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Assessing maternity care access: impacts on cesarean sections and dystocia

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Abstract

Background As South Korea grapples with a declining birthrate, maternity care accessibility has become challenging. This study examines the association with labour intervention and pregnancy complication, specifically focusing on C-section and dystocia in maternity disparities.

Methods Data from the South Korean NHIS-NID was used to analyze 1,437,186 women with childbirths between 2010 and 2015. The research defines 50 specific districts as Obstetrically Underserved Areas produced by the Ministry of Health and Welfare in 2011. C-Section were assessed through using medical procedure and DRG codes, while dystocia was defined using ICD-10 code. Logistic regression analysis was used to examine the significance of the association.

Results Among the population residing in underserved areas, 42,873 out of a total of 1,437,186 individuals were identified. For nationwide cases, the odds ratios (ORs) for C-Section were 1.11 (95% CI: 1.08–1.13) and dystocia were 1.07 (95% CI: 1.05–1.09). In relatively accessible urban areas, the ORs for C-Section and dystocia, based on whether they were obstetrically underserved areas, were 1.16 (95% CI: 1.13–1.18) and 1.10 (95% CI: 1.08–1.19), respectively.

Conclusion Poor accessibility to maternity care facilities is closely linked to high-risk pregnancies, including an increased incidence of dystocia and a higher rate of C-sections. Insufficient access to maternity care not only raises the risk of serious pregnancy complications. Consequently, there is a pressing need for multi-faceted efforts to bridge this disparity.

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Background

While the majority of pregnancies and births proceed without complications, it's important to recognize that all pregnancies carry some level of risk [1]. Around 15% of pregnant women will encounter a potentially life-threatening complication that requires skilled care, and some may need substantial obstetrical interventions to ensure survival [2]. The prompt identification and effective management of factors contributing to the escalation from severe maternal morbidity to mortality have the capacity to significantly enhance pregnancy care and avert tragic outcomes [3]. One contributing factor is maternity care access, which could be a key element in mitigating the negative outcomes.



The Republic of Korea faces the challenge of having the lowest fertility rate globally, recording a total fertility rate of 0.77 in 2023 [4]. This, exacerbated by factors such as a low service fee for delivery, a decline in obstetricians due to concerns about medical disputes, a perceived lack of quality of life [5], low profitability [6] has resulted in the closure of many maternal hospitals in rural areas. In response to this issue, the Korean government introduced a financial support program in 2011 aimed at establishing maternal hospitals in “Obstetrically Underserved Areas (OUA)” [7]. Despite these efforts, maternal services continue to decline, resulting in poorer health outcomes for those in vulnerable areas and increased expenditures related to prenatal and medical care for patients.

Since the initiation of the Obstetrically Underserved Area (OUA) program in 2011, over a decade has passed. During this period, the South Korean birth rate has reached a new historic low, and the the OUA program has expanded to include new areas. While previous studies have explored aspects of the OUA program, such as service satisfaction through qualitative studies [6] and related reports on program outcomes [8], there has been a notable absence in examining actual pregnancy complication or labour intervention. Given that the program has spanned over a decade, there is an imperative to assess the real impact of maternity access on pregnancy complication and labour intervention. The primary objective of our study was to identify the association between maternity care access, labor interventions, and pregnancy complications, with a specific focus on cesarean sections (C-sections) and dystocia.

Methods

Data and study population

The study utilized data sourced from the South Korean National Health Insurance Service National Health Information Database (NHIS-NHID) spanning the years 2002 to 2020. The NHIS provides comprehensive support for academic and policy-related health and medical research. The NHID encompasses a wealth of information, including eligibility status, insurance rates, medical examination outcomes, treatment details derived from claim data, and information on medical facilities [9].

For the study, a customized dataset extracted from the NHIS was utilized, focusing on South Korean women who gave birth between 2010 and 2015. Information that could be used to identify specific participants either during or after data collection is not available to the authors. A total of 3,272,358 individuals with claims featuring delivery-related codes (procedure codes, Diagnosis Related Group (DRG) codes, or ICD-10 codes) between 2010 and 2015 were initially considered. Exclusions were made for individuals born outside the specified timeframe or those with missing birth year information.

Ultimately, the analysis focused on the final cohort of 1,437,186 women who gave birth between 2010 and 2015.

Variables

The variable of interest in this study was Obstetrically Underserved Areas (OUAs), which was defined by the Ministry of Health and Welfare based on two criteria: (1) where the proportion of pregnant people delivering at a maternal hospital reachable within 60 min is less than 30%, or (2) where the proportion of fertile women unable to reach a maternal hospital within 60 min is more than 30%. Geographic Information System (GIS) was used to estimate distance and time, with public transportation as the basis for travel time calculation. In this study, pregnant individuals residing in OUAs were classified as living in OUAs.

The primary dependent variable was labor interventions, which included Cesarean section (C-section) as identified by medical procedures and Diagnosis Related Group (DRG) codes, and for pregnancy complications, dystocia defined by ICD-10 codes ('O33', 'O34', 'O65', 'O66'). The inclusion of C-section in the Diagnosis Related Group (DRG) code began in 2002. However, until June 2012, its participation was optional. From July 2012, primary hospitals were mandated to adopt DRG, while tertiary hospitals had to implement DRG from July 2013 [10]. The other covariates include age (18–24, 25–29, 30–34, 35–39, those over 40), national medical insurance status (corporate, regional, medical aid), maternal year (2011, 2012, 2013, 2014, 2015), malformation and malpresentation.

Statistical analyses

The study population's overall characteristics were assessed using chi-squared tests and univariate analysis. Employing the logistic regression analysis, we investigated the association between maternity care access and c-sections and dystocia adjusting for covariates. Access to maternity care was examined between OUA and non-OUA regions nationwide, as well as between OUA and metropolitan areas. Results were reported using odds ratios (OR) and 95% confidence intervals (CI). All statistical analyses were conducted with SAS version 9.4 Enterprise (SAS Institute, Cary, NC), and all *P*-values were two-sided with a significance level of 0.05.

Results

Table 1 presents the result of the general characteristics according to the Obstetrically Underserved Areas. Among the 1,437,186 participants, those who gave birth in Obstetrically Underserved Areas were 42,873 (2.8%) and those who did not were 1,394,313 (97.3%).

Table 2 presents the results of logistic regression analyses for all variables, comparing individuals across the

Table 1 General characteristics of the study population

Variables	Obstetrically Underserved Areas				P-value
	No		Yes		
	N	%	N	%	
Total	1,394,313	97.3	42,873	2.8	
Age (years)					
18–24	87,644	6.3	5,286	12.3	<0.0001
25–29	396,246	28.4	14,036	32.7	
30–34	657,039	47.1	16,896	39.4	
35–39	222,447	16.0	5,698	13.3	
≥ 40	30,937	2.2	957	2.2	
National Medical Insurance Status					
Corporate	444,575	31.9	18,198	42.4	<0.0001
Regional	610,225	43.8	17,021	39.7	
Medical aid	339,513	24.3	7,654	17.9	
Malformation					
No	1,305,839	93.7	40,445	94.3	<0.0001
Yes	88,474	6.3	2,428	5.7	
Malpresentation					
No	1,312,201	94.1	40,719	95.0	<0.0001
Yes	82,112	5.9	2,154	5.0	

Table 2 Logistic regression analysis on pregnancy complications according to Obstetrically Underserved areas comparing nationwide

Variables	Outcomes*			
	C-Section		Dystocia	
	OR	95% CI	OR	95% CI
Obstetrically Underserved Areas				
No	1.00		1.00	
Yes	1.11	(1.08-1.13)	1.07	(1.05-1.09)
Maternal Year				
18–24	1.00		1.00	
25–29	1.29	(1.27-1.32)	1.25	(1.23-1.28)
30–34	1.61	(1.59-1.64)	1.47	(1.45-1.50)
35–39	2.28	(2.23-2.32)	1.88	(1.85-1.92)
≥ 40	3.48	(3.38-3.58)	2.45	(2.38-2.52)
National Medical Insurance Status				
Corporate	1.00		1.00	
Regional	1.18	(1.17-1.19)	1.11	(1.10-1.12)
Medical aid	1.20	(1.14-1.26)	1.05	(1.00-1.10)
Malformation				
No	1.00		1.00	
Yes	2.00	(1.97-2.03)	0.65	(0.64-0.67)
Malpresentation				
No	1.00		1.00	
Yes	6.57	(6.46-6.68)	0.82	(0.80-0.83)

*Adjusted with all covariates

Table 3 Logistic regression analysis on pregnancy complications according to Obstetrically Underserved areas comparing to capital and metropolitan cities

Variables	Outcomes*			
	C-Section		Dystocia	
	OR	95% CI	OR	95% CI
Obstetrically Underserved Areas				
No	1.00		1.00	
Yes	1.16	(1.13-1.18)	1.10	(1.08-1.13)
Maternal Year				
18–24	1.00		1.00	
25–29	1.27	(1.24-1.30)	1.25	(1.22-1.28)
30–34	1.60	(1.57-1.63)	1.50	(1.46-1.53)
35–39	2.27	(2.22-2.33)	1.96	(1.92-2.01)
≥ 40	3.52	(3.40-3.64)	2.61	(2.53-2.70)
National Medical Insurance Status				
Corporate	1.00		1.00	
Regional	1.19	(1.18-1.20)	1.12	(1.10-1.13)
Medical aid	1.22	(1.15-1.30)	1.08	(1.01-1.14)
Malformation				
No	1.00		1.00	
Yes	1.73	(1.70-1.76)	0.62	(0.61-0.63)
Malpresentation				
No	1.00		1.00	
Yes	7.25	(7.10-7.39)	0.77	(0.75-0.78)

*Adjusted with all covariates

entire South Korean area. Individuals born in Obstetrically Underserved Areas had higher odds of experiencing C-section and Dystocia compared to individuals who were not born in Obstetrically Underserved Areas,

respectively (C-Section: OR=1.11 CI=1.08–1.13; Dystocia: OR=1.07 CI=1.05–1.09).

Table 3 presents the results of logistic regression analyses for all variables, comparing individuals who gave

birth in the Metropolitan city. Children born in Obstetrically Underserved Areas had higher odds of C-sections and dystocia compared to children who were not born in Obstetrically Underserved Areas, respectively (C-Section: OR=1.16 CI=1.13–1.18; Dystocia: OR=1.10 CI=1.08–1.13).

Discussion

This study aimed to investigate the association between access to maternity care and labor interventions, as well as pregnancy complications. The results indicated that among the population residing in underserved areas, both nationwide and in relatively accessible urban areas, there was a higher incidence of C-section and dystocia. In the analysis focused on mothers residing in relatively urban areas, an increased incidence of C-section and dystocia was observed.

Our study results, along with other studies, provides further support to the growing body of evidence of maternity care access in underserved areas. Even in developed countries, ensuring and maintaining an adequate supply of maternity services, especially in rural areas, has emerged as a significant challenge. For instance, in the United States, over 5.6 million women reside in areas with limited or no access to maternity care [11]. This issue is also prevalent in European regions, including France, where between 1998 and 2003, approximately 20% of maternity units closed [12], despite a rise in as the number of births increased by 3%. As a result of these closures, the count of women in France who gave birth and resided more than 30 km from a maternity ward increased from 10,310 to 13,679 (a rise of +33%), with those more than 45 km away growing from 736 to 1,520 (+106%) [13].

The analysis revealed an increase in C-section rates among individuals living in underserved areas, a trend that has been observed across various countries. For example, this pattern is also evident in studies from Inner Mongolia [14], where rural hospitals demonstrated a lower rate of emergency C-sections but a higher incidence of planned C-sections. The increase in C-sections may be attributed to non-medical factors, particularly the absence of surgical coverage on weekends, prompting the scheduling of C-sections as a precautionary measure in anticipation of potential issues requiring surgical intervention [15]. This trend is also observed in Japan [16], as C-section rates increased in rural areas due to the shortage of obstetric personnels. Furthermore, in Spain, budget cuts resulted in a reduction in the number of obstetric personnel, which has led to increased C-section rates [17].

In South Korea, however there seems to unique factors that seems to influence higher rate of c-sections. Firstly, the proportion of premature and low-weight babies

among all births is steadily increasing [18]. Additionally, the average age for first-time childbirth is 33.58 years in South Korea [19], which is later compared to other OECD countries. This trend towards older pregnancies may contribute to an increase in pregnancy complications, such as gestational diabetes [20]. Consequently, there might have been an increase in C-sections as a preventive measure. However, regardless of the age group, there has been a notable increase in C-sections, accounting for more than 50% of cases [21]. This trend could be attributed to a preference among pregnant women for C-sections rather than a reflection of actual medical complications. Although exact figures are not available, elective cesareans, including cesarean section on maternal requests, influenced by preferences from both pregnant women and healthcare providers [22].

An unwarranted increase in C-sections without medical necessity poses a significant concern. A study revealed that a C-section rate exceeding 10% did not contribute to the provision of health improvement measures for mothers or newborns [23]. Moreover, the elevated rate of C-section deliveries was associated with various health issues, including an placenta previa and placenta accreta [24], maternal morbidity and mortality, fetal and neonatal morbidity, maternal morbidity and mortality, neonatal morbidity [25]. Consequently, if the prevalence of C-section deliveries continues to rise, it is highly likely to result in more harmful impacts [26]. Given the trend towards increased C-sections in underserved areas across different countries, it is crucial to provide more options and support for mothers in rural regions.

There are important limitations to our study. Our study has several notable limitations. Firstly, in regions lacking obstetric facilities, the tendency of mothers to seek hospitalization in areas with more obstetric resources may introduce inaccuracies into the research findings. A comprehensive, long-term study is imperative to fully comprehend the health implications for both mothers and newborns in such areas. Secondly, the mandatory adoption of C-section reporting varied between primary hospitals (starting in 2012) and tertiary hospitals (starting in 2013), which may have influenced the results. However, since C-sections were identified not only through DRG codes but also through individual procedure codes, the likelihood of omitting C-section data due to the number of hospitals billing DRG codes is low.

Despite certain limitations, this study possesses notable strengths. Firstly, leveraging the NHIS-NHID data enabled research encompassing the entire population that gave birth between 2010 and 2015. This extensive dataset allowed for the exploration of relationships and the prevalence of pregnancy complications in maternity desert areas. Additionally, the findings of our research

can be broadly generalized to the wider population of pregnant women.

Conclusion

In conclusion, this research underscores the heightened risk of obstetric challenges of dystocia faced by mothers in areas with limited accessibility to maternity care facilities during childbirth. Insufficient access to maternity care not only raises the risk of serious pregnancy complications but can also result in more c-sections, even in the absence of medical conditions.

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Author contributions

The final manuscript has been seen and approved by all authors and we have taken due care to ensure the integrity of the work as in the following; study concepts/study design: S.H.K, M.J.Y; data analysis/interpretation: S.H.K; manuscript drafting : M.P ; approval of final version of submitted manuscript: S.Y.K, M.J.Y;

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Data availability

South Korean National Health Insurance Service National Information Database (NHIS-NHID) is available upon request (<https://nhiss.nhis.or.kr/bd/ay/bdaya001iv.do>).

Declarations

Ethics approval and consent to participate

This study was approved by the Institutional Review Board of Gachon University Gil Medical Center (GCIIRB2022-086) and adheres to the tenets of the Declaration of Helsinki. The NHIS-NHID data do not contain any identifying information; hence, additional approval for written informed consent was not required.

Competing interests

The authors declare no competing interests.

Consent for Publication

Not applicable.

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