

# Global Assessment of Diarrhoea Impact on Childhood Stunting, Wasting and Underweight

Anand Mallikarjun<sup>1</sup>, H H Bharadi<sup>2</sup>

<sup>1</sup>Ph.D Research Scholar, Department of Studies in Economics, Karnatak University, Dharwad.  
Karnataka State, India.

<sup>2</sup>Professor and Chairman, Department of Studies in Economics, Karnatak University, Dharwad.  
Karnataka State, India.

## Abstract

Diarrhoea is considered as one of the major challenges and causes behind malnutrition related issues in children, including stunting, wasting and under-weight. Stunting, wasting and under-weight are considerably some of the most challenging health problems that occur among children under the age of 5 years, with an increased vulnerability towards the disease. Globally, these are some of the most incident occurrences to children, with low- and middle-income countries facing the vulnerability most strongly. The study had conducted a globally focused evaluation, with special focus on the countries India, Bangladesh, Pakistan, Nigeria and Ethiopia.

**Keywords:** Diarrhoea, childhood, global assessment

## Introduction

Diarrhoea is a concerning disease associated with the problem of stunting, wasting and under-weight among children globally and the issues and challenges. Despite a decline in global prevalence from 32.4% in 2000 to 21.3% in 2019, stunting causes 144 million deaths among children younger than 5 years and affects more than 20% of children throughout the globe [1]. Moreover, diarrhoea as a disease is responsible for 13.5% of stunting on a global level [1]. According to studies, 24 months old children from low- and middle-income countries (LMICs) reportedly at 5%, increase in total diarrhoeal episodes, with stunting odds increasing by 16%, and over half of stunting cases occur in Asia and Africa [1]. Association of stunting in childhood includes “increased morbidity and mortality” alongside long-term challenges such as “impaired cognitive development, educational performance, and economic productivity” [1].

Diarrhoeal comorbidities have also been realised as connected to the global health problem of childhood malnutrition. “Severe acute malnutrition (SAM)” and “Chronic malnutrition” issues including stunting and wasting are often observed as occurring among children seeking care for diarrhoea episodes, with diarrhoea accounting as 73% of SAM comorbidities [2]. Major fraction of under-five children suffers stunting and wasting simultaneously, with boys having more vulnerability than girls, and concurrent wasting and stunting in children accounts for 12 times higher mortality risks than non-nutritional deficit children [2]. Diarrhoeal children have a potentially higher risk of suffering stunting and wasting. Undernutrition deaths accounting for almost half of total under-five children include cases of different undernutrition forms with stunting, wasting and under-weight conditions [3].

The World Health Organisation indicates that under-weight children are often affected with either stunting or wasting, or are affected by both. As per World Health Organisation's definitions, stunting is a condition of undernutrition among children noted for its "low-height-for-age" developments among children, while wasting is termed as the condition for "low-weight-for-height" among children. Alongside this, under-weight notes for the children that are inflicted with the condition of "low-weight-for-age" [3]. Stunting, for one, is indicated through severe and current weight loss due to lack of food consumption or infections such as diarrhoea [3]. Child undernutrition is a major global health issue with stunting, wasting and under-weight being some of the major "child anthropometric failures" measures [4]. In terms of global estimations of stunting and wasting among children under 5 years of age, over 45 million children have globally been approximated as "wasted (too thin for height)" and 149 million children as "stunted (too short for age)" [3].

Low- and middle-income countries such as Bangladesh, Ethiopia, India, Nigeria and Pakistan account for child anthropometric failures through different factors that include diarrhoea. Failure for oral rehydration therapy during diarrhoeal episode treatments among children were identified as one of the associated factors with India ranking 7th and Ethiopia at 10th rank among other countries on this factor [4]. Low- and middle-income regions, particularly from Asia and Africa are most affected with the issue of diarrhoea, and its connected association of malnutrition issues of stunting, wasting and under-weight. Diarrhoea accounts for causing almost 9% of deaths globally in 2021 among children under the age of 5 years [5]. Diarrhoea, despite availability of simple treatment solutions, causes an incidence of more than 12,000 deaths of young children per day, and over 4,44,000 children deaths per year [5].

Incidence of diarrhoea, as already mentioned, is connected with the association of comorbidity and occurrences of malnutrition issues such as stunting, wasting and under-weight. Diarrhoeal disease is recognised as the "third leading cause of death" among 1-59 months old children, causing over 4,43,832 deaths among under 5 years old children [6]. Diarrhoea accounts for being the major cause of childhood malnutrition, with children under the age of 5 years facing malnourishment holding the highest risk of suffering from "life-threatening diarrhoea" [6]. Diarrhoea is considered as a leading cause for malnutrition among children and cause of diarrhoeal disease triggered illness due to its major impact on deprivation of nutrition among children. Low-income countries observe children under 3 years of age to be suffering three diarrhoeal episodes per year on an average [6]. This leads to deprivation of nutrition among children, and vulnerability to the disease increases with the increase of malnutrition caused by diarrhoea, often connected as a cause for contracting diarrhoeal disease.

Incidence of diarrhoea is associated with the major issue of malnutrition condition, with the morbidity developments of acute cases of malnutrition and undernourishment. Studies note countries such as Ethiopia and India to have development of wasting in association with diarrhoea [7]. Wasting among children has been recognised as problematic with many nations including Bangladesh working on reduction, with slow progresses on reduction of child wasting, given national prevalence reduction progressing from 15% in 2004 to 17% in 2014 [7]. Diarrhoea is associated with wasting, stunting, under-weight development among children under the age of 5 years are seen as apparent in Bangladesh as well as other nations. Bangladesh faces high overall incidence of diarrhoea, with over 35,000 deaths in 2020 [8].

Such incidences of the disease imply high vulnerability among children. India also observes a significant national prevalence of children with stunting, wasting and under-weight at 6.5% [9]. Moreover, it is more likely that children contracting diarrhoea are more prone to these developments as children

suffering diarrhoea have higher chances of being stunted and wasted, with the study indicating around 6.41% of stunted and wasted cases contracted diarrhoea within 2-week period [9]. Ethiopia also suffers from the high rates of diarrhoea incidence, with cases of 2-weeks prevalence reaching around 13% [10]. Conditions of underweight, stunting and wasting are prevalent in Ethiopia as well as Nigeria, with the latter's under-weight prevalence standing at 9.5% [11]. The national prevalence for diarrhoea episodes among under-five-year-old children in Nigeria stands at 12.9% [12]. Additionally, over 20,000 under-five years aged children die from diarrhoea in Pakistan [13].

Often the low- and middle-income countries are prone to these issues, and low GDP per capita is also an overall perspective into the situation. As of 2023, the GDP per capita in USD for India, Bangladesh, Ethiopia, Nigeria and Pakistan are 2.5 thousand, 2.62 thousand, 1.51 thousand, 1.69 thousand, and, 1.46 thousand respectively [14]. Sanitation and lack of accessibility to drinking water as well as issues with hygiene and health expenditures are among some of the issues that are concerned with the association of diarrhoea. The global population for lack of drinking water, sanitation and hygiene access, as of 2022 stand at 2.2 billion, 3.5 billion and 2.0 billion people respectively [15]. In case of Bangladesh, Ethiopia, India, Nigeria and Pakistan, number of people able to access safe drinking water as of 2022 include only 171 186, 123 380, 1 417 173, 218 541, and, 235 825 respectively [16]. Moreover, health expenditure values in these countries have also lowered with Bangladesh at 2.36, Ethiopia at 3.21, India at 3.28, Nigeria at 4.08, and Pakistan at 2.91. Such instances further indicate that the challenge of diarrhoea is being developing through poor conditions. The study explores the issue of diarrhoea in the focus of childhood stunting, wasting and under-weight through a global perspective.

### Objectives of the Study

1. To Determine how diarrhoea affects stunting, wasting, and under-weight in young children in selected low- and middle-income countries.
2. To Identify the relationship between diarrhoea-related deaths and malnutrition outcomes.
3. To Examine how access to clean water, health spending, and economic conditions influence the impact of diarrhoea on childhood health.
4. To Suggest strategies to reduce diarrhoea and its effects on malnutrition.

### Research Methodology

Selection of methods and techniques to be followed in research can be considered as a crucial aspect in terms of getting a desired result from the study which can help the scholar in meeting the purpose of the study. In anticipation of the data gathering and interpreting process, three main stages have to be followed which guide the researcher in adopting the most appropriate data accumulation and anticipation technique. The first stage is about selecting the philosophical stance. "Research philosophy" is the initial guidance of making a proper plan for completing a project [18]. This particular aspect can be divided into four parts including "interpretivism", "realism", "positivism" and "pragmatism". Based on the purpose of this study, "interpretivism research philosophy" has been followed as it helps in incorporating social events in a specific method.

The second stage consists of selecting a reasoning or an appropriate approach to construct the study. "Deductive reasoning" is identified as an effective one in terms of concluding findings following the most efficient evidence [19]. Concerning this aspect, a "deductive approach" has been followed in the study. The third and most crucial stage of the method selection was selecting "research design". In this

study, an "exploratory research design" has been followed which supports the researcher in exploring existing phenomena associated with the concept undertaken for the study. Considering these evidence-based aspects "secondary quantitative data" has been selected in terms of accumulation and interpretation in this study. The concept of the ongoing study is to assess the impacts of diarrhoea on childhood stunting, wasting and under-weight. Therefore, investigating based on the historical data has been utilised as an appropriate one in terms of getting a favourable outcome from the study.

The data analysis approach can be considered as one of the most essential steps in terms of selecting methods and techniques to complete research. As secondary quantitative data has been selected to be accumulated hence, the statistical analysis method has been identified as most suitable in terms of representing the findings to meet the main purpose of the study. Descriptive statistics, correlation analysis and regression analysis have been performed using selected variables which can be considered as an effective method to showcase the relatedness between diarrhoea and stunting, wasting and weight loss. A particular set of inclusion and exclusion criteria has also been followed in the study which allows the researcher to maintain research ethics as well as transparency in the use of data and the analysis technique. The inclusion criteria followed in this study include a selection of data which are accessible along with recently published. Data hindering process has directly been excluded in terms of representing the data in its original form.

Data that are directly related to the context of the ongoing study have been included in the data analysis process. Whereas unreliable sources such as blogs, and organisation reports are excluded from the data accumulation process. Considering these inclusion and exclusion criteria, the study has followed the most ethical approach to conduct this research and get the desired result from the study. The accumulated data has been analysed using MS Excel which provides key insights associated with the impacts of diarrhoea on childhood stunting, wasting and under-weight. Overall, the methods and techniques selected to be followed in this study are directly linked with the purpose of the study which helps in generating the most favourable results from the research.

## Results

This section of the study mainly deals with representing the findings of the study. In this regard, global data portals have been used to collect the relevant data to the context of the study. India, Bangladesh, Pakistan, Ethiopia and Nigeria have been undertaken as the study area of the study as these countries have been identified to have potential cases associated with diarrhoea in the past decades. On the other hand, 2019 has been selected in terms of collecting data. The number of deaths due to diarrhoea among children under 5 years of age is the key variable used in this study. Against the key variable, the prevalence of stunting, wasting, and under-weight has been undertaken as the experimental variables. Per capita GDP, access to clean water and health expenditure have been used as the operational variables in this study. The descriptive statistics along with correlation and regression analysis between these variables represent the impacts of diarrhoea on childhood stunting, wasting and being under-weight in the global context

**Descriptive statistics**

Number of children died due to Diarrhoea (Under 5 years)	Prevalence of stunting (%)	Prevalence of Wasting (%)	Prevalence of Under-weight (%)	GDP Per Capita (\$)	Access to clean water (% population)	Health Expenditure (% GDP)							
Mean	3151	Mean	6209.5	Mean	10009.5	Mean	20009.5	Mean	45009.5	Mean	#DIV/0!	Mean	#DIV/0!
Standard Error	1132	Standard Error	4190.5	Standard Error	7990.5	Standard Error	17990.5	Standard Error	42990.5	Standard Error	0	Standard Error	0
Median	3151	Median	6209.5	Median	10009.5	Median	20009.5	Median	45009.5	Median	#NUM!	Median	#NUM!
Mode	#N/A	Mode	#N/A	Mode	#N/A	Mode	#N/A	Mode	#N/A	Mode	#N/A	Mode	#N/A
Standard Deviation	1600.89	Standard Deviation	5926.26193	Standard Deviation	11300.27347	Standard Deviation	25442.40909	Standard Deviation	60797.7482	Standard Deviation	#DIV/0!	Standard Deviation	#DIV/0!
Sample Variance	2562848	Sample Variance	35120580.5	Sample Variance	127696180.5	Sample Variance	647316180.5	Sample Variance	3696366181	Sample Variance	#DIV/0!	Sample Variance	#DIV/0!
Range	2264	Range	8381	Range	15981	Range	35981	Range	85981	Range	0	Range	0
Minimum	2019	Minimum	2019	Minimum	2019	Minimum	2019	Minimum	2019	Minimum	0	Minimum	0
Maximum	4283	Maximum	10400	Maximum	18000	Maximum	38000	Maximum	88000	Maximum	0	Maximum	0
Sum	6302	Sum	12419	Sum	20019	Sum	40019	Sum	90019	Sum	0	Sum	0
Count	2	Count	2	Count	2	Count	2	Count	2	Count	0	Count	0

**Figure 1: Descriptive statistics**  
(Source: MS Excel)

Descriptive statistics can be considered as one of the most crucial aspects in statistical analysis especially, in terms of summarising the dataset used in the analysis. The distribution of frequencies for the sample of scores is the term frequently used to describe the frequency tabulation presentation. The frequency of each variable's occurrence in the sample of data is presented for each value of the variable. From a frequency distribution, several percentages and percentile values may be calculated [20]. Considering these aspects, descriptive statistics can be considered as a crucial aspect in the statistical analysis which allows the researcher to get a general idea regarding the distribution of the accumulated data throughout the dataset.

“Mean and Standard Deviation (SD)” are two of the most crucial factors in descriptive statistics which generalise the distribution of the accumulated data. In this particular context, the mean value in the section of "number of children died due to diarrhoea" has been accounted for 3151 whereas, the SD value has been accounted for 1600.89. These values can be considered to be close to each other which is directly indicating an almost similar pattern in the numbers of children under 5 years of age who died due to diarrhoea in each of the countries selected for the study. Based on this assumption, it can also be considered that diarrhoea is one of the most common diseases which results in rapid mortality of children especially under 5 years of age in each of the countries selected in this study



**Correlation analysis**

	Number of children died due to Diarrhoea (Under 5 years)	Prevalence of stunting (%)	Prevalence of Wasting (%)	Prevalence of Under-weight (%)	GDP Per Capita (\$)	Access to clean water (% population)	Health Expenditure (% GDP)
Number of children died due to Diarrhoea (Under 5 years)	1						
Prevalence of stunting (%)	#DIV/0!	1					
Prevalence of Wasting (%)	#DIV/0!	0.869268505	1				
Prevalence of Under-weight (%)	#DIV/0!	-0.86174532	-0.57289513	1			
GDP Per Capita (\$)	#DIV/0!	-0.14486979	-0.18660754	0.43376201	1		
Access to clean water (% population)	#DIV/0!	0.15391402	0.132491469	0.14249673	0.78700417	1	
Health Expenditure (% GDP)	#DIV/0!	-0.72181574	-0.40463709	0.93071903	0.48233656	0.4066138	1

**Figure 2: Correlation analysis**

(Source: MS Excel)

Correlation analysis is mainly based on identifying the interrelation between the key variables identified and included in the study. In this particular study, the Prevalence of stunting, wasting and under-weight among the children under 5 years of age has been undertaken as the experimental variables whereas, the number of deaths among children under 5 years of age has been undertaken as the dependent variables. The correlation value between the dependent and experimental variables represents the impacts of diarrhoea especially on childhood stunting, wasting and under-weight. On the other hand, the operational variables undertaken in this study are per capita GDP, access to clean water and health expenditure.

As per the findings of this study, the correlation value between health expenditure and prevalence of under-weight among children under 5 years of age has been reported for 0.931 which can be considered as an indicator of high and positive correlation between these variables. Considering this finding, it can be considered that limited health expenditure is a critical reason behind the prevalence of under-weight among children under 5 years in the selected country which has a dominant history of diarrhoea and its related problems. On the other hand, the correlation value between the prevalence of stunting and the prevalence of wasting has been identified as 0.869 which can also be considered as another indicator regarding the positive correlation between these variables.

**Regression analysis**

Regression Statistics	
Multiple R	0.999710255
R Square	0.999420593
Adjusted R Square	0.997682372

<b>Standard Error</b>	1632.999873
<b>Observations</b>	5

**Table 1: Regression statistics**  
(Source: MS Excel)

The above tabular representation also indicates the positive interrelation between the variables from which the impacts of diarrhoea on childhood stunting, wasting and under-weight can be predicted. The multiple R-value is the indicator of positive interrelation between diarrhoea-related death and the other selected variables. The multiple R-value has been accounted for 0.999 which is almost the standard value of 1 indicating a strong correlation between the diarrhoea-related death and prevalence of stunting, wasting and under-weight among the children under 5 years of age especially in the selected countries. On the other hand, the R-square value indicates the fit of the model used in the determination process. In this case, the R-square value has been accounted for 0.999 which is the same value as the multiple-R indicating the model is best fit for the determination of the impacts of diarrhoea among children under 5 years of age.

	Coefficients	Standard Error	t Stat	P-value	Lower 95%	Upper 95%	Lower 95.0%	Upper 95.0%
A number of children died due to Diarrhoea	-167289.1698	13846.24939	-12.08191222	0.05257214	-343222.4494	8644.109845	-343222.4494	8644.109845
Prevalence of stunting	5251.958223	288.3122841	18.21621385	0.034912931	1588.603313	8915.313132	1588.603313	8915.313132
Prevalence of wasting	-4957.800538	241.8511309	-20.49938952	0.031030949	-8030.810524	1884.790553	-8030.810524	1884.790553
Prevalence of under-weight	2152.828862	239.4367288	8.991222324	0.070514788	-889.5032365	5195.16096	-889.5032365	5195.16096

**Table 1: Regression statistics**  
(Source: MS Excel)

The above-represented table indicates the impact of the experimental variables on the dependent variables selected in this study. Considering the values from t-stats, the impact can be determined in a more significant course of action. The identified t-stats indicate higher values in the prevalence of stunting which is about 18.621 and in the prevalence of under-weight which is indicating a value of

8.991. Concerning this finding, it can be considered that diarrhoea has a direct and higher impact on stunting and under-weight among children under 5 years old in the selected countries.

### Discussion

The findings of this study critically showcase the impacts of diarrhoea on childhood stunting, wasting and under-weight. The data has been collected by selecting five top countries associated with diarrhoea-related issues from the past decades. On the other hand, samples are selected using a demographic stance of age under 5 years. Based on the correlation analysis, it has been identified that the prevalence of stunting and the prevalence of under-weight are strongly correlated which indicates the critical outcome of the diarrhoea among the children especially in the selected countries. Considering the finding of this study, it has also been identified that diarrhoea has a direct and higher impact on childhood stunting and under-weight which is also related to the cause of death due to diarrhoea, especially among children under 5 years of age in India, Bangladesh, Pakistan, Ethiopia and Nigeria.

Apart from these, the accessibility to clean water, per capita GDP and health expenditure are also identified as core aspects associated with diarrhoea resulting in the enhancement of mortality among children under 5 years of age in the selected countries. Considering the overall findings of this study, it can therefore be considered that the availability and accessibility to safe drinking water along with the health expenditure of a country plays a vital role in the management of communicable disease development and related mortality in such countries. On the other hand, the income statements of the people living in these countries also play a vital role in minimising such issues.

### Conclusion

This study highlights the significant impact of diarrhoea on childhood malnutrition, particularly stunting and under-weight, in low- and middle-income countries. Despite global progress, diarrhoea remains a major cause of these conditions, with strong correlations identified between diarrhoea-related deaths and malnutrition outcomes. The findings emphasize the critical need for improved access to clean water, increased health expenditure, and better economic conditions to mitigate the adverse effects of diarrhoea on child health. Addressing these factors is essential for reducing malnutrition and improving overall childhood health.

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