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Research Article

An Analytical Framework for the Study of Child Morality in Pakistan

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ABSTRACT

Child mortality is one of the most commonly used indicators of the socio-economic development of a population. Even though Pakistan has made considerable progress in reducing child mortality, it remains higher than in many countries and developing nations. The main aim of the study is to gain information about child mortality due to different diseases. The data set is taken from a Secondary Internet resource (www.kaggal.com). The dataset consists of child mortality under 5year age caused by different diseases in Pakistan. A graphical representation of the different diseases is drawn to have a quick view of different diseases. The correlation matrix is also computed in this analysis. Malaria has a strong positive or negative correlation with other neonatal diseases, drowning, Tuberculosis, neonatal preterm birth, diarrheal disease and other disease interpreted as similar. The factor analysis is used to explore the underlying dimension of multiple variables. Factor analysis showed that 99% of the variance is explained by HIV/AIDS, other neonatal diseases, tuberculosis, and diarrheal disease. The extracted percentage of variance shows that the first component accounts for 63.868%, the second 22.093%, and the third 7.57% of variance characteristics.

Keywords: Child Mortality, Pakistan, Diseases, Graphical Representation, Correlation Matrix; Factor Analysis.

INTRODUCTION

Child mortality is related to the loss of youngsters under the age limit of five. The child mortality rate means under-five mortality rate, is the likelihood of death between birth and the age of five, symbolized as a percentage of 1000 live births. Pakistan is one of the developing nations with low overall health conditions, ranking 154th out of 195 countries in terms of healthcare availability and quality. Child mortality is caused by various reasons, including a lack of access to healthcare, poverty and socioeconomic inequality, a lack of immunization, conflict add emergency situation, and environmental factors. Lozano et al. (2011), 50% of the total global incidence of child mortality occurred in five countries, for example, India 22% Nigeria 13% Pakistan 6% Democratic Republic of the Congo 6% and China 4%. According to UNICEF (2019), around 5.3 million children died globally in the year 2018; of these 2.5 million children died within 30 days of their birth, 1.5 million children died before reaching the age of one year and 1.3 million children died in the first 5 years. Child mortality occurs due to different diseases such as (Malaria, HIV/AIDS, Meningitis, Nutritional Deficiency, Neonatal Disorder, Whooping Cough, Lower Respiratory Infection, Congenital Birth Defects, Measles,
Neonatal Sepsis, Neonatal Encephalopathy due to Birth Asphyxia and Trauma, Drowning, Tuberculosis, Neonatal Preterm Birth, Diarrheal Disease, Neoplasm, Syphilis). Malaria is a parasitic illness caused by plasmodium parasite infection which spread to humans by attack of infected female Anopheles mosquitoes.

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The parasites replicate within the body of humans, causing fever and other signs to recur. HIV (human immunodeficiency viruses) is an infectious disease that weakened the immune system and making it difficult for the body to fight infections and diseases. AIDS (acquired immunodeficiency syndrome) is the last stage of HIV infection and is diagnostic when a person's immune system is severely comprised. Meningitis is a medical disorder that causes irritation of the meninges, which are the protective membranes that surround the brain and spinal cord. Bacteria, viruses, fungi, and parasites are all major causes of meningitis. Meningitis is an acute illness of the meninges, the membranes that surround the brain and spinal cord. Nutritional deficiencies are a disorder that occurs when the human system does not acquire an appropriate number of critical nutrients necessary for good functioning and well-being. It can arise as a result of inadequate nutritional intake, poor absorption or utilization of vitamins and minerals by the body, enhanced nutrient needs, or significant nutrient loss. Neonatal disorders are disruptions in a newborn's normal body, organs, and unusual function. Obstetricians play a critical role in reducing the number of newborn illnesses. It is distinguished by intense, violent coughing episodes and a peculiar "whooping" sound when the patient gasps for air. Infections of the lower respiratory system, such as those of the lungs, bronchi, and bronchioles, are known as lower respiratory infections (LRIs). Pneumonia, bronchitis, bronchiolitis, and respiratory Syncytial Virus (RSV) are examples of common LRIs. Congenital birth defects are structural or functional abnormalities apparent at birth that might affect a child's health and development in the long run. Heart defects, cleft lip and palate, limb anomalies, genetic abnormalities, metabolic problems, muscle weakness, and cystic fibrosis are among examples. Congenital birth abnormalities can be caused by genetic factors, environmental exposures during pregnancy, or a mix of the two. Measles is a severe viral respiratory virus that causes a maculopapular rash after an initial sign of a high temperature, weakness, cough, coryza, and conjunctivitis. One of the most spreadable diseases around, it can spread for up to two hours after an infected individual has left a location. Neonatal sepsis is a disease of the blood circulation in newborn infants fewer than 28 days old that arises from bacteria such as E coli, Listeria. GBS was a significant cause of newborn sepsis, however this has become less prevalent as a result of women receiving medical care during pregnancy. Neonatal encephalopathy due to birth asphyxia and trauma is a syndrome in which a baby who is newly born suffers from brain problems or impairment as a result of oxygen shortage and physical trauma via birth. Drowning is a process of experiencing respiratory impairment due to submersion or immersion in liquid, resulting in suffocation or asphyxia. Causes include lack of swimming skills, inadequate supervision, alcohol consumption, seizures, hazardous water conditions, and unsafe behaviors around water. The bacterium Mycobacterium tuberculosis is the source of the transmittable disease known as tuberculosis (TB). When an infected individual coughs, sneezes, or talks, it travels through the air and damages the lungs as well as other regions of the body. Latent TB infection and active TB illness are the two main types. A premature birth is a baby born before the thirty-seventh week of pregnancy. This can result in major health concerns, particularly if they are delivered prematurely. Premature births are classified into four types: late preterm, moderate preterm, very preterm, and highly preterm. The majority of premature deliveries occur in the late preterm period. A set of medical conditions known as diarrheal conditions are characterized by uncontrolled, frequent bowel motions. They may result from bacteria, viruses, or parasite infections as well as from affected food and water, inadequate sanitation, and non-infectious factors such medicine, food allergies, and other underlying medical disorders. Neoplasms are abnormal lumps of tissue that emerge when cells reproduce and expand faster than they should or do not die when they should. Tumor is another term for neoplasm. Tumors are classified into three types: benign (not cancerous), premalignant (not cancerous), and malignant (cancerous). Syphilis is a highly infectious illness that is transmitted through sexual interaction, including both oral and anal intercourse. It can lead to major long-term issues including arthritis, injury to the brain, and blindness. The key purpose of the study is to gain information about child mortality due to different disease.

Imdad *et. al*., (2011) investigated the effect of Vitamin A supplementation on babies and childhood mortality. The protective benefits of vitamin A supplementation on all-cause and disease-specific mortality from diarrhea, measles, pneumonia, meningitis and sepsis were estimated using the pooled data. The finding of six trials combined revealed that newborn vitamin A supplementation decreased all-cause mortality by 12%. Preventive vitamin A supplementation reduced all-cause mortality by 25% in children aged between 6 to 59 months, according to old studies vitamin A supplementation significantly decreased diarrhea-specific mortality in children aged between 6 to 59 months by 30%. This impact had been suggested for included in the tool for saving lives.

Tariku, (2019) studied the effect of earlier birth intervals on child mortality in Ethiopia. The dependent variable in the study was child mortality. The previous period of birth was employed as an independent variable. Control factors were maternal age, education, work wealth index, child sex, wantedness of birth, and place of residence. A bivariate Logistic

Regression Analysis was performed investigator influence of the previous birth interval on child mortality. A Multivariate Logistic Regression technique was used to explore the influence of previous birth interval on child mortality after controlling the covariates. Health workers should provide health education on the effects of a short prior birth gap, and family planning should be promoted at all levels.

Fatima *et al*., (2021) examined comorbidities and outcomes in childrens with severe acute malnutrition, visiting a Tertiary hospital in Karachi's urban slums. An aggregate of 195 children participated in the research, with 112 (557.44%) being male, 126 (64.62 %) having MUAC of >= 80mm, 103(52.82 %) having acute watery diarrhea, 46(23.59%) having pneumonia and 32(16.41%) having TB. Comorbidities such as intestine inflammation, pneumonia, and TB were frequently occurring and lead to a high death rate.

Asif and Parvaiz (2022) studied determinants of child mortality in Pakistan: the moderating role of mother's education. This study examines the effect of unmet needs for family planning (UMNFP) and socioeconomic variables on child mortality (CM). The dependent variable was categorical, with two options: mother has ever suffered child death or mother has never experienced child death. The association between a mother's education and child mortality was investigated using binary logistic regression analysis. According to the findings, a mother's education acts as a moderator in the association between a mother's job and child mortality. In the case of a highly educated woman, the favourable effects of a woman's employment on child mortality reduce and become negative.

DATA COLLECTION

In the analyses, the data has been taken from the Secondary Internet resource (www.kaggal.com). The dataset has 17 diseases (*Malaria, HIV/AIDS, Meningitis, Nutritional* Deficiency*, Neonatal Disorder, Whooping Cough, Lower Respiratory Infection, Congenital Birth Defects, Measles, Neonatal Sepsis, Neonatal Encephalopathy due to Birth Asphyxia and Trauma, Drowning, Tuberculosis, Neonatal Preterm Birth, Diarrheal Disease, Neoplasm, Syphilis*) that cause child mortality and the different age group under 5. The year for child mortality is observed from 1990 to 2019.

METHODS

In the analysis of the data, we use different techniques of statistics that are descriptive statistics, correlation, bar chart and factor analysis.

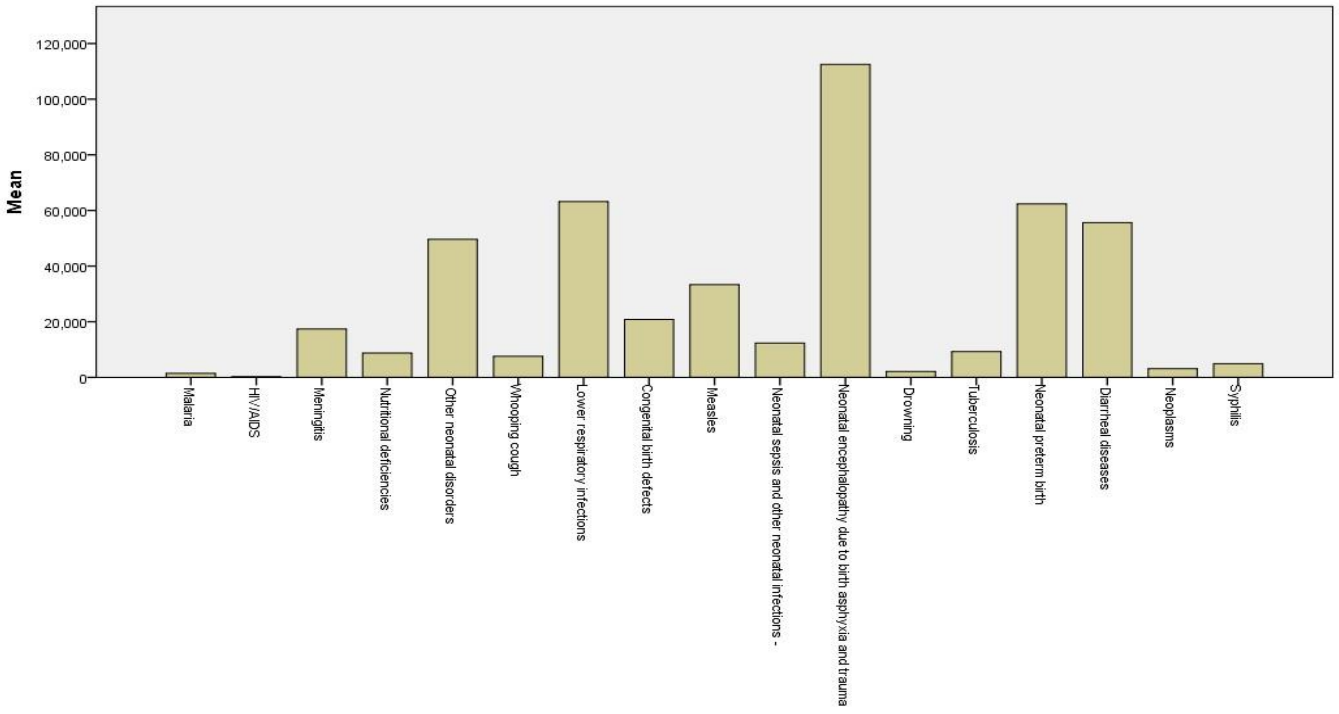

Figure 1. Child Deaths due to Different Diseases due to birth asphyxia and trauma and the least occurs disease is HIV/AIDS.

It shows that most child deaths occur due to Neonatal encephalopathy due to birth asphyxia and trauma. The first highest disease occurs is Neonatal encephalopathy.

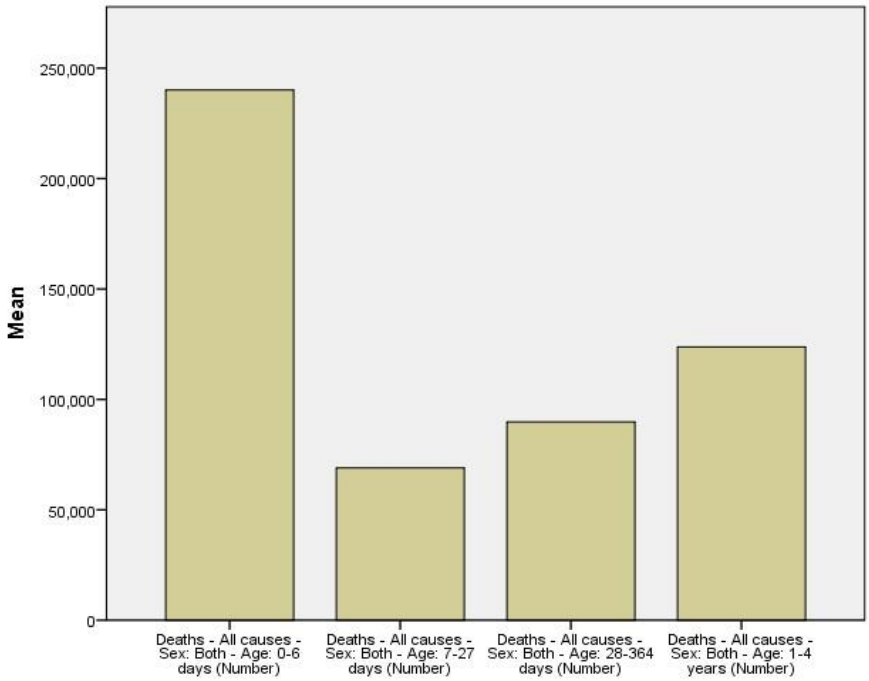

Figure 2. Child Deaths All Causes in Different Ages.
It shows that most of the death occurs in the age of 0-6 days. The first highest age group is 0-6 days.

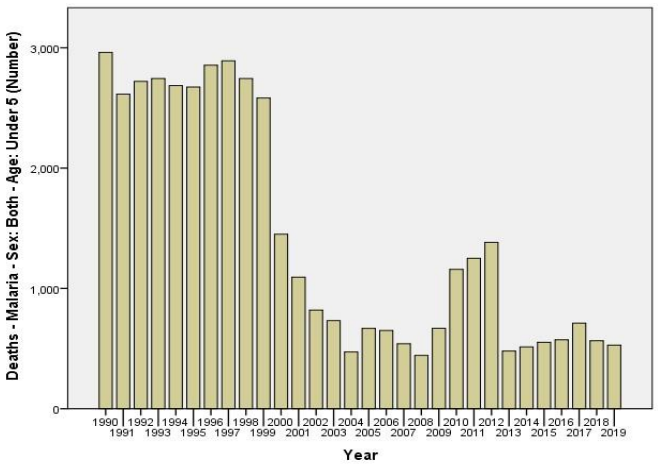

Figure 3. Child deaths due to malaria in different years.

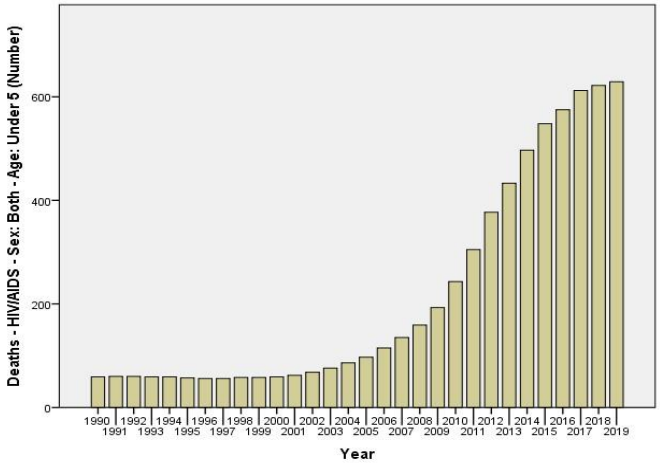

Figure 4. child deaths due to HIV/aids in different years.

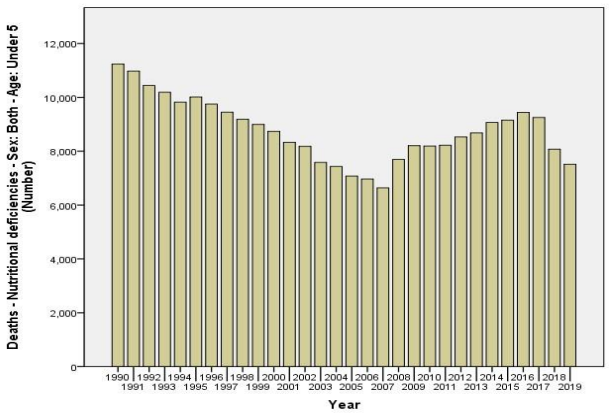

Figure 5. Child deaths due to meningitis in different years.

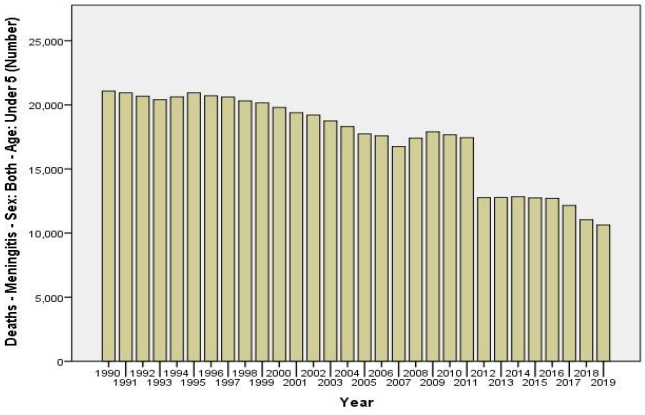

Figure 6. child deaths due to nutritional deficiency in different years.

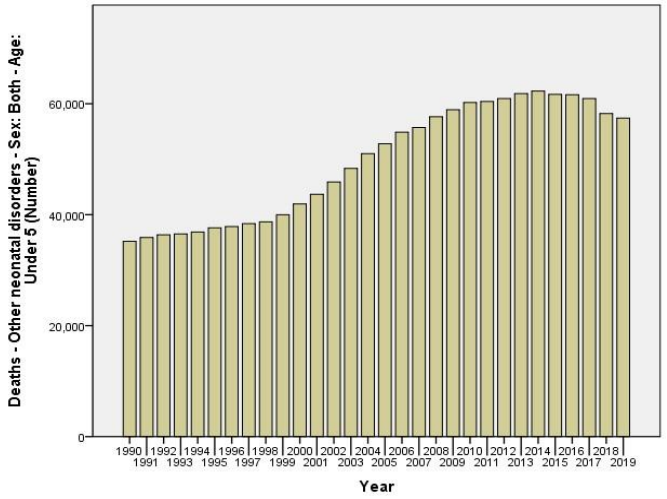

Figure 7. Child deaths due to other neonatal disorder in different years.

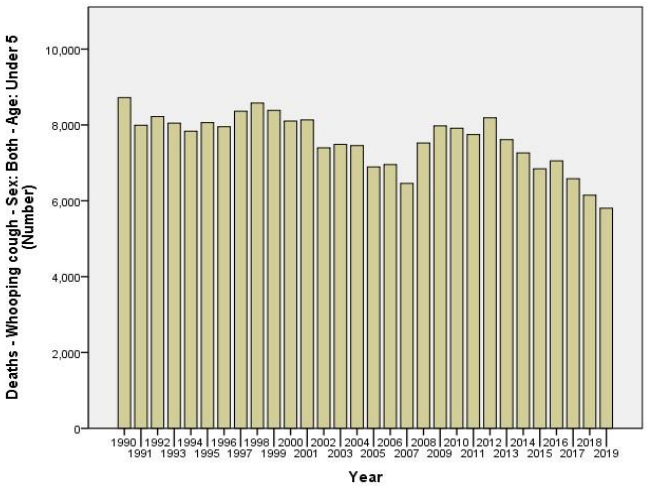

Figure 8. child deaths due to whooping cough in different years.

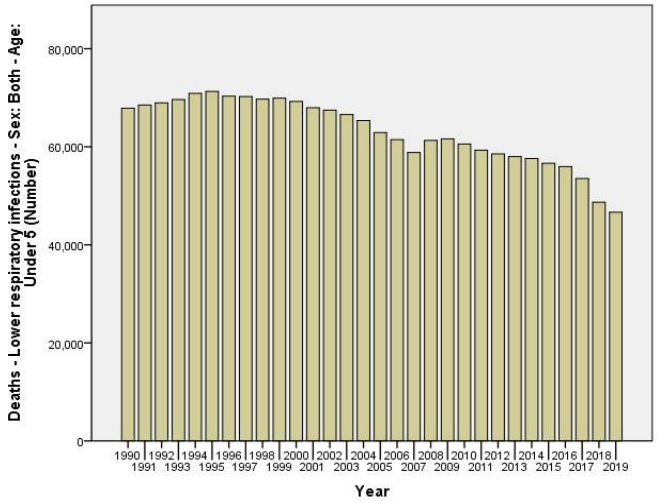

Figure 9. Child deaths due to lower respiratory infection in different years.

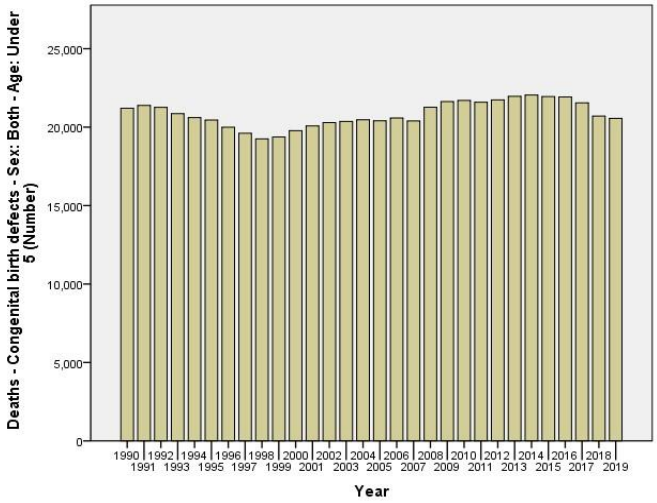

Figure 10. Child deaths due to congenital birth defects in different years.

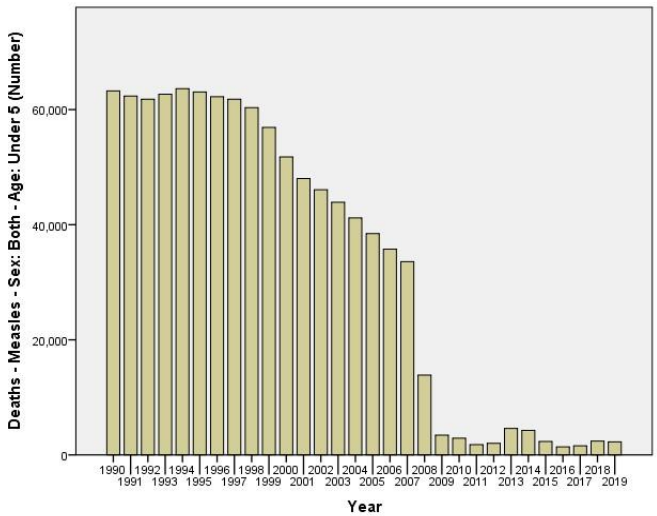

Figure 11. Child deaths due to measles in different years.

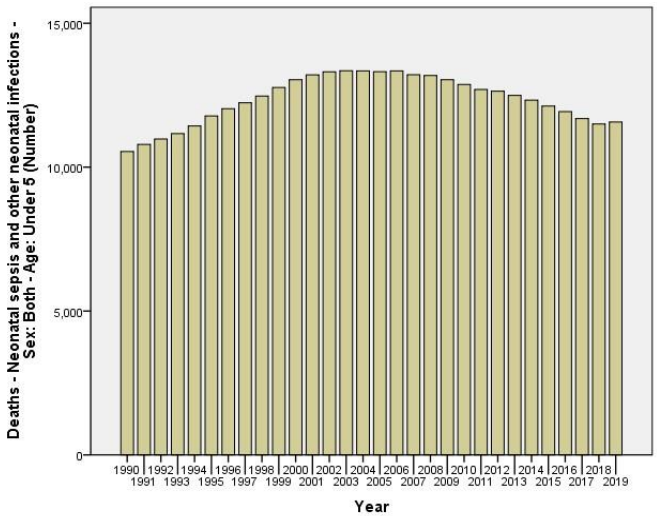

Figure 12. Child deaths due to neonatal sepsis and other neonatal disorder in different years.

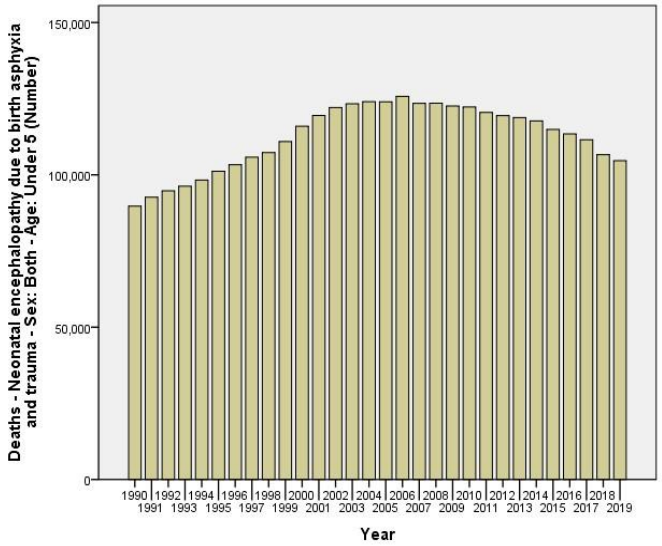

Figure 13.Child deaths due to neonatal encephalopathy and trauma in different years.

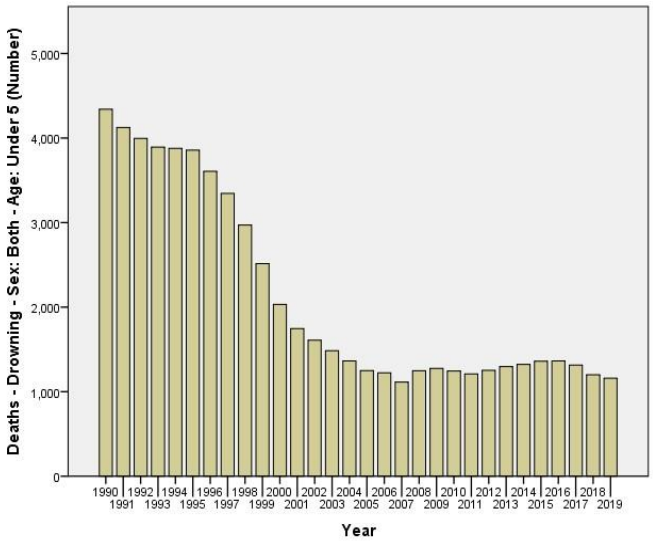

Figure 14. Child deaths due to drowning in due to asphyxia birth different years.

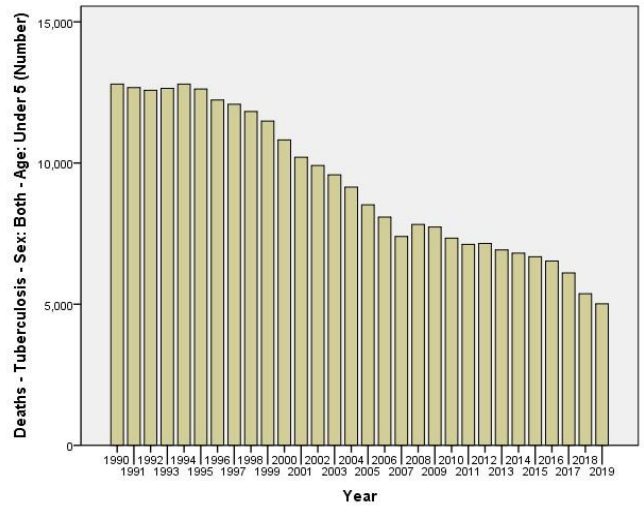

Figure 15. Child deaths due to tuberculosis in different years.

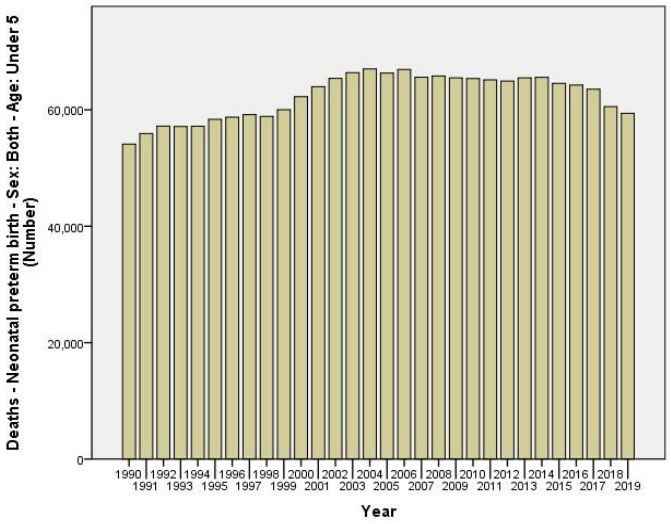

Figure 16. Child deaths due to neonatal preterm in different years.

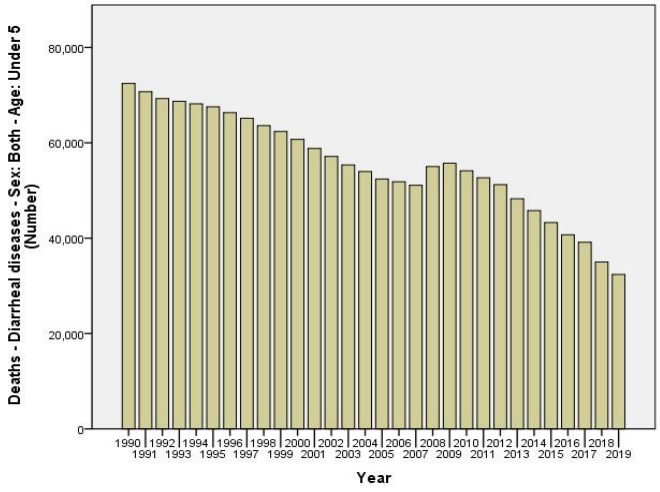

Figure 17. Child deaths due to diarrheal disease in different years.

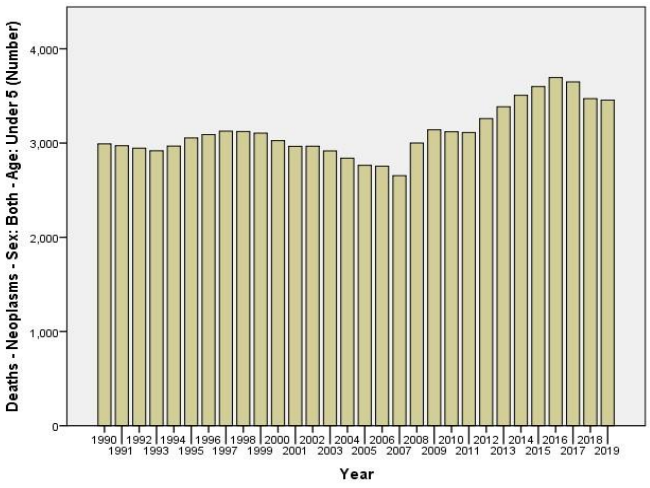

Figure 18. Child deaths due to neoplasm in different years.

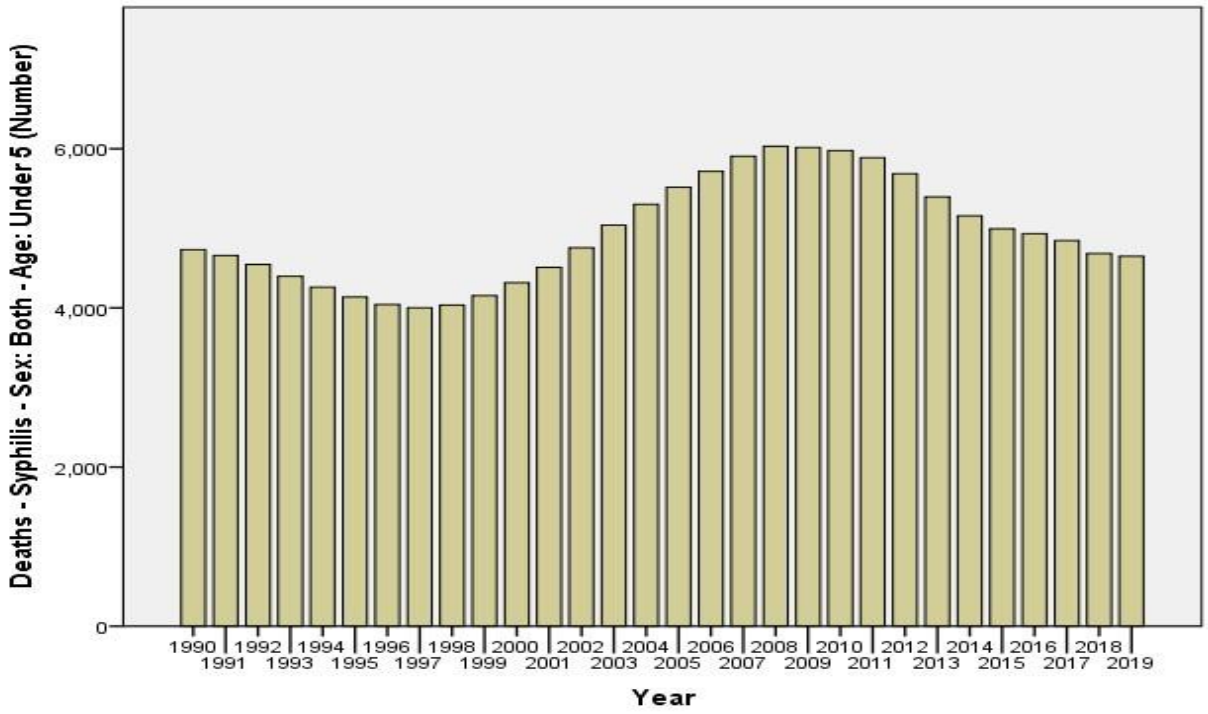

Figure 19. Child Deaths due to Syphilis in Different Years.

From the above graphs they show different trends. The graph of the trend increases in HIV/AIDS and graph of the trend decreases in tuberculosis. The graphs of the trend increase or decrease with the passage of time in the variables like (*Malaria, Meningitis, Nutritional Deficiency, Neonatal Disorder, Whooping Cough, Lower Respiratory Infection, Congenital Birth Defects, Measles, Neonatal Sepsis, Neonatal Encephalopathy due to Birth Asphyxia and Trauma, Drowning, Neonatal Preterm Birth, Diarrheal Disease, Neoplasm, Syphilis*).

Table 1. Descriptive statistics death due to different disease, sex both, age under 5 years.

Death due to Different Disease	N	Mean	Std. Deviation	Coefficient of Variation
Malaria (1)	30	1424.63	988.74	0.694032837
HIV/AIDS (2)	30	215.77	210.291	0.974607221
Meningitis (3)	30	17403.83	3442.982	0.197828984
Nutritional deficiencies (4)	30	8768.93	1168.826	0.133291747
Other neonatal disorders (5)	30	49658.8	10310.05	0.207617784
Whooping cough (6)	30	7589.63	727.082	0.0957994
Lower respiratory infections (7)	30	63183.77	6783.847	0.107366923
Congenital birth defects (8)	30	20833.87	813.717	0.03905741
Measles (9)	30	33323.87	26141.749	0.784475183
Neonatal sepsis and other neonatal infections (10)	30	12346.83	849.395	0.068794581
Neonatal encephalopathy due to birth asphyxia and trauma (11)	30	112474.3	10841.971	0.096395071
Drowning (12)	30	2119.97	1159.279	0.546837455
Tuberculosis (13)	30	9266.2	2584.446	0.278911096
Neonatal preterm birth (14)	30	62355.43	3856.91	0.061853635
Diarrheal diseases (15)	30	55627.83	10767.01	0.193554377
Neoplasms (16)	30	3119.03	270.586	0.086753253
Syphilis (17)	30	4942.57	661.899	0.133917982

In Table 1, The highest mean value in child mortality due to different diseases is in Neonatal encephalopathy due to birth asphyxia and trauma and lowest mean is HIV/AIDS. The highest standard deviation in child mortality due to different diseases is measles and lowest standard deviation is HIV/AIDS. The coefficient of variation shows variation in the data. Most of the variation occur in HIV/AIDS and less variation disease is congenital birth defects.
The highest mean in different age and lowest mean is 7-27 days. The highest standard deviation in different age groups is 1-4 years and lowest standard deviation is 7-27 days. The coefficient of variation shows variation in the data. Most of the variation occur in 1-4 years and less variation in 0-6 days.

Table 2. Descriptive statistics of age group under 5.

Age	N	Mean	Standard Deviation	Coefficient of Variation
Age: 0-6 days	30	240097.8	13485.955	0.056169
Age: 7-27 days	30	68940.63	5316.577	0.077118
Age: 28-364 days	30	89822.6	5500.013	0.061232
Age: 1-4 years	30	123757.7	39213.486	0.316857

Table 3. Correlation matrix of between disease sex both and all causes of disease group is 0-6 days.

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
(1)	1.																
(2)	.58	1															
(3)	.72	-.96	1														
(4)	.77	-.15	.364	1													
(5)	.87	.78	-.85	-.59	1												
(6)	.73	-.67	.740	.569	-.63	1											
(7)	.74	-.92	.946	.447	-.86	.810	1										
(8)	.40	.59	-.54	0.13	.624	-.22	-.53	1									
(9)	.78	-.86	.882	.446	-.97	.582	.893	-.68	1								
(10)	.57	-0.2	-.02	-.82	.384	-.13	-.02	-.24	0.2	1							
(11)	.79	0.12	-.33	-.86	.679	-.32	-.32	0.09	.53	.93	1						
(12)	.94	-.57	.710	.837	-.90	.629	.725	-.28	.81	-.68	-.87	1					
(13)	.89	-.83	.911	.634	-.97	.759	.941	-.51	.95	-.32	-.61	.905	1				
(14)	.86	0.27	-.44	-.80	.768	-.41	-.42	0.26	.61	.84	.974	-.90	-.69	1			
(15)	.86	-.88	.941	.577	-.87	.844	.941	-.37	.86	-.23	-.49	.838	.954	.58	1		
(16)	.27	.87	-.74	0.21	.511	-.33	-.62	.484	.65	-.32	-.08	-.28	-.54	.03	-.63	1	
(17)	.69	0.24	-.38	-.61	.748	-.31	-.49	.580	.66	.489	.70	-.69	-.64	.73	-.41	-.1	1

The highest positive correlation between different disease is neonatal encephalopathy due to birth asphyxia and trauma and neonatal preterm birth and the high negative correlation between different disease are measles and other neonatal disorder.

Table 4. Communality of different diseases.

Death due to Different Disease	Initial	Extraction
Malaria	1	0.918084
HIV/AIDS	1	0.989056
Meningitis	1	0.961188
Nutritional Deficiencies	1	0.951146
Other Neonatal Disorders	1	0.988046
Whooping Cough	1	0.776898
Lower Respiratory Infections	1	0.944705

Congenital Birth Defects	1	0.949422
Measles	1	0.963866
Neonatal Sepsis and other Neonatal Infections	1	0.930678
Neonatal Encephalopathy due to Birth Asphyxia and Trauma	1	0.95935
Drowning	1	0.979676
Tuberculosis	1	0.989371
Neonatal Preterm Birth	1	0.937428
Diarrheal Diseases	1	0.995948
Neoplasms	1	0.781788
Syphilis	1	0.883492

99%of the factor variance is explained by HIV/AIDS, other neonatal diseases, tuberculosis, and diarrheal disease. All factors have communality greater than 0.5, so all the factors are important.

Table 5. Total Variation Explained.

Component	Initial Eigenvalues			Extraction Sums of Squared Loadings		
	Total	% Of Variance	Cumulativ e %	Total	% Of Variance	Cumulativ e %
1	10.857	63.868	63.868	10.857	63.868	63.868
2	3.756	22.093	85.96	3.756	22.093	85.96
3	1.287	7.57	93.53	1.287	7.57	93.53
4	0.694	4.08	97.611			
5	0.238	1.398	99.009			
6	0.062	0.364	99.373			
7	0.055	0.323	99.697			
8	0.018	0.103	99.8			
9	0.015	0.089	99.889			
10	0.009	0.052	99.942			
11	0.004	0.021	99.963			
12	0.003	0.017	99.98			
13	0.002	0.012	99.992			
14	0.001	0.004	99.996			
15	0	0.002	99.998			
16	0	0.002	100			
17	7.33E-05	0	100			

According to Table 4.5 above, the values for the first component are 10.857 > 1, the second component is 3.756 > 1, the third component is 1.287 > 1, and the fourth component to the last component is less than 1. As a result, the 17 variables listed above stand for three components. Additionally, the extracted sum of squared holding% of variance shows that the first component accounts for 63.868 %, the second 22.093%, and the third 7.57% of the variance characteristics from the given data (Table 4.5). Consequently, three elements are sufficient to describe all of the features or components highlighted by the 17 variables mentioned.

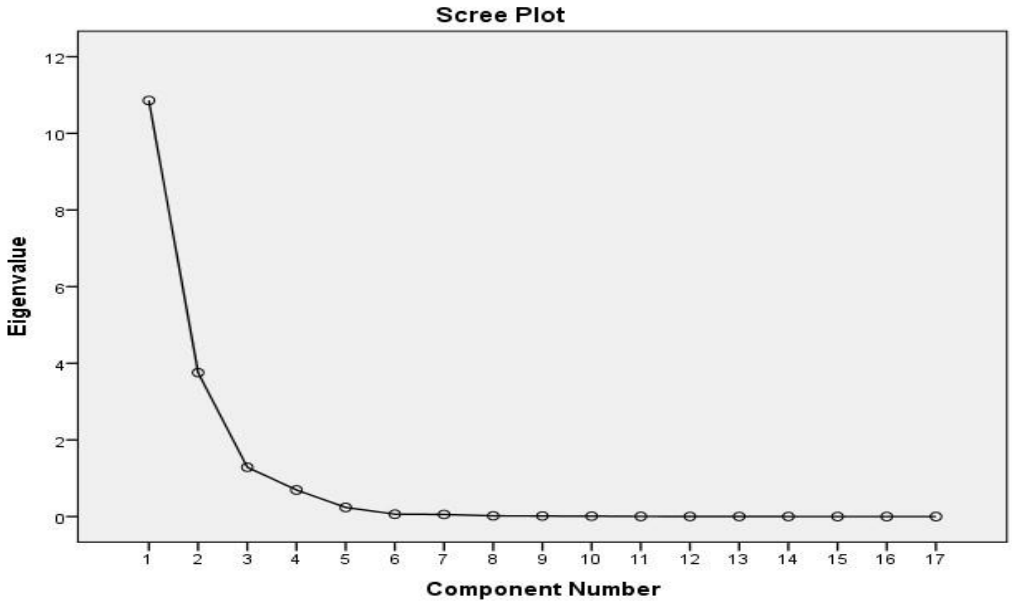

Figure 20. Scree Plot of the Component.

The scree plot gives us the common factor and the unique factor. The elbow can make on the third factor so we consider the first three components of the following data as the common factor and the other fourteen should be considered as unique factors.

Table 6. Component Matrix.

	Component		
Death due to Different Disease	1	2	3
Malaria	0.933	-0.216	0.037
HIV/AIDS	-0.777	-0.615	-0.083
Meningitis	0.876	0.424	0.117
Nutritional deficiencies	0.685	-0.634	0.283
Other neonatal disorders	-0.977	-0.04	0.178
Whooping cough	0.742	0.161	0.448
Lower respiratory infections	0.888	0.376	0.118
Congenital birth defects	-0.508	-0.436	0.708
Measles	0.934	0.225	-0.202
Neonatal sepsis and other neonatal infections	-0.426	0.863	-0.063
Neonatal encephalopathy due to birth asphyxia and trauma	-0.701	0.68	0.066
Drowning	0.942	-0.295	0.069
Tuberculosis	0.988	0.106	0.035
Neonatal preterm birth	-0.781	0.556	0.135
Diarrheal diseases	0.933	0.217	0.279
Neoplasms	-0.479	-0.742	-0.044
Syphilis	-0.688	0.356	0.533

In the first component, tuberculosis has a very high loading as compared to the other factors so it may more contribute to the variable. In the second component, neonatal sepsis and other neonatal disorder have very high loading as compared to the other factors so it may more contribute to the variable. In the third component, Congenital birth defects has a very high loading as compared to the other factors so it may more contribute to the variable.

CONCLUSION

The average value of Neonatal encephalopathy due to birth asphyxia and trauma is high, while HIV/AIDS is very low. When compared to other causes of mortality, HIV/AIDS has a comparatively high level of variability. The average value

of age group 0-6 days is high, and the average value of 7-27 days is low. When compared to the other age group,1-4 age group has very high variability.

Factor analysis showed that 99% of the variance is explained by HIV/AIDS, other neonatal diseases, tuberculosis, and diarrheal disease. The extracted percentage of variance shows that the first component accounts for 63.868%, the second 22.093%, and the third 7.57% of variance characteristics.

In this research, we examined the different disease that cause child mortality and the variation in different years for child mortality in different disease in Pakistan.

For future work, the relationship between child mortality and various factors such as disease prevalence, socioeconomic status, access to healthcare, and other relevant variables can be studied. For this purpose, the data of child mortality and various factors can be taken in this analysis. Similarly, different statistical techniques can be applied for the purpose of analysis such as survival analysis technique (Kaplan Meier curve), Multiple regression model, ARIMA.

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