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Paternal and self-educational attainment as a risk indicator for periodontal disease among Korean adults.

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Abstract

This study was performed to assess the relationship between socioeconomic position, according to parental education and participants' own education, and periodontitis in a large probability sample of the Korean population using data from the Korea National Health and Nutrition Examination Survey. Multiple logistic regression analyses were used to assess the associations of periodontitis and the socioeconomic position with adjustments with confounding factors. In male participants aged 19-39 and 40-64 the prevalence of periodontitis increased with fewer educational years. Paternal education showed significant impacts on males aged 19-39 and 40-64. In females, the presence of periodontitis was influenced by participants' own education in those participants aged 19-39 and 40-64. In females aged 19-39 and 40-64, the maternal education and paternal education had an association with the presence of periodontitis. Parental education combined with individuals' own education was associated with the prevalence of periodontitis after adjustment. This study evaluated the combined socioeconomic position using parental education and participants' own education. This study showed that higher socioeconomic position during childhood and greater educational attainment was both associated with decreased periodontitis in adulthood.

Keywords: Epidemiology, Education, Health surveys, Periodontitis, Socioeconomic factors.

Abbreviations:

CPI: Community Periodontal Index; KNHANES: Korea National Health and Nutrition Examination Survey.

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Introduction

Previous studies have shown the association between socioeconomic position and health outcomes. Several studies have examined the impact of socioeconomic status on the health-related behaviors of adults [1-3]. For example, the relationship between lower socioeconomic position and elevated risk of high blood glucose has been noted [4]. Women with declining socioeconomic position also showed a higher risk of diabetes when compared with women with stable, high socioeconomic position from childhood to adulthood [5]. In the case of South Korea, less-educated women have been shown to have a higher prevalence of metabolic syndrome [6]. Furthermore, low childhood socioeconomic status from high-income countries is typically associated with an elevated risk of adult obesity [7]. Lower socioeconomic status is related to more tobacco use, and it was shown that those who completed only obligatory education reported a higher risk of tobacco use [8].

In detail, parental education has been reported to be closely related to child health [9,10]. Adolescents with lower parent education have shown an increased cardiovascular risk [11]. Additionally, lower parent education appears to be related to increased insulin resistance both cross-sectionally and over time in Black and White adolescents [12]. Socioeconomic status and adiposity in childhood were evaluated, with parental education as the socioeconomic status indicator, and inverse associations with adiposity were found [13]. Furthermore, a significant and graded association has been found between parental socioeconomic position and cognitive function both prior to and after adjustment for respondents' education [14]. A lower level of education for a child's mother and father has been shown to be the most important socioeconomic factor associated with the concentration of lead in children's blood [15]. Additionally, the relation between socioeconomic status and inflammation during adolescence was assessed, and adolescents with less-educated parents tended to have higher inflammation, evaluated by the levels of C-reactive protein,

interleukin-6, and tumor necrosis factor α soluble receptor-2 fibrinogen [11,16].

In a previous report, lower socioeconomic groups were significantly more likely to present with periodontitis [17]. However, there is limited information regarding the association between the combined socioeconomic position according to parental education and participants' own education and periodontitis in the Korean population. Thus, this study was performed to assess this relationship in a large probability sample of the Korean population using data from the Korea National Health and Nutrition Examination Survey.

Material and Methods

Overview of the survey

This study is a secondary data analysis of data collected during the Korean National Health and Nutrition Examination Survey (KNHANES) conducted during 2008-2010. KNHANES is a cross-sectional survey based on stratified, multistage probability samples of Korean households, representing the civilian, noninstitutionalized population. It includes a health interview, a survey of health behaviors, and a nutritional and health examination following a standardized protocol.

Initially, a total of 29,235 individuals participated in the KNHANES survey. The number of surveys was reduced to 21,811 by excluding participants younger than 19. The analysis in this study was confined to a total of 14,316 responses that had no missing values for the reproductive factors and outcome variables (Figure 1). All participants signed informed consent forms. This study was approved by the Institutional Review Board of the Korean Center for Disease Control and Prevention and conducted according to the Helsinki Declaration-based Ethical Principles for Medical Research Involving Human Subjects. The Institutional Review Board at the Catholic University of Korea approved this study.

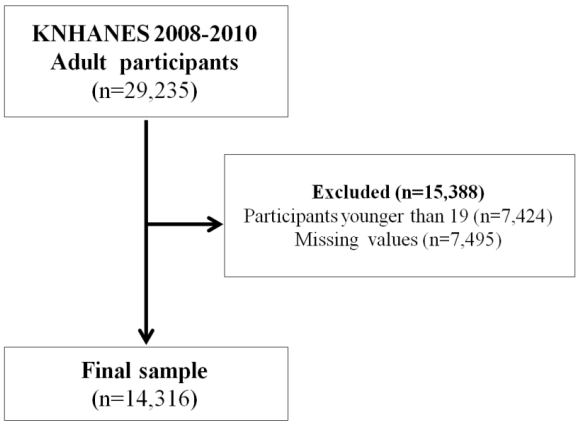

Figure 1. Participant flow chart.

Socioeconomic position

Participants' own education level was categorized into four groups according to the number of years of schooling: less than 7 y (elementary school graduate or lower), 7-9 y (some middle school or middle school graduate), 10-12 y (some high school or high school graduate), and greater than 13 y (university education or higher) [18]. The economic status was evaluated by monthly household income level. The income level was divided into quartiles. The first quartile included households with a monthly income<1092.4 USD, the second quartile included those with an income of 1092.4 ≤ x<2334.3 USD, the third included those with an income of 2334.3 ≤ x<3734.8 USD, and the fourth included those with an income ≥ 3734.8 USD.

The paternal and maternal education level was categorized into five groups according to the number of years of schooling: (1) uneducated, village school, or Chinese classics; (2) elementary school education; (3) middle school education; (4) high school education; and (5) college or university education.

Demographic and lifestyle variables

Smoking status was categorized into three groups in accordance with participants' responses: (1) nonsmokers-individuals who had never smoked or had smoked<100 cigarettes in their life; (2) ex-smokers-participants who had smoked in the past but had stopped smoking; and (3) current smokers-those who were smoking currently and had smoked ≥ 100 cigarettes [19].

The individuals were regarded as regular physical exercisers if they performed moderate exercise five times or more per week for 30 min or more per session or performed vigorous exercise three times or more per week for 20 min or more per session [20]. Dwelling places were categorized into urban areas (administrative divisions of "dong") or rural areas (administrative divisions of "eup" or "myeon") [18]. Having an occupation or not was obtained from the survey.

Oral health behaviors and periodontal treatment needs

The Community Periodontal Index (CPI) was used to assess periodontal treatment needs and defined periodontal disease as CPI of 3 and 4 [21]. Having had a dental checkup within a year, self-reported oral status, chewing ability, speech, frequency of tooth brushing per day, and use of secondary oral products were evaluated. Secondary oral products included dental floss, mouthwash, interdental brushes, and electric toothbrushes [19].

Description of metabolic syndrome, diabetes, and hypertension

Metabolic syndrome was defined according to previous reports [22]. According to these criteria, three or more of the following must be fulfilled: waist circumference ≥ 90 cm in men and ≥ 80 cm in women; fasting triglycerides ≥ 150 mg/dL or use of lipid-lowering medication; high-density lipoprotein cholesterol<40 mg/dL in men and <50 mg/dL in women or use of lipid-lowering medication; blood pressure ≥ 130/85 mm Hg or use of antihypertensive medication; and fasting blood

glucose ≥ 100 mg/dL or current use of antidiabetic medication [23]. Diabetes was diagnosed if fasting blood sugar was >126 mg/dL or the individual was currently using antidiabetic medications [24]. Hypertension was defined as a systolic blood pressure of >160 mm Hg, a diastolic blood pressure of >90 mm Hg, or the current use of systemic antihypertensive drugs [25].

Statistical analyses

All data are presented as mean ± standard error or as % (standard error). Logarithmic transformation was performed to achieve normal distribution when necessary. Student's t-test or a chi-square test was used to investigate differences in the presence of periodontitis according to the variables. Multiple logistic regression analyses were used to assess the associations between periodontitis and socioeconomic position. Model 1 was unadjusted, whereas Model 2 was adjusted for age, sex, body mass index, smoking, drinking, and exercise. Model 3 was adjusted for the variables in Model 2 plus metabolic syndrome, frequency of tooth brushing per day, use of secondary oral products, and having had a dental check-up within a year. The survey procedure of a statistical software package (SAS version 9.2 for Windows, SAS Institute, Cary, NC, USA) was used for statistical analyses to account for the complex sampling design. Two-sided P values of <0.05 were considered statistically significant.

Results

Table 1 describes the baseline characteristics of the study individuals according to sex. The percentage of participants with high school education was highest in both males and females. The percentage of individuals with an income in the fourth quartile (highest quartile) was highest in both males and females.

Table 2 describes the characteristics of the individuals categorized by age and presence of periodontitis. In male participants aged 19 to 39, the prevalence of periodontitis increased with fewer educational years (P=0.0474). Similar trends were noted in male participants aged 40 to 64 (P=0.0008). The participants' income did not produce statistically significant differences between the groups. Maternal education showed significant differences in males aged 19-39. Paternal education showed significant impacts on males aged 19-39 and 40-64. In females, the presence of periodontitis was influenced by participants' own education in those participants aged 19 to 39 and 40 to 64. In females aged 19-39 and 40-64, maternal education and paternal education also had an association with the presence of periodontitis.

Table 3 shows the percentage of individuals categorized by paternal education and participants' own socioeconomic position. In males, the percentage of participants who had a dental check-up within one year was highest for those with the highest paternal education and the highest own socioeconomic position. In males, the percentage of diabetes, hypertension, and metabolic syndrome was lowest in the highest paternal education group and those with the highest own socioeconomic position. Similar trends were seen in female participants.

Table 4 shows the adjusted odds ratio, 95% confidence interval, and P value of periodontitis in the multivariate logistic regression model for socioeconomic position. An association between paternal education and socioeconomic position and periodontitis was seen after adjustments. Adjusted odds ratios and their 95% confidence intervals of male individuals with a university education or higher and paternal education of middle school or higher were 0.752 (0.588, 0.963) after controlling for age, sex, body mass index, smoking, drinking, metabolic syndrome, frequency of tooth brushing per day, use of secondary oral products, and having had a dental checkup within a year (Model 3) when male individuals with a high school education or lower and a paternal education of elementary school or lower were considered as a reference (P<0.05). Adjusted odds ratios and their 95% confidence intervals of male individuals with the highest quartile of income and a paternal education of middle school or higher were 0.601 (0.464, 0.78) after adjustments when male individuals with an income of quartile 1 to 3 and a paternal education of elementary school or lower were considered as a reference (P<0.05). Similar trends were achieved with female participants, with adjusted odds ratios and their 95% confidence intervals of 0.509 (0.401, 0.648) and 0.543 (0.419, 0.704), respectively.

Table 1. *Characteristics of the study population.*

	Sex		P-value
	Male	Female	
Unweighted (n)	5,895	8,421	
Age (y)			0.0002
19-39	45.8 (1)	44.7 (0.9)	
40-64	40.7 (0.9)	39.2 (0.7)	
65 or older	13.6 (0.5)	16.1 (0.5)	
Participant's education			<0.0001
Elementary school education or lower	9.4 (0.5)	19.9 (0.7)	
Middle school education	9.4 (0.4)	9.3 (0.4)	
High school education	43.3 (0.9)	39.5 (0.8)	
University education or higher	38.0 (0.9)	31.4 (0.8)	
Participant's income			0.0141
Q1: The lowest quartile	13.1 (0.6)	14.7 (0.6)	
Q2	24.2 (0.8)	25.0 (0.7)	
Q3	31.3 (0.8)	29.7 (0.7)	
Q4:The highest quartile	31.5 (1.0)	30.7 (0.9)	
Education of mother			0.6464
Uneducated, village school, Chinese classics	18.1 (0.6)	18.9 (0.6)	

Elementary school education	30.2 (0.8)	28.9 (0.7)	
Middle school education	17.1 (0.6)	17.0 (0.5)	
High school education	22.5 (0.7)	23.0 (0.6)	
College or university education	12.1 (0.7)	12.2 (0.6)	
Education of father			0.0023
Uneducated, village school, Chinese classics	23.0 (0.7)	26.1 (0.7)	
Elementary school education	38.3 (0.8)	35.8 (0.7)	
Middle school education	15.8 (0.6)	16.4 (0.5)	
High school education	18.7 (0.7)	17.5 (0.6)	
College or university education	4.2 (0.4)	4.2 (0.3)	
Smoking			<0.0001
Nonsmoker	24.2 (0.7)	90.2 (0.4)	
Ex-smoker	30.3 (0.7)	4.3 (0.3)	
Current smoker	45.5 (0.8)	5.4 (0.3)	
Drinking			<0.0001
Nondrinker	12.6 (0.5)	32.3 (0.7)	
Mild to moderate drinker	69.3 (0.7)	65.6 (0.7)	
Heavy drinker	18.0 (0.6)	2.2 (0.2)	
Exercise (yes)	28.7 (0.8)	23.2 (0.6)	<0.0001
Dwelling (urban)	80.4 (1.7)	82.1 (1.5)	0.0026
Occupation (yes)	78.3 (0.8)	49.3 (0.7)	<0.0001
Dental checkup within a year (yes)	27.7 (0.9)	27.7 (0.8)	0.9596
Self-reported oral status			0.0036
Favorable	13.7 (0.5)	11.5 (0.5)	
Average	40.7 (0.8)	42.0 (0.8)	
Problematic	45.6 (0.9)	46.6 (0.7)	
Chewing			0.9341
Discomfort	25 (0.8)	25.0 (0.6)	
Minor problem	15.4 (0.7)	15.1 (0.5)	
No discomfort	59.6 (0.9)	59.9 (0.7)	
Speech			0.129
Discomfort	6.3 (0.3)	7.3 (0.3)	
Minor problem	6.9 (0.4)	7.0 (0.4)	
No discomfort	86.8 (0.5)	85.8 (0.5)	
Frequency of tooth brushing per day			<0.0001
≤ 1	14.4 (0.6)	7.3 (0.4)	
2	44.6 (0.8)	41.6 (0.7)	
≥ 3	41 (0.9)	51.1 (0.8)	
Use of secondary oral products (yes)	38.9 (0.9)	47.8 (0.8)	<0.0001
Metabolic syndrome	27.6 (0.8)	20.1 (0.6)	<0.0001
Diabetes mellitus	8.2 (0.4)	6.3 (0.3)	0.0002
Hypertension	29.5 (0.8)	19.9 (0.6)	<0.0001

Data are presented as percentages (standard error). *P values were obtained by the chi-square test for categorical variables.

Table 2. *Characteristics of the individuals categorized by age and presence of periodontitis.*

	Male								
	Age 19-39 (y)			**Age 40-64 (y)**			**Age 65 (y) or greater**		
	Periodontal treatment needs (CPI 3 and 4)		**P-value**	**Periodontal treatment needs (CPI 3 and 4)**		**P-value**	**Periodontal treatment needs (CPI 3 and 4)**		**P-value**
	No	**Yes**		**No**	**Yes**		**No**	**Yes**	
Participant's education			0.0474			0.0008			0.2822
Elementary school education or lower	0.2 (0.1)	0.8 (0.5)		8.1 (0.9)	11.2 (1.1)		38.9 (2.4)	39.7 (2.2)	
Middle school education	1.2 (0.3)	1.9 (0.7)		12.4 (1.1)	16.7 (1.2)		21.4 (1.8)	21.0 (1.6)	
High school education	53.6 (1.4)	47.9 (3.1)		38.9 (1.7)	39.3 (1.7)		22.1 (1.8)	25.5 (1.8)	
University education or higher	45.0 (1.4)	49.4 (3.1)		40.5 (1.8)	32.8 (1.8)		17.7 (2.3)	13.8 (1.4)	
Participant's income			0.1207			0.0698			0.2892
Q1: The lowest quartile	10.4 (1.2)	12.6 (2.1)		7.8 (1)	9.0 (1.1)		35 (2.1)	34.6 (2.1)	
Q2	24.8 (1.3)	26.3 (2.5)		21.5 (1.5)	22.9 (1.5)		28.1 (2)	26.4 (1.7)	
Q3	33.4 (1.4)	37.3 (3.0)		30.4 (1.6)	34.1 (1.6)		17.5 (1.5)	21.7 (1.7)	
Q4:The highest quartile	31.4 (1.5)	23.8 (2.9)		40.3 (1.8)	34.1 (1.8)		19.4 (2)	17.3 (1.7)	

Education of mother			<0.0001			0.051		0.4532
Uneducated, village school, Chinese classics	2.1 (0.4)	4.2 (1.2)		20.9 (1.3)	25.1 (1.5)		55.0 (2.0)	57.7 (2.1)	
Elementary school education	21.1 (1.2)	31.5 (2.8)		38.1 (1.6)	40.3 (1.7)		29.6 (1.7)	28.4 (1.9)	
Middle school education	20.8 (1.2)	24 (2.8)		17.1 (1.2)	14.9 (1.2)		7.6 (1.3)	4.9 (0.8)	
High school education	36.1 (1.3)	28.9 (3)		15.2 (1.1)	12.9 (1.2)		5.5 (1.1)	6.1 (1.2)	
College or university education	20 (1.3)	11.4 (2.2)		8.8 (1)	6.8 (0.9)		2.4 (0.6)	2.8 (0.7)	
Education of father			<0.0001			0.0454		0.3247
Uneducated, village school, Chinese classics	3.8 (0.5)	7.5 (1.5)		28.2 (1.4)	31.5 (1.6)		63.5 (2.2)	67.5 (2.1)	
Elementary school education	28.5 (1.3)	45.0 (3.2)		48.5 (1.7)	50.7 (1.7)		31.3 (1.9)	27.4 (1.9)	
Middle school education	24.4 (1.3)	18.5 (2.1)		13 (1.1)	9.8 (1.0)		3.3 (0.8)	2.1 (0.5)	
High school education	35.1 (1.5)	25.0 (2.5)		8.2 (1)	6.9 (0.9)		1.4 (0.4)	2.1 (0.7)	
College or university education	8.3 (0.8)	4.0 (1.4)		2.0 (0.5)	1.1 (0.3)		0.6 (0.4)	1.0 (0.4)	
Female									
	Age 19-39 (y)			**Age 40-64 (y)**			**Age 65 (y) or greater**		
	Periodontal treatment needs (CPI 3 and 4)		**P-value**	**Periodontal treatment needs (CPI 3 and 4)**		**P-value**	**Periodontal treatment needs (CPI 3 and 4)**		**P-value**
	No	**Yes**		**No**	**Yes**	**No**	**Yes**		
Participant's education			0.0013			<0.0001			0.2093
Elementary school education or lower	0.6 (0.2)	1.5 (0.8)		15.2 (0.9)	26.7 (1.9)		74.3 (1.8)	79.0 (1.7)	
Middle school education	1.5 (0.3)	4.9 (1.7)		17.4 (1.0)	17.0 (1.3)		11.3 (1.1)	10.5 (1.4)	
High school education	47.2 (1.2)	50.4 (3.8)		43 (1.3)	42.2 (2.0)		10.4 (1.1)	7.9 (1.0)	
University education or higher	50.7 (1.3)	43.2 (3.8)		24.5 (1.3)	14.1 (1.4)		3.9 (0.8)	2.7 (0.7)	
Participant's income			0.1343			<0.0001			0.0103
Q1: The lowest quartile	8.1 (0.8)	6.2 (1.6)		9.4 (0.8)	11.0 (1.1)		44.3 (1.9)	46.2 (2.3)	
Q2	24.6 (1)	31.5 (3.4)		22.3 (1.2)	30.0 (1.7)		27.0 (1.7)	23.3 (1.6)	
Q3	34.0 (1.2)	34.5 (3.4)		30.3 (1.2)	29.7 (1.8)		14.1 (1.3)	19.7 (1.7)	
Q4:The highest quartile	33.3 (1.3)	27.8 (3.5)		38 (1.6)	29.3 (1.8)		14.6 (1.5)	10.8 (1.4)	
Education of mother			<0.0001			<0.0001			0.0462
Uneducated, village school, Chinese classics	2.0 (0.3)	5.1 (1.5)		19.2 (1.0)	27.0 (1.7)		56.3 (1.8)	61.6 (2.1)	
Elementary school education	21.7 (0.9)	34.2 (3.1)		37.0 (1.2)	38.6 (1.9)		24.9 (1.5)	25.3 (1.9)	
Middle school education	21.6 (0.9)	18.0 (2.5)		17.5 (0.9)	13.7 (1.2)		7.4 (0.9)	5.4 (0.8)	
High school education	36.0 (1.2)	30.9 (3)		16.4 (0.9)	13.1 (1.3)		7.2 (1.0)	5.6 (1.0)	
College or university education	18.7 (1)	11.8 (2.6)		9.9 (0.9)	7.6 (1.1)		4.2 (0.9)	2.1 (0.6)	
Education of father			<0.0001			0.0002			0.6128
Uneducated, village school, Chinese classics	4.3 (0.4)	7.2 (1.6)		28.7 (1.1)	37.7 (1.9)		72.3 (1.6)	75.2 (1.9)	
Elementary school education	29.4 (1.1)	43.9 (3.3)		48.5 (1.2)	44.4 (1.9)		23.1 (1.5)	21.4 (1.8)	
Middle school education	25.5 (1.0)	19.5 (2.6)		12.8 (0.8)	11.7 (1.2)		2.3 (0.6)	1.3 (0.4)	

High school education	32.6 (1.1)	26.5 (3.3)	8.0 (0.7)	5.0 (0.9)	1.9 (0.5)	1.8 (0.6)
College or university education	8.2 (0.7)	3.0 (1.5)	2.0 (0.4)	1.2 (0.4)	0.4 (0.2)	0.3 (0.2)

Data are presented as percentages (standard error). *P values were obtained by the chi-square test for categorical variables.

Table 3. *Relationship between socioeconomic position and systemic diseases and dental checkup within a year.*

	Education of father	**Elementary school education or lower**	**Elementary school education or lower**	**Middle school education or higher**	**Middle school education or higher**	**P-value**	**Education of father**	**Elementary school education or lower**	**Elementary school education or lower**	**Middle school education or higher**	**Middle school education or higher**	**P-value**
	Participant's education	**High school education or lower**	**University education or higher**	**High school education or lower**	**University education or higher**		**Participant's income**	**Q1–Q3**	**Q4:The highest quartile**	**Q1–Q3**	**Q4:The highest quartile**	
Male	Dental checkup within a year (yes)	23.3 (1.2)	24.8 (1.5)	33.7 (2.2)	34.0 (1.6)	<0.0001	Dental checkup within a year (yes)	23.0 (1.2)	25.4 (1.3)	34.2 (2.1)	36.4 (2.1)	<0.0001
	Diabetes mellitus	12.8 (0.7)	5.2 (0.7)	8.2 (1.2)	5.0 (0.7)	<0.0001	Diabetes mellitus	12.6 (0.8)	5.0 (0.6)	8.7 (1.1)	5.2 (0.8)	<0.0001
	Hypertension	38.1 (1.2)	22.8 (1.4)	31.5 (1.9)	23.4 (1.4)	<0.0001	Hypertension	36.5 (1.2)	23.5 (1.2)	35.9 (1.8)	22.4 (1.6)	<0.0001
	Metabolic syndrome	34.9 (1.2)	19.7 (1.3)	28.1 (1.8)	25.4 (1.4)	<0.0001	Metabolic syndrome	33.8 (1.2)	21.0 (1.2)	31.0 (1.8)	25.3 (1.7)	<0.0001
Female	Dental checkup within a year (yes)	21.9 (1)	28.0 (1.3)	31.8 (2.5)	35.7 (1.5)	<0.0001	Dental checkup within a year (yes)	20.6 (1)	27.9 (1.3)	32.0 (1.9)	38.1 (1.7)	<0.0001
	Diabetes mellitus	10.9 (0.6)	5 (0.6)	2.3 (0.9)	1.4 (0.4)	<0.0001	Diabetes mellitus	11.1 (0.6)	4.0 (0.5)	5.0 (0.8)	2.1 (0.4)	<0.0001
	Hypertension	35.2 (0.9)	14.6 (0.9)	6.9 (1.3)	4.5 (0.6)	<0.0001	Hypertension	33.2 (1)	10.6 (0.7)	23.9 (1.7)	8.6 (0.8)	<0.0001
	Metabolic syndrome	33.9 (1)	15.1 (0.9)	11.0 (1.7)	5.7 (0.6)	<0.0001	Metabolic syndrome	33.7 (1.1)	12.1 (0.8)	20.7 (1.4)	8.2 (0.8)	<0.0001

Table 4. *Adjusted odds ratio, 95% confidence interval, and P value of periodontitis in multivariate logistic regression model for socioeconomic position.*

Male					
Education of father	**Elementary school education or lower**	**Elementary school education or lower**	**Middle school education or higher**	**Middle school education or higher**	**P-value**
Participant's education	**High school education or lower**	**University education or higher**	**High school education or lower**	**University education or higher**	
Prevalence (%)	47.7 (1.4)	23.8 (1.4)	37.9 (2.2)	24.0 (1.5)	<0.0001
Model 1	1	0.344 (0.290,0.407)	0.671 (0.555,0.812)	0.347 (0.29,0.416)	<0.0001
Model 2	1	0.795 (0.657,0.961)	1.036 (0.842,1.275)	0.718 (0.585,0.881)	0.0032
Model 3	1	0.816 (0.641,1.039)	1.217 (0.955,1.551)	0.752 (0.588,0.963)	0.0025
Education of father	Elementary school education or lower	Elementary school education or lower	Middle school education or higher	Middle school education or higher	P-value
Participant's income	Q1–Q3	Q1–Q3	Q4:The highest quartile	Q4:The highest quartile	

Prevalence (%)	46.3 (1.4)	24.7 (1.4)	41.8 (2.2)	22.4 (1.7)	<0.0001
Model 1	1	0.381 (0.324,0.449)	0.835 (0.691,1.009)	0.336 (0.273,0.414)	<0.0001
Model 2	1	0.81 (0.669,0.98)	0.966 (0.795,1.174)	0.632 (0.503,0.795)	0.0006
Model 3	1	0.791 (0.63,0.994)	0.902 (0.712,1.141)	0.601 (0.464,0.78)	0.0017
Female					
Education of father	**Elementary school education or lower**	**Elementary school education or lower**	**Middle school education or higher**	**Middle school education or higher**	**P-value**
Participant's education	**High school education or lower**	**University education or higher**	**High school education or lower**	**University education or higher**	
Prevalence (%)	33.8 (1.1)	17.1 (1)	16 (1.9)	9 (0.8)	<0.0001
Model 1	1	0.404 (0.346, 0.47)	0.372 (0.279, 0.497)	0.194 (0.159, 0.236)	<0.0001
Model 2	1	0.781 (0.661, 0.922)	0.853 (0.635, 1.145)	0.525 (0.421, 0.655)	<0.0001
Model 3	1	0.803 (0.66, 0.977)	0.792 (0.56, 1.119)	0.509 (0.401, 0.648)	<0.0001
Education of father	**Elementary school education or lower**	**Elementary school education or lower**	**Middle school education or higher**	**Middle school education or higher**	**P-value**
Participant's income	**Q1-Q3**	**Q1-Q3**	**Q4: The highest quartile**	**Q4: The highest quartile**	
Prevalence (%)	32.8 (1.1)	14.7 (0.9)	25.9 (1.8)	10.9 (1)	<0.0001
Model 1	1	0.353 (0.304, 0.411)	0.716 (0.594, 0.862)	0.252 (0.205, 0.309)	<0.0001
Model 2	1	0.754 (0.635, 0.895)	0.92 (0.747, 1.133)	0.572 (0.455, 0.719)	<0.0001
Model 3	1	0.774 (0.635, 0.944)	0.856 (0.667, 1.1)	0.543 (0.419, 0.704)	<0.0001

Model 1: Unadjusted; Model 2: Adjusted for age, sex, body mass index, smoking, drinking, and exercise; Model 3: Model 2 plus adjusted for metabolic syndrome, frequency of tooth brushing per day, use of secondary oral products, and having had a dental checkup within a year.

Discussion

This study assessed the association between the combined socioeconomic position using parental education and participants' own education and periodontal status in a large probability sample of the Korean population. Parental education combined with individuals' own education was associated with the prevalence of periodontitis after adjustment for age, sex, body mass index, smoking, drinking, exercise, metabolic syndrome, frequency of tooth brushing per day, use of secondary oral products, and having had a dental checkup within a year.

The associations between socioeconomic position and oral diseases have been previously evaluated. For example, it was observed that socioeconomic factors are considered a strong risk indicator of schoolchildren's caries experience [26]. Specifically, mothers' schooling is negatively associated (odd ratios=0.95) with caries in primary dentition [27]. Furthermore, respondents who had low income and low education are more likely to have fewer teeth compared with their referent groups [28].

This study assessed the relationship between socioeconomic position and periodontitis. A previous study evaluated the socioeconomic factors associated with the prevalence of periodontitis in Koreans, and it was observed that participants with higher income were less likely to have periodontitis [17]. It was also shown that early-life socioeconomic disadvantages were significantly associated with periodontitis in adulthood [29]. Previous study demonstrated the existence of significant social gradients in periodontal diseases already among adolescents [30].

The effects of one's socioeconomic position, especially parental education, may be partially explained by the following. Parents with a lower level of education may not be aware of good oral hygiene practices. To demonstrate, a previous study assessed the social characteristics, demographic determinants, and oral hygiene practices among children, and a significant association was found among parents' educational status and oral hygiene practices [31]. Furthermore, people with less education may lack oral health knowledge, and this may lead to fewer visits to dental clinics. In this vein, a previous report evaluated the determinants regarding access to dental care facilities, and it demonstrated that increased childhood dental attendance was associated with a high level of the mother's education [32]. Similarly, the prevalence of periodontal outcomes was investigated and differed significantly depending on paternal and maternal education [33].

The effects of one's socioeconomic position, especially parental education, may also be explained by the following. The socioeconomic status gradient in systemic diseases reflects behavioral as well as physiological pathways, and systemic

inflammation seems to be involved [34]. Low socioeconomic status has been associated with an increased exposure to adverse life circumstances, which can trigger biological responses and result in an increased risk for systemic diseases [34]. Similarly, social disadvantage, specifically low parent education, has been associated with increased inflammation in adolescence [11].

Parental education should also be considered regarding maternal and paternal sides. In a previous study, oral hygiene status was evaluated in relation to the sociodemographic factors of children and adults who were hearing impaired and attending a special school; a multiple regression analysis showed that the education of the mother was the single best predictor for oral hygiene status and explained 92% of the variance [35]. Likewise, the odd ratios for parental education regarding tooth loss was evaluated, and an odd ratios of 1.8 regarding tooth loss for a father who achieved only primary school education and an odd ratios of 2.0 for a mother with primary school education only were shown [36]. Furthermore, a low socioeconomic position is more consistently associated with a worse profile for women [37]. Additionally, longitudinal studies drawn from high-income countries have demonstrated long-term associations of early childhood socioeconomic deprivation with increased adiposity in adulthood, particularly in women [7]. Moreover, maternal education has been reported to have a strong impact on infant and child mortality [38]; maternal education is closely related to child health, measured either by nutritional status or by infant and child mortality, but the effect of father's education on infant and child mortality appears to be about one half that of the mother's education [9]. However, one report emphasized the paternal education [30]. The occurrence of all periodontal outcomes investigated followed social gradients, and paternal education was reported to be one of the most influential variables.

It should be considered that Korea has experienced substantial social changes during the past century, and the education level was relatively low for older generations, especially for women [6]. It was shown that the paternal education level was less than elementary school for 34.9% of the men in the older cohort, compared with 7.9% of men in the younger cohort [4].

Several limitations should be mentioned for this study. First, due to the design of this study as a cross-sectional study, a causal relationship between socioeconomic position, including participants' own and their parental education, and periodontitis could not be determined [18]. Additionally, maternal education was not precisely analysed due to the substantial social changes during the past century, which restricted the education of women for several decades [4]. Still, despite its limitations, this study had several strengths. This study was based on highly reliable data from a large, nationally representative population using sample weights and adjustments for the complex sample design of the survey [21]. The study also assessed parental education to analyse the socioeconomic status, and subgroup analysis for sex differences was performed.

Conclusion

This study evaluated the combined socioeconomic position using parental education and participants' own education. This study showed that higher socioeconomic position during childhood and greater educational attainment are both associated with periodontitis in adulthood. Therefore, people with lower education and a lower parental education level should be targeted more for public oral health education. In addition, improvements in both parental socioeconomic circumstances and the educational attainment of their offspring may reduce the risk of periodontal diseases.

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Conflict of Interest

The authors report no conflicts of interest related to this study. The author does not have any financial interest in the companies whose materials are included in the article.

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