories. The impact of education was most evident in females, whereas males with lower education and a lower economic status did not present a higher risk for MS. With regard to income and occupation, we observed that individual annual income was significant only in the single analysis and not in multivariate regression analysis. Participants belonging to the middle income group exhibited a low risk of MS; however, those in higher or lower levels of income were at higher risk. Interestingly, after adjusting for age, gender and education level in the multivariate logistic regression model, annual income was not significantly associated with the incidence of MS. When we had the opportunity to shed light on the gradients of incidence of MS across gender, education, and income, the difference between genders and education was observed.

Mechanisms responsible for the incidence of the MS increase in women after age 50 were presumably due to menopause. Possible mechanisms for the stronger associations between socioeconomic status (SES) and metabolic syndrome observed in women compared with men may be related to the following reasons. Firstly, it has been shown that women with low education have higher unemployment (Thurston et al. 2005). Secondly, educational attainment is associated with knowledge of healthcare. Leisure-time physical activity is reduced in people with low SES (Pekkanen et al. 1995).

In our study, we also explored the association of MS components and SES; we found that education as an important index of SES was mainly related to abdominal obesity, fast blood glucose, and high blood pressure. From these results, we inferred that different educational levels might lead to the lack of health knowledge, unhealthy behavior and habits and different economic status, and finally the development of MS. Considering all subjects accepted the health check, and the difference in disposable income per person per year on average for each locality (counties and cities in Taiwan) was not very big (from 172.6 to 357.2 thousands NT dollar according to year 2002), the effect of education was mainly focused on the behavior and habits in the study population.

The current study has several strengths, including a follow-up of a sample of a large population in Taiwan, the use of multivariate logistic regression models and simultaneous adjustment of confounding variables in the association of risk factors with MS, and finding a cohort relationship between socioeconomic status and MS. Most of the risk factors were interrelated, and a prospective study also would better enable us to determine causality.

Several limitations should be considered when examining the results of the current study. While only annual individual income was measured, household income may be different, and so the influence of income was unclear compared to education. As the participants of this study were apparently healthy adults who undergo yearly health checkups, this could have affected the incidence of MS. Despite these limitations, the results still have valid practical implications.

In conclusion, our study sample showed that the 5-year cumulative incidence of MS was 11.37%, and the weighted incidence was 12.46%; 14.95% for men and 9.89% for

Table 4 Incidence of the metabolic syndrome and each component according to socioeconomic status in the Taiwan Major Longitudinal health-check-up-based Population Database (MJLPD), Taiwan, 1998–2002

Variable	Metabolic syndrome	Abdominal obesity[a]	Fast blood glucose[a]	High blood pressure[a]	High triglycerides[a]	Low HDL cholesterol[a]
Education						
Middle school and lower	386 (15.7)	538 (21.8)	1,031 (41.8)	992 (40.2)	399 (16.2)	439 (17.8)
High school	212 (10.1)	249 (11.9)	740 (35.4)	462 (22.1)	333 (15.9)	407 (19.4)
Junior college	192 (10.5)	209 (11.4)	613 (33.5)	389 (21.3)	314 (17.2)	364 (19.9)
College and higher	248 (9.0)*	277 (10.1)*	1,007 (36.6)*	529 (19.2)*	457 (16.6)	499 (18.1)
Income						
Low	440 (12.5)	598 (17.0)	1,307 (37.1)	1,119 (31.8)	497 (14.1)	641 (18.2)
Middle	549 (10.4)	626 (11.9)	1,913 (36.2)	1,189 (22.5)	911 (17.3)	1,009 (19.1)
High	78 (13.3)*	76 (12.9)*	274 (46.8)*	136 (23.2)*	140 (23.9)	109 (18.6)*

The values represent no. (%)

* $P < 0.05$ from Chi-square test for trend

[a] Abdominal obesity, fast blood glucose, high blood pressure, high triglycerides, low HDL-cholesterol according to the modified ATP III criteria (published in 2005)

Table 5 Proportion of the number of the metabolic syndrome's components according to socioeconomic status in the Taiwan Major Longitudinal health-check-up-based Population Database (MJLPD), Taiwan, 1998–2002

	Numbers of MS component[a]						Total
	0	1	2	3	4	5	
Education*							
Middle school and lower	578 (23.4)	871 (35.3)	631 (25.6)	290 (11.8)	85 (3.4)	11 (0.4)	2,466 (100.0)
High school	772 (36.9)	719 (34.4)	390 (18.6)	157 (7.5)	54 (2.6)	1 (0.0)	2,093 (100.0)
Junior college	699 (38.2)	615 (33.6)	323 (17.7)	146 (8.0)	41 (2.2)	5 (0.3)	1,829 (100.0)
College and higher	1,068 (38.8)	898 (32.6)	538 (19.5)	203 (7.4)	39 (1.4)	6 (0.2)	2,752 (100.0)
Income*							
Low	1,111 (31.5)	1,223 (34.7)	748 (21.2)	329 (9.3)	100 (2.8)	11 (0.3)	3,522 (100.0)
Middle	1,908 (36.2)	1,779 (33.7)	1,040 (19.7)	419 (7.9)	119 (2.3)	11 (0.2)	5,276 (100.0)
High	170 (29.0)	190 (32.4)	149 (25.4)	66 (11.2)	11 (1.9)	1 (0.2)	587 (100.0)

The values represent no. (%)

* $P < 0.05$ from Chi-square test for distribution of proportion of the number of components

[a] Numbers of MS component according to the modified ATP III criteria (published in 2005)

women. The incidence of MS increased in women with lower education as they became older, and socioeconomic status exhibited more influence on women, enabling us to observe significant interaction between gender and socioeconomic status. When adjusting for behavior (such as smoking, drinking, and sports activity), family history, gender, and age, the education level was an important socioeconomic determinant of MS in the population involved in this study.

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Conflict of interest None of the authors has any conflict of interest.

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