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The Main Determinants of Under 5 Mortality Rate (U5MR) in OECD Countries: A Cross-Sectional Study

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Abstract

Introduction
Child mortality indices are key elements that reflect health status of societies and inform policy makers to take suitable policies to reduce them. This study was performed to examine the main determinants of under 5 mortality rate (U5MR) in Organization for Economic Co-operation and Development (OECD) countries in two cross-sections, 2010 and 2013, and the results of them was compared.

Materials and Methods
This was a cross- sectional study. The data on U5MR, health expenditure, Gross National Income (GNI) per capita, physician and nurses' density, ratio of female to male primary, secondary and tertiary school enrollment was gathered from World Health Organization (WHO) and World Bank datasets. Pearson correlation and regression models was used for analyzing the data for years 2010 and 2013. Stata 11 was used for analyzing the data.

Results
Pearson correlation was negative for all variables in 2010 and all variables in 2013, expect ratio of females to males secondary enrollment, had negative correlation with U5MR. Regression analysis showed that, all variables, except ratio of female to male primary enrollment had negative effect on U5MR in 2010. Also, GNI had negative effect on U5MR in 2010 and its coefficient was significant. The β-coefficient of healthcare expenditures was -0.964 and -0.746 in 2010 and 2013, respectively and was statistically significant just in 2010. Two of three variables in which included for women literacy had negative effect on U5MR in 2010 and all of them had negative effect in 2013.

Conclusion
The study results showed that all variables, including health expenditures, gross national income per capita, and density of physicians and nurses and females literacy, had inversed effect on under 5 mortality rate in OECD countries.

***Key words*:** Child mortality, GNI, Healthcare expenditures, U5MR.

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Introduction

Child mortality indices are principal indicators of population health and well-being. Therefore, there are many indicators of child mortality which have been used to determine levels and trends of population health, including the neonatal and post neonatal, infant, child and under 5 mortality rates (U5MR) (1). The U5MR has been selected as one of the most important indicator of child mortality because it presents the best concept of capturing mortality risks during the susceptible years of childhood (2). Because of the importance of reducing U5MR for societies, it is one of the United Nation 2015 Millennium Development Goals aims (3).

Altogether, the statistics on child and infant mortality rates imply the countries level of socio-economic development and quality of life. They used for evaluating and observing population and health plans and policies (4). Acute respiratory infections, gender differences, vitamin A deficiency, HIV, malnutrition and etc are most reasons for U5MR. About 25-30 percent of children born to infected mothers grow to be infected with HIV and most of them died before 5 years old in developing countries. 54 percent of child-hood death is because of malnutrition globally (3-7).

Given the importance of under 5 mortality, many studies have been examined to determine the determinant of it for example, Susuman and Hamisi survey a demographic scenario for U5MR in Tanzania. Based on their study maternal education can improve mothers behavior in using health services which reduce under 5 years mortality (7). Ram et al. compared neonatal and U5MR in 597 district of India. According to findings 37 percent of mortality rate fell down each year between 2001 and 2012(3). Fernandes et al. examined the effects of health system strengthening on under 5, infant and neonatal mortality in Mozambique. Based on this study, improvement in the public sector health workforce, institutional birth coverage and government health financing are some reasons that decrease U5MR in Mozambique (6).

An ordinary issue on the outline of policy makers is the adjustment the concept of welfare state, particularly when talk about expediency of reducing the existence of government in significant fields like health or education. In this framework, analyzing the effects of public health expenditures on health and longevity, with the purpose of determining of the consequences of health polices is in interest. Public medical expenditures become effective in improving life expectancy (8).

Many factors could effect on child mortality in macro level. Therefore identifying and assessing the factors affecting the child mortality could be the first step in planning to reduce the mortality and promoting the society health and life expectancy. Also, understanding this determinants of health policy makers can help to take more cost-effective interventions and policies to reducing child mortality. Given the importance of these factors, the aim of this study was to investigate the macro determinants of under-five mortality rate (U5MR) using econometrics models in Organization of Cooperation and Development (OECD) countries in 2010 and 2013.

Materials and Methods

This was a cross sectional study. An econometrics model was used to analyze factors which effected under five mortality rate (U5MR) in OECD countries in 2010 and 2013. For this purpose, we used macroeconomics data on under 5 mortality rate, healthcare expenditure, GNI, physician and nurses' density, ratio of female to male primary, secondly and tertiary enrollment from World Health

Organization (WHO) and World Bank datasets for OECD countries in 2010 and 2013. Pearson correlation and regression models was used to examine the relationship between the U5MR and other variables. So, the association between U5MR and the other variables were examined with Pearson correlation at first. Then the regression models were fitted. Mortality models such as under 5 mortality are in nonlinear form. Therefore, for estimating these models they must be changed into log-log form. The primary econometrics model of under five mortality determinants used in this study is shown below:

$$U5MR = \alpha + HCE^{\beta_1} + GNI^{\beta_2} + PHYD^{\beta_3} + NURD^{\beta_4} + LIT1^{\beta_5} + LIT2^{\beta_6} + LIT3^{\beta_7} + U$$

Where:
HCE = Public health expenditures, (% of total health expenditures);
GNI = Gross national income per capita, PPP (current international $);
PHYD = Physicians' density (physician per 1000 people);
NURD = Nurses' density (nurse per 1000 people);
LIT1 = Ratio of female to male primary enrollment;
LIT2 = Ratio of female to male secondary enrollment;
LIT3 = Ratio of female to male primary enrollment;
U = Residuals.

The final econometrics form of model was log-log form as following:

$$LU5MR = \beta_0 + \beta_1 LHCE + \beta_2 LGNI + \beta_3 LPHYD + \beta_4 LNURD + \beta_5 LHCE + \beta_6 LIT1 + \beta_6 LIT2 + \beta_7 LIT3 + \varepsilon$$

Where:
L = Symbol of logarithm;
B_0 = logarithm of α and;
Ɛ = the symbol of residuals.

We estimated the model at first, then Breusch-Pagan test for heteroskedasticity and Ramsey RESET test for omitted variable were done (9). The stata 11 was used for analyze the model.

Results

The Pearson correlation between U5MR and independent variables has been shown in (Table.1). As it appears all variables had negative correlation with U5MR in 2010. Correlation between U5MR and other variables, except LIT2, were negative in 2013.

The correlation between U5MR and HCE, GNI, PHYD, NURSD were statistically significant, but LIT1 and LIT2 had no significant correlation with U5MR in 2010. NURSD and LIT3 had the strongest and the weakest correlation with U5MR, respectively in 2013.

Table1: Pearson correlation between U5MR and independent variables in 2010 and 2013

Variables	2010		2013	
	r	p-value	r	p-value
HCE	-0.379	0.02	-0.545	0.000
GNI	-0.502	0.002	-0.503	0.002
PHYD	-0.0455	0.006	-0.63	0.000
NURSD	-0.33	0.05	-0.671	0.000
LIT1	-0.214	0.22	-0.303	0.08
LIT2	-0.138	0.43	0.206	0.24
LIT3	-0.39	0.032	-0.155	0.37

The determinant of U5MR was investigated using the cross sectional regression models. The Breusch-Pagan test showed there were no heteroskedasticity in two regression models (p>0.01). Also, the null hypothesis in Ramsey RESET test, which indicates there are no omitted variable in the model was not rejected (p>0.01). The (Table.2) shows the result of the regression models. The result of 2010 showed that all variables, except ratio of female to male primary enrollment (LLIT1) had negative effect on under 5 mortality rate (U5MR). The β-coefficient of LHCE was -0.964 and was statistically significant. Also, Gross National Income per capita (LGNI) and ratio of female to male secondary enrollment (LLIT2) had significant effect on U5MR. The R^2 of the estimated model was 0.63.

Also, (Table.2) shows, the β-coefficient for LHCE, LGNI, LPHYD, LNURD, LLIT1, LLIT2 and LLIT3 were -0.746, 0 .089, -0.721, -0.512, -6.52, -0.53 and -0.08, respectively in 2013. Only, the effects of LPHYD and LNURD was statistically significant in this year.

Table2: The result of regression analysis of determinant of U5MR in OECD countries

Variables	2010			2013		
	β-coefficient	Standard error	p-value	β-coefficient	Standard error	p-value
LHCE	-0.964	0.424	0.030	-0.746	0 .459	0.116
LGNI	-0.627	0.190	0.003	0 .089	0.235	0.70
LPHYD	-0.338	0.208	0.116	-0.721	0.345	0.047
LNURD	-0.002	0.040	0.960	-0.512	0.187	0.01
LLIT1	7.62	7.89	0.343	-6.52	7.88	0.41
LLIT2	-4.22	1.85	0.032	-0.53	2.06	0.79
LLIT3	-0.175	0.325	0.595	-0.08	0.29	0.79
Constant	-2.23	34.31	0.949	38.47	35.57	0.28
R-squared	0.63			0.64		

Discussion

Empirical studies on child mortality at macro levels are more useful for designing health policies (10). Under-five mortality rate (U5MR) is one of the most important index in health sector because implies the level of development and health status of countries. We analyzed some factors that influence on U5MR. The result of the study showed that all variable included had negative correlation with U5MR in 2010 and all variables, except LIT2, had negative correlation with U5MR in 2013.

The regression analysis depicted that public health expenditures had negative effect on U5MR in OECD countries in 2010 and 2013, but this effect was significant in 2010. Also, per capita gross national income had negative effect on child mortality so that under the ceteris paribus 10% increase in GNI could decrease U5MR by 6.27% in 2010. The physician and nurse density, both, had decreasing effect on child mortality in

2013. Two variables of 3 variable in which included for maternal schooling had negative impact on U5MR and only ratio of female to male secondary enrollment in school had significant effect in 2010. Also, all of these three variable had negative effect on U5MR in 2013. The R2 of regression showed that 63% and 64% of variance of under-five mortality rate are explained by independent variables in which included in the regression models in 2010 and 2013, respectively.

Some study conducted to investigate determinant of child mortality all over the world and include different variable in their studies (10-15). Limin Wang found that access to electricity, income, vaccination in the first year of birth, and public health expenditure significantly reduce child mortality that confirms our findings about the effect of gross national income and healthcare expenditures on child mortality (10). Also, according to Howeling et al study the relation between GNI and U5MR is negative but this relation is weaker for the poor compare with the rich people. Ethnic fragmentation and public spending strongly associated with U5MR among the poor compared with the rich. The effect of female literacy, democracy and state strength on U5MR was not different in poor and rich (16). It worth noting that public and private health expenditure may have different effect on child mortality so that some evidence have been shown the increase the private health expenditures could have inverse effect on child mortality(17).

Rezaei et al examined determinants of infant mortality in Iran. The study results showed that the number of physician per capita, mean years of schooling and GDP were inversely related to infant mortality (18). Therefore, the access to healthcare services such as physician and nurse services have been shown as important determinants of societies' health (19). the study that conducted by Robinson for investigating relationships between infant and under-five mortality rate and the distribution of health professionals, GNP per capita, and female literacy in 155 countries, showed that higher density of general practitioners and nurses in the countries is associated with lower infant and under-five mortality rates. The correlation coefficients for U5MR were −0·81 and−0·72 for physicians and nurses, respectively ($P < 0·001$). This implies that countries with higher number of physician and nurses have low child mortality which this confirms our findings (20). Totally, better access to health workforce such as physician and nurse is related to improved service operation and health achievements, too (21). Inequality in distribution of healthcare resources especially physicians adversely effect on population health. Almost rural and remote area of countries have fewer access to this resources than urban area. Therefore people and, especially children, usually have inappropriate health status and higher mortality in these zones. This issue is true in urban poor, too (22, 23).

In the case of female literacy, it is important factor in child health and low literacy could resulted in many adverse health outcome (24, 25). Literacy empowers women to create healthy households and increase their ability in use of healthcare services particularly in child bearing and child rearing periods. This could improve the family health especially for children (26). Altogether, our study depicted that female literacy could decreasing effect on under-five mortality rate. The result of many study which conducted for investigating the determinant of child mortality is consistent with this finding (18, 27).

We used macro data of WHO data set. It is valid data set but this data may potentially have some errors. Also, some other factors may could effect on child mortality, then other study could try to investigate the

effects of other variables on under-five mortality rate in OECD countries and other settings. We suggest to future study to consider micro data and other econometrics methods to provide new evidence about child mortality.

Conclusions

Our results showed that all variables, including health expenditures, gross national income per capita, and density of physicians and nurses and female literacy, had inversed effect on under 5 mortality rate in OECD countries. Given the substantial focus of international public health programmes on improving child survival and importance of information about determinants of child mortality, this findings could be very useful for policy maker. Therefore, policy maker should consider the effects of this factors in planning for improving the child survival and control of child mortality.

Conflict of interests: None.

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