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Research Paper:

Socioeconomic Determinants of Disability and Mortality Due to Congenital Anomalies: A Secondary Analysis of Existing Data

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ABSTRACT

Objective Congenital anomalies are functional or structural anomalies that can occur as a single or a group of anomalies. Studies have shown that socioeconomic factors can affect congenital anomalies such that the middle- and low-income countries suffer more from the congenital anomalies. This study aimed to determine the essential socioeconomic determinants of the Disability-Adjusted Life Year (DALY) for congenital anomalies in children aged <5 years.

Materials & Methods This is a cross-sectional study using the latest available data in 2017, which were extracted from the international databases of the World Bank, the Institute for Health Metrics and Evaluation, and the United Nations Educational, Scientific, and Cultural Organization. In the study, we analyzed data from 196 countries divided into 6 geographical regions of African Region (AFRO), European Region (EURO), Pan American Health Organization (PAHO), Eastern Mediterranean Region (EMRO), Western Pacific Region (WPRO), and South-East Asia Region (SEARO). To identify the main determinants of the DALY, Gross Domestic Products (GDP) per capita, poverty rate, government, private and external health expenditures per capita, mean years of schooling, and literacy rate were used. Data analysis was performed in STATA v.15 using the one-way ANOVA and the linear regression analysis.

Results The lowest and highest rates of DALY was reported in Luxembourg (856.29 per 100000 population) and Sudan (21714.7 per 100000 population), respectively. The AFRO and EURO regions had the highest (9392.78±4250.56), and the lowest (2969.11±1961.64) mean of DALY. In Iran, the DALY rate was reported 7721.48 per 100000 population, which was higher than those in the EURO and PAHO regions and lower than those in the AFRO and EMRO regions. The results of linear regression analysis showed that mean years of schooling was the strongest predictor of DALY (β=-0.44, P=0.001) followed by the poverty rate (β=0.36, P=0.002). The results of one-way ANOVA indicated that the rate of DALY was significantly different between different social and economic groups, and it was higher in the lower socioeconomic groups.

Conclusion Mean years of schooling and poverty rate are the strongest predictors of DALY for congenital anomalies in children under 5 years of age. Low-income countries, especially those in the AFRO and EMRO regions, are the most prone to the disability and premature death caused by congenital anomalies in children under 5 years of age compared to the high-income countries. Therefore, the equitable distribution of screening and health care services and educational infrastructures for deprived and lower socioeconomic countries should be taken into account by national and international health organizations.

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Extended Abstract

Introduction

Congenital anomalies include a range of functional or structural anomalies that can occur as a single anomaly or a group of anomalies [1]. The World Health Organization (WHO) estimated that about 6% of infants worldwide are born with some form of congenital anomaly, and more than 300000 infants aged <4 weeks die each year from congenital anomalies [2]. Congenital birth defects are the leading cause of infant mortality, especially in developed countries, whose prevalence has been about 21% of total infant deaths [3]. In Iran, Vatankhah et al. showed that the overall prevalence of congenital anomalies among infants is about 2.3%, precisely reporting 3% among boys and 2% among girls [4]. In a study to identify and record congenital anomalies in Tabriz City, Iran during 2000-2011, Dastgiri et al. reported the overall prevalence of congenital anomalies about 202.9 per 10000 live births [5]. Various factors can affect the occurrence of congenital anomalies. For example, Seddigi et al. showed that consanguineous marriages, contraceptive methods, and male gender could increase the chances of congenital anomalies in infants [6]. Other studies show that family history of genetic disorders, alcohol, and tobacco use during pregnancy, use of unspecified drugs, maternal age, history of abortion, and maternal education level may be associated with an increased risk of congenital anomalies [7-10].

In recent decades, the role of social and economic determinants in the incidence of communicable and non-communicable diseases has been considered by policymakers and researchers in the health system. Social determinants of health can play an essential role in determining the health status of individuals. Variables such as literacy status or education can play an essential role in preventing diseases or disorders and increase people's chances of accessing health care services [11-13]. Studies showed that low-income countries bear a large part of the burden of infectious diseases. With regard to congenital anomalies, studies show that congenital anomalies and their risk factors are mainly seen in people with lower socioeconomic status [14, 15]. For example, Clark et al. in a study in Scotland, showed that the prevalence of orofacial clefts increased with the decrease in socioeconomic status [16].

Table 1. One-way ANOVA results of comparing the mean score of DALY between different social and economic groups

Social and Economic Variables		No.	Mean±SD*		
			DALY	YLD	YLL
Region	AFRO	45	93.78±42.56	26.31±59.45	104.64±48.67
	EMRO	23	77.88±46.51	21.89±29.66	86.24±53.47
	EURO	52	29.11±19.64	23.58±23.76	31.26±22.41
	PAHO	38	49.26±24.15	170.71±13.94	54.49±27.57
	SEARO	11	58.04±35.25	245.31±48.22	63.91±39.85
	WPRO	26	52.62±36.64	211.15±34.67	57.25±41.06
Income	Low	30	110.74±44.87	267.51±68.42	123.88±51.31
	Lower than moderate	46	77.55±37.41	240.24±42.28	85.87±42.94
	Higher than moderate	57	48.86±22.01	209.36±38.88	53.43±26.13
	High	61	28.17±15.61	207.17±34.84	30.26±18.35
Mean years of schooling (Years)	1-5	32	11.41±46.77	261.67±31.34	123.13±53.35
	6-10	83	63.38±32.98	215.87±57.75	70.21±37.02
	11-15	74	32.43±20.96	220.62±37.51	34.74±23.52

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*The mean difference of DALY, YLD and YLL between different groups for the studied variables is significant at the level of 0.05.

Table 2. Regression model coefficients for determining the predictors of DALY for congenital anomalies in children aged <5 years

Variable	Non-standardized Coefficient	Standardized Coefficient	t	Sig.
GDP per capita	0.01	0.07	3.45	0.592
Poverty	83.76	0.36*	3.22	0.002
GHE	-0.47	-0.11	-0.84	0.4
PVT	0.53	0.05	0.46	0.64
EXT	-2.28	-0.02	-0.32	0.74
Mean years of schooling	-628.16	-0.44*	-3.31	0.001
Literacy rate	11.9	0.05	0.68	0.494

*Significant at P<0.05.

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This study investigates the role of socioeconomic variables in determining the degree of disability caused by congenital anomalies. The variable of Disability Adjusted-Life Year (DALY) in children under 5 years of age was used as an outcome variable. Hence, this study aims to compare the DALY for congenital anomalies among different countries and determine its most critical socioeconomic predictors.

Materials and Methods

This study is a quantitative and cross-sectional study that was performed as a secondary analysis of existing data. The latest data for 2017 were extracted from the databases of the World Bank, the Institute for Health Metrics and Evaluation, and the United Nations Educational, Scientific, and Cultural Organization. Data from 196 countries were analyzed. The countries are divided into 6 geographical regions: African Region (AFRO), European Region (EURO), Pan American Health Organization (PAHO), Eastern Mediterranean Region (EMRO), Western Pacific Region (WPRO), and South-East Asia Region (SEARO), according to the World Health Organization. There were 45 AFRO countries, 23 EMRO countries, 11 SEARO countries, 27 WPRO countries, 55 EURO countries, and 41 PAHO countries. The DALY is expressed per 100000 children less than 5 years of age. The DALY index consists of two components: the Years Lost due to Disability (YLD) and the Years of Life Lost (YLL) due to dying early. Economic determinants included Gross Domestic Product (GDP) per capita (in 2017), poverty, and health expenditures. Health expenditures are divided into three groups: Government Health Expenditure (GHE) per capita, Private health expenditure (PVT) per capita, and External health expenditure (EXT) per capita. The poverty rate is considered the proportion of the population that falls below the poverty line [17]. GHEs are the expenditures incurred by governments and spent from government resources in the health system. PVTs are the expenditures spent by non-governmental resources in the health system, such as expenses paid by patients out of pocket. Finally, EXTs are the expenditures spent from external resources in the health system, such as financial aids from international organizations [18]. The literacy rate (for population over 15 years of age) and mean years of schooling are also examined as two social determinants of health for each of the study countries. Data analysis was performed using one-way ANOVA for comparing the mean score of DALY between different groups and linear regression analysis for determining the predictors of DALY for congenital anomalies in children less than 5 years of age.

Results

In this study, the available data from 196 countries were examined. The DALY rate due to congenital anomalies in 2017 for children aged <5 years in Iran was about 7721.48 per 100000 population. It was higher than the average DALY rate in EURO and PAHO countries and was almost equal to the average DALY rate reported in the EMRO region. The largest amount of this rate was related to the YLD component. The lowest DALY rate was associated with Luxembourg (856.29 per 100000 population), and the highest rate (21714.7 per 100000 population) was related to Sudan. Based on the regions, AFRO Region had the highest mean rates of DALY (9392.78±4250.56), YLD (266.31± 59.45), and YLL (104.64±48.67), while the EURO region had the lowest mean rates of DALY (2969.11±1961.64), YLD (31.26± 22.41), and YLL (170.71±13.94) compared to other regions (Table 1).

The results of one-way ANOVA showed that the distribution of DALY, YLD, and YLL rates was significantly different between the 6 regions, income groups, and

schooling groups. The distribution of YLD and YLL varied significantly among income groups and were higher in low-income countries. Moreover, the DALY rate was higher in countries with lower literacy rates, and the difference between them was statistically significant. According to the standard coefficients in the linear regression model, the mean years of schooling (β=-0.44, P=0.001) was the strongest predictor of DALY for congenital anomalies in children aged <5 years followed by poverty rate (β=0.36, P=0.002) such that with the increase in the poverty rate, the DALY rate significantly increased (Table 2). Other study variables had no statistically significant relationship with the DALY rate.

Discussion and Conclusion

Mean years of schooling and poverty were the strongest predictors of DALY for congenital anomalies in children under 5 years of age. This finding shows that the level of education and literacy is an important and significant factor in determining the rate of disability and premature death due to congenital anomalies in these children. The average level of education in the AFRO and EMRO regions is significantly lower than that in the other areas. In these countries, due to factors such as lack of income and educational infrastructure, there are fewer opportunities to study or continue to study, and this factor can be useful in recognizing and preventing congenital anomalies. UNESCO reported that approximately one-fifth of children between the ages of 6 and 11, and one-third of adolescents between the ages of 12 and 14 in sub-Saharan Africa are out of school [19]. This finding can highlight the role of social determinants of health in health status and prevention of congenital anomalies. In previous studies, a lack of health awareness and knowledge has been identified as the most critical barriers to access health care services [20].

In line with the results of previous studies, our results reported that the low level of education was one of the most critical risk factors of congenital anomalies. Taye et al. showed that low maternal education was one of the significant risk factors for congenital anomalies in Ethiopia [7]. Pawluk reported that the prevalence of consanguineous marriage, early marriage, and having more than 4 children were higher in people with low socioeconomic status. These factors increased the risk of congenital anomalies in these groups [21]. Our analysis revealed that African countries are most likely to have congenital anomalies in children under 5 years of age. Consistent with this finding, the Global Burden of Disease Study 2016 showed that countries with poorer social and demographic indicators had higher rates of congenital anomalies [14]. Sitkin et al. also showed that the lack of prenatal diagnostic tools and legal protections for abortions with congenital anomalies in low-income countries could lead to a high incidence of congenital anomalies in these countries [22]. Liu et al. in 2015 reported that in low- and very low-income countries with the highest under-5 mortality rates (e.g. Angola, Central African Republic, Chad, Mali, Nigeria, Sierra Leone, and Somalia). The congenital anomaly was a significant cause of death in children under 5 years of age [23]. In these countries, polio, malaria, and diarrhea are the three leading causes of death under five. In countries with the lowest under-5 mortality rates (such as the EURO countries), congenital anomalies are also the leading cause of death [15]. Olusanya et al. reported that the 4 disorders of epilepsy, mental retardation, and visual and auditory impairments are responsible for 28.9 million (19.9%) of the healthy years lost due to disability in children and adolescents.

In low-income countries where the government accounts for a smaller share of health costs, people have less access to governmental screening and health care services [25]. Governments, as health care providers, have an essential role in promoting the health of people; lack of funding for health care by governments can endanger the health of all people. Providing prevention and screening services is one of the essential tasks of governments in providing health services which, if left ignored, could endanger the health of individuals and incur irreparable costs to the health systems and economies of countries. This study suggests that equitable distribution of screening services and health care and educational infrastructure for deprived and low socioeconomic groups should be on the agenda of international organizations and national health systems. Providing screening services can effectively reduce health costs, the occurrence of congenital anomalies, and their mortality rates in children under 5 years of age. Since our study used the latest data available in the mentioned databases, some data were not available for some variables and countries during the study period. Therefore, we inevitably used data from previous years. The poverty rate was an economic variable because the complete data were related to this index.

Mean years of schooling and poverty are the strongest predictors of DALY for congenital anomalies in children under 5 years of age. Low-income countries, especially those in the AFRO and EMRO regions, are the most prone to disability and premature death caused by congenital anomalies among children under 5 years of age.

Ethical Considerations

Compliance with ethical guidelines

This study was approved by the Ethics Committee of the Kermanshah University of Medical Sciences (Code: IR.KUMS.REC.1399.182).

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Authors' contributions

Conceptualization and supervision: Shahin Soltani and Behzad Karami Matin; Methodology: Ali Kazemi Karyani and Moslem Soofi; Investigation, writing – original draft, and writing – review & editing: All authors; Data collection: Bita Shokri, Shiva Amani, Zahra Shahbazi; Data analysis: Ali Kazemi Karyani and Moslem Soofi; Funding acquisition and Resources: Behzad Karami Matin and Shahin Soltani.

Conflict of interest

The authors declared no conflict of interest.