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Impact of Environmental Degradation and Income Inequality on Health Status in South Asian Countries

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ABSTRACT

A few empirical studies are found on the impact of environmental degradation and income inequality on health status. The current research is an attempt to fill this gap by analyzing the consequences of environmental degradation and income inequality on health status in South Asian countries over the time period of 1980-2014 using a multivariate framework. Child mortality and life expectancy are used as proxies of health status. Employing recent panel data econometric techniques, we find that all variables are non-stationary and cointegrated. Our estimated results suggest that environmental degradation and income inequality are detrimental for health status in long-run. Moreover, there exists unidirectional causality running from income inequality to health status in South Asia. The findings of the present study open up new insight for policy makers to design a comprehensive social, economic and energy supply policies to minimize the detrimental impact of environmental pollution and income inequality.

KEY WORDS: *environmental degradation, Income inequality, Health status, South Asia, panel data, child mortality*

1-INTRODUCTION

Population health is a major economic concern in most developing countries. The role of health in the process of development is very important because it is one of the main components of human capital investment. In developing countries, labor force is the most plentiful factor of production and healthy labor force can contribute high levels of output. Three of the eight Millennium Development Goals (MDGs) are related to health because it is central to global agenda of reducing poverty, as well as an important measure of human well-being in its own right. Therefore, it becomes necessary to explore the determinants of population health so that appropriate measures could be taken to tackle the health issues [11]. Health is assumed to be one of the most significant measures of welfare and quality of life because the satisfaction gained by the use of goods and services can be maximized only in the presence of good health status [36]. It plays the role of catalyst to enhance the earning capacity and self-esteem of the individuals [43].

South Asia, a strategically important region, is experiencing exceptionally severe challenges related to public health on geographic and demographic scale. Pakistan, India, Bangladesh, Sri Lanka and Nepal constitute almost one-fifth of the world population. More significantly, these nations are home to 66% of the population of the world living on under $1 a day. Low life expectancy, malnutrition, child mortality, and occurrence of HIV/AIDS and TB are second in South Asia just after Sub-Saharan Africa. The area faces not just these health related issues like lack of sanitation facilities, poor maternal health and lack of healthcare services but also a rising trend in the epidemic diseases. In spite of these interlinked challenges, the average expenditures of these five countries on health are less than 3.2% of their GDP, whereas global average expenditures on health are 8.2%. Amongst the world's region, South Asia is probably the only one, where a decline in health expenditures is observed during the period of 2000 and 2006 (48). For further detail, see Figure 1 and 2.

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Figure 1. Child Mortality Per 1000 in South Asian Countries (1980-2014)

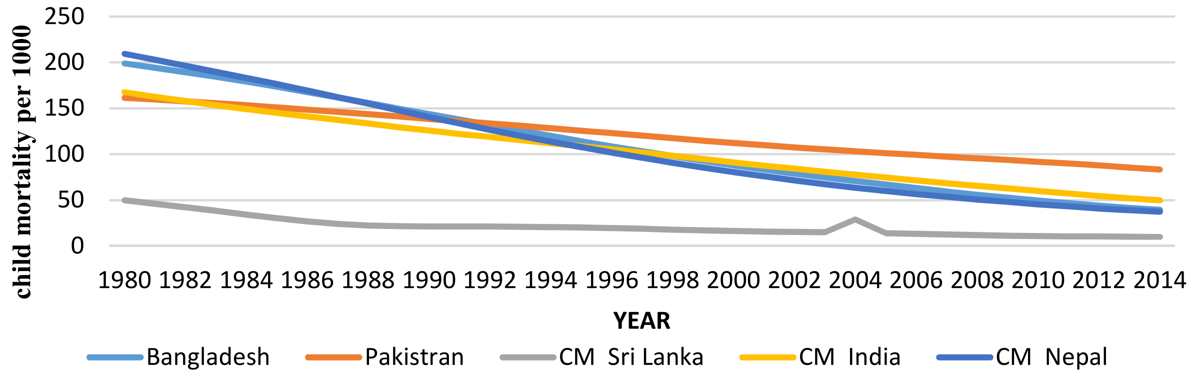
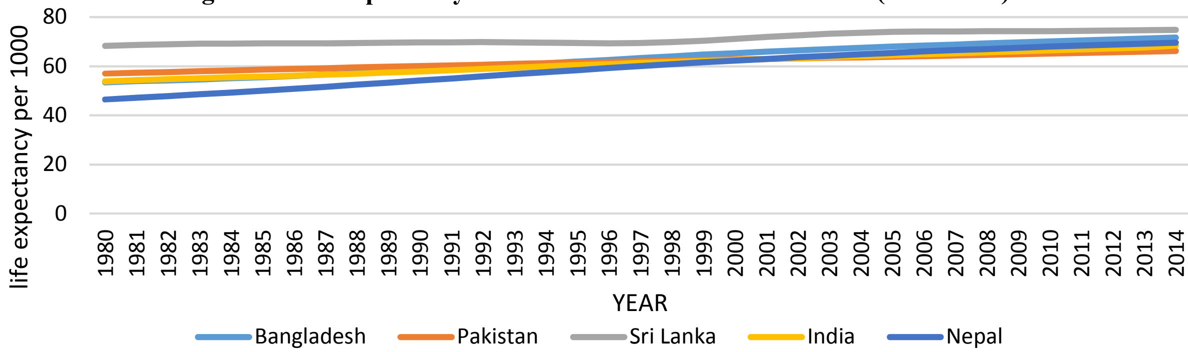
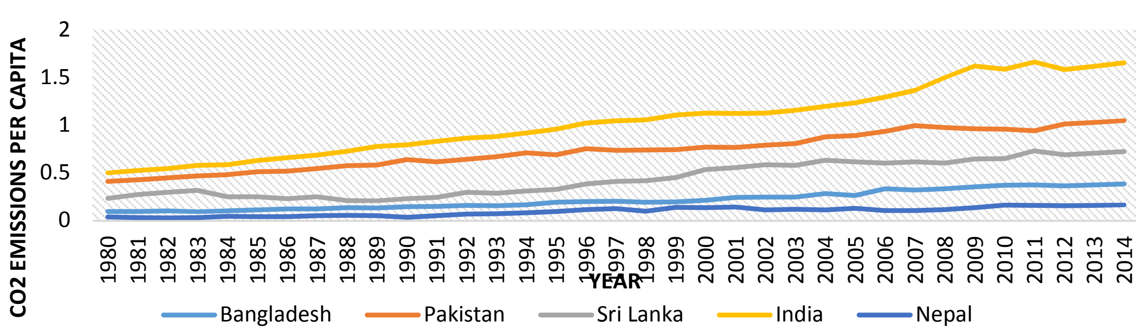


Figure 2:Life Expectancy Per 1000 In South Asian Countries (1980-2014)



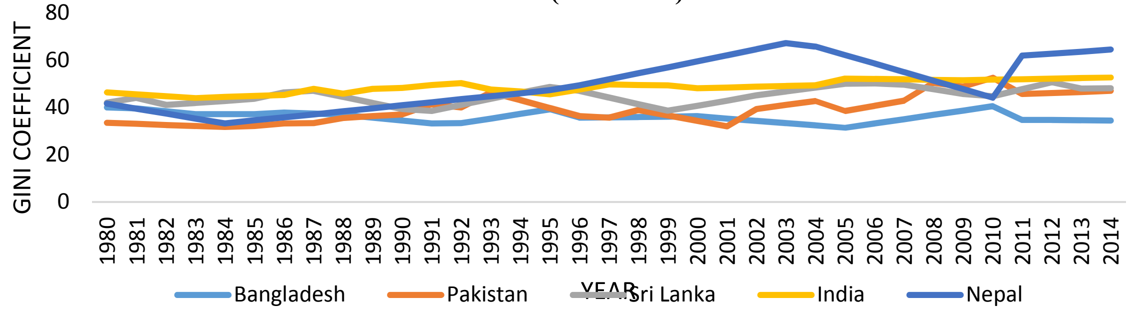
South Asian economies are exposed to numerous environmental issues. The leading issues include land degradation, air pollution and water pollution. In South Asia, 1.67 billion population is residing only in 4.8 % of the world's land area. With India on the lead, while Pakistan is second with respect to population in South Asia. The largest source contributing to air pollution is vehicular emissions, in urban areas especially. In India, an increase of nearly 65% in the total motor vehicles has been observed during the period of 2001-2012. Population density and industrialization have made air pollution a real threat. Increasing trend in the quantity of pollutants, e.g. nitrogen oxide and particulate matter was observed in South Asian region. The carbon emissions have also increased by approximately 24% during the period of 2006-2010. The biggest contribution to CO_2 emissions is made by India. The contribution of other countries is only 10.82 % of the South Asian region. Yet, CO_2 emissions per capita in South Asia are still lagging behind the global average [42]. Figure 3 portray the same situation.

Figure 3: CO2 emissions (matric tons per capita) in south asian countries (1980-2014)



High values of Gini coefficient estimated by World Fact book for South Asian countries describe the phenomenon of increasing inequality of income in the region. The unequal distribution of income in India, measured by the Gini coefficient was 33.6%, followed by Nepal 32.8% and Bangladesh 32.1% in 2010. In Pakistan and Sri Lanka the value of Gini coefficient was 29.6% 49% respectively in 2010 [The World Fact Book, CIA, 2011].

Figure 4: Income Inequality Measured By Gini Coefficient in South Asian Countries (1980-2014)



There is a close association between income inequality and health. To achieve healthy status, equal income distribution is a pre-requisite. Health status of individuals is influenced by income inequality, whether they are living in developing countries or developed countries [41; 45]. The debate was opened by [41] that income distribution and health status are closely related. Afterwards a number of researchers and policy makers made efforts to investigate the causes of differences in the status of health of individuals within country and among the countries. As a consequence, the literature related to equality of health status enhanced significantly [1,10,9]

The central objective of study is to investigate the nexus among environmental degradation, income inequality and health status in South Asia countries namely, Pakistan, India, Bangladesh, Sri Lanka and Nepal covering the period from 1980 to 2014. The literature that discusses the impact of environmental degradation and inequality of income on health status with reference to South Asian countries is not available to the best of my knowledge. The current study is an attempt to fill this gap by analyzing the relationship between environmental degradation, income inequality and health in South Asia. The further contribution of the current study is the application of the latest panel data techniques to analysis more reliable empirical results.

2-EMPIRICAL LITERATURE

On theoretical basis, four mechanisms are developed that show how population health can be affected by unequal distribution of income [32]. The second mechanism is related to *absolute income hypothesis* which states that people's own income can influence their health, as it enables them to get good nutrition and better health facilities. According to absolute income hypothesis, population health is not influenced by the distribution of income. Especially in case of less developed countries, average income plays more obvious role in affecting population's health as compared to the role of unequal distribution of income, whereas the case is opposite for the rich countries [11]. It is so because people in poor countries have to spend a significant amount of their incomes for the attainment of health facilities while in rich countries the provision of health facilities to all citizens is the responsibility of the state so people in rich countries do not have to spend a large share of their incomes to get health facilities.

The second mechanism is related to *relative income hypothesis* which explains the fact that other people's income can also affect population's health status. When people compare their incomes with those who are earning higher incomes, they feel distressed. Increasing inequality in income may lead to sense of insecurity and loss of self-confidence [46]. Within a country, a person's health is dependent on his personal income, however among the countries this association becomes weak and factor of unequal distribution of income adversely & strongly affects individual's health. [46]. The third mechanism which explains that unequal distribution of income may affect health of population negatively is termed as *psychosocial hypothesis.* Another way through which inequality of income can influence health is social comparisons which lower down social capital, confidence & efficiency [25 and 32]. Inequality of income has adverse impact on health as poor status in the social ranking provokes pessimistic feelings like embarrassment & mistrust which will provide a route to dangerous activities like smoking, imprudent drinking and harmful drugs[33]. The fourth hypothesis which assumes a negative association among inequality of income and health is termed as *Neo-materialism hypothesis*. Supporters of this hypothesis claim that inequality of income first affects the division of available resources and then it influences human health [7 and 29]. So it can be recommended that poor health might be the result of increasing inequality of income which leads to less expenditures on the provision of health care facilities to the poor by the state.

Theoretically, all the arguments found in the literature indicate a negative impact of income inequality on health status. However, empirical findings do not reach on a single conclusion. For example [42] observed the impact of inequality of income on health and trust using 30 high income economies covering the period from 1981-2014. The findings of the study discovered that inequality of income adversely affected social trust which in turn lowered the health of young people having age between 16 to 25 years. This negative impact gradually vanished with the passage of time and after the age of 36 no adverse effect on health were detected. Investigating the impact of unequal distribution of income on population health in 65 low and middle income economies using data [19] showed that GDP per capita, budget spent on education by the government and public health expenditures positively and significantly affects life expectancy. However, Gini coefficient negatively and significantly affects life expectancy. According to [21] in developed countries, unequal distribution of income had a positive and significant impact on life expectancy. In developing economies, wider unequal distribution of income resulted in significantly lesser life expectancy as compared to developing economies which had relatively more equal income distribution. The coefficient of income distribution, irrespective of the kind of measure used, was found to be insignificant in all Islamic nations, In a research by [15] on finding the association among population health and unequal distribution of income for a set of Islamic countries. It was concluded by [12] that the impact of unequal distribution of income is more in less developed economies as compared to developed economies. Working on impact of unequal distribution of income on health in a sample of 61 emerging economies [16] found that mortality rate was not significantly affected by health expenditure . While [1] explored the effect made by unequal distribution of income on health status for 44 countries and found that inequality of income and education were important determinants of health. However, the effect of income inequality was found to be significant only when income level, education and savings were controlled.

Association was found among the unequal distribution of income and health at the aggregate level [35] in 30 countries using a period of 40 years. On excluding the economic growth variable, the unequal distribution of income may have resulted in better health. Estimated results [29] supported neo-materialism hypothesis that assumed a negative association between unequal distribution of income and health. Health inequalities were found in socially marginalized groups in U.S. and they had no health care, very minimum wages, poor transportation facilities, underfunded schools and poor housing. Another study [25] proved negative association between unequal distribution of income and health status in American households of 50 U.S. states covering the time span of 1980 and 1990, [24] revealed that inequality of income significantly affected mortality trends. The study of [8] observed the inter link between ecological footprints, economic activities, CO_2 emissions and rates of infant mortality and below-5 mortality in a sample of 66 countries having low income from 1980 – 2010. Results revealed that positive relation was found between economic activities and rates of infant mortality and below 5 mortality rate in sub-Saharan Africa.

It was observed [3] that the U.S states with most equal power distribution, best environmental policies and the strongest environmental quality had least pre-mature death rate and vice versa. It was found by [20] that increase in air pollution negatively affected human health. The presence of the bi-directional causality between life longevity and environmental quality for a cross section of 132 countries was verified by [31]. Unequal distribution of income on health decreased with the inclusion of environmental degradation [13]. The findings of the study [34] to explore the association between income, health and environment using data for 108 countries, showed that the positive impact of GDP on population's health was strong enough to overcome the negative impact of CO_2 and as a result life expectancy increased with the increase in GDP. In a study related to Pakistan the results for the long run & short run models indicated negative association among unequal distribution of income and health [38]. While [36] found an adverse impact of air pollution on health status of adults and children in urban areas of Pakistan. Soil and water contaminated by radioactive materials cause huge losses to health of living organisms [27]. Not only physical but mental health and psychological development of children also depend upon green space and healthy environment around them [26*]*.For further detail, the table for literature review is displayed in Appendix.

MATERIALS AND METHODS

Model selection and Data Sources

Model 1.

$$HS_{it} = \beta_0 + \beta_1 CO_{2it} + \beta_2 GDPPC_{it} + \beta_3 EDU_{it} + \beta_4 LFERT_{it} + \beta_5 HEPC_{it} + \mu_{it} \qquad \text{[eq.1]}$$

Following [12], firstly we analyze the impact of environmental quality on health status.
Where,
HS = Child mortality and life expectancy are used as proxy for health status and child mortality is measured in under 5 mortality per 1000 live births while life expectancy at birth in total years
CO_2 = an indicator for environmental quality, Carbon dioxide emissions metric tons per capita, taken from World Development Indicators (WDI) online source of data
GDPPC= GDP per capita at constant 2005 US dollars,
EDU = school education for 25 years, data is taken from Barro and Lee (Latest version).
LFERT = Log of fertility rate described as total births per woman
HEPC = Per capita health expenditures, constant 2011 international US dollars, taken from UNDP Human Development Reports [various issues].

Model 2..
$HS_{it} = \beta_0 + \beta_1 CO_{2it} + \beta_2 GDPPC_{it} + \beta_3 EDU_{it} + \beta_4 LFERT_{it} + \beta_5 HEPC_{it} + \beta_6 GINI_{it} + \mu_{it}$ [eq.2]

Second, we investigate the impact of environmental degradation on health status in the presence of income inequality. Where GINI= Gini index is used as a measure of income and data is extracted from Standardized World Inequality of income Database [SWIID].

Empirical Methodology
The first step in empirical methodology is to find the integrated order of the selected variables by applying various unit root tests. IPS and LLC panel unit root tests are used in the current study. Both these tests are used in balanced panel as is the case in present study.
After confirmation of the integrated order of variables, the question arises whether co-integration exists between variables or not. For this purpose, Pedroni cointegration technique is applied. Pedroni uses various tests for co-integration in panel data analysis allowing for considerable heterogeneity. He assumes trend for the cross section units and constitutes the null hypothesis that there is no co-integration among the selected variables. The rejection of null hypothesis in the panel implies that the variables are co-integrated. Padroni's test permits for numerous regressors for the co-integration vector to change in various sections of panel. Moreover, it gives the appropriate critical values in complex regressions [40]. Pedroni proposed the following panel regression model

$Y_{it} = \alpha_i + \sum_{m=1}^{N} \beta mi\, X_{mit} + \delta_t + \mu_{it}$ [3] source: [40].

Pedroni has proposed seven different co-integration statistics to get the within and between effects in panel. The first category comprises of 4 tests which includes within dimension pooling. Second category comprises of 3 tests which include "between dimensions pooling" and are termed as co-integration statistics for group mean panel. Pedroni concludes that in the seven statistics the distortions in size are negligible and power is high especially for a long time span. A major shortcoming of Pedroni's test is that it deals with a single co-integrating vector.
On the basis of the multivariate framework presented by [23 and 33] presented Fisher co-integration technique. Johansen presented two different methods for this purpose. One is a trace statistics while other is maximum Eigen values statistics to check the existence of co-integrating vectors when time series is not stationary at level. This test follows system methods and aims to find more than one co-integrated vectors. When cross-section units are small and the time span is long, the system method gives better results [22]. Both techniques are applied in the present study.
After the verification of co-integration between all the variables, the next step is to calculate the related co-integration parameters. Fully modified OLS by [39] has been applied to estimate the co-integration parameters in the panel. FMOLS is not affected y large size distortions when endogeneity and heterogeneity are present and provides consistent and reliable estimates.
In order to check panel causality, test [12] is applied, which is a simple form of non-causality test. To check causality, the model under consideration is as follows:

$$X_{it} = \alpha_i + \sum_{p=1}^{P} \gamma_i^{(p)} X_{i,t-m} + \sum_{p=1}^{P} \pi_i^{(p)} Z_{i,t-k} + \varepsilon_{it} \qquad [4] \quad \text{source: [14]}$$

Where i = 1, 2,3,4,5. And t= 1, 2…. T
Z and X are two stationary variables in the above equation, which are observed for 5 cross sections in T time period. $\pi_i = [\pi_i^{[1]}, \ldots\ldots\ldots, \pi_i^{[p]}]'$ and α_i the intercept term is supposed to remain fixed and p represents time dimension. Homogeneous order of lag [P] for each country in the panel is assumed. Regression coefficient $\pi_i^{[p]}$ and

autoregressive parameter $\gamma_i^{[p]}$ are allowed to change across the cross-sectional units in the panel. Null hypothesis presumes the existence of no causal association in any cross-sectional entity of the panel. This is named as Homogeneous Non- Causality hypothesis [HNC].
The alternative hypothesis [H_a] is named as Heterogeneous Non- Causality hypothesis [HENC]. This hypothesis assumed that no causal link is running from x to z in case of a $N_1 < N$ distinct processes. Although N_1 is not known, yet it provides the following condition:$0 \leq N_1 / N_1 < 1$.
The average statistics $W_{N.T}^{[HNC]}$is proposed to have link with Homogeneous Non-Causality hypothesis [HNC] is stated below

$$W_{N,T}^{HNC} = \frac{1}{N}\sum_{i=1}^{N} W_{i,T} \qquad [5]$$

Whereas $W_{i,T}$ shows the individual Wald test statistics for i^th cross-sectional related to the individual test. The test statistics $Z_{N,T}^{HNC}$ for $T, N \to \infty$ is given below:

$$Z_{N,T}^{HNC} = \sqrt{\frac{N}{2M}}(W_{N,T}^{HNC} - M) \to N(0,1) \qquad [6]$$

RESULTS AND DISCUSSION

Before formal econometric modeling, first of all the integration order of selected variables is checked. For this purpose, panel unit root tests: IPS and LLC are applied. Table 1 and 2 show the results of selected variables at level while Table 3 and 4 explain the results at first difference. The results show that selected variables are not stationary at level while become stationary by taking their first difference in the case of South Asian countries. The conclusion based on the results is that all selected variables have integrated of order 1 i.e. I [1].

Table 1: IPS Unit Root Test Results at Level

Variables	Constant	P-value	Constant & trend	P-value
CO_{2it}	3.337	0.999	-0.221	0.412
$GDPPC_{it}$	7.558	1.000	2.739	0.996
$GINI_{it}$	-0.123	0.451	-0.656	0.255
CM_{it}	0.362	0.641	2.394	0.991
EDU_{it}	2.805	0.997	-0.858	0.195
$HEPC_{it}$	2.064	0.980	2.501	0.993
$FERT_{it}$	0.260	0.602	1.562	0.940
LE_{it}	2.575	0.995	0.800	0.788

Table 2: LLC Panel Unit Root Results at Level

Variables	Constant	P-value	Constant & trend	P-value
LE_{it}	3.438	0.999	18.070	1.000
CO_{2it}	0.747	0.772	-0.916	0.179
$GDPPC_{it}$	5.811	1.000	0.470	0.681
EDU_{it}	0.081	0.532	-0.532	0.297
$HEPC_{it}$	26.128	1.000	30.290	1.000
$FERT_{it}$	-0.788	0.215	1.585	0.280
CM_{it}	-0.331	0.370	2.972	0.998
$GINI_{it}$	0.814	0.792	-0.109	0.456

Table 3: IPS Panel Unit Root Results at 1st Difference

Variables	Constant	P-value	Constant & trend	P-value
CO_{2it}	-4.955	0.000	-3.839	0.000
$GDPPC_{it}$	-3.552	0.000	-5.017	0.000
$GINI_{it}$	-6.079	0.000	-4.676	0.000
CM_{it}	-1.685	0.045	-1.930	0.027
LE_{it}	-3.975	0.000	-5.164	0.000
$FERT_{it}$	-4.138	0.000	-4.443	0.000
EDU_{it}	-4.881	0.000	-3.394	0.000
$HEPC_{it}$	-2.716	0.003	-2.465	0.006

Table 4: LLC Panel Unit Root Results at 1st Difference

Variables	Constant	P-value	Constant & trend	P-value
CO_{2it}	-2.879	0.002	-3.348	0.000
$GDPPC_{it}$	-3.162	0.000	-4.156	0.000
$GINI_{it}$	-4.418	0.000	-3.099	0.000
CM_{it}	-2.319	0.010	3.229	0.999
EDU_{it}	-4.463	0.000	-3.099	0.000
$HEPC_{it}$	-0.020	0.000	-0.018	0.000
$FERT_{it}$	-0.788	0.215	1.585	0.280
LE_{it}	-3.549	0.000	-6.631	0.000

To examine the long run relationship between variables Pedroni cointegration technique is applied first (Table 5). The results of seven statistics show that the null of no cointegration is rejected in at least two statistics in all selected models. These results reveal the evidence of cointegrated relationship between variables in South Asian countries. To further validate the cointegration among variables, Johansen Fisher technique for panel cointegration given by [30] is applied (table 6). Trace statistics as well as the Maximum Eigen statistics show the presence of more than two cointegrating vectors at 1% level of significance in all selected models. These results further confirm the existence of long run association between variables in South Asian countries over the period 1980-2014.

Table 5: Pedroni Cointegration Results

Statistics	Panel v-statistics	Panel δ-statistics	Panel pp-statistics	Panel adf-statistics	Group δ-statistics	Group pp-statistics	Group adf-statistics
$CM_{it} = f\,[CO_{2it}, GDPPC_{it}, FERT_{it}, EDU_{it}, HEPC_{it}]$							
Coefficient	4.596	-1.511	-5.410	-5.402	1.252	-0.809	-0.063
P-value	0.000	0.065	0.000	0.000	0.894	0.209	0.474
$CM_{it} = f\,[CO_{2it}, GDPPC_{it}, FERT_{it}, EDU_{it}, HEPC_{it}, GINI_{it}]$							
Coefficient	4.123	-0.996	-5.527	-5.519	1.847	-0.243	0.526
P-value	0.000	0.159	0.000	0.000	0.967	0.403	0.700
$LE_{it} = f\,[CO_{2it}, GDPPC_{it}, FERT_{it}, EDU_{it}, HEPC_{it}]$							
Coefficient	-2.074	-0.471	-2.302	-0.278	0.095	-2.448	0.065
P-value	0.981	0.318	0.010	0.390	0.537	0.007	0.526
$LE_{it} = f\,[CO_{2it}, GDPPC_{it}, FERT_{it}, EDU_{it}, HEPC_{it}, GINI_{it}]$							
Coefficient	-2.539	-0.130	-2.034	0.117	0.728	-2.023	0.486
P-value	0.994	0.551	0.021	0.547	0.766	0.021	0.686

Table 6: Johansen Fisher Panel Co-integration Results

No. of CE[s]	None	At most1	At most 2	At most 3	At most 4	At most 5	At most 6
$CM_{it} = f\,[CO_{2it}, GDPPC_{it}, FERT_{it}, EDU_{it}, HEPC_{it}]$							
Trace Statistics	246.5	105.1	63.24	40.00	30.81	27.77	
P-value	0.000	0.000	0.000	0.000	0.000	0.002	
Max Eigen Statistics	153.9	51.05	30.77	19.33	21.35	27.77	
P-value	0.000	0.000	0.000	0.036	0.018	0.002	
$CM_{it} = f\,[CO_{2it}, GDPPC_{it}, FERT_{it}, EDU_{it}, HEPC_{it}, GINI_{it}]$							
Trace Statistics	281.5	176.8	104.3	70.02	44.04	33.45	28.97
P-value	0.000	0.000	0.000	0.000	0.000	0.000	0.001
Max Eigen Statistics	246.0	89.94	42.51	33.79	20.81	23.11	28.97
P-value	0.000	0.000	0.000	0.000	0.022	0.010	0.001
$LE_{it} = f\,[CO_{2it}, GDPPC_{it}, FERT_{it}, EDU_{it}, HEPC_{it}]$							
Trace Statistics	298.5	174.3	101.0	61.58	32.55	28.77	
P-value	0.000	0.000	0.000	0.000	0.000	0.001	
Max Eigen Statistics	166.4	100.0	48.80	40.61	23.14	28.77	
P-value	0.000	0.000	0.000	0.000	0.010	0.001	
$LE_{it} = f\,[CO_{2it}, GDPPC_{it}, FERT_{it}, EDU_{it}, HEPC_{it}, GINI_{it}]$							
Trace Statistics	281.9	247.4	166.9	109.5	63.44	37.31	28.67
P-value	0.000	0.000	0.000	0.000	0.000	0.000	0.001
Max Eigen Statistics	352.1	117.8	76.90	56.18	37.39	28.24	28.67
P-value	0.000	0.000	0.000	0.000	0.000	0.001	0.001

After the confirmation of cointegration among the variables, the long run coefficients are estimated. FMOLS technique is applied to evaluate long run coefficients. The estimated results are reported in Table 7. The results by taking child mortality as dependent variable explain that CO_2 emissions increases child mortality in selected South Asian countries during the time span of 1980-2014. This outcome is in line with the studies of [6, 5and 12] which concluded that child mortality increases when the environment deteriorates or carbon emissions increase. The negative coefficient of income per capita demonstrates that child mortality decreases with the increase in income of population in South Asian countries. This finding is similar to the results of [15, 1 and 13].The sign of the coefficient of fertility rate is positive which implies that as the fertility rate increases, it causes child mortality to rise in the panel of South Asian countries. This outcome supports the findings of [12 and 16].The negative sign of education level displays that increase in the level of education brings a decrease in child mortality. This outcome coincides with the findings of [1 and 13]. Similarly child mortality decreases with the increase in per capita health expenditures.

By taking life expectancy as dependent variable, the results show that CO_2 emission, fertility rate and per capita health expenditures decrease life expectancy in South Asian countries. However increase in per capita income and level of education increases the span of life in our selected panel. One interesting result is that life expectancy decreases with the increase in per capita health expenditures. The reason may be that majority of the people in South Asian countries have poor adult diet, are indulged in smoking and also face several occupational hazards. All these factors adversely affect the lungs function which results in squeezing of expected life span [4]. Furthermore, a minor share of GDP reserved for providing health facilities to the poor in South Asian countries is not properly spent. As a result, the major part of the population, living below the subsistence level finds it difficult to face the emerging diseases and natural calamities which results in a decline of expected life span.

Next two models describe the results of environmental degradation on health status by incorporating income inequality. The findings show that income inequality negatively impacts health status in selected panel. These results are consistent with the findings of [2, 46 and 29]. The numerical value of coefficient of CO_2 emission decreases in both models by incorporating the measure of income inequality.

Table 7: Results of Fully Modified OLS

$CM_{it} = f\,[CO_{2it}, GDPPC_{it}, FERT_{it}, EDU_{it}, HEPC_{it}]$						
Variables	CO_{2it}	$GDPPC_{it}$	$FERT_{it}$	EDU_{it}	$HEPC_{it}$	
Coefficient	2.049	-0.708	1.230	-0.640	-0.191	
P- value	0.000	0.000	0.000	0.000	0.000	
$LE_{it} = f\,[CO_{2it}, GDPPC_{it}, FERT_{it}, EDU_{it}, HEPC_{it}]$						
Variables	CO_{2it}	$GDPPC_{it}$	$LFERT_{it}$	EDU_{it}	$HEPC_{it}$	
Coefficient	-0.517	0.125	-0.167	0.565	-0.278	

P- value	0.000	0.000	0.000	0.000	0.000	
$CM_{it} = f\,[CO_{2it}, GDPPC_{it}, FERT_{it}, EDU_{it}, HEPC_{it}, GINI_{it}]$						
Variables	CO_{2it}	$GDPPC_{it}$	$LFERT_{it}$	EDU_{it}	$HEPC_{it}$	$GINI_{it}$
Coefficient	0.152	-0.739	0.786	-0.032	0.150	-0.001
P- value	0.000	0.000	0.000	0.000	0.000	0.000
$LE_{it} = f\,[CO_{2it}, GDPPC_{it}, FERT_{it}, EDU_{it}, HEPC_{it}, GINI_{it}]$						
Variables	CO_{2it}	$GDPPC_{it}$	$LFERT_{it}$	EDU_{it}	$HEPC_{it}$	$GINI_{it}$
Coefficient	-0.390	0.137	-0.147	0.371	-0.365	-0.242
P- value	0.000	0.000	0.000	0.000	0.000	0.000

After confirmation of co-integration among the variables the direction of causality is investigated by applying Dumitrescu and Hurlin [DH] panel causality. Table 8 presents the empirical results of DH causality test[1]. The empirical results explain unidirectional causality running from child mortality to CO_2 emissions per capita, child mortality to GINI, child mortality to Health expenditures per capita and child mortality to GDP per capita while no reverse causation is found between these variables. There exists bidirectional causality between education and child mortality and between fertility and child mortality. When life expectancy is used a proxy for health the results show the evidence of bidirectional causality running from GDP per capita to life expectancy, life expectancy to GDP per capita. There exists bidirectional causality between education and life expectancy, between fertility and life expectancy, health expenditures per capita and life expectancy, between CO_2 emissions and life expectancy and also between GINI and life expectancy at 1% level of significance.

Table 8: DH Panel Causality Results

$CM_{it} = f\,[CO_{2it}, GDPPC_{it}, FERT_{it}, EDU_{it}, HEPC_{it}, GINI_{it}]$			
$CM_{it} \rightarrow CO_{2it}$	5.720	3.428	0.000
$CO_{2it} \rightarrow CM_{it}$	3.452	1.248	0.211
$CM_{it} \rightarrow EDU_{it}$	6.709	4.372	0.000
$EDU_{it} \rightarrow CM_{it}$	4.245	2.006	0.044
$CM_{it} \rightarrow GINI_{it}$	5.274	2.994	0.002
$GINI_{it} \rightarrow CM_{it}$	2.447	0.281	0.778
$FERT_{it} \rightarrow CM_{it}$	7.097	4.751	0.000
$CM_{it} \rightarrow FERT_{it}$	26.625	23.521	0.000
$GDPPC_{it} \rightarrow CM_{it}$	3.102	0.911	0.362
$CM_{it} \rightarrow GDPPC_{it}$	5.001	2.737	0.006
$HEPC_{it} \rightarrow CM_{it}$	3.578	1.368	0.171
$CM_{it} \rightarrow HEPC_{it}$	7.792	5.419	0.000
$LE_{it} = f\,[CO_{2it}, GDPPC_{it}, FERT_{it}, EDU_{it}, HEPC_{it}, GINI_{it}]$			
$GDPPC_{it} \rightarrow LE_{it}$	21.152	18.260	0.000
$LE_{it} \rightarrow GDPPC_{it}$	4.112	1.882	0.059
$HEPC_{it} \rightarrow LE_{it}$	8.015	5.633	0.000
$LE_{it} \rightarrow HEPC_{it}$	8.167	5.780	0.000
$FERT_{it} \rightarrow LE_{it}$	23.336	20.359	0.000
$LE_{it} \rightarrow FERT_{it}$	119.726	113.006	0.000

[1] There is no difference in the causality results of health status and environmental degradation, health status and environmental degradation by incorporating income inequality. For this reason Table 8 just provides the results of health status and environmental degradation by incorporating income inequality Models.

$GINI_{it} \rightarrow LE_{it}$	7.156	5.146	0.000
$LE_{it} \rightarrow GINI_{it}$	6.783	4.443	0.000
$CO_{2it} \rightarrow LE_{it}$	16.131	13.435	0.000
$LE_{it} \rightarrow CO_{2it}$	5.046	2.780	0.005
$EDU_{it} \rightarrow LE_{it}$	33.007	29.618	0.000
$LE_{it} \rightarrow EDU_{it}$	6.207	3.890	0.000

Conclusion and Policy Implications

The primary objective of this study was to find the relationship between environmental degradation, inequality of income and health status in South Asian countries. Panel data was used from the period of 1980-2014. IPS and LLC [unit root tests] were used to find out the stationary level of the variables. To check the long run relationship among the variables, Pedroni, [1999] and Fisher cointegration techniques developed by [30] were used. After the confirmation of cointegration, [14] causality test was applied to find out causal relationships among the variables. The results of unit root and cointegration tests reveal that all the variables are stationary at first difference and cointegrated. The results of FMOLS show that environmental degradation and income inequality negatively impacts health status. Causality results show that income inequality Granger cause health status in South Asian countries.
As far as policy recommendation is concerned, the results of the present study propose that two major problems faced by South Asian countries are environmental deterioration and income inequality which are adversely affecting health. Therefore, it is inevitable for South Asian countries to sustain clean environment and minimize the inequalities in income to improve the health of future generations. To address current environmental issues, renewable energy sources like wind and solar energy, sustainable urbanization [17] should be promoted to minimize the level of CO_2 emissions which is the main contributor of air pollution. Adoption of environment friendly technologies should be encouraged. Efforts should be made to preserve the environment and control the depletion of natural resources. Strict environmental laws must be formulated and implemented which should prohibit the issuance of licenses to those industries which emit more CO_2 emissions. Strong institutions should be developed to assure the successful implementation of environmental laws. To minimize the detrimental impact of income inequality on health, the Governments should implement distributive policies to mitigate the negative effects of income inequality on health. Progressive system of taxation can be helpful to serve the purpose as it shifts the burden of taxes towards elite class. Policymakers should focus on the provision of education and health care facilities to the deprived class to bridge the gap between rich and poor. Institutional set up should be improved for the implementation of reform policies aimed at raising average living standards.

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Appendix

Income Inequality and Health						
Study	**Study period**	**Sample countries**	**Inequality variable**	**Health measure**	**Methodology**	**Effect**
Hajebi and Razmi [2014]	2000- 2011	65 low & middle income economies	Gini coefficient	life expectancy	Fixed effect model	Negative
Herzer and Nunnenkam [2014]	1976-2010	80 developing and developed countries	Gini coefficient	life expectancy	Panel Cointegration	Negative in Developing and Positive in Developed
Nasreen *et al.*, [2012]	1973-2010	Pakistan	Gini Coefficient,	IMR and the Life Expectancy	co-integration and Error Correction Model	Negative
Esmaeili et al., [2011]	1996-2004	Islamic countries	Gini coefficient	IMR and Life Expectancy	Pooled OLS	Insignificant
Drabo [2010]	1970-2000	91 developing and developed countries	Gini coefficient	logit of under-five survival rate	GMM System estimation	negative
Franz & Roy [2006]		61 emerging economies	Gini coefficient	*Total Fertility*	multivariate approach	Positive
Asafu-Adjaye [2004]	six time periods	44 countries	*Gini coefficient*	IMR and life expectancy at birth	OLS	Positive Negative
Mellor & Milyo, [2001]	1995-1999	30 countries	Household income	Self-reported health status	Probit models	

Environment and Health						
Study	**Study period**	**Sample countries**	**Environment measure**	**Health measure**	**Methodology**	**Effect**
Chuang et al., [2015]	1980 –2010	66 countries	CO_2 emissions	IMR & below-5 mortality	Linear mixed models	CO_2 emissions Negative for low income countries
			ecological footprints	---------do-----	Linear mixed models	Positive for sub Saharan Africa and negative for Latin America
Mehrara and Masoumi [2014]	1995-2012	108 developing countries	CO_2 emissions	life expectancy	Two-stage least squares model	Negative
					Panel vector autoregressive method	Negative
Mariani et al., [2009]		132 countries	Environment Performance Index	Life expectancy.	OLG model	Positive
Hansen and Selte, [2000]	1991-1996	Canada [Oslo]	air pollution [PM_{10}]	sick-leaves	Logit model	Positive

Income inequality, Environment and Health							
Study	**Study period**	**Sample countries**	**Income Inequality**	**Environment measure**	**Health measure**	**Methodology**	**Effect**
Drabo [2011]	1970-2000	90 Developed and Developing countries	Presence of Gini Coefficient	emission [CO2]	Under Five Mortality Rates	Generalized Method of Moments [GMM system].	Negative
				emission [SO2]			Negative
				biological oxygen demand [BOD]			Negative
Boyce [2001]	2001	50 states of U.S	Power distribution	environment stress [ES]	Premature Death Rate	OLS	Positive
Gangadharan and Valenzuela [2001]	1998	51 countries	GNP	CO2	Life Expectancy	2SLS	Negative
						OLS	Negative
					Child mortality rate	2SLS	Positive
						OLS	Negative