An Analysis of Inter-relationship between Maternal Mortality and Development in Low Human Development Countries#

G. S. Premakumara[1]* and S. V. Kavitha[2]

[1]Assistant Professor, Department of Economics, Sir M.V. PG Centre, University of Mysore, Tubinakere, Mandya - 571402, Karnataka, India
[2]Research Scholar, Department of Economics, Sir M.V. PG Centre, University of Mysore, Tubinakere, Mandya - 571402, Karnataka, India

Abstract

This paper is an attempt to examine the inter-relationship between Maternal Mortality Rate (MMR) with human and economic development in 15 Low Human Development (LHD) countries. The study is purely based on secondary sources of data. The correlation, regression, normality test and factor analysis have been used to interpret the data. It has found from the bi-variate correlation that in LHD countries, only Life Expectancy at Birth (LEB) has significant relationship with Maternal Mortality Rate (MMR), and none of other parameters have significant association with MMR. It has found from the factor and regression analysis that GDP per capita and gender inequality have significantly determined the level of MMR. Accordingly, in LHD countries still income has major role in determination of MMR and gender issues also play considerable role in determination of MMR. As it has been identified, income is a necessary condition for reduction of MMR. Therefore, in LHD countries, there is a need to increase income at foster rate in order to fight against high level of MMR. And there is also need to reduce the gender inequality to reduce the MMR.

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

1. Introduction

The human development paradigm introduced in the early 1990s sought to shift focus from national income as the only indicator of development to expanding the choices of people. The concept of human development was introduced by United Nations Development Programme (UNDP) in 1990, in the first global Human Development Report (HDR). Human development index is a multidimensional concept which represents various capabilities of the human wellbeing like long healthy life, education and standard of living. Maternal mortality is one of the indicators which represent the health situation of women in a country. It has attracted many policy makers at global and national level due to its importance in formulating the suitable health policies for a better world. It is always negatively having relationship with human development. Poor women in remote areas are the least likely to receive adequate health care. Reducing maternal mortality is an indispensable goal of each and every countries of the world (Lee, K S, & Hsieh, H L, 1997).

Generally, based on the level of achievement in human development, the countries at the global level can be divided into four categories, like Very High Human Development (VHHD) countries, High Human Development (HHD) countries, Medium

Human Development (MHD) countries and Low Human Development (LHD) countries. Most of the low human development countries are sufferings from severe problems like violence of human rights, lack of medical facilities, lack of education, higher level of unemployment, existence of vicious circle of poverty, under utilization of natural and human resources, lack of technical skills, existence of traditional beliefs. Securing women community and reduction of maternal mortality was the least concern in low human development countries till last three decades which were main responsible for lower the level of human development in these countries. In recent years, increasing attention has been paid to maternal mortality trends in lower human development countries, especially in the context of the United Nations Millennium Declaration (UNMD). The fifth Millennium Development Goal (MDG) initially articulated one target: "To reduce maternal mortality rate by three quarters by 2015" (Ndola Prata & Gerdts, 2010).

Most of the low human development countries come under the group of under developed countries. Some of the LHDCs are Pakistan, Nepal, Afghanistan, Kenya, Niger, Sudan, Uganda, Nigeria have higher the level of maternal mortality and lower the level of human development compare to VHHDCs like USA, England, Germany, Norway, Canada, Japan and others and it is followed by HHDCs like Uruguay, Turkey, Malaysia, Thailand, China, Iran, Sri Lank and others and MHDCs like India, South Africa, Indonesia, Iraq, Bhutan, Bangladesh and others. Even though, they are making sincere efforts to targeting the magnitude of the problem, still it exists.

2. Literature Reviews

The concept of human development has attracted many scholars since the publication of first human development report. Human development and its associates especially maternal mortality is one of the most concerning and also must reducing factors of many developing countries like India. Ruiz & Popoff (2015) provided an analysis of human development and its relationship to maternal mortality. It has proved that there is negative relationship between MMR

and GDP (Chirowa, F & Van, 2013 & Cohen, R L & Adam, 2014). Shyama Kuruvilla, S & Sadia (2014) has explored the relationship between gender inequality, health expenditure and maternal mortality. Some of studies like Kim and Bhalatra (2014) have found that there is inverse relationship between GII and MMR. Khalid, A & Iqbal (2015) provided an analysis of GDI and its relationship to maternal mortality. It is found that there is two-way relationship between gender gap and maternal mortality (Seung-Ah Choe & Kim, 2016). Tim Ensor and Fitzmaurice (2010) have found that there is inverse relationship between GDP per capita and MMR.

The most of the previous studies have proved negative relationship between MMR and health (Bishai, D M & Schweitzer, 2016 & Sajedinejad, S & Mohammad, 2015). Some of studies also found that there is inverse relationship between literacy rate and maternal mortality (Piane, 2014 & Pillai, V K & FangHsun, 2013). The studies by Rana, M J & et.al., (2019), Alkema, L (2016), Jeffery, P & Jeffery, R (2010), & Karmbor-Ballaha & et al., (2019) provided valuable insights into human development and maternal mortality rate.

However, majority of the studies failed to compute the relationship between human development and maternal mortality at Low Human Development Countries. There is also found that lack of systematic studies regarding this. Hence, the present study is a new attempt to estimate the relationship between maternal mortality with human and economic development, particularly in LHDCs.

3. Methodology and Data Sources

The present study has used cross section data for selected 15 countries from low human development, classified by UNDP. There are more threats to human development in Low Human Development Countries. In this direction, there is urgent need to know the status of human development among major 15 Low Human Development Countries which is latterly uses for the comparison purposes. These 15 countries have been chosen for which the comparable data are available. Data have collected for the recent years from World

DevelopmentReportsandHumanDevelopmentReports. The 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

The parameters used in the study are clearly represents status of human development and its associate factors. The correlation co-efficient matrix used to estimate the relationship between MMR and selected parameters of human and economic development. Data presented in the form of graphs and processed form.

The present study by using the correlation co-efficient values computed for all the countries of the world, expects the following relationships between MMR and selected parameters of human and economic development. Most of these expectations have also confirmed by most of the previous studies. Accordingly, these expectations have been treated as theoretical expectations. 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 recognized from factor analysis then they have used for regression analysis.

4. Analysis and Discussion

Inter-relationship between maternal mortality with human and economic development in LHD countries has estimated and analyzed in the following section. Fifteen countries have selected for this analysis from LHD countries: Nepal, Pakistan, Kenya, Angola, Myanmar, Cameroon, Nigeria, Zimbabwe, Tanzania, Uganda, Sudan, Afghanistan, Malawi, Mali and Niger, have selected for the analysis for which comparative data are available.
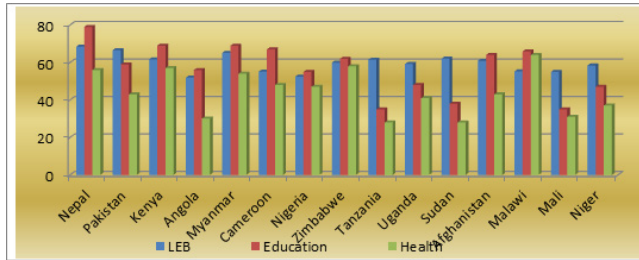
In the following section an attempt has made to present the data for LHD countries in order to know their status in terms of MMR, human development, economic development and satisfaction of people about health and education.
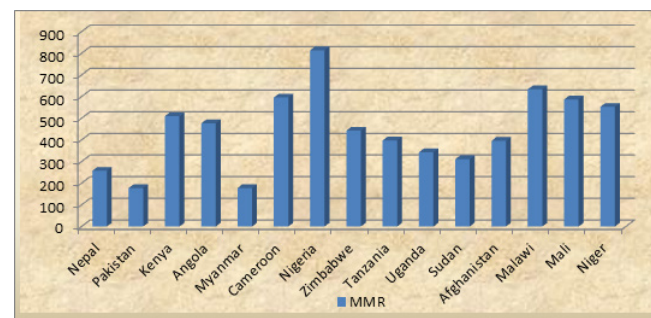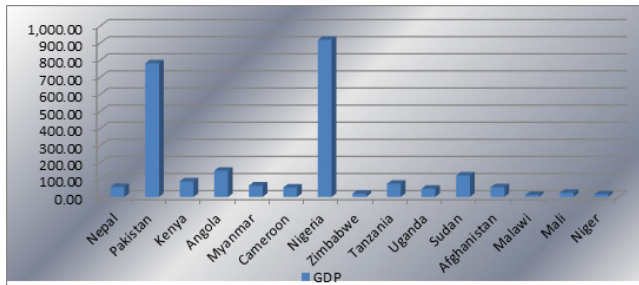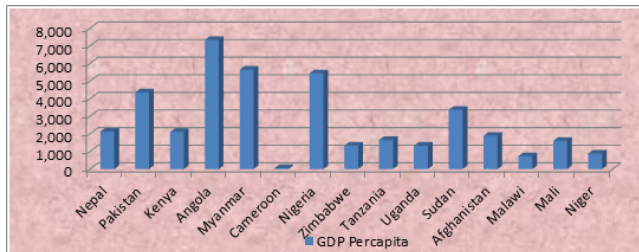

Graph 1. MMR in LHD countries.
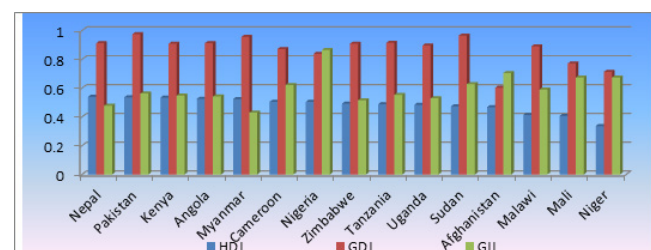
Graph 2. HDI, GDI and GII in LHD countries.

Graph 3. LEB, education, and health in LHD countries.

Graph 4. GDP in LHD countries.

Graph 5. GDP Per capita in LHD countries.
Source for above all graphs: World Human Development Report, 2015.

It has been found from Graph 1 that among the LHD countries, MMR was relatively high in Nigeria and Malawi. MMR was relatively low in Pakistan and Myanmar. MMR was moderate in other LHD countries. It has been found from Graph 2 that among the LHD countries, HDI was relatively high in Pakistan and Kenya. HDI was relatively low in Nepal and Niger. HDI was moderate in other LHD countries. It has been found from Graph 2 that among the LHD countries, GDI was relatively high in Pakistan and Sudan. GDI was relatively low in Nigeria and Cameroon. GDI was moderate in other LHD countries. It has been found from Graph 3 that among the LHD countries, GII was relatively high in Nigeria and Afghanistan. GII was relatively low in Myanmar and Nepal. GII was moderate in other LHD countries. It has been found from Graph 3

that among the LHD countries, LEB was relatively high in Nepal and Pakistan. LEB was relatively low in Angola and Nigeria. LEB was moderate in other LHD countries. It has been found from Graph 3 that among the LHD countries, satisfaction about expenditure on education was relatively high in Nepal, Kenya and Myanmar. It was relatively low in Tanzania and Mali. Satisfaction about expenditure on education was moderate in other LHD countries.

Further, it has been found from Graph 3 that among the LHD countries, satisfaction about expenditure on health was relatively high in Malawi and Zimbabwe. It was relatively low in Tanzania and Sudan. Satisfaction about expenditure on health was moderate in other LHD countries. It has been found from Graph 4 that among the LHD countries, GDP was relatively high in Nigeria and Pakistan. GDP was relatively low in Malawi and Niger. GDP was moderate in other LHD countries. It has been found from Graph 5 that among the LHD countries, GDP per capita was relatively high in Angola and Myanmar. GDP per capita was relatively low in Cameroon and Malawi. GDP per capita was moderate in other LHD countries.

5. Correlation between MMR and Related Parameters

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

Relationship of MMR with HDI has estimated and presented in the (Table 1) by using the Pearson correlation method and it was found that the relationship of MMR with HDI was negative but not significant. As a matter of fact, this result was theoretically expected with significance. Therefore, relationship of MMR has not been significantly established with HDI in LHD countries.

Relationship of MMR with LEB has estimated and presented in (Table 1) by using the Pearson correlation method and it was found that the relationship

Table 1. Correlations between MMR and related parameters in LHD countries (Coefficient values lies between −1 and +1)

Description		HDI	LEB	GDI	GII	GDP	GDP per capita	Education	Health
MMR	Pearson Correlation	−.410	−.847**	−.386	.723**	.143	−.187	−.140	.063
	Sig. (2-tailed)	0.129	0.000	.155	.002	.612	.504	.619	.823
	N	15	15	15	15	15	15	15	15

** Correlation is significant at the 0.01 level (2-tailed)
Source: World Human Development Report, 2015

of MMR with LEB was negative and it is significant. As a matter of fact, this result was theoretically expected with significance. Therefore, relationship of MMR has been significantly established with LEB in LHD countries.

Relationship of MMR with GDI has estimated and presented in (Table 1) by using the Pearson correlation method and it was found that the relationship of MMR with GDI was negative but not significant. As a matter of fact, this result was theoretically expected with significance. Therefore, relationship of MMR has not been significantly established with GDI in LHD countries.

Relationship of MMR with GII has estimated and presented in (Table 1) by using the Pearson correlation method and it was found that the relationship of MMR with GII was positive and it is significant. As a matter of fact, this result was not theoretically expected. Accordingly, there is a problem in LHD countries and there is a need to identify the reasons for this phenomenon.

Relationship of MMR with GDP has estimated and presented in (Table 1) by using the Pearson correlation method and found that the relationship of MMR with GDP was positive but not significant. As a matter of fact, this result was not theoretically expected. Accordingly, there is a problem in LHD countries and there is a need to identify the reasons for this phenomenon.

Relationship of MMR with GDP per capita has estimated and presented in (Table 1) by the using Pearson correlation method and found that the relationship of MMR with GDP per capita was negative but not significant. As a matter of fact, this result was theoretically expected with significance. Therefore, relationship of MMR has not been significantly established with GDP per capita in LHD countries.

Relationship of MMR with satisfaction about expenditure on education has estimated and presented in (Table 1) by using the Pearson correlation method and found that the relationship of MMR with Satisfaction about expenditure on education was negative but not significant. As a matter of fact, this result was theoretically expected. Therefore, relationship of MMR has not been significantly established with satisfaction about expenditure on education in LHD countries.

Relationship of MMR with health has estimated and presented in (Table 1) by using the Pearson correlation method and found that the relationship of MMR with Satisfaction about expenditure on health was positive but not significant. As a matter of fact, this result was not theoretically expected. Accordingly, there is a problem in LHD countries and there is a need to identify the reasons for this phenomenon.

Hence, in LHD countries, individually, MMR has found unrelated with each of the human development and the economic development parameters.

6. Normality of Data for LHD Countries

Before using the data for further analysis they were tested for normal distribution. The results of the Jarque-Bera test for parameters used for LHD countries have been presented in the (Table 2).

Table 2.   Normality tests

Variable	JB test Value	P-Value	Argument
MMR	0.268	0.874	**Data normally distributed**
HDI	4.326	0.114	**Data normally distributed**
LEB	0.524	0.769	**Data normally distributed**
GDI	6.532	0.038	Data not normally distributed
GII	2.691	0.260	**Data normally distributed**
GDP	15.62	0.000	Data not normally distributed
GDP Per Capita	2.202	0.332	**Data normally distributed**
Education	0.797	0.671	**Data normally distributed**
Health	0.950	0.621	**Data normally distributed**

It is found from the (Table 2) that in LHD countries data for GDI and GDP have not been normally distributed. Hence, these parameters have not been used for further analysis. The other parameters have been normally distributed, since the JB test value is insufficient to reject the null hypotheses. Accordingly, these parameters have been used for further analysis.

7. Factor Analysis for LHD Countries

Most of the parameters used in the correlation analysis individually have not played a significant and expected role in determination of MMR in LHD countries. Accordingly, in this section, factor analysis has been 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
HDI	1.000	0.819
LEB	1.000	0.797
GII	1.000	0.757
GDP per capita	1.000	0.890
Education	1.000	0.935
Health	1.000	0.940
Extraction Method: Principal Component Analysis		

Sources: Computed by the researcher using base data

Extraction communalities have explained variation in data from each variable by using the principal component extraction method. It is found in the (Table 3) that the extraction that the extraction communalities

are high and they are well explained by the variation in the data by the components (Table 3).

Table 4.   Total variance explained by components

Components	Initial Eigen Values			Extraction Sums of Squared Loadings		
1	2.605	43.409	43.409	2.605	43.409	43.409
2	1.430	23.841	67.250	1.430	23.841	67.250
3	1.102	18.373	85.623	1.102	18.373	85.623
4	0.432	7.197	92.820	Not computed since initial Eigen values are less than 1		
5	0.316	5.272	98.092			
6	0.114	1.908	100.000			
Extraction Method: Principal Component Analysis						

Sources: Computed by the researcher using base data

It is found from the (Table 4) that the maximum numbers of components extracted from the principal component analysis are 06. The first component explains maximum variation in data (43.409 percent). The second component explains the second highest variations in the data (23.841 percent) and the second component is unrelated with the first component. The third component explains the third highest variation in data (18.373 percent) and the third component is unrelated with the first and the second components. The fourth, the fifth and the sixth components have not been considered for the further analysis since their Eigen values are less than one. The first, the second and the third components together explain 85.62 percent of variation in the data. Hence, the first, the second and the third components have been considered for regression analysis.
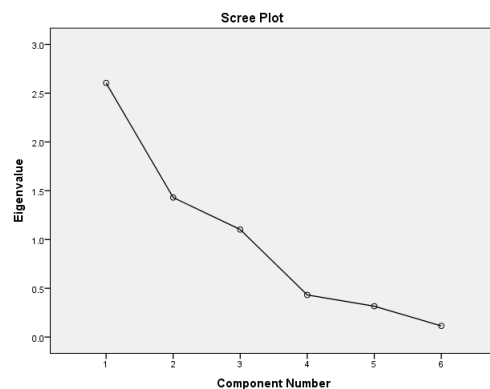
Graph 6.   Scree Plot for Identification of Component.

The sequence of components based on Eigen values are presented in the graph 5. The first, the second and the third components are plotted close to the vertical

axis and other components are also plotted close to the horizontal axis.

Table 5. Component matrix and component transformation matrix for LHD countries

Variables	Component		
	1	2	3
HDI	0.702	0.547	0.161
LEB	0.641	0.064	−0.618
GII	−0.689	−0.104	0.521
GDP per capita	0.131	0.862	0.360
Education	0.841	−0.260	0.401
Health	0.708	−0.553	0.364
Component Transformation Matrix			
Component	1	2	3
1	0.708	0.636	0.308
2	−0.481	0.114	0.869
3	0.518	−0.763	0.387
Extraction Method: Principal Component Analysis			
3 components extracted			

Sources: Computed by the researcher using base data

Variation in data explained by each variable has been presented in the previous (Table 4) with the help of Eigen values. Based on Eigen values three components have been extracted. The first component is identified with the highest positive component matrix value, the second component is also identified with the highest positive component matrix value and the third component too is identified with the highest positive component matrix value. The component matrix identified the possible variables represented in each component. Accordingly, the first component is represented by Education, Health, HDI and LEB. The second component is represented by GDP per capita, and the third component is represented by GII.

8. Impact of Components on MMR in LHD Countries

In the following section an attempt has been made to analyze the impact of components on MMR. The model constructed is based on the results obtained from factor analysis. As a matter of fact, three components have been generated from factor analysis and each of the components has been considered as independent variables in the following regression model.

$$MMR = \alpha + \beta_1\,RFS1 + \beta_2\,RFS2 + \beta_3\,RFS3 + e$$

Where;

MMR = Maternal Mortality Rate

RFS1 = Regression Factor Score1 = Component 1(C1) which represents Education, Health, HDI and LEB.

RFS2 = Regression Factor Score2 = Component 2 (C2) which represents GDP per capita.

RFS3 = Regression Factor Score3 = Component 3 (C3) which represents GII.

α = Constant of the model

β = Co-efficient for independent variables

e = Error of the model

9. Results

$$MMR = 445.067 + 0.129RFS1 - 0.897\,RFS2 - 0.223\,RFS3$$

t: (23.978) (1.196) (−8.300) (−2.065)

Sig: 0.000 0.257 0.000 0.063

F: 24.862, Sig: 0.000

$R^2 = 0.871$, Adjusted $R^2 = 0.836$

Impact of components on MMR has been estimated and presented above. It has been found from the results that the model is fairly fitted with high R squared and adjusted R squared values. F value explains the total variability of MMR by independent variables. F value is significant and therefore, independent variables used in the model have significantly explained the independent variable. The constant is positive and significant. Therefore, when there is no influence of independent variables, MMR in LHD countries will be equal to 445.067. 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 negative and significant. Therefore, GDP per capita in the low human development countries has played significant role in determination of MMR. As GDP per capita increased, MMR decreased in the low human development countries. C3 is negative and also significant at ten percent level. Therefore, as gender inequalities decreased, value for GII increased and MMR decreased in the low human development countries. Accordingly, only income and gender issues have played a significant role in determination of MMR in the low human development countries.

The other factors were found insignificant or insufficient to explain the variations in the MMR.

10. Conclusion

The present paper examined the relationships of MMR with human and economic development in low human development countries. The cross section data for 15 low human development countries have used with correlation, factor and regression analysis. In LHD countries only LEB has significant relationship with MMR, and none of other parameters have significant association with MMR. It has found from the factor and regression analysis that GDP per capita and gender inequality have significantly determined the level of MMR. Accordingly, in LHD countries still income has major role in determination of MMR and gender issues also play considerable role in determination of MMR. As it has been identified, income in a necessary condition for and reduce the gender inequality reduction of MMR. Therefore, in LHD countries there is a need to increase income at foster rate in order to fight against high level of MMR.

11. References

Alkema, L. (2016). Global, regional, and national levels and trends in maternal mortality between 1990 and 2015, with scenario-based projections to 2030: A systematic analysis by the UN Maternal Mortality Estimation Inter-Agency Group. *Lancet*, 387, 462-74. https://doi.org/10.1016/S0140-6736(15)00838-7

David M. Bishai, R. C., & Schweitzer, J. (2016). Factors Contributing to Maternal and Child Mortality Reductions in 146 Low- and Middle-Income Countries between 1990 and 2010. PLOS, 45-56.

Ensor, T, C. S., & W.J., G. (2010). The impact of economic recession on maternal and infant mortality: Lessons from history. *BMC Public Health*, 45–67. https://doi.org/10.1186/1471-2458-10-727. PMid:21106089 PMCid:PMC3002333

Jeffery, P. & Jeffery, R. (2010). Only when the boat has started sinking: A maternal death in rural north India. *Social Science & Medicine*, 71, 1711-1718. https://doi.org/10.1016/j.socscimed.2010.05.002. PMid:20561728 PMCid:PMC2981873

Frank Chirowa, S. A., & Van, M. (2013). Gender Inequality, Health Expenditure and Maternal Mortality in SubSaharan SubSaharan. Afr J Prim Health Care Fam Med., 5(1): 471.

Juan Ignacio Ruiz, K. N., & Federico Popoff, A. I. (2015). Inequality as a Powerful Predictor of Infant and Maternal Mortality Around The World. PLoS One, 10(10): e0140796.

Karmbor-Ballah, E., G., Fallah, M., P., Silverstein, J., B., Gilbert, H., N., Desai, I., K., Mukherjee, J., S., & et al. (2019). Maternal mortality and the metempsychosis of user fees in Liberia: A mixed-methods analysis. *Scientific African*, 3. https://doi.org/10.1016/j.sciaf.2019.e00050

Khalid, A., & Iqbal, M. (2015). Women health in Pakistan: An analysis of millennium development goals (MDGS) through locally constructed indices. *JRSP*, 52(2).

Kim, J., I., & Gukbin. (2014). Labor force participation and secondary education of Gender Inequality Index (GII) associated with Healthy Life Expectancy (HLE) at birth. *International Journal for Equity in Health*, 78-90. https://doi.org/10.1186/s12939-014-0106-2. PMid:25403614 PMCid:PMC4240826

Lee, K-s., Park, S-c., Khoshnood, B., Hsieh, H., L., & Mittendorf, R. (1997). Human development index as a predictor of infant and maternal mortality rates. *National Institutes of Health (J Pediatr)*, 131(3), 430-3. https://doi.org/10.1016/S0022-3476(97)80070-4

Ndola Prata, P. P., & Gerdts, C. E. (2010). Maternal Mortality in Developing Countries: Challenges in Scaling-Up Priority Interventions. Women's Health, 6(2), 311-327.

Piane, G., M. (2014). Maternal mortality correlates by nation. *Open Journal of Preventive Medicine*, 4, 751-759. https://doi.org/10.4236/ojpm.2014.410085

Robert L Cohen, Y. N., & Adam, T. (2014). Country Progress Towards The Millennium Development Goals: Adjusting for Socio-Economic Factors Reveals Greater Progress and New challenges. Globalization and Health, 10:67.

Rana, M., J., Gautam, A., Golia, S., Uttamachary, Reja, T., Nanda, P. Datta, N., Verma, R. (2019). Planning of births and maternal, child health, and nutritional outcomes: Recent evidence from India, *Public Health*, 169, 14-25. https://doi.org/10.1016/j.puhe.2018.11.019. PMid:30772525. PMCid:PMC6483972

Seung-Ah Choe, S.-i. C., & Kim, H. (2016). Gender Gap Matters in Maternal Mortality in Low and Lower-Middle-Income Countries: A Study of the Global Gender Gap Index. Global Public Health, 1-12.

Shyama Kuruvilla, J. S., & Sadia. (2014). Success Factors for Reducing Maternal and Child Mortality. WHO, 89-96.

Sima Sajedinejad, R. M., & Mohammad, K. (2015). Maternal Mortality: A Crosssectional Study in Global Health. Global Health, 11: 4.

Tim Ensor, S. C., & Fitzmaurice, A. (2010). The Impact of Economic Recession on Maternal and Infant Mortality: Lessons from History. BMC Public Health, 45-67.

Vijayan K. Pillai, A. M., & FangHsun. (2013). Maternal Mortality and Female Literacy Rates in Developing Countries during 1970-2000: A Latent Growth Curve Analysis. International Journal of Population Research, 2013 (2013): 11.