Original Article

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Associations Between Preschool Education Experiences and Adulthood Self-rated Health

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Objectives: This study aimed to examine the association between preschool education experiences and adulthood self-rated health using representative data from a national population-based survey.

Methods: Data from the Korean Labor and Income Panel Study in 2006 and 2012 were used. A total of 2391 men and women 21-41 years of age were analyzed. Log-binomial regression analyses were conducted to examine the associations between preschool education experience and self-rated health in adulthood. Parental socioeconomic position (SEP) indicators were considered as confounders of the association between preschool education experience and adulthood subjective health, while current SEP indicators were analyzed as mediators. Age-adjusted prevalence ratios (PRs) and the associated 95% confidence intervals (CIs) were estimated.

Results: Compared with men without any experience of preschool education, those with both kindergarten and other preschool education experiences showed a lower prevalence of self-rated poor health (PR, 0.65; 95% CI, 0.47 to 0.89). In women, however, such an association was not evident. The relationship of preschool education experiences with self-rated poor health in adulthood among men was confounded by parental SEP indicators and was also mediated by current SEP indicators. After adjustment for parental and current SEP indicators, the magnitude of the associations between preschool education experiences and adulthood subjective health was attenuated in men.

Conclusions: Preschool education experience was associated with adulthood self-rated health in men. However, this association was explained by parental and current SEP indicators. Further investigations employing a larger sample size and objective health outcomes are warranted in the future.

Key words: Early intervention, Longitudinal studies, Preschool child, Socioeconomic factors, Republic of Korea

INTRODUCTION

Many studies have shown that adulthood health is heavily dependent on early childhood factors. The fetal origin hypothesis [1], which emphasized the significance of the fetal period in determining adulthood health, has developed into the developmental origin of health and disease hypothesis, which argues that factors after the fetal period are also of great significance [2,3]. Developments in neuroscience have revealed the importance of early childhood in brain development [4]. Cognitive and non-cognitive skills during childhood have also been reported to affect health outcomes such as adulthood mortality [5,6]. In addition, interest in childhood factors has increased in regards to health inequalities in adulthood [7,8].

Evidence showing that early childhood education before elementary school has significant effects on adulthood health

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has also accumulated. According to the result of the Carolina Abecedarian Project (ABC project), the early childhood educational intervention greatly reduced the risk of cardiovascular and metabolic diseases [9]. According to a longitudinal follow-up study on the effects of preschool education in South Australia on adulthood cardiometabolic risk, preschool education reduced the risks of high blood pressure and hypercholesterolemia [10]. However, a review conducted by D'Onise and colleagues [11] regarding the effects of preschool education on adulthood health indicated that, although preschool education had a positive effect on adulthood health behavior, the effects on chronic disease were unclear. Investment in preschool children may improve cognitive and non-cognitive skills during the developmental period, which hence may have positive effects on adulthood health [9]. High-quality education during early childhood could not only improve cognitive skills, but also improve access to social and economic resources in adulthood life, reduce health risk behavior, and alleviate mental stress [12].

Although many studies have explored the effects of preschool education on adulthood health, the paucity of research using samples from general population, the lack of investigations into late adulthood health outcomes other than young adulthood outcomes, and small sample sizes have been pointed out as limitations of the studies [11]. In particular, most studies on this topic have been conducted in Western developed countries, and, to the best of our knowledge, no studies have been conducted in Asian countries.

This study used the nationally representative Korean Labor and Income Panel Study (KLIPS) data to investigate the relationship between preschool education and adulthood self-rated health, and examine the roles of socioeconomic position (SEP) indicators on this relationship.

METHODS

Conceptual Model of the Research

Figure 1 shows the conceptual model of this research. Prior Korean studies revealed that parental SEP affects an individual's own SEP [13], and an individual's current SEP has been reported to be related to his or her self-rated health [14]. In addition, parental SEP has been shown to affect an individual's adulthood health independently of own SEP [15]. According to the conceptual model in Figure 1, preschool education experiences are influenced by parental SEP (Figure 1Ⓐ), and

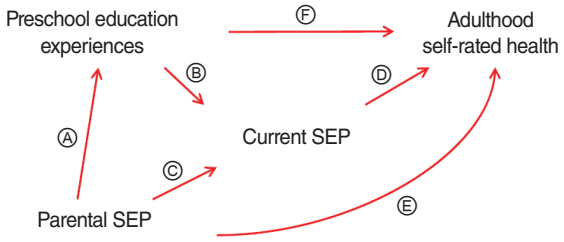

Figure 1. The model of the study on the associations between preschool education experiences and adulthood self-rated health. SEP, socioeconomic position.

early childhood education experiences can affect the current SEP (own education, household income) (Figure 1Ⓑ). Parental SEP affects the current SEP (Figure 1Ⓒ). The current SEP affects the self-rated health in adulthood (Figure 1Ⓓ), and the SEP of the parent can affect self-rated health in adulthood independently of the current SEP (Figure 1Ⓔ). This study estimated the magnitude of the relationships between preschool education experiences and adulthood self-rated health, and examined whether such experiences still had independent effects on the health outcome after considering the parental SEP and the current SEP (Figure 1Ⓕ). Parental SEP was considered as a confounder in the relationship between preschool education experience and adulthood self-rated health, while the current SEP was considered as a mediator.

Data and Study Subjects

This study utilized the KLIPS, which is a longitudinal study investigating the economic activities, mobility in the labor market, income and expenditure, education and occupational training, and social lives of Korean households and household members who live in urban areas [16]. The KLIPS first began in 1998, and 18 waves of the survey have been conducted as of 2016. This study used data from the ninth wave in 2006, which contains information regarding preschool education experiences, and data from the 15th wave in 2012, which contains information regarding individuals' health conditions. The early childhood education experiences used in this study reflect retrospective data acquired through individuals' recall in 2006, while health indicators were prospectively collected in 2012.

The information regarding preschool education was acquired from an additional survey for the youth of the ninth KLIPS, conducted in 2006. This additional survey was designed for individuals between the ages of 15 and 35 and explored participants' household environment, education, friendships,

and school life since childhood. The information for parental SEP was mainly obtained from the first and fourth waves of the KLIPS. For subjects newly included in the KLIPS after the first wave in 1998, the parental SEP data were obtained from the questionnaires of the earliest year when the individuals participated in the KLIPS. The data from the 15th KLIPS conducted in 2012 (the most recent health data available at the time of the analysis) were used to assess participants' current self-rated health and current SEP. Of the 4352 respondents of the ninth KLIPS (between 15 and 35 years of age), 2949 participated in the 15th KLIPS. After excluding participants with missing information regarding parental SEP, a total of 2391 (81.1% of 2949) individuals were included as subjects of the analysis.

Preschool Education Experiences

Information regarding preschool education was obtained from the ninth KLIPS, which contained the questions `Did you attend kindergarten before enrolling in a primary school? (A kindergarten is an educational institution in accordance with the Primary Education Act/Children Education Promotion Act, and does not include nurseries as defined in the Early Childhood Education Act.)'; and `Did you attend a child-care institution or private educational institution other than kindergarten before entering primary school?' Using the responses to these two questions, the participants were sorted into 4 groups: those with no preschool education experience, those with only other preschool education, those with only kindergarten experience, and those with kindergarten and other preschool education. The survey regarding preschool education contained a question about the type of other preschool education received, with responses including: nursery, playhouse, private academy related to primary school curriculum, private academy for arts or sports, other private academy, individual and group tutoring, home delivery study books, special education facilities, missionary-run nursery, YMCA, and sports centers.

Parental Socioeconomic Position

The education level of the mother and father, the main breadwinner's occupational class at age 14, and the employment status of the mother at age 3 were used as parental SEP indicators of an individual. The education level of the father and the main breadwinner's occupational class were included in the first KLIPS in 1998, and the maternal education level was obtained from the fourth KLIPS. For subjects who were added as new panels to subsequent waves of the KLIPS, the parental education level and the occupation of the main breadwinner were obtained from the first year survey of the individuals. The education level of the father and the mother was categorized into 4 groups: middle school or less, high school, college or higher, and refuse to answer. According to a prior Korean study conducted using the mortality follow-up data of the KLIPS, individuals that responded with `refuse to answer' or `don't know' to the question regarding parental education level had a higher adulthood risk of death [15]. The occupation (when a respondent was aged 14) of the main breadwinner of the family was categorized as manual worker, non-manual worker, and `refuse to answer'. Information regarding the employment status of the mother when a respondent was at age 3 was acquired from the ninth KLIPS, and responses were grouped into `working' and `staying at home'. With regards to the economic activities of the mother at the age of 3, rather than considering the response as pure recollection of the memory at the age of 3, it was assumed that respondents were in the position to acquire sufficient information regarding their mothers' economic activities through interactions with the family during their lifetime, and hence to make a proper evaluation of the mother's economic position when the participant was 3 years old.

Current Socioeconomic Position

Current SEP indicators were identified through an individual's education level and household income. The 15th KLIPS individual dataset was used to determine individuals' education level, with responses of high school or below, junior college or community college education, and university or higher. Since most of the younger subjects had not completed their education, the education level of individuals was determined based on attendance rather than graduation. Of the study subjects, 39.9% (n=473) were between the age of 21-25. In this group, 233 of 282 respondents with a university or higher education (82.6%) had not graduated yet, and 57 of the 138 respondents with junior college or community college education (41.3%) had not graduated yet. Household data from the 15th KLIPS were used to obtain household income. Household income in the KLIPS was subdivided into earned income, financial income, real estate income, social insurance income, transfer income, other income, and earned income tax credit. In this research, the equivalized household income was calculated by summing the household income in all areas for the last year and dividing the sum by the square root of the number of

household members. This equivalized household income was divided into quartiles (Q1, lowest income group; Q2; Q3; and Q4, highest income group) for the analysis.

Health Outcome Variable

The health outcome variable was self-rated health. Individual data from the 15th KLIPS were used to assess self-rated health. Self-rated health status was determined by subjects' responses to the question `In general, how would you rate your overall health status?' Response categories were: 1) very good, 2) good, 3) fair, 4) poor, and 4) very poor. Responses of `very good' and `good' were considered indicative of good health, while responses of `poor' and `very poor' were considered to indicate poor health. The proportion of subjects who responded with `poor' and `very poor' was 2.85% of the overall sample. Hence, to take into consideration the fact that the age distribution of the subjects during the time of the survey was young, with a range of 21-41 years old, those who responded with `fair' were also included in the self-rated poor health group.

Statistical Analysis

In the first step of the analysis, the subjects were separated by gender, and the distribution of characteristics of the subjects (age, preschool education experience, parental SEP, and current SEP) was identified (Table 1). The age-adjusted prevalence of self-rated poor health according to preschool education experience was shown in Table 2. Direct age standardization using 5-year age groups was employed with the entire sample as the standard population. In addition, the prevalence ratio (PR) was also produced using the group without preschool education experience as the reference. The distribution of preschool education experiences according to age and SEP indicators was also shown in Table 3, along with an examination of patterns in the PR of self-rated poor health according to preschool education experiences when parental SEP and current SEP indicators were adjusted for (Figure 1Ⓕ) (Table 4). The PR was estimated using a log-binomial regression model and, in cases where the model did not converge, the robust Poisson model (Tables 2 and 4) [17]. SAS version 9.4 (SAS Institute Inc., Cary, NC, USA) was used for all analyses.

RESULTS

Table 1 presents the distribution of study subjects' characteristics (age, preschool education experiences, and parental and current SEP indicators) according to gender. Age, preschool education experiences, and the individual's education level tended to be different between men and women, however, the differences in household income and parental SEPs were not clear. Individuals who received other preschool education accounted for 6.0% of men and women. The percentage of men who had no preschool education experience was higher than that of women (37.3% vs. 34.4%) while the percentage of women who had both kindergarten and other preschool education experiences was higher than that of men (19.9% vs. 24.6%). Of own educational groups, the percentage of individuals who had a university or higher level of education was highest for both men and women. The percentage of those with a university or higher level of education was higher in men than in women (47.8% vs. 40.5%). For the parents' education level, both men and women had a similar pattern, with middle school or less being the most common. Overall, however, the father's education level tended to be higher than that of the mother. Manual occupational class for the main breadwinner was more prevalent than non-manual, and more than 60% of respondents stated 'staying at home' with regards to the employment status of mother at age 3.

Table 2 shows the prevalence of age-adjusted self-rated poor health and associated PR according to preschool education experience. The overall prevalence of self-rated poor health was similar between genders, with a prevalence of 28.4% among men (95% CI, 25.7 to 31.2%) and 28.2% among women (95% CI, 25.8 to 30.8%). The prevalence of age-adjusted self-rated poor health was lowest among respondents who reported both kindergarten and other preschool education in both men and women, followed by those who had a kindergarten education. The prevalence of age-adjusted self-rated poor health tended to be higher in respondents who reported other preschool experience than in those who reported no experience, however, the difference between two groups was not statistically significant. The differences of the prevalence between the groups with different preschool experiences were clearer in men than in women. For example, while a difference of approximately 20 percentage points (%p) was found in the prevalence of self-rated poor health between respondents with both a kindergarten education and other preschool education (21.6%) and those who received other preschool education (41.8%) for men, the equivalent values for women were 26.8 and 31.4% respectively, corresponding to a 4.6%p difference. Table 2 also presents the results of age-adjusted PRs. For men, a statistically

Table 1. Baseline characteristics of study subjects by gender according to preschool education experience and socioeconomic position indicators

	Men	Women	*p*-value
Age (y)			
21-25	232 (21.7)	241 (18.2)	<0.001
26-30	157 (14.7)	214 (16.2)	
31-35	213 (20.0)	365 (27.6)	
36-41	465 (43.6)	504 (38.1)	
Mean±standard deviation	32.8±6.3	32.5±6.1	0.28
Preschool education experience			
No experience	398 (37.3)	455 (34.4)	0.05
Other preschool education	64 (6.0)	79 (6.0)	
Kindergarten education	393 (36.8)	465 (35.1)	
Both kindergarten and other preschool education	212 (19.9)	325 (24.6)	
Own education			
University or higher	510 (47.8)	536 (40.5)	0.002
Junior college or community college education	271 (25.4)	385 (29.1)	
High school or less	286 (26.8)	403 (30.4)	
Equivalized household income quartiles			
Q4 (highest)	267 (25.0)	331 (25.0)	0.91
Q3	260 (24.4)	337 (25.5)	
Q2	273 (25.6)	325 (24.6)	
Q1 (lowest)	267 (25.0)	331 (25.0)	
Father's education			
College or higher	172 (16.1)	190 (14.4)	0.57
High school	401 (37.6)	520 (39.3)	
Middle school or less	479 (44.9)	599 (45.2)	
Do not know/refuse to answer	15 (1.4)	15 (1.1)	
Mother's education			
College or higher	65 (6.1)	71 (5.4)	0.75
High school	319 (29.9)	407 (30.7)	
Middle school or less	671 (62.9)	835 (63.1)	
Do not know/refuse to answer	12 (1.1)	11 (0.8)	
Main breadwinner's occupational class (at age 14)			
Non-manual	409 (38.3)	503 (38.0)	0.87
Manual	583 (54.6)	734 (55.4)	
Refuse to answer	75 (7.0)	87 (6.6)	
Employment status of the mother at age 3			
Working	392 (36.7)	505 (38.1)	0.48
Staying at home	675 (63.3)	819 (61.9)	

Values are presented as number (%).

Table 2. Age-standardized and age-adjusted self rate poor health by gender according to preschool education experience

	Men		Women	
	Prevalence (95% CI)	PR (95% CI)	Prevalence (95% CI)	PR (95% CI)
Overall prevalence of poor health	28.4 (25.7, 31.2)		28.2 (25.8, 30.8)	
No experience	33.5 (28.4, 39.5)	1.00 (reference)	29.0 (24.6, 34.3)	1.00 (reference)
Other preschool education	41.8 (30.6, 57.2)	1.25 (0.87, 1.79)	31.4 (22.4, 43.9)	1.08 (0.74, 1.57)
Kindergarten education	26.0 (22.0, 30.7)	0.78 (0.60, 1.00)	28.5 (24.3, 33.4)	0.98 (0.77, 1.25)
Both kindergarten and other preschool education	21.6 (16.7, 28.0)	0.65 (0.47, 0.89)	26.8 (22.1, 32.6)	0.92 (0.70, 1.22)

PR, prevalence ratio; CI, confidence interval.

Table 3. Study subjects by preschool education experience according to age and socioeconomic position indicators

	No experience	Other preschool education only	Kindergarten education only	Both kindergarten and other preschool education	Total (n)
Age (y)					
21-25	27 (5.7)	25 (5.3)	233 (49.3)	188 (39.8)	473
26-30	29 (7.8)	27 (7.3)	186 (50.1)	129 (34.8)	371
31-35	171 (29.6)	37 (6.4)	250 (43.3)	120 (20.8)	578
36-41	626 (64.6)	54 (5.6)	189 (19.5)	100 (10.3)	969
Own education					
University or higher	233 (22.3)	58 (5.5)	424 (40.5)	331 (31.6)	1046
Junior college or community college education	211 (32.2)	47 (7.2)	257 (39.2)	141 (21.5)	656
High school or less	409 (59.4)	38 (5.5)	177 (25.7)	65 (9.4)	689
Equivalized household income quartiles					
Q4 (highest)	157 (26.3)	34 (5.7)	242 (40.5)	165 (27.6)	598
Q3	213 (35.7)	39 (6.5)	201 (33.7)	144 (24.1)	597
Q2	206 (34.5)	39 (6.5)	217 (36.3)	136 (22.7)	598
Q1 (lowest)	277 (46.3)	31 (5.2)	198 (33.1)	92 (15.4)	598
Father's education					
College or higher	36 (9.9)	11 (3.0)	157 (43.4)	158 (43.7)	362
High school	227 (24.65)	67 (7.3)	364 (39.5)	263 (28.6)	921
Middle school or less	578 (53.6)	63 (5.8)	324 (30.1)	113 (10.5)	1078
Do not know/refuse to answer	12 (40.0)	2 (6.7)	13 (43.3)	3 (10.0)	30
Mother's education					
College or higher	5 (3.7)	5 (3.7)	58 (42.7)	68 (50.0)	136
High school	105 (14.5)	38 (5.2)	322 (44.4)	261 (36.0)	726
Middle school or less	733 (48.7)	99 (6.6)	469 (31.1)	205 (13.6)	1506
Do not know/refuse to answer	10 (43.5)	1 (4.4)	9 (39.1)	3 (13.0)	23
Main breadwinner's occupational class (at age 14)					
Non-manual	220 (24.1)	54 (5.9)	364 (39.9)	274 (30.0)	912
Manual	559 (42.4)	79 (6.0)	441 (33.5)	238 (18.1)	1317
No response	74 (45.7)	10 (6.2)	53 (32.7)	25 (15.4)	162
Employment status of the mother at age 3					
Working	417 (46.5)	39 (4.4)	301 (33.6)	140 (15.6)	897
Staying at home	436 (29.2)	104 (7.0)	557 (37.3)	397 (26.6)	1494

Values are presented as number (%).

significant PR of 0.65 (95% CI, 0.47 to 0.89) was found between those who had no preschool education and those who had both kindergarten and other preschool education. For men, the PR of self-rated poor health was also significantly lower (0.78; 95% CI, 0.60 to 1.00) among those with kindergarten education. The PR of self-rated poor health was a statistically insignificant 1.25 (95% CI, 0.87 to 1.79) in those with other preschool education relative to those with no experience. While the pattern of PRs in women was generally similar to that observed for men, the PRs were statistically insignificant.

Table 3 presents the distribution of preschool education experiences by age, current SEP, and parental SEP. As age increased, the percentage of those with no experience increased, while the percentage of those with both kindergarten and other preschool education increased as age decreased. For example, while the percentage of respondents with no preschool experience between the ages of 21 and 25 was only 5.7%, the corresponding percentage in the 36-41 age group was 64.6%. In contrast, 39.8% of the members of the 21-25 age group had both kindergarten and other preschool education, compared to only 10.3% of the 36-41 age group. As the respondents' own education level decreased, the percentage of those with no experience increased, while as the education level increased, the percentage of those with a kindergarten education (kindergarten education only or both kindergarten and other preschool education) increased. Furthermore, lower household incomes

Table 4. Poor self-rated health by preschool education experiences[1] after adjusting for age (baseline model) and other socioeconomic position (SEP) indicators

	Other preschool education	Kindergarten education	Both kindergarten and other preschool education
Men			
Baseline model (adjusted for age)	1.25 (0.87, 1.79)	0.78 (0.60, 1.00)	0.65 (0.47, 0.89)
Father's education	1.33 (0.92, 1.93)	0.85 (0.66, 1.10)	0.75 (0.54, 1.04)
Mother's education	1.28 (0.89, 1.82)	0.82 (0.64, 1.07)	0.71 (0.51, 0.99)
Main breadwinner's occupational class (at age 14)	1.28 (0.90, 1.83)	0.86 (0.67, 1.11)	0.76 (0.55, 1.05)
The employment status of the mother at age 3	1.25 (0.88, 1.79)	0.77 (0.60, 0.99)	0.64 (0.46, 0.88)
All parental SEP indicators[2]	1.30 (0.85, 1.97)	0.88 (0.65, 1.19)	0.79 (0.52, 1.21)
Household income	1.30 (0.91, 1.87)	0.83 (0.64, 1.07)	0.70 (0.51, 0.98)
Own education level	1.34 (0.94, 1.91)	0.90 (0.70, 1.16)	0.71 (0.52, 0.98)
Current SEP indicators[3]	1.36 (0.95, 1.95)	0.93 (0.72, 1.20)	0.76 (0.55, 1.05)
All SEP indicators[4]	1.36 (0.88, 2.10)	0.99 (0.73, 1.33)	0.87 (0.57, 1.34)
Women			
Baseline model (adjusted for age)	1.08 (0.74, 1.57)	0.98 (0.77, 1.25)	0.92 (0.70, 1.22)
Father's education	1.09 (0.75, 1.59)	1.03 (0.80, 1.31)	1.00 (0.75, 1.33)
Mother's education	1.10 (0.75, 1.60)	1.00 (0.78, 1.28)	0.95 (0.72, 1.26)
Main breadwinner's occupational class (at age 14)	1.10 (0.75, 1.61)	1.01 (0.79, 1.29)	0.97 (0.73, 1.27)
The employment status of the mother at age 3	1.14 (0.78, 1.66)	1.00 (0.78, 1.27)	0.95 (0.72, 1.25)
All parental SEP indicators[2]	1.12 (0.71, 1.78)	1.02 (0.76, 1.37)	0.98 (0.68, 1.42)
Household income	1.12 (0.77, 1.64)	1.03 (0.81, 1.31)	0.98 (0.75, 1.29)
Own education level	1.12 (0.77, 1.64)	1.01 (0.79, 1.30)	0.98 (0.74, 1.30)
Current SEP indicators[3]	1.15 (0.79, 1.68)	1.04 (0.82, 1.33)	1.01 (0.76, 1.33)
All SEP indicators[4]	1.18 (0.75, 1.86)	1.08 (0.80, 1.45)	1.05 (0.73, 1.53)

Values are presented as prevalence ratio (95% confidence interval).
[1]Reference level: no preschool education experience.
[2]A statistical adjustment was made for the father's education, the mother's education, main breadwinner's occupational class (at age 14), and the employment status of the mother at age 3.
[3]A statistical adjustment was made for subjects' own education level and household income.
[4]A statistical adjustment was made for all SEP indicators (parental and own).

were associated with higher percentages of respondents with no experience and lower percentages of respondents with both kindergarten and other preschool education. In addition, as the parent's education level increased, so did the percentage of respondents with kindergarten education, while respondents with parental education being middle school or less showed a relatively higher percentage of no experience with preschool education. Non-manual parental occupation was associated with a higher prevalence of kindergarten education experience. In contrast, manual parental occupation was associated with a higher prevalence of no preschool education experience. With regards to the employment status of the mother at age 3, those who responded that their mother stayed at home had a higher percentage of kindergarten education experience.

Table 4 presents the changes in the PRs of self-rated poor health according to preschool education after adjustments for the parental and current SEP indicators. In men, the PR of self-rated poor health in respondents with both kindergarten and other preschool education relative to that of those with no experience in the baseline model was 0.65 (95% CI, 0.47 to 0.89). When the father's education level and the main breadwinner's occupation were adjusted for, the PR attenuated to 0.75 (95% CI, 0.54 to 1.04) and 0.76 (95% CI, 0.55 to 1.05), respectively. However, when the employment status of the mother at age 3 was adjusted for, the change was meagre, with a PR of 0.64 (95% CI, 0.46 to 0.88). The PR of self-rated poor health in those with both kindergarten and other preschool education after adjusting for parental SEP indicators was 0.79 (95% CI, 0.52 to 1.21), while when the respondent's current SEP was adjusted for, the PR was 0.76 (95% CI, 0.55 to 1.05). When all the socioeconomic position indicators were adjusted for, the PR of self-rated poor health in those with both kindergarten and other

preschool education was 0.87 (95% CI, 0.57 to 1.34), which was statistically insignificant. A similar tendency was found in the PR of self-rated poor health among those with a kindergarten education after adjustments for the SEP indicators. In contrast, the PR of self-rated poor health in those with other preschool education experience tended to be greater than 1, and although the PR showed an increasing tendency after adjustment for both the parental and current SEP indicators, it was statistically insignificant. For women, the PR of self-rated poor health according to preschool education experience was statistically insignificant. However, similar patterns to those observed in men were noted when the parental and current SEPs were adjusted for.

DISCUSSION

In this study, a relationship was found between preschool education experience and adulthood self-rated health. This relationship was clearer in men than in women. For men, the age-adjusted PR of self-rated poor health among those with kindergarten and other preschool education was 0.65 (95% CI, 0.47 to 0.89) compared to those with no experience. However, when parental SEP, which was considered as a confounder in this study, was adjusted for, the PR was 0.79 (95% CI, 0.52 to 1.21), and when current SEP, which was considered as a mediator, was additionally adjusted for, the PR became 0.87 (95% CI, 0.57 to 1.34). Even when the respondents' current education levels were defined based on graduation rather than attendance, the results did not change very much (data not shown). This means that the relationship between preschool education experience and adulthood self-rated health was largely attributable to the confounding effect of parental SEP. In addition, the results of our analysis show that current SEP played as a mediator in the relationship between preschool education experiences and adulthood self-rated health. Lower parental and current SEPs were associated with a higher chance that an individual reported having self-rated poor health (Supplemental Table 1). The PR after adjusting for parental SEP can be viewed as the total effect size of preschool education on self-rated adulthood health. However, due to limitations in sample size, no statistically significant results were found.

The relationship between preschool education and self-rated adulthood health was more distinct in men than in women. A follow-up study of the ABC project also indicated that the difference in adulthood health indicators between the group with childhood education intervention and the group without was clearer in men than in women [9]. It has also been reported that the relationship between childhood SEP and cause-specific mortality has different pattern according to gender. [18]. Additional research is required to understand the magnitude of the influence of preschool education on adulthood health and to see if the mechanism differs between men and women.

The self-rated health of respondents with other preschool education was poorer than that of those with no experience. This pattern was true in both men and women. It is possible that in household environments where both parents must engage in economic activity but have limited access to official educational institutions like kindergartens for their children, other preschool education such as private tutoring would be a alternative way to solve the lack of parenting. In addition, according to a recent study in South Korea, tutoring that does not consider the child's developmental status was rather detrimental [19,20]. Hence, for children who received only tutoring without kindergarten education, the possibility that the tutoring was provided in a way that is unhelpful to child development must be taken into consideration when interpreting our results.

Meanwhile, respondents with both kindergarten and other preschool education had a lower prevalence of self-rated poor health than those with kindergarten education only. This indicates the possibility that the quality of the education provided to children who receive both kindergarten and other preschool education may be different from that of the education offered to children who receive only other preschool education. However, the KLIPS did not contain the necessary information required to evaluate the quality of other forms of preschool education. In our additional analysis (Supplemental Table 2) that classified participants into groups with a kindergarten education and without a kindergarten education, the PR of self-rated poor health in men in the kindergarten education group was 0.70 (95% CI, 0.56 to 0.87) in the age-adjusted baseline model. When all the SEPs were adjusted for, the PR was 0.84 (95% CI, 0.67 to 1.05). These findings suggest that that kindergarten education might have a positive effect on adulthood health (Supplemental Table 1).

Parental SEP can be seen as a confounder in the relationship between preschool education experience and self-rated health. Children from households with a high parental SEP were found to be more likely to have preschool education experience. In addition, parental SEP can affect an individual's self-rated health. According to the results of our analysis, the

main breadwinner's occupation and the father's education level had a relatively higher confounding effect than the other indicators. This appeared to be true for both men and women (Table 4). The education level of the father, who is generally the main breadwinner, is an important SEP indicator regarding the household's level of wealth, which might well affect the preschool education experience of a child. Adjusting for the employment status of the mother at age 3 did not make much difference in the relationship between preschool education experience and self-rated health for men.

Korean women who have completed higher education in the past might not appear in a job market after a marriage with a man with a high SEP (homogamy). While, it is possible for some Korean women to enter into a job market due to difficult household economic conditions. In addition, it is also possible for women who received higher education to be economically active for her social achievements. Since the women analyzed in this study who were engaged in economic activity came from a variety of social backgrounds, the effect of the maternal employment status on the relationship between preschool education experience and self-rated health might have been weak. Furthermore, current SEP was a mediator affecting how preschool education experience influences adulthood self-rated health (Figure 1). The mediating effect of the individual's education and household income, which were used as indicators for subjects' current SEP, was similar for both men and women.

This research is meaningful because, to the best of our knowledge, this is the first Asian study to evaluate the relationship between preschool education experiences and adulthood health. Furthermore, it also has the strength of utilizing a data source (KLIPS) representative of the overall population. However, this study has a few limitations. First, the information provided about preschool education experiences in this study did not include indicators regarding the quality of the education. However, when considering that a kindergarten is an educational institution managed by the Primary Education Act/ Children Education Promotion Act, the categorization of preschool educational institutions as the main educational group would be reasonable. Second, the KLIPS does not contain objective health data, such as biomedical parameters.

Hence, adulthood health could only be evaluated using self-rated poor health in this study. Research using more diverse and objective adulthood health indicators is required in the future. Third, because the individual's own education level and the parental SEPs were collected based on recall, they may not be entirely accurate. However, some studies have argued that the use of recalled early childhood information tended to show a reduced impact of early childhood SEP on future health than was found when using historical information in life-course studies [21,22]. This suggests that the health effects of preschool education experience measured in this study may have been underestimated. Fourth, this study did not assess the effects of other mediators, such as health behaviors.

This study examined the relationships between preschool education experiences and self-rated poor health using data from the KLIPS. For men, a lower age-adjusted prevalence of self-rated poor health was found in subjects with kindergarten education experience than in subjects without kindergarten education. However, the relationship between preschool education experience and adulthood health was not statistically significant when the parental SEPs were adjusted for. In a situation where preschool education is expanding, the implications of research regarding the casual relationship between the quality of preschool education and adulthood health are tremendous. Subsequent research using objective adulthood health outcome indicators with sufficient sample sizes and information regarding the quality and time of preschool education is required.

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CONFLICT OF INTEREST

The authors have no conflicts of interest associated with the material in this paper.

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REFERENCES

1. Barker DJ. The fetal and infant origins of adult disease. BMJ 1990;301(6761):1111.
2. Barker DJ, Osmond C, Forsén TJ, Kajantie E, Eriksson JG. Trajec-

tories of growth among children who have coronary events as adults. N Engl J Med 2005;353(17):1802-1809.
3. Gillman MW, Barker D, Bier D, Cagampang F, Challis J, Fall C, et al. Meeting report on the 3rd International Congress on Developmental Origins of Health and Disease (DOHaD). Pediatr Res 2007;61(5 Pt 1):625-629.
4. Shonkoff JP, Phillips DA, editors. From neurons to neighborhoods: the science of early childhood development. Washington, DC: National Academies Press; 2000, p. 182-218.
5. Calvin CM, Deary IJ, Fenton C, Roberts BA, Der G, Leckenby N, et al. Intelligence in youth and all-cause-mortality: systematic review with meta-analysis. Int J Epidemiol 2011;40(3):626-644.
6. Moffitt TE, Arseneault L, Belsky D, Dickson N, Hancox RJ, Harrington H, et al. A gradient of childhood self-control predicts health, wealth, and public safety. Proc Natl Acad Sci U S A 2011;108(7):2693-2698.
7. Shonkoff JP, Boyce WT, McEwen BS. Neuroscience, molecular biology, and the childhood roots of health disparities: building a new framework for health promotion and disease prevention. JAMA 2009;301(21):2252-2259.
8. World Health Organization. Early child development: a powerful equalizer; 2007 [cited 2017 Jun 10]. Available from: http://www.who.int/maternal_child_adolescent/documents/ecd_final_m30/en/.
9. Campbell F, Conti G, Heckman JJ, Moon SH, Pinto R, Pungello E, et al. Early childhood investments substantially boost adult health. Science 2014;343(6178):1478-1485.
10. D'Onise K, Lynch JW, McDermott RA. Does an early childhood intervention affect cardiometabolic risk in adulthood? Evidence from a longitudinal study of preschool attendance in South Australia. Public Health 2012;126(8):682-689.
11. D'Onise K, Lynch JW, Sawyer MG, McDermott RA. Can preschool improve child health outcomes? A systematic review. Soc Sci Med 2010;70(9):1423-1440.
12. Muennig P. Can universal pre-kindergarten programs improve population health and longevity? Mechanisms, evidence, and policy implications. Soc Sci Med 2015;127:116-123.
13. Phang H, Kim G. Change and inheritance: the structure and process of social status achievement in Korea. Korean J Sociol 2001;35(3):1-30 (Korean).
14. Kim M, Chung W, Lim S, Yoon S, Lee J, Kim E, et al. Socioeconomic inequity in self-rated health status and contribution of health behavioral factors in Korea. J Prev Med Public Health 2010;43(1):50-61 (Korean).
15. Khang YH. Relationship between childhood socio-economic position and mortality risk in adult males of the Korea Labour and Income Panel Study (KLIPS). Public Health 2006;120(8):724-731.
16. Korea Labor Institute. Korean Labor & Income Panel Study (KLIPS) [cited 2016 Sep 6]. Available from: https://www.kli.re.kr/klips/contents.do?key=137 (Korean).
17. Richardson DB, Kinlaw AC, MacLehose RF, Cole SR. Standardized binomial models for risk or prevalence ratios and differences. Int J Epidemiol 2015;44(5):1660-1672.
18. Galobardes B, Lynch JW, Smith GD. Is the association between childhood socioeconomic circumstances and cause-specific mortality established? Update of a systematic review. J Epidemiol Community Health 2008;62(5):387-390.
19. Woo NH, Kim YM, Shin ES. Early private learning. Korean J Child Stud 2009;30(6):249-265 (Korean).
20. Baek HJ, Kim HS, Woo NH. A study on the behavioral problems of preschoolers who experienced early supplementary education. Korea J Child Care Educ 2005;43:23-43 (Korean).
21. Kauhanen L, Lakka HM, Lynch JW, Kauhanen J. Social disadvantages in childhood and risk of all-cause death and cardiovascular disease in later life: a comparison of historical and retrospective childhood information. Int J Epidemiol 2006;35(4):962-968.
22. Galobardes B, Lynch JW, Davey Smith G. Childhood socioeconomic circumstances and cause-specific mortality in adulthood: systematic review and interpretation. Epidemiol Rev 2004;26:7-21.

Supplemental Table 1. Poor self-rated health according to socioeconomic position (SEP) indicators by gender

	Univariate (age adjusted)	All parental socioeconomic position indicators	All own socioeconomic position indicators	Overall indicators
Men				
Parental SEP indicators				
Father's education				
College or higher	1.00 (reference)	1.00 (reference)		1.00 (reference)
High school	1.37 (0.99, 1.88)	1.27 (0.71, 2.29)		1.24 (0.69, 2.23)
Middle school or less	1.94 (1.42, 2.65)	1.71 (0.90, 3.22)		1.54 (0.81, 2.96)
Do not know/refuse to answer	2.60 (1.32, 5.11)	2.21 (0.95, 5.10)		1.84 (0.81, 4.20)
Mother's education				
College or higher	1.00 (reference)	1.00 (reference)		1.00 (reference)
High school	1.21 (0.76, 1.93)	0.89 (0.43, 1.83)		0.86 (0.42, 1.76)
Middle school or less	1.65 (1.05, 2.60)	0.91 (0.41, 1.99)		0.85 (0.39, 1.86)
Do not know/refuse to answer	2.34 (1.04, 5.29)	1.19 (0.44, 3.22)		0.99 (0.34, 2.83)
Father's occupational class (at age 14)				
Non-manual	1.00 (reference)	1.00 (Reference)		1.00 (Reference)
Manual	1.72 (1.38, 2.13)	1.52 (1.11, 2.07)		1.46 (1.07, 1.99)
No response	0.98 (0.62, 1.55)	0.89 (0.51, 1.58)		0.85 (0.48, 1.49)
Employment status of the mother at age 3				
Working	1.00 (reference)	1.00 (reference)		1.00 (reference))
Staying at home	1.09 (0.89, 1.33)	1.23 (0.96, 1.57)		1.24 (0.98, 1.57)
Current SEP indicators				
Own education				
University or higher	1.00 (reference)		1.00 (reference)	1.00 (reference)
Junior college or community college education	1.05 (0.81, 1.36)		1.00 (0.77, 1.30)	0.92 (0.66, 1.28)
High school or less	1.83 (1.49, 2.25)		1.74 (1.41, 2.17)	1.50 (1.13, 1.99)
Equivalized household income quartiles				
Q4 (highest)	1.00 (reference)		1.00 (reference)	1.00 (reference)
Q3	1.39 (1.05, 1.85)		1.33 (1.00, 1.76)	1.30 (0.91, 1.84)
Q2	1.31 (0.98, 1.75)		1.17 (0.88, 1.57)	1.13 (0.76, 1.66)
Q1 (lowest)	1.49 (1.13, 1.95)		1.29 (0.98, 1.71)	1.21 (0.86, 1.71)
Women				
Parental SEP indicators				
Father's education				
College or higher	1.00 (reference)	1.00 (reference)		1.00 (reference)
High school	1.34 (1.00, 1.79)	1.39 (0.89, 2.16)		1.36 (0.88, 2.12)
Middle school or less	1.40 (1.04, 1.88)	1.48 (0.88, 2.48)		1.39 (0.83, 2.32)
Do not know/refuse to answer	1.28 (0.48, 3.44)	1.30 (0.50, 3.37)		1.09 (0.42, 2.78)
Mother's education				
College or higher	1.00 (reference)	1.00 (reference)		1.00 (reference)
High school	1.15 (0.77, 1.73)	0.91 (0.48, 1.75)		0.91 (0.47, 1.77)
Middle school or less	1.21 (0.81, 1.81)	0.81 (0.41, 1.60)		0.81 (0.41, 1.62)
Do not know/refuse to answer	0.64 (0.12, 3.53)	0.44 (0.07, 2.78)		0.43 (0.07, 2.60)
Father's occupational class (at age 14)				
Non-manual	1.00 (reference)	1.00 (reference)		1.00 (reference)
Manual	1.16 (0.96, 1.41)	1.08 (0.83, 1.39)		1.04 (0.80, 1.34)
No response	1.23 (0.86, 1.76)	1.19 (0.79, 1.79)		1.14 (0.76, 1.70)
Employment status of the mother at age 3				
Working	1.00 (reference)	1.00 (reference)		1.00 (reference))
Staying at home	0.84 (0.71, 1.01)	0.87 (0.69, 1.09)		0.87 (0.69, 1.09)
Current SEP indicators				
Own education				
University or higher	1.00 (reference)		1.00 (reference)	1.00 (reference)
Junior college or community college education	1.00 (0.80, 1.25)		0.95 (0.76, 1.18)	0.94 (0.71, 1.24)
High school or less	1.24 (1.00, 1.55)		1.11 (0.89, 1.40)	1.09 (0.82, 1.45)
Equivalized household income quartiles				
Q4 (highest)	1.00 (reference)		1.00 (reference)	1.00 (reference)
Q3	1.45 (1.11, 1.91)		1.45 (1.10, 1.90)	1.40 (1.01, 1.94)
Q2	1.32 (1.00, 1.75)		1.31 (0.98, 1.74)	1.25 (0.87, 1.79)
Q1 (lowest)	1.70 (1.31, 2.20)		1.64 (1.25, 2.16)	1.60 (1.14, 2.24)

Values are presented as prevalence ratio (95% confidence interval).

Supplemental Table 2. Poor self-rated health by kindergarten experience[1] after adjustment for age (baseline model) and other socioeconomic position (SEP) indicators

	Kindergarten education
Men	
Baseline model (adjusted for age)	0.70 (0.56, 0.87)
Father's education	0.77 (0.61, 0.96)
Mother's education	0.75 (0.59, 0.94)
Main breadwinner's occupational class (at age 14)	0.78 (0.63, 0.98)
Employment status of the mother at age 3	0.69 (0.55, 0.86)
All parental SEP indicators[2]	0.82 (0.66, 1.02)
Household income	0.83 (0.64, 1.07)
Own education level	0.74 (0.59, 0.93)
Current SEP indicators[3]	0.81 (0.65, 1.02)
All SEP indicators[4]	0.84 (0.67, 1.05)
Women	
Baseline model (adjusted for age)	0.94 (0.76, 1.16)
Father's education	1.00 (0.80, 1.24)
Mother's education	0.96 (0.77, 1.19)
Main breadwinner's occupational class (at age 14)	0.97 (0.79, 1.20)
Employment status of the mother at age 3	0.95 (0.77, 1.18)
All parental SEP indicators[2]	1.00 (0.80, 1.24)
Household income	0.99 (0.80, 1.22)
Own education level	0.98 (0.79, 1.21)
Current SEP indicators[3]	1.00 (0.81, 1.24)
All SEP indicators[4]	1.04 (0.83, 1.29)

Values are presented as prevalence ratio (95% confidence interval).
[1]Reference level: no kindergarten experience.
[2]A statistical adjustment was made for the father's education, the mother's education, main breadwinner's occupational class (at age 14), and the employment status of the mother at age 3.
[3]A statistical adjustment was made for subjects' own education level and household income.
[4]A statistical adjustment was made for all SEP indicators (parental and own).