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"An Empirical Analysis of Inter-Relationship between Maternal Mortality and Development in Very High Human Development Countries"

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Abstract: *Maternal mortality is defined as death of a maternal woman within the 42 days of pregnancy termination. One of the United Nations' Millennium Development Goals is to reduce the maternal mortality rate by 75 percent by 2015. Causes of maternal mortality include postpartum hemorrhage, eclampsia, obstructed labor, and sepsis. Many developing nations lack adequate health care and family planning, and pregnant women have minimal access to skilled labor and emergency care. It has been observed that very high human development countries are better off in MMR and have positive relationship with human and economic development. Given this back ground in the present study an attempt has made to establish the relationship between maternal mortality and human development parameters and development. The study has used secondary cross section data along with factor analysis. It has found from the study that both human and economic developments have failed to explain the variations in the MMR. Both correlation analysis and factor analysis have proved that economic development has negative impact on MMR and human development parameters are ineffective in positively influence and reduce the MMR. To be specific, HDI and LEB have no significant influence on MMR in VHHD countries. GDP, instead of decreasing MMR, it has increased MMR. Therefore, in VHHD countries GDP, per capita income, human development process, gender development process and GII are independently or jointly failed to reduce MMR.*

Keywords: *Maternal Mortality, Human Development, Gender, Life Expectancy, Health, Education, and Income*

I. Introduction

Maternal Mortality Rate is the number of resident maternal deaths within 42 days of pregnancy termination due to complications of pregnancy, childbirth, and the puerperium in a specified geographic area (state, county, etc.) divided by total resident live births for the same geographic area for a specified time period, usually a calendar year, multiplied by 100,000. Approximately 529,000 women die from pregnancy-related causes annually and almost all (99 percent) of these maternal deaths occur in developing nations (World Health Orgonization,2004). One of the United Nations' "Millennium Development Goals" is to reduce the maternal mortality rate by 75 percent by 2015. Causes of maternal mortality include postpartum hemorrhage, eclampsia, obstructed labor, and sepsis. Many developing nations lack adequate health care and family planning, and pregnant women have minimal access to skilled labor and emergency care (Millennium Development Goals India Country Report,2014).

The "United Nations Human Development Index" (HDI) is a composite index of life expectancy, literacy, and per capita gross domestic product that measures the socio-economic development of a country. Human Development Index is a powerful predictor of maternal mortality rates. It accounts for 82 percent to 85 percent of the variation in maternal mortality rates among countries. Each component of HDI is also strongly correlated with maternal mortality rates (Human Development Report,1990)

The HDI is a composite measure of health, education and income that was introduced in the first "Human Development Report" in 1990. The scores for the three HDI dimension indices are then aggregated into a composite index using geometric mean. Human development index is one of the best indicators especially to estimate maternal mortality rates and a predictor to understand health inequity in different countries. Improving these indicators might promote maternal health and decrease maternal mortality in the world (Human Development report,1990).

II. Methodology

The present study has used cross section data for selected 60 countries of the world. The United Nations Organization has divided countries of the world as very high human development, high human development, medium human development and low human development countries based on their level of attainment in human development index. For the present study 15 countries have been considered from each development group for which the comparable data are available. Data have collected for the recent years from world development reports and human development reports. Each group of countries has considered separately for analysis in order to understand the intensive relationship between maternal mortality and development. Data have collected for the following parameters;

MMR = Maternal Mortality Rate
HDI = Human Development Index
LEB = Life Expectancy at Birth
GDI = Gender Development Index
GII = Gender Inequality Index
GDP = Gross Domestic Product (ppp $ billions)
GDPPCI = GDP Per-Capita Income (ppp $ billions)
ESP = Education Satisfaction of the People (Maximum is 100)
HSP = Health Satisfaction of the People

Except MMR, all the parameters used in the study are represents human development along with economic development including satisfaction of people about health and education. The correlation co-efficient matrix used to estimate the relationship between MMR and selected parameters of human development. Data presented in the form of graphs and correlation co-efficient measured with the help of SPSS.

The present study by using the previous studies expects the following relationships between MMR and selected parameters of human development. The theoretical expectations are;

*The expected relationship between MMR and HDI is negative.
*The expected relationship between MMR and LEB is negative.
* The expected relationship between MMR and GDI is negative.
*The expected relationship between MMR and GII is negative.
* The expected relationship between MMR and GDP is negative.
**The expected relationship between MMR and GDP per-capita is negative.
*The expected relationship between MMR and educational satisfaction is negative.
* The expected relationship between MMR and health satisfaction is negative.

Normality of Data has checked with Jarque-Bera test for all the parameters. The parameters which have found normal have used for factor analysis and regression analysis. Once the factors identified from factor analysis then they have used for regression analysis. The analysis will be made in the sequence of VHHD counties, HHD countries, MHD countries and LHD countries.

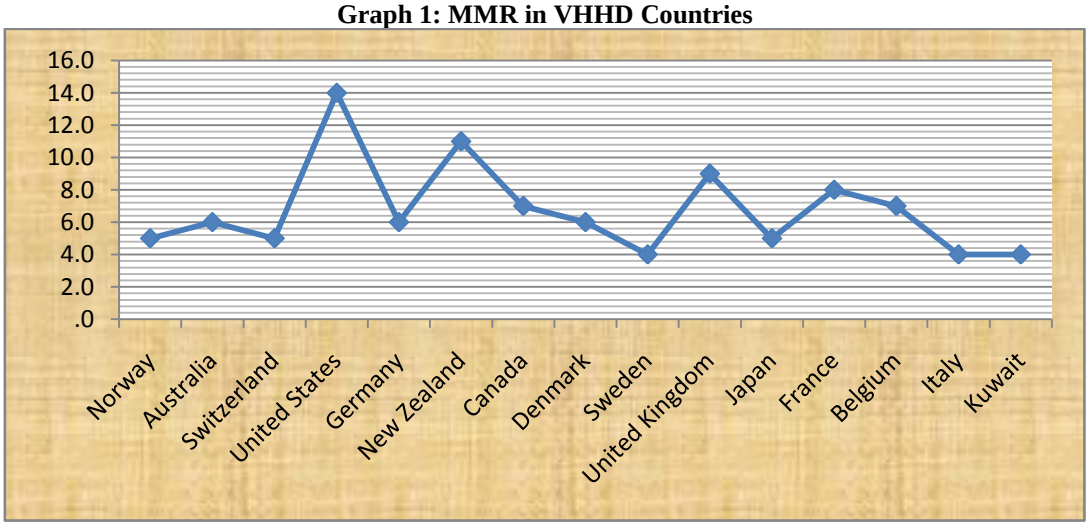
The Empirical Analysis of Inter-Relationship between Maternal Mortality and Development in the VHHD Countries

Inter-relationship between maternal mortality with human and economic development in VHHD countries has estimated and analysed in the following section. Fifteen countries have selected for this analysis from VHHD countries: Norway, Australia, Switzerland, United States, Germany, New Zealand, Canada, Denmark, Sweden, United Kingdom, Japan, France, Belgium, Italy and Kuwait, have selected for the analysis for which comparative data are available.

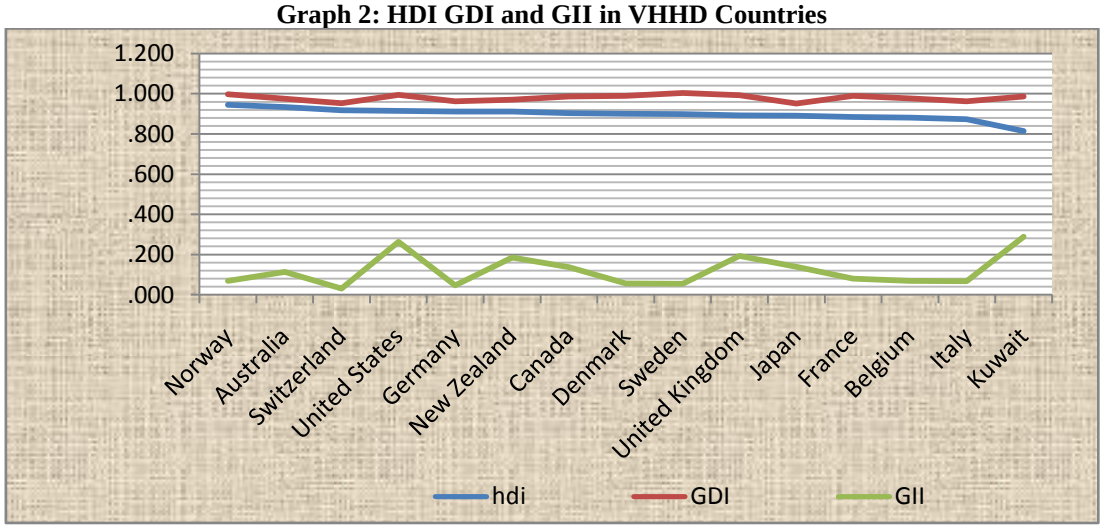
Data Presentation for VHHD Countries:

In the following section an attempt has made to present the data for VHHD countries in order to know their status in terms of MMR, human development, economic development and satisfaction of people about health and education.

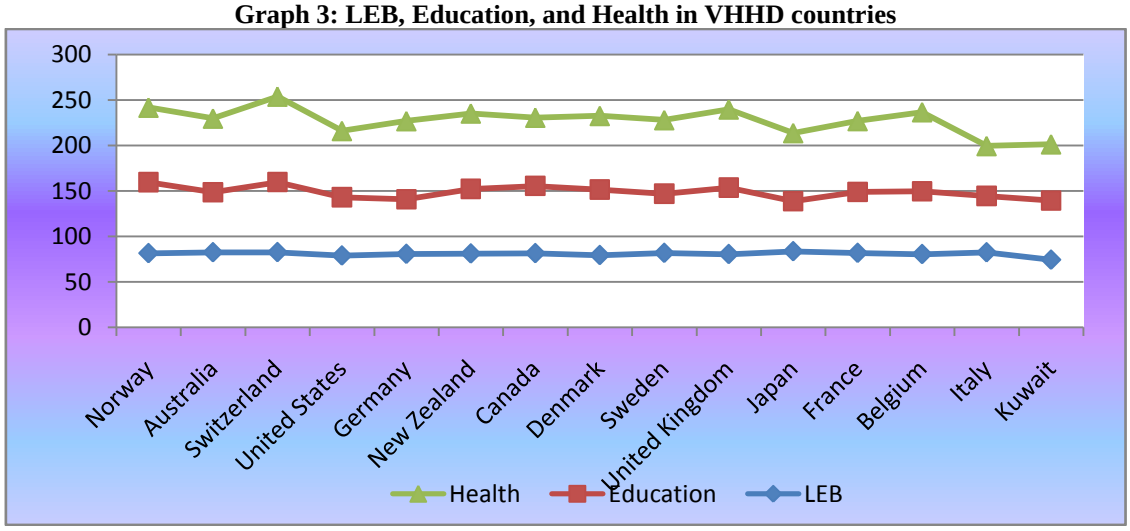
Graph 1: MMR in VHHD Countries



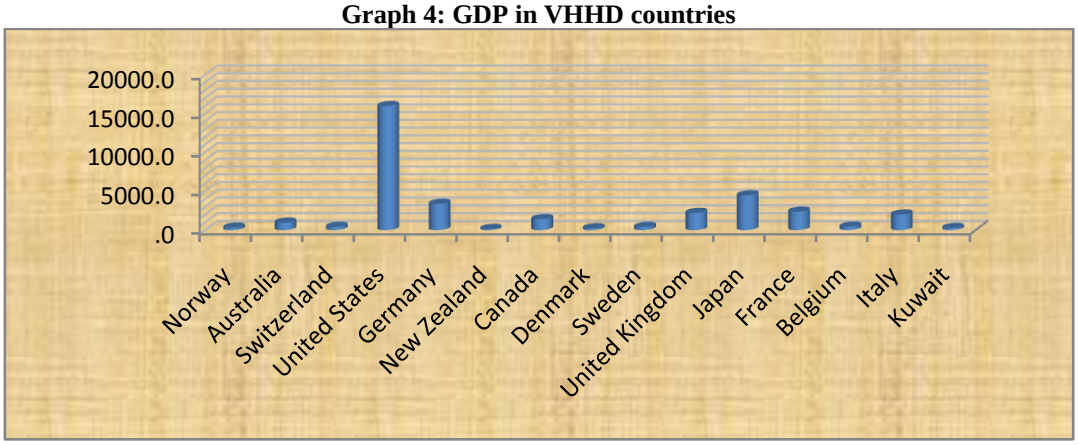
Graph 2: HDI GDI and GII in VHHD Countries



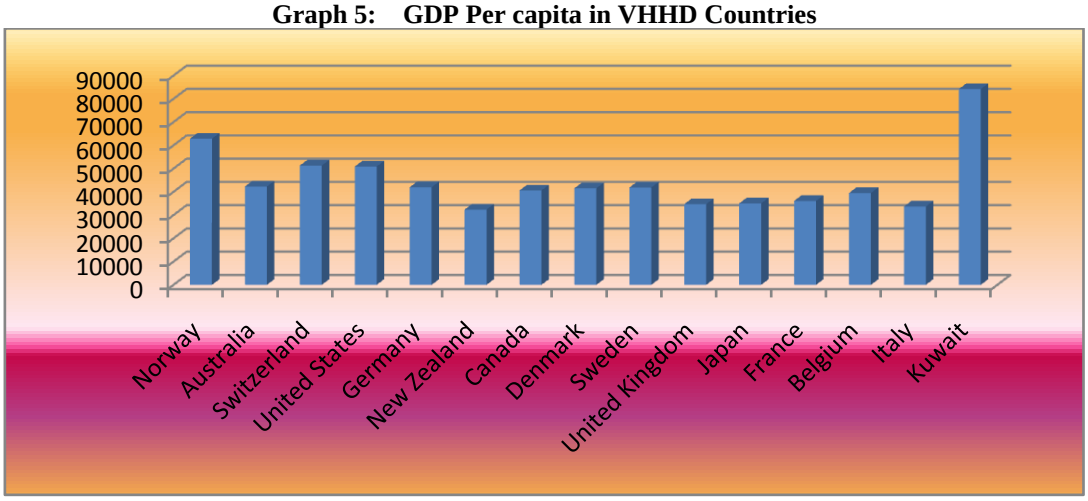
Graph 3: LEB, Education, and Health in VHHD countries



Graph 4: GDP in VHHD countries



Graph 5: GDP Per capita in VHHD Countries



Source for above all graphs: World Human Development Report, 2015.

The above graphs have presented information as well as variations in terms of status of MMR and related parameters. It has found from the graph one that among the VHHD countries MMR was relatively high in United States and New Zealand. MMR was relatively low in Sweden, Italy and Kuwait. MMR was moderate in other VHHD countries. It has found from the graph that among the VHHD countries, HDI was relatively high in Norway and Australia. HDI was relatively low in Kuwait and Italy. HDI was moderate in other VHHD countries. It has found from the graph two that among the VHHD countries, GDI was relatively high in Norway, Sweden and Denmark.GDI was relatively low in Japan and Italy. GDI was moderate in other VHHD countries. It has found from the graph three that among the VHHD countries, GII was relatively high in Kuwait and United States.GII was relatively low in Switzerland and Sweden. GII was moderate in other VHHD countries. It has found from the graph four that among the VHHD countries, LEB was relatively high in Australia, Switzerland and Japan. LEB was relatively low in Kuwait, France and Belgium. LEB was moderate in other VHHD countries. It has found from the graph five that among the VHHD countries, satisfaction about expenditure on education was relatively high in Norway and Switzerland. It was relatively low in Japan and Germany. Satisfaction about expenditure on education was moderate in other VHHD countries. It has found from the graph six that among the VHHD countries, satisfaction about expenditure on health was relatively high in Switzerland and United Kingdom. It was relatively low in Italy and Kuwait. Satisfaction about expenditure on health was moderate in other VHHD countries. It has found from the graph seven that among the VHHD countries, GDP was relatively high in United States and Japan. GDP was relatively low in New Zealand and Denmark. GDP was moderate in other VHHD countries. It has found from the graph eight that among the VHHD countries, GDP per capita was relatively high in Kuwait and Norway. GDP per capita was relatively low in Italy, New Zealand and United Kingdom. GDP per capita was moderate in other VHHD countries.

Correlation between MMR and Related Parameters:

In the following section an attempt has made to establish the relationship between MMR and related variables namely; HDI, LEB, GDI, GII, GDP, GDP per capita, satisfaction about health and education.

Table 1: Correlations between MMR and Related Parameters in VHHD Countries (Coefficients values lies between -1 and +1)

Description		HDI	LEB	GDI	GII	GDP	GDP Per capita	Education	Health
MMR	Pearson Correlation	.252	-.121	.237	.506*	.671***	-.250	.089	.163
	Sig. (2-tailed)	.365	.666	.395	.054	.006	.369	.753	.560
	N	15	15	15	15	15	15	15	15
***. Correlation is significant at the 0.01 level (2-tailed).									
*. Correlation is significant at the 0.10 level (2-tailed).									

Source: World Human Development Report, 2015.

Relationship of MMR with HDI has estimated by using Pearson correlation method and found that the relationship of MMR with HDI was positive but not significant. Matter of fact this result was not theoretically expected. Accordingly, there is a problem in VHHD countries and needs to identify the reasons for this phenomenon.

Relationship of MMR with LEB has estimated by using Pearson correlation method and found that the relationship of MMR with LEB was negative but not significant. Matter of fact this result was theoretically expected with significance. Therefore, relationship of MMR has not significantly established with LEB in VHHD countries.

Relationship of MMR with GDI has estimated by using Pearson correlation method and found that the relationship of MMR with GDI was positive but not significant. Matter of fact this result was not theoretically expected. Accordingly, there is a problem in VHHD countries and needs to identify the reasons for this phenomenon.

Relationship of MMR with GII has estimated by using Pearson correlation method and found that the relationship of MMR with GII was positive and it is significant. Matter of fact this result was not theoretically expected. Accordingly, there is a problem in VHHD countries and needs to identify the reasons for this phenomenon.

Relationship of MMR with GDP has estimated by using Pearson correlation method and found that the relationship of MMR with GDP was positive and it is significant. Matter of fact this result was not theoretically expected. Accordingly, there is a problem in VHHD countries and needs to identify the reasons for this phenomenon.

Relationship of MMR with GDP per capita has estimated by using Pearson correlation method and found that the relationship of MMR with GDP per capita was negative but not significant. Matter of fact this result was theoretically expected with significance. Therefore, relationship of MMR has not significantly established with GDP per capita in VHHD courtiers.

Relationship of MMR with satisfaction about expenditure on education has estimated by using Pearson correlation method and found that the relationship of MMR with Satisfaction about expenditure on education was positive but not significant. Matter of fact this result was not theoretically expected. Accordingly, there is a problem in VHHD countries and needs to identify the reasons for this phenomenon.

Relationship of MMR with health has estimated by using Pearson correlation method and found that the relationship of MMR with Satisfaction about expenditure on health was positive but not significant. Matter of fact this result was not theoretically expected. Accordingly, there is a problem in VHHD countries and needs to identify the reasons for this phenomenon.

Hence, in VHHD countries MMR has been found unrelated with each of human development and economic development parameters.

Normality of Data:

Before using the data for further analysis they have tested for normal distribution. The results of Jarque-Bera test for parameters used for VHHD countries have presented below;

Table 2: Normality Tests

Variable	JB test Value	P-Value	Argument
MMR	5.053	0.039	Data not normally distributed
HDI	6.852	0.032	Data not normally distributed
LEB	15.710	0.000	Data not normally distributed
GDI	1.063	0.587	**Data normally distributed**
GII	5.361	0.036	Data not normally distributed
GDP	55.84	0.000	Data not normally distributed
GDP Per Capita	13.841	0.000	Data not normally distributed
Education	0.318	0.852	**Data normally distributed**
Health	2.774	0.249	**Data normally distributed**

In VHHD countries data for MMR, HDI, LEB, GII, GDP, and GDP per capita have not normally distributed. Hence, these parameters have not been used for further analysis. The other parameters have normally distributed, since the JB test value is insufficient to reject the null hypotheses. Accordingly, these parameters have been used for further analysis.

Factor Analysis for VHHD Countries:

Most of the parameters used in the correlation analysis individually have not played significant and expected role in determination of MMR in VHHD countries. Accordingly, in this section, factor analysis has used to identify the components to explain the data variation which have been used to measure the determination of MMR.

Table 3: Communalities to Explain the Variation in Data from Each Variable

Variables	Initial	Extraction
GDI	1.000	0.922
Education	1.000	0.805
Health	1.000	0.869
Extraction Method: Principal Component Analysis.		

Sources: Computed by researcher using base data

Extraction communalities have explained variation in data from each variable by using principal component extraction method. In the above table, extraction communalities are high and they well explained the variation in the data by the components.

Table 4: Total Variance Explained by Component

Component	Initial Eigen Values			Extraction Sums of Squared Loadings		
1	1.558	51.929	51.929	1.558	51.929	51.929
2	1.038	34.600	86.530	1.038	34.600	86.530
3	0.404	13.470	100.000	Not computed since initial Eigen values are less than 1.		
Extraction Method: Principal Component Analysis.						

Sources: Computed by researcher using base data

The maximum numbers of components extracted from the principal component analysis are 3. The first component explains maximum variation in data (51.929 percent). The second component explains second highest variations in the data (34.600 percent) and the second component is unrelated with first component. The third components have not considered for the further analysis since their Eigen values are less than one. First and second components together explain 86.530 percent of variation in the data. Hence, first and second components have considered for regression analysis.

The above scree plot presents sequence of components based on Eigen values. First and second components are plotted close to vertical axis other components are also plotted close to horizontal axis.

Table 5: Component Matrix and Component Transformation Matrix for VHHD Countries

Component Matrix		
Variables	Component	
	1	2
Education	0.897	
Health	0.709	-0.605
GDI	0.501	0.819
Component Transformation Matrix		
Component	1	2
1	0.855	0.519
2	-0.519	0.855
Extraction Method: Principal Component Analysis.		
2 components extracted.		

Sources: Computed by researcher using base data

Variation in data explained by each variable has presented in the previous table with the help of Eigen values. Based on Eigen values two components have extracted. The first component is identified with highest positive component matrix value and the second component is also identified with highest positive component matrix value. The component matrix identified the possible variables represented in each component. Accordingly, first component is represented by Health and Education. The second component is represented by GDI. Third component has not been significantly represented by any of the parameters.

Impact of Components on MMR in VHHD Countries:

In the following section an attempt has made in to analyze the impact of components on MMR. The model constructed based on the results obtained from factor analysis. Matters of fact, two components have generated from factor analysis and both the components have considered as independent variables in the following regression model.

$MMR = \alpha + \beta_1 RFS1 + \beta_2 RFS2 + e$

Where;

MMR = Maternal Mortality Rate

RFS1 = Regression Factor Score1 = Componant1 which represents Health and Education.

RFS2 = Regression Factor Score2 = Component 2 which represents GDI.

α = Constant of the model

β = Co-efficient for independent variables

e = Error of the model

III. Results

MMR = 6.733 + 0.124 RFS1 + 0.185 RFS2

t: (8.797) (0.441) (0.656)

Sig: 0.000 0.667 0.524

F: 0.312, Sig: 0.737

$R^2 = 0.490$, Adjusted $R^2 = 0.409$.

Impact of components on MMR has estimated and presented above. It has been found from the results that the model is fairly fitted with moderate R squared and adjusted R squared values. F value explains the total variability of MMR by independent variables. F value is not significant and therefore, independent variables used in the model are not significantly explained the independent variable. The constant is positive and significant. Therefore, when there is no influence of independent variables, MMR in VHHD countries will be equal to 6.733. Individual coefficients explain the impact of each independent variable on MMR. The co-efficient for C1 is positive but not significant. The co-efficient of C2 is positive but not significant. Therefore, health and education together have failed to explain the variation in MMR. GDI also found insignificant in determining MMR. Hence, once again it has been proved by the factor analysis that in VHHD countries human development and economic development parameters have not been playing significant role in determination of MMR.

IV. Conclusion

In the present work inter-relationship between MMR and development has been measured. It has found from the analysis that both human and economic developments have failed to explain the variations in the

MMR. Both correlation analysis and factor analysis have proved that economic development has negative impact on MMR and human development parameters are ineffective in positively influence and reduce the MMR. To be specific, HDI and LEB have no significant influence on MMR in VHHD countries. GDP, instead of decreasing MMR, it has increased MMR. Therefore, in VHHD countries GDP, per capita income, human development process, gender development process and GII are independently or jointly failed to reduce MMR.

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