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Original Research

Does maternal age at childbirth and parity have any effect on hearing loss? The 2008-2012 Korean National Health and Nutrition Examination Survey

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Summary

Objective: This study aimed to assess hearing loss according to maternal age at childbirth and parity. *Materials and Methods:* The data used in this study were obtained from the 2008-2012 Korean National Health and Nutrition Examination Survey. This study included a total of 3,961 females that were subdivided into groups of unilateral and bilateral hearing loss. Pure tone threshold above 40 dB was defined as hearing loss. T-tests or Chi-squared tests were performed to identify differences in baseline clinical characteristics. A multivariate regression and multivariate logistic regression analysis were used to identify associations between childbearing age and hearing loss. *Result:* Bilateral hearing loss was significantly higher in women with younger age at first birth and older age at last birth. Bilateral hearing loss patients had higher parity than unilateral hearing loss patients, and unilateral hearing loss patients had higher parity than normal hearing group. Age at first childbirth showed a positive relationship with hearing loss after adjusting for lifestyle factors. Age at last childbirth also showed a positive relationship with hearing loss after adjusting for life style factors. Parity showed a positive relationship with hearing loss after adjusting for life style factors. *Conclusion:* This study suggests that hearing loss is increased in females who experienced their first childbirth at a younger age or their last childbirth at a later age. Bilateral and unilateral hearing loss also have positive correlation with higher parity. Some studies suggest that estrogen has a protective effect on hearing function. Because childbearing age and parity could be related to the women's estrogen level, future studies will be access the relationship between childbearing age and hearing loss, or the relationship between parity and hearing loss due to an effect of estrogen.

Key words: Parity; Maternal age; Childbirth; Hearing loss.

Introduction

Hearing function, especially in old age (presbycusis) is important to the quality of life in an aging society. There are many studies aiming to identify the related risk factors of hearing loss [1-5], but only few studies are focusing on the relationship between the maternal age at childbirth and hearing loss. Therefore, the authors investigated the associations of maternal age or parity with hearing loss in large number of Korean population.

Epidemiologic studies conducted by government with national scale can provide powerful data for investigating the prevalence of disease and relationship between the disease and the epidemiological factors. The Korea National Health and Nutrition Examination Survey (KNHANES) was started in 1998 to examine the general health and nutrition status of populations in South Korea. From 2008 to 2012, 10,000–12,000 individuals were selected annually, and they were interviewed on their health and nutrition and asked to undergo a basic health assessment which included blood pressure measurements, blood and urine collection, a pulmonary function test, a dental examination, an ophthalmologic examination, and an otolaryngologic examination. This study was undertaken to determine the associations of maternal age or parity with hearing loss in South Korea based on the survey data obtained from the 2008 to 2012 KNHANES.

The relationship between the maternal age at childbirth and hearing loss, or the parity and hearing loss was not evaluated. Only the relationship between the estrogen and hearing loss has been evaluated in few studies [6, 7]. Estrogen, progesterone, and other hormones during pregnancy increase significantly than in non-pregnant females [8]. Therefore, higher parity could be related to the longer and intensive exposure of estrogen. In this study, the relationship between the maternal age at childbirth (or parity) and hearing loss has been evaluated with powerful number of participants, thus the authors attempted to formulate a cautious suggestion of the relationship between the female hormone level and hearing loss.

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Materials and Methods

Written informed consent was obtained from all participants prior to the survey. The present study was reviewed and approved by the Institutional Review Board of the Catholic University of Korea in Seoul, Korea.

The data obtained from the 2008–2012 Korea National Health and Nutrition Examination Survey (KNHANES) were analyzed in this study. The KNHANES is designed to accurately assess the health and nutritional status of the non-institutionalized civilian population of Korea and has been conducted annually since 1998 by the Division of Chronic Disease Surveillance, Korea Centers for Disease Control and Prevention (KCDC). This study included a total of 3,961 females from the collected data of KNHANES. The participants were subdivided into groups of unilateral and bilateral hearing loss. Then they were analyzed by their age of the first birth and the last birth and also their parity. Pure tone threshold above 40 dB was defined as hearing loss.

Statistical analyses were performed using the SAS survey procedure (ver. 9.3) to reflect the complex sampling design and sampling weights of KNHANES and to provide nationally representative prevalence estimates. *T*-tests or Chi-squared tests were performed to identify differences in baseline clinical characteristics. Multivariate regression and multivariate logistic regression analyses were used to identify associations between childbearing age and hearing loss. *P*-values under 0.05 were considered as significant.

Results

The baseline clinical characteristics of the study population are shown in Table 1. No relationship was observed between the epidemiological factors like BMI, current smoking, regular exercise, and the bilateral sensorineural hearing loss according to the simple regression analysis. However, factors like age, greater than a high school education, parity, age at first childbirth, and age at last birth were significantly associated with bilateral hearing loss, which were defined as pure tone threshold level above 40 dB.

Table 2 shows multivariate regression analysis performed to assess the relationship between the maternal age at childbirth (first or last) and hearing threshold, or relationship between the parity and the hearing threshold. They were analyzed according to the hearing frequency from 500 Hz to 6,000 Hz.

Maternal age of first childbirth showed a negative relationship with hearing threshold at all frequency. On the other hand, maternal age of last childbirth showed a positive relationship with hearing threshold at all frequency. Parity showed a positive relationship with hearing threshold at all frequency, implying that higher parity could be an independent risk factor for bilateral sensorineural hearing loss.

Table 3 shows the results of the multivariate logistic regression analysis of the relationship between maternal age and bilateral hearing loss. Age at first childbirth showed a generally positive relationship with hearing loss after adjusting for life style factors, although it was statistically insignificant (model 1, 2, and 3). Age at last childbirth also showed a generally positive relationship with hearing loss after adjusting for life style factors although it was statistically insignificant (model 1, 2, and 3). Parity showed a generally positive relationship with bilateral sensorineural hearing loss after adjusting for lifestyle factors although it was statistically insignificant (model 1, 2, and 3). Especially higher parity above 3 and 4 (model 3) showed a significantly positive relationship with bilateral sensorineural hearing loss.

Table 1. — *Baseline clinical characteristics of the study population.*

	Bilateral sensorineural hearing loss		
	No	Yes	*p*
N	3,583	378	< 0.001*
Age (years)	62.2±0.2	73.6±0.5	0.001*
Body mass index (kg/m^2)	24.3±0.1	23.6±0.2	< 0.001*
Age of first birth (years)	24±0.1	22.5±0.2	< 0.001*
Age of last birth (years)	30.4±0.1	33±0.3	< 0.001*
Parity	3.16±0.04	4.4±0.1	0.2505
Current smoker (%)	5.2(0.6)	7.2(1.9)	0.0026
Drink(month)	27.8(0.9)	19.1(2.4)	0.1959
Regular physical exerciser (%)	15.5(0.8)	12.3(2.2)	0.0638
Education(%)	25.1(1.1)	6.1(1.5)	<.0001*

*Data are presented as means ± standard error (SE) or percentage (SE). *Significant at p < 0.05, obtained by Student's t-test or chi-square test.*

To piece the results of Tables 2 and 3 together, the authors could draw a constant result that the higher parity has a positive relationship with bilateral sensorineural hearing loss. Another result shown from Tables 2 and 3 is that the first childbirth at a younger age and the last childbirth at a later age have a positive relationship with bilateral sensorineural hearing loss. These results can also be found in Figure 1. In Figure 1, bilateral sensorineural hearing loss women have the tendency of a younger age at the first childbirth, an older age at the last childbirth, and a higher parity than unilateral sensorineural hearing loss. The authors carefully suggest the possibility that the younger the age at the first childbirth, the older the age at the last childbirth, and the higher the parity could influence the more affected side of hearing loss.

Discussion

This study suggests that hearing loss is increased in females who experienced their first childbirth at a younger age or their last childbirth at a later age. Bilateral and unilateral hearing loss also have a positive correlation with higher parity. The individual maternal age of childbirth and parity should change the period of their exposure of female hormones. The results from this study suggest the possibility of the relationship of the hearing loss and female hormones, especially estrogen.

Several studies investigated the relationship between es-

Table 2. — *Multivariate regression analysis of maternal age, parity. and bilateral hearing loss.*

	Age of first birth			Age of last birth			Parity		
Hz	Beta	S.E	*p*	Beta	S.E	*p*	Beta	S.E	*p*
500	-0.79	-0.19	<0.0001*	0.59	0.2	<0.0001*	2.73	0.31	<.0001*
1,000	-0.9	-0.21	<0.0001*	0.62	0.19	<0.0001*	2.94	0.31	<.0001*
2,000	-0.94	-0.2	<0.0001*	0.77	0.22	<0.0001*	3.43	0.34	<.0001*
3,000	-1.11	-0.22	<0.0001*	0.9	0.24	<0.0001*	4.04	0.36	<.0001*
4,000	-1.18	-0.22	<0.0001*	1.02	0.25	<0.0001*	4.41	0.37	<.0001*
6,000	-1.46	-0.23	<0.0001*	1.22	0.26	<0.0001*	5.27	0.38	<.0001*

*S.E : standard error. * Significant at p <0.05, obtained by linear regression analyses.*

Table 3. — *Odds ratios (95% confidence intervals) of relationship between maternal age, parity, and bilateral hearing loss.*

	Model 1	Model 2	Model 3
First birth age (years)			
> 30	1.068 (0.495,2.305)	1.037 (0.477,2.251)	1.01 (0.433,2.358)
25-29	1.024 (0.638,1.646)	1.014 (0.627,1.638)	1.087 (0.653,1.809)
20-24	0.961 (0.631,1.462)	0.956 (0.623,1.466)	0.96 (0.613,1.502)
< 19	1	1	1
Last birth age(years)			
> 35	1.136 (0.546,2.365)	1.162 (0.548,2.467)	1.065 (0.488,2.323)
30-34	0.924 (0.439,1.944)	0.941 (0.438,2.023)	0.94 (0.431,2.05)
25-29	0.969 (0.459,2.048)	0.993 (0.461,2.138)	0.997 (0.454,2.186)
< 24	1	1	1
Parity			
1	1	1	1
2	1.559 (0.679,3.58)	1.566 (0.663,3.696)	1.785 (0.702,4.539)
3	2.165 (0.945,4.962)	2.247 (0.955,5.287)	2.68 (1.05,6.836)*
> 4	2.304 (1.044,5.085)*	2.43 (1.068,5.531)*	2.848 (1.14,7.116)*

Model 1: non-adjusted. Model 2: Model 1 plus adjustments for age and BMI. Model 3: Model 2 plus adjustments for more lifestyle factors (age, BMI, smoke, drink, exercise, education, income, stress). Significant at p < 0.05, obtained by linear regression analyses.*

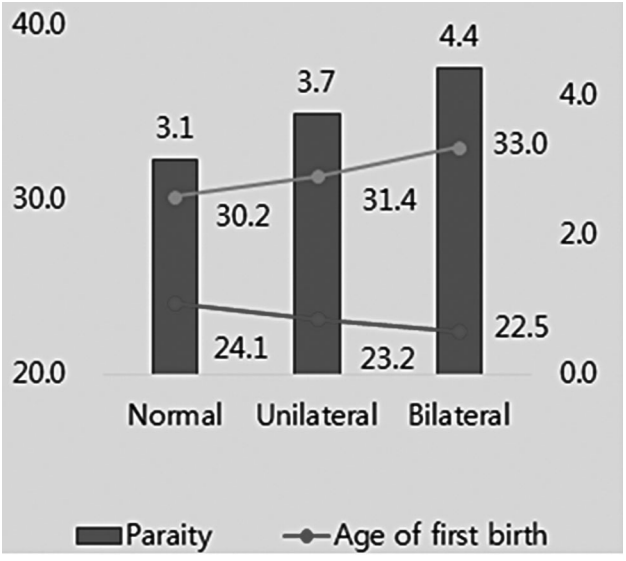

Figure 1. — Mean maternal age and parity in normal, unilateral hearing loss, and bilateral hearing loss patients.

trogen and hearing loss [6-8]. These studies generally suggest that the lower estrogen level is related to the hearing loss. Estrogen receptor-β seems to be important for maintaining normal inner ear function and may have a protective effect on hearing. For example, in Turner's syndrome (45,X) patients, who generally have defective estrogens due to ovarian dysgenesis, ear and hearing problems are common. There have also been some case reports of estrogen giving rise to sudden hearing loss after use of the oral contraceptive pill [9] and HRT. The results of these studies do not match the results of the present study, because the higher parity would imply the longer and intensive exposure of estrogen as mentioned above. However, these studies including the present have value in the sense that these trials could open a new prospect for the treatment of hearing loss, especially in sudden sensorineural hearing loss. Studies investigating the relationship between the female hormone and the hearing loss, and by extension, the relationship between the sex hormone and the hearing loss will be promising area for the hearing loss in both age-related and other pathological conditions.

In this study, bilateral and unilateral sensorineural hearing loss seems to increase in females who experience their first childbirth at a younger age or their last childbirth at a later age. Bilateral and unilateral sensorineural hearing loss also have a positive correlation with higher parity. These

data suggest that childbearing age and parity could be an independent risk factors for hearing loss, and the possibility of the relationship of estrogen and sensorineural hearing loss, future studies will be required to reveal the further pathophysiological mechanism and new concept of hormonal treatment for the hearing loss.

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