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Original Article

Impact of Socio-Health Factors on Life Expectancy in the Low and Lower Middle Income Countries

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Abstract

Background: This study is concerned with understanding the impact of demographic changes, socioeconomic inequalities, and the availability of health factors on life expectancy (LE) in the low and lower middle income countries.

Methods: The cross-country data were collected from 91 countries from the United Nations agencies in 2012. LE is the response variable with demographics (total fertility rate, and adolescent fertility rate), socioeconomic status (mean year of schooling, and gross national income per capita), and health factors (physician density, and HIV prevalence rate) are as the three main predictors. Stepwise multiple regression analysis is used to extract the main factors.

Results: The necessity of more healthcare resources and higher levels of socioeconomic advantages are more likely to increase LE. On the other hand, demographic changes and health factors are more likely to increase LE by way of decease fertility rates and disease prevalence.

Conclusion: These findings suggest that international efforts should aim at increasing LE, especially in the low income countries through the elimination of HIV prevalence, adolescent fertility, and illiteracy.

Keywords: Life expectancy, Socio-health factors, Low and lower middle income countries, Stepwise regression analysis

Introduction

The expansion of life expectancy (LE) is a primary interest of medical and socioeconomic research. In many parts of the world, LE has been increasing steadily over the past few decades, due to increases in technology, medication, and international supports. According to the World Health Organization (WHO)'s World Health Report (1), people are healthier, wealthier, and living longer today than 30 years ago. The average global LE at birth is estimated to increase by 7 years from 1998 to 2025, with 26 countries having an LE at birth above 80 years. The wide variations of LE still exist between high income and low-income countries. The increases in LE are attributed to improvements in sanitation and access to clean water; medical advances, including childhood vaccines; and massive increases in agricultural development. The level and variability of LE has important implications for individual and aggregate human behavior. It affects fertility behavior, economic growth, human capital investment, intergenerational transfers, and incentives for pension benefit claims (2-3). Therefore, LE reflects the health of a country's people and the quality of healthcare they receive when they are ill (4-5).

The demographic and socioeconomic predictors of LE may consist of gender, age, education, and Gross National Income (GNI) per capita (4-7). A study in South Korea, based on census data showed that there was a positive impact on LE from changes of income (7). Another study on Thai people found that older people with higher income and advanced education experienced better health outcomes and health satisfaction (8). Inequalities in income and education have recently been identified to account for regional inequalities in LE as well as in other health indicators (9). Unemployment was found to affect negatively health outcomes (10). Moreover, longer LE was associated with low infant mortality rates and high literacy rates (11). The health-related factors determinants of LE may consist of healthcare expenditures, healthcare resources, mortality rates, the prevalence of Human Immunodeficiency Virus (HIV), and health outcomes (12). The healthcare services such as increased number of physicians, hospital deliveries, and prenatal examination could reduce mortality and result in an increase in LE (13-14). Although evidence of the effects of demographics, socioeconomic instability, and healthcare resources on LE has been proved in previous studies, there has been relatively little research undertaken in the low and lower middle-income countries taken together. Hence, the present study endeavors to fill this gap in the literature. Consequently, it is not only a critical issue in population health research but also a pressing public health concern, with significant implications for healthcare policies. Therefore, the main purpose of this study was to develop an explanatory model to account for the factors that contribute to the LE. This study will observe the effects of demographic, socioeconomic, and health factors on a country's average LE. It is believed that, this study would be very helpful to understand which variables have the greatest impact on average LE across countries. This knowledge could then an aid for the policymakers and government officials alike in deciding how to best allocate their limited resources.

Materials and Methods

The most common variables were selected that have shown impacts on LE in the previous studies (7, 15-19). Data and necessary information were obtained from the WHO (20), United Nations Development Programs (21), and World Population Data Sheet (22). All the variables, their sources and descriptions are included in a table of the Appendix A. A list of these countries is shown in Appendix B. It was investigated the effects of some demographic, socioeconomic status, and the availability of health factors on LE. In this study, LE is the dependent variable and refers to LE at birth. There are three main determinants: demographic variables, socioeconomic status, and health factors. Demographic variables include the total fertility rate (TFR) and adolescent fertility rate; socioeconomic variables include mean year of schooling, and GNI per capita; and health-related factors include the HIV prevalence arte and number of physicians per ten thousand populations in a given year. Data and necessary information were obtained from 91 low and lower middle-income countries except Solomon Islands, Marshall Islands, and Tuvalu due to unavailability of data. The data has been used for univariate analysis, to carry out the description of the variables and their attributes on data in list; bivariate analysis, to find the correlations among the variables; and finally, backward multiple linear regression analysis, to examine the average relationship between LE and socio-health factors and find out the most prominent affecting factors on LE.

The univariate multiple regression analysis examined each independent variables with LE as the dependent variable. The underlying multiple linear regression model corresponding to each variable is:

$$y = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \ldots\ldots\ldots\ldots + \beta_k X_k + \varepsilon, \quad [1]$$

where Y is the response variable (LE), X_i (i =1, 2, 3,. . ., k) are the predictors, β_0 is the intercept term, $\beta_1, \beta_2, \ldots\ldots\beta_k$ are the unknown regression coefficients, and ε is the error term with a $N(0, \sigma^2)$ distribution. The variance inflation factor (VIF) was used to check for the multicollinearity problem among the predictors. The variance inflation for independent variables X_j is:

$$VIF_j = \frac{1}{1 - R_j^2}, \quad j = 1, 2\ldots\ldots\ldots, p, \quad [2]$$

where p is the number of predictors and R_j^2 is the square of the multiple correlation coefficient of the *j th* variable with the remaining (*p*-1) variables, where:

i. if 0<VIF<5, there is no evidence of a multicollinearity problem;
ii. if 5<VIF<10, there is a moderate multicollinearity problem; and
iii. if VIF>10, there is a serious multicollinearity problem of those variables.

The Statistical Package for Social Sciences (SPSS) version 17.0 (SPSS Inc, Chicago, IL, USA) was used for statistical analysis.

Appendix A: Variables, their descriptions and sources

Variables	Descriptions	Sources
Life expectancy	The average number of years a newborn infant can expect to live under current mortality levels.	(22)
Total fertility rate (TFR)	The average number of children a woman would have assuming that current age-specific birth rates remain constant throughout her childbearing years (ages 15-49).	(22)
Adolescent fertility rate	Number of births to women ages 15-19 per 1000 women ages 15-19.	(21)
HIV prevalence rate	Estimated number of adult population aged 15-49 years per 100 populations.	(20)
Physicians density	Number of physicians per ten thousand populations	(20)
Gross National Income (GNI) per capita	GNI PPP per capita is gross national income in purchasing power parity (PPP) divided by mid-year population. GNI PPP refers to gross national income converted to "international" dollars using a purchasing power parity conversion factor. International dollars indicate the amount of goods and services one could buy in the USA with a given amount of money.	(21)
Mean year of schooling	Average number of years of education received by people 25 and older, converted from education attainment levels using official durations of each level.	(21)

Appendix B: Countries included in the analysis, by geographical region[a] (**N=91**)

		Countries	
Regions	**n**	**Low income**	**Lower middle income**
Africa	**44**		
Eastern Africa	15	Burundi, Comoros, Eritrea, Ethiopia, Kenya, Madagascar, Malawi, Mozambique, Rwanda, Somalia, Uganda, United Republic of Tanzania, Zambia, Zimbabwe	Djibouti,
Middle Africa	7	Central African Republic, Chad, Democratic Republic of the Congo	Angola, Cameroon, Congo, Sao Tome and Principe
Northern Africa	4		Egypt, Morocco, Sudan, Tunisia
Southern Africa	2		Lesotho, Swaziland
Western Africa	16	Benin, Burkina Faso, Gambia, Ghana, Guinea, Guinea-Bissau, Liberia, Mali, Mauritania, Niger, Sierra Leone, Togo	Cape Verde, Côte d'Ivoire, Nigeria, Senegal
Oceania	**6**		Kiribati, Micronesia, Papua New Guinea, Samoa, Tonga, Vanuatu
Asia	**26**		
Eastern Asia	4	Democratic People's Republic of Korea	China, Maldives, Mongolia
Southern Asia	7	Bangladesh, Myanmar, Nepal	Bhutan, India, Pakistan, Sri Lanka
South-Eastern Asia	6	Cambodia, Lao People's republic	Indonesia, Philippines, Thailand, Viet Nam
Western Asia	9	Afghanistan, Kyrgyzstan	Armenia, Georgia, Iraq, Jordan, Syrian Arab Republic, Timor-Leste, Yemen
Latin America and the Caribbean	**10**		
Caribbean	1	Haiti	
Central America	5		Belize, El Salvador, Guatemala, Honduras, Nicaragua
South America	4		Bolivia, Ecuador, Guyana, Paraguay
Southern and Eastern Europe	**0**		
Eastern Europe	0		
Southern Europe	0		
Eurasia	**5**	Tajikistan	Republic of Moldova, Turkmenistan, Ukraine, Uzbekistan

n= number of countries. [a]Based on the United Nations' geographical regions

Results

A total of 91 low and lower middle-income countries were included in this study. Univariate, bivariate and backward multiple regression approaches have been applied as the statistical tools. Effects of HIV prevalence rate, physician density, TFR, adolescent fertility rate, mean year of schooling, and GNI per capita on LE are examined here in turn.

Background statistics of predictor and response variables are explained in Table 1. It explains the maximum and minimum values for all the cases as well as their means, medians, and standard deviations (SD) to explore the main features of data of these countries under study. This analysis is useful because different variables are often measured in different units, and have very different ranges.

Univariateanalysis

Table 1: Descriptive statistics of the dependent and independent variables of all countries (N=91)

Variables	n	Minimum	Maximum	Mean	Median	SE Mean	SD
Life expectancy (Y)	91	47	76.00	63.18	65.00	0.93	8.90
HIV prevalence rate (X_1)	76	0.05	25.90	2.56	0.90	0.54	4.72
Physicians density (X_2)	87	0.10	45.40	6.82	2.70	1.03	9.60
Total fertility rate (X_3)	91	1.30	7.10	3.95	3.80	0.15	1.45
Adolescent fertility rate (X_4)	90	5.70	207.10	76.39	69.70	5.05	47.88
Mean years of schooling (X_5)	90	1.20	12.10	5.59	5.25	0.28	2.61
Gross National Income (X_6)	89	265.00	7694.00	2790.69	2242.00	203.70	1921.69

Note: n= Number of countries, SE Mean=Standard error of mean, SD=Standard deviation

Table 1 provides most important information and significant results of the study countries regarding LE and its determinants are discussed here. The LE at birth among the African courtiers is seen very low compared to other countries. Of these countries, the LE of Sierra Leone is the lowest (47 years), the LE are 48 years are of Central African Republic, Democratic Republic Congo, Guinea-Bissau, Lesotho, Swaziland, Zambia, Zimbabwe; which is around half compared to the developed countries like Japan (83 years), Italy (82 years), Switzerland (82 years), etc. (22). The HIV prevalence rates are seen the highest among the African countries (Swaziland 25.90%; Lesotho 23.60%; Zimbabwe 14.30%) whereas most developed countries it is <0.10% (20). For the case of physician density, it is seen very few in the African countries. It is found that only one physician per one hundred thousand people in Haiti and Tanzania, two physicians per one hundred thousand people in Niger, Ethiopia, Sierra Leone, Rwanda and some other countries (20). However, the TFR and adolescent fertility among the African countries are highest compared to other countries in the globe. The TFR of Nigeria is 7.10, in Somalia it is 6.40 where as it is on an average 1.60 in the developed countries (22). Similar trend is found for the adolescent fertility rate. In Niger, the adolescent fertility rate is 207.10, which is the highest in the world. In Congo, it is 201.40 takes place the second highest position in the globe (21). Mean year of schooling were seen in the African countries are very low (Mozambique 1.20 years; Burkina Faso 1.30 years) (21). For the case of GNI were found very small of the countries where the LE are lower (e.g., GNI per capita of Liberia is only 265$) (21).

Bivariateanalysis

The correlation coefficients (*r*) were derived to examine direction, strength and significance of linear relationships between the variables (Table 2)

The significant similar relationships were found between LE with physician density (r = 0.55, P<0.01), mean year of schooling (r = 0.57, P<0.01), and national income (r = 0.70, P<0.01). On the other hand, significant opposite relations were found of HIV prevalence rate (r = -0.55, P<0.01), TFR (r = -0.76, P<0.01), and adolescent fertility rate (r = -0.64, P<0.01) with LE. Again, physician density (r = -0.28, P<0.05), mean year of schooling (r = -0.04) and national income (r = -0.20) were negatively correlated, and TFR (r = 0.25, P<0.05) and adolescent fertility rate (*r* = 0.28) were positive correlated with HIV prevalence rate among the low and lower middle income countries.

Table 2: Correlation between the variables that were examined

	Y	X_1	X_2	X_3	X_4	X_5	X_6
Life expectancy (Y)	1						
HIV prevalence rate (X_1)	-0.55**	1					
Physicians density (X_2)	0.55**	-0.28*	1				
Total fertility rate (X_3)	-0.76**	0.25*	-0.62**	1			
Adolescent fertility rate (X_4)	-0.64**	0.22	-0.48**	0.71**	1		
Mean years of schooling (X_5)	0.57**	-0.09	0.71**	-0.61**	-0.54**	1	
Gross National Income (X_6)	0.69**	-0.20	0.56**	-0.68**	-0.49**	0.58**	1

Note: *Significant at $P<0.05$ level, and ** Significant at $P<0.01$ level

The TFR (*r* = -0.62, $P<0.01$), and adolescent fertility rate (*r* = -0.48, $P<0.01$) were negatively correlated and mean years of schooling (*r* = 0.71, $P<0.01$) and national income (*r* = 0.56, $P<0.01$) were positively significantly correlated with the physicians density. The adolescent fertility rate (*r* = 0.71, $P<0.01$) is positively, and mean years of schooling (*r* = -0.61, $P<0.01$) and national income (*r* = -0.68, $P<0.01$) were negatively significantly correlated with TFR. The mean year of schooling (*r* = -0.54, $P<0.01$) and national income (*r* = -0.49, $P<0.01$) were negatively significantly correlated with adolescent fertility rate. Again, significantly positively correlation (*r* = 0.58, $P<0.01$) was found between schooling and national income.

Backward multiple regression analysis

An impact analysis helps to standardize the effect of each independent variable on the dependent variable, and allows one to determine reasonably, which independent variable affects the dependent variable the most. Three sets of multiple linear regressions were conducted where LE was the dependent variable and HIV prevalence rate, physicians' density, TFR, adolescent fertility rate, mean years of schooling, and GNI per capita were the predictors. The results are presented in the following table (Table 3). Since, the VIF for the case of all predictors were less than five, so there is no evidence of a multicollinearity problem.

Table 3: Backward multiple linear regression models explaining the life expectancy

Explanatory Variables	**Standardized coefficients and variance inflation factors (VIF)**					
	Model 1	VIF	Model 2	VIF	Model 3	VIF
HIV prevalence rate (X_1)	-0.42**	1.26	-0.42**	1.26	-0.40**	1.11
Physicians density (X_2)	0.10	3.00	0.10	2.99		
Total fertility rate (X_3)	-0.43**	4.41	-0.49**	2.69	-0.48**	2.66
Adolescent fertility rate (X_4)	-0.08	2.45				
Mean years of schooling (X_5)	0.20*	3.32	0.20*	3.32	0.13*	1.94
Gross National Income (X_6)	0.22**	2.19	0.20**	2.10	0.20**	2.09
Adjusted R^2	0.62		0.71		0.78	

Note: *Significant at $P<0.05$ level, and ** Significant at $P<0.01$ level

In the above three models (Model 1, Model 2, and Model 3), HIV prevalence rate, TFR, and adolescent fertility rate indicated negative associations; and physician number, average schooling year and GNI indicated positive associations with LE. In Model 1, all the predictors were included. Among these predictors HIV prevalence rate, TFR, mean years of schooling and GNI were found as the significant predictors of LE. All the predictors except adolescent fertility rate were retained in Model 2, where HIV prevalence rate, TFR, mean year of schooling and GNI were found as the significant predictors of LE. Finally, in Model 3, HIV prevalence rate, TFR, average schooling year and GNI were retained and all these were significant predictors to be explained the LE.

Discussion

The study has clarified that HIV prevalence rate, TFR, mean year of schooling, and GNI per capita were the significant predictors of LE in the low and lower middle income countries. Significant associations between physicians' number, and adolescent fertility rate were also found. These findings are also important because they indicate the link between health and policy or economics at the country level, and highlight the direction of health policy in the current world.

The coefficient for HIV was statistically significant and negative in all three regressions. HIV had the largest impact in each individual regression. The HIV is a non-curable virus that eventually attacks the immune system of the infected individual. Without treatment, the net median survival time with HIV is 9-11 years (23), meaning that individuals who have tested positive for HIV face a drastically reduced life span (24). A greater percentage of infected adults could also mean higher HIV transmission rates to children (25). These factors should bias a country's average LE downward. Thus, it is hypothesized that as the percentage of adults infected with HIV increases, average LE will decrease.

The coefficient for physician density was statistically significant and positive. If there is a lack of medical personnel that treats the general population, most individuals would likely not have a way of receiving ordinary medical care. Thus, it is hypothesized that as physicians per ten thousand people increases, average LE increases. Availability and access to healthcare services is an important resource to protect oneself from disease onset and to accelerate recovery from illness and disabilities. For the case of physician density on healthcare was positively associated with LE. This is generally consistent with previous work done in Western societies that show the important role that healthcare access plays in the survival of children and older people (9, 14). A study of Shaw (12) identified that more healthcare services available in rural areas can improve the odds of survival and healthy survival of older people. In addition, maternal and fetal-neonatal survival depends on a continuum of basic services through pregnancy, delivery, and the postpartum or newborn period (4). However, inability to get access to healthcare services for severe childhood illness could affect psychological development and accelerate the degradation of the functional level of specific organs in adulthood. All these adversities may reduce an individual's reserve capacity to resist disease, thus increasing mortality and health problems at later ages and lead to reduced LE. Therefore, this might explain the findings regarding the significance of increasing physician number and its impact on LE.

We predicted that the LE to be negatively correlated with adolescent reproduction and TFR. Delay reproduction increases survivorship, a relationship that has been observed worldwide (26). Various studies have found that adolescents who anticipate having a shorter lifespan reproduce at an earlier age than adolescents who expect to have a longer lifespan (27-29).The causal links between LE, and reproduction are dependent on the stage of the demographic transition a population is experiencing. Countries vary in the rates at which they pass through stages in the demographic transition. Some countries, such as China, Brazil, and Thailand, have moved through the stages of demographic transition rapidly because of economic and social changes; other countries, particularly in Africa, have stalled owing to economic stagnation and the impact of AIDS. Therefore, when examining the relationships between LE and reproduction it is important to control for economic factors and disease indicators. Indeed, these factors may account for the lack of any correlation between LE and age at first birth among populations with low LE (<60 years).

The study results show that higher education levels among the population have a positive impact on LE. The coefficient for mean year of schooling was statistically significant and positive, which confirmed the original hypothesis. This finding has important implication that is, higher levels of education are typically associated with more timely receipt of healthcare, and people are more likely to be aware of their health. This might suggest that with higher educational levels, people are more aware of the importance of obtaining adequate prenatal care and can be encouraged to optimize the use of maternal health services and avoid situations such as delivering a low-birth-weight baby or encountering other childbirth-related complications. It has been shown that individuals with more education earn higher real wages. Greater real wages mean average household income is higher, enabling people to increase the quality and quantity of the healthcare services they purchase. Moreover, people with more education can better comprehend information about proper nutrition, hygiene, and healthcare services, as well as common illness-preventative measures. Thus, it is hypothesized that as average years of schooling increases, average LE will increase.

One measure of a country's standard of living is per capita GNI, and studies consistently show it is related to LE. There is a considerable body of research linking income inequality to poor health outcomes. Poorer countries obviously have less to spend on preventive medicine and healthcare than wealthier countries. That may explain why average longevity is much shorter in poor countries. There is also a statistically meaningful relationship between income distribution and LE and in this study it is established the impact of GNI on average LE. Results of this study claims that inflation rate and increase in GNI increase LE (10, 18). These findings have significant implications. Besides implementing economic reconstruction processes such as increasing job opportunities, policy makers would have increased awareness that economic hardship can affect vulnerable populations such as elderly people, whose health status will deteriorate. A previous study found that death rates of elderly people were substantially higher in the lower-income groups (8). This leads to the policy implications of this study results namely, that economic upturns are associated with greater LE rates and vice versa for economic downturns.

A limitation of this study is that we only analyzed data for the most common determining factors, ie, those that were found to be significantly associated with life expectancy in previous studies. In addition, the analysis was limited to low and lower middle income countries. Data on the 91 counties were obtained from specialized United Nations. However, the sources and quality of data vary according to country. Some low-income countries have comprehensive civil registration and vital statistics and regular censuses of the entire population. However, many lower middle income countries have incomplete or dysfunctional birth and death registration systems and therefore lack continuous empirical data on mortality and life expectancy.

Conclusion

The study presented an analysis of how demographics, socioeconomic status, and health factors affect LE in the low and lower middle-income countries. It is clearly identified the factors support what is the current thinking on how to improve average LE throughout the low and lower middle income countries. Increases in education, and physicians' numbers, and national income significantly contribute to higher average LE. The analysis also indicates that the factor with the biggest impact on a nation's average LE is the percentage of adults who are infected with HIV. This suggests that international efforts should be aimed at increasing average LE, especially in the poor countries to eliminate the higher prevalence of HIV. The study consisted of data from 91 countries and measured the effects of six different determinants from demographic, socioeconomic and health factors. Further research with data sets that are more expansive and a wider range of factors would enhance policymakers' understanding of which factors influence average LE the most.

Ethical considerations

Ethical issues (Including plagiarism, Informed Consent, misconduct, data fabrication and/or falsification, double publication and/or submission, redundancy, etc.) have been completely observed by the authors.

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References

1. WHO (2008). World health report 2008: Primary health care now more than over. *World Health Organization (WHO),* Geneva, Switzerland.
2. Zhang J, Zhang J, Lee RD (2001). Mortality decline and long run economic growth. *Journal of Public Economics,* 80:485–507.
3. Coile C, Diamond P, Gruber J, Jousten A (2002). Delays in claiming social security benefits. *Journal of Public Economics,* 84:357–85.
4. Meara ER, Richards S, Cutier DM (2008). The gap gets bigger: changes on mortality and life expectancy, by education, 1981-2000. *Health Aff (Millwood),* 27(2):350-60.
5. Shkolnikov VM, Andreev EM, Jasilionis D, Leinsalu M, Antonova OI, McKee M (2006). The changing relation between education and life expectancy in central and eastern Europe in the 1990s. *J Epidemiol Community Health,* 60:875-81.
6. Bulled NL, Sosis R (2010). Examining the relationship between life expectancy, reproduction, and educational attainment. *Hum Nat,* 21:269-89.
7. Khang YH, Yang S, Cho HJ, Jung-Choi K, Yun SC (2010). Decomposition of socioeconomic differences in life expectancy at birth by age and cause of death among 4 million South Korean public servants and their dependents. *Int J Epidemiol,* 39:1656-66.
8. Zimmer Z, Amornsirisomboon P (2001). Socioeconomic status and health among older adults in Thailand: an examination using multiple indicators. *Soc Sci Med,* 52:1297-1311.
9. Hoi le V, Phuc HD, Dung TV, Chuc NTK, Lindholm L (2009). Remaining life expectancy among older people in a rural area of Vietnam: trends and socioeconomic inequalities during a period of multiple transitions. *BMC Public Health*, 9:471.
10. Karlsson M, Nilsson T, Lyttkens CH, Leeson G (2010). Income inequality and health: importance of a cross-country perspective. *Soc Sci Med*, 70:875-85.
11. Lin CC, Rogot E, Johnson NJ, Sorlie PD, Arias E (2003). A further study of life expectancy by socioeconomic factors in the National Longitudinal Mortality Study. *Ethn Dis*, 13:240-47.
12. Shaw JW, Horrace WC, Vogel RJ (2005). The determinants of life expectancy: an analysis of the OECD health data. *South Econ J*, 71:768-83.
13. Mondal MNI, Shitan M (2013). Factors affecting the HIV/AIDS epidemic: an ecological analysis of global data. *African Health Sciences*, 13(2):301-10.
14. Seubsman SA, Kelly MJ, Yiengprugsawan V, Sleigh AC (2011). Thai Cohort Study Team. Gender, socio-economic status, and self-rated health in a transitional middle-income setting: evidence from Thailand. *Asia Pac J Public Health,* 23:754-65.
15. Lin RT, Chen YM, Chien LC, Chan CC (2012). Political and Social Determinants of Life Expectancy in Less Developed Countries: A longitudinal Study. *BMC Public Health*, 12:85.
16. Mondal MNI, Shitan M (2014). Relative Importance of Factors on Life Expectancy in the Low and Lower Middle Income Countries. *J Epidemiol*, 24 (2): (In press**)**
17. Robine JM (2003). The relevance of population health indicators. *J Epidemiol Community Health,* 57:318-23.
18. Tang JL, Griffiths S (2009). Review paper: epidemiology, evidence-based medicine, and public health. *Asia Pac J Public Health,* 21:244-51.
19. Anderson KG (2010). Life expectancy and the timing of history events in developing countries. *Human Nature*, 21:103-23.
20. WHO (2011). World Health Statistics 2011. *World Health Organization* (WHO), Geneva, Switzerland.
21. UNDP (2011). Human Development Report 2011. *United Nations Development Program* (UNDP), UN Plaza, New York, NY 10017, USA.
22. PRB (2012). World Population Data Sheet 2012. *Population Reference Bureau* (PRB), Washington DC, USA.

23. Mondal MNI, Shitan M. Projection of Human Immunodeficiency Virus among the High Risk Groups in Malaysia. *Jpn. Infect. Dis.,* 2013; 66(5): 421-24.
24. Mondal NI, Takaku H, Ohkusa Y. Impact of Age at Marriage and Migration on HIV and AIDS Epidemics in Japan. *MBC International Journal for Equity in Health,* 2009; 8:23.
25. Mondal MNI, Hiroshi T, Yasush O, Tamie S, Nobuhiko O. HIV Acquisition and Transmission in Bangladesh: Turning to the Concentrated Epidemic. *Jpn. Infect. Dis.*, 2009; 62:111-19.
26. Schultz TP (1993). Returns to women's education. In E. M. King& M. A. Hill (Eds.). *Women's education in developing countries: Barriers, benefits, and policies.* Baltimore: Johns Hopkins University Press.
27. Brumbach BH, Figueredo AJ, Ellis BJ (2009). Effects of harsh and unpredictable environments in adolescence on the development of life history strategies: a longitudinal test of an environmental model. *Human Nature,* 20:204-68.
28. Geronimus AT (2004). Teenage childbearing as cultural prism. *Br Med Bul*, 2004, 69, 155-66.
29. Wilson M, Daly M (1997). Life expectancy, economic inequality, homicide, and reproductive timing in Chicago neighborhoods. *Br Med J*, 314:1271-74.