American Journal of Public Health Research, 2015, Vol. 3, No. 4A, 27-30
Available online at http://pubs.sciepub.com/ajphr/3/4A/5

DOI:10.12691/ajphr-3-4A-5

Time Trend of Pneumonia in under Five Children of Nepal

Brijesh Sathian[1,*], Asis De[1], Padam Simkhada[2], Kalpana Malla[1], Arnab Ghosh[1], Sahisnuta Basnet[1], Bedanta Roy[1], Indrajit Banerjee[1], H S Supram[1], Suresh Devkota[1]

[1]Faculty, Manipal College of Medical Sciences, Pokhara, Nepal
[2] Faculty, Centre for Public Health, Liverpool John Moores University, UK
*Corresponding author: drsathian@gmail.com.

Received April 08, 2015; Revised April 29, 2015; Accepted June 28, 2015

Abstract Globally, Pneumonia is the leading communicable disease which is the reason of fatality in children. In 2013, there was approximately 935 000 child death in less than 5 years old because of Pneumonia, which was 15% of all the deaths in children. The scenario is more or less same in sub-Saharan Africa and South Asia. The objective of the study was to collate information from existing data and chart out the trends of the incidence of Pneumonia (mild + severe) per 1,000 children under five years (new visits) in the future. A secondary data analysis of the incidence of Pneumonia (mild + severe) per 1,000 children under five years (new visits) in Nepal was done between 2005 to 2014. The survey was conducted under the administrative supervision of the population division of the Ministry of Health and Population (MOHP). Curve fitting method was used to find out the convenient model. The data was analysed using Statistical Package for the Social Sciences (SPSS) for Windows Version 16.0 (SPSS Inc; Chicago, IL, USA). A p-value of < 0.05 (two-tailed) was used to establish statistical significance. Excluding the constant term in the equation, the best fitted model was cubic, for the prediction of incidence of Pneumonia (mild + severe) per 1,000 children under five years (new visits). It is estimated that there will be 331 with 95% CI (0,1000) cases of Pneumonia (mild + severe) per 1,000 children under five years during 2020 in Nepal. The year wise incidence of Pneumonia (mild + severe) per 1,000 children under five years (new visits) in Nepal is having an increasing trend. The result provides reference data for organizing, planning, and evaluation of childhood pneumonia control program. Strengthening the health care delivery system and community-based prevention strategies and case management will facilitate to trim down pneumonia cases and the overall burden of this public health threat.

Keywords: *Pneumonia, Under Five Children, Nepal*

Cite This Article: Brijesh Sathian, Asis De, Padam Simkhada, Kalpana Malla, Arnab Ghosh, Indrajit Banerjee, Bedanta Roy, H S Supram, Elayedath Rajesh, and Suresh Devkota, "Time Trend of Pneumonia in under Five Children of Nepal." *American Journal of Public Health Research*, vol. 3, no. 4A (2015): 27-30. doi: 10.12691/ajphr-3-4A-5.

1. Introduction

Globally, Pneumonia is the leading communicable disease which is the reason of fatality in children. During 2013, it was reported that approximately 935 000 children less than 5 years old died due to Pneumonia, which was 15% of all the deaths in children. The scenario is more or less same in sub-Saharan Africa and South Asia. [1]. There is an increase of the incidence of Pneumonia (mild + severe) per 1,000 children under five years (new visits) in Nepal. It is reported in the 2014 Nepal annual report of the Ministry of Health and Population (MoHP) and Department of Health Services (DoHS) that the incidence of Pneumonia (mild + severe) per 1,000 children under five years (new visits) is 244 [2]. Dorringston et al conducted a study in South Africa to project communicable disease and his model was appropriate, reliable and useful [3]. Another study done by Hall et al in the United States also provided a reliable model to estimate HIV incidence [4]. Allen et al also studied in England the use of Markov model for HIV disease progression [5]. Statistical modelling and forecasting techniques can be used in the prediction of the incidence of Pneumonia in under five years children.

2. Aim and Objectives

The objective of the study was to collate information from existing data and chart out the trends of the incidence of Pneumonia (mild + severe) per 1,000 children under five years (new visits) in the future.

3. Materials and Methods

A secondary data analysis of the incidence of Pneumonia (mild + severe) per 1,000 children under five years (new visits) in Nepal was done for the period between 2005 to 2014. The survey was conducted under

the administrative supervision of the population division of the Ministry of Health and Population (MOHP) [2,6-12].

The data was analysed using Statistical Package for the Social Sciences (SPSS) for Windows Version 16.0 (SPSS Inc; Chicago, IL, USA) and GraphPad Prism 6. A p-value of < 0.05 (two-tailed) was used to establish statistical significance. The incidence of Pneumonia (mild + severe) per 1,000 children under five years (new visits) from 2005 to 2014 plotted in y-axis against the corresponding year in the x-axis. Curve fitting method was applied to choose the proper curve for a given data points. The models used were Compound, Linear, Power, Logarithmic, S, Inverse, Growth, Quadratic, Exponential and Cubic.

1. Liner Model

$$Y = b_0 + (b_1 \times t)$$

2. Logarithmic Model

$$Y = b_0 + [b_1 \times \ln(t)]$$

3. Inverse Model

$$Y = b_0 + \left[\frac{b_1}{t}\right]$$

4. Quadratic Model

$$Y = b_0 + (b_1 \times t) + (b_2 \times t^2)$$

5. Cubic Model

$$Y = b_0 + (b_1 \times t) + (b_2 \times t^2) + (b_3 \times t^3)$$

6. Compound Model

$$Y = b_0 \times b_1^t$$

7. Power Model

$$Y = b_0 \times (t^{b_t}) \; or$$

$$\ln(Y) = \ln(b_0) + (b_1 \times \ln(t))$$

8. S-curve Model

$$Y = \exp\left(b_0 + \frac{b_1}{t}\right)$$

9. Growth Model

$$Y = \exp(b_0 + b_1 t)$$

10. Exponential Model

$$Y = b_0 e^{b_1 t}$$

To select the best fitting curve for the testing of hypothesis F-test was used. P-value was taken as significant when < 0.05 (two-tailed). R^2 value > 0.90 was considered significant for prediction. The Cubic model was the best fitted model for incidence of Pneumonia (mild + severe) per 1,000 children under five years (new visits) from 2005 to 2014 (Figure 2). In the cubic model, m_0 is the constant term and m_1 and m_2 are coefficient terms. Where Y is the incidence of Pneumonia (mild + severe) per 1,000 children under five years (new visits) and X is the corresponding year; 1=2005, 2=2006, 3=2007, 4=2008 and so on.

4. Results

Table 1, Table 2 and Graph 1 illustrate the parameter estimates and the model summary for different models including the constant term. Considering the constant term in the model, none of the model was the best fit, for the prediction of incidence of Pneumonia (mild + severe) per 1,000 children under five years (new visits).

Table 1. Model Summary with Constant Term in The Model

Equation	R Square	F	df1	df2	Sig.
Linear	.748	23.708	1	8	.001
Logarithmic	.805	33.082	1	8	.000
Inverse	.639	14.184	1	8	.005
Quadratic	.874	24.380	2	7	.001
Cubic	.900	17.933	3	6	.002
Compound	.743	23.126	1	8	.001
Power	.813	34.784	1	8	.000
S	.658	15.416	1	8	.004
Growth	.743	23.126	1	8	.001
Exponential	.743	23.126	1	8	.001

Table 2. Parameter Estimates with Constant Term in The Model

Equation	Constant	b1	b2	b3
Linear	120.933	15.267		
Logarithmic	106.057	65.440		
Inverse	250.053	-154.161		
Quadratic	66.267	42.600	-2.485	
Cubic	105.567	7.743	5.073	-.458
Compound	125.133	1.087		
Power	114.897	.359		
S	5.537	-.855		
Growth	4.829	.083		
Exponential	125.133	.083		

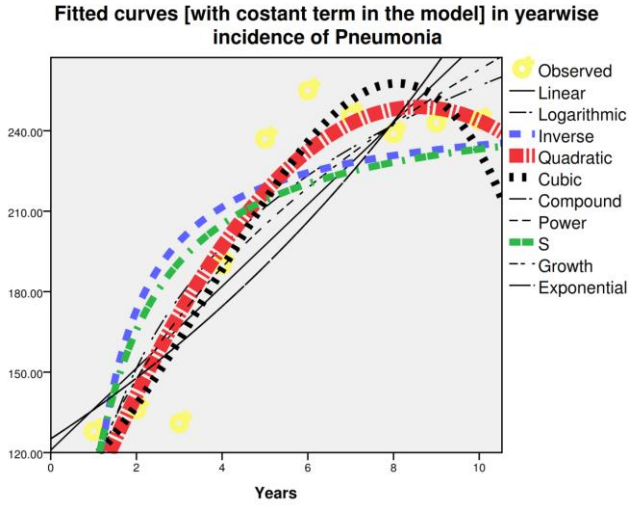

Figure 1. Fitted Curves with Constant Term in The Model Year Wise Incidence of Pneumonia (Mild + Severe) Per 1,000 Children Under Five years (New Visits) from 2005 to 2014

Table 3. Model Summary without Constant Term in The Model

Equation	R Square	F	df1	df2	Sig.
Linear	.915	97.008	1	9	.000
Logarithmic	.945	153.477	1	9	.000
Inverse	.353	4.903	1	9	.054
Quadratic	.986	274.350	2	8	.000
Cubic	.988	185.358	3	7	.000
Compound	.821	41.273	1	9	.000
Power	.859	54.851	1	9	.000
S	.511	9.393	1	9	.013
Growth	.821	41.273	1	9	.000
Exponential	.821	41.273	1	9	.000

Table 3, Table 4 and graph 2 portray the parameter estimates and the model summary for different models, excluding the constant term. Excluding the constant term in the equation, the best fitted was the cubic model, for the prediction of the incidence of pneumonia (mild + severe) per 1,000 children under five years (new visits).

Table 4. Parameter Estimates without Constant Term in The Model

Equation	b1	b2	b3
Linear	32.543		
Logarithmic	123.375		
Inverse	318.425		
Quadratic	67.749	-4.481	
Cubic	81.702	-8.940	.320
Compound	2.166		
Power	2.951		
S	9.610		
Growth	.773		
Exponential	.773		

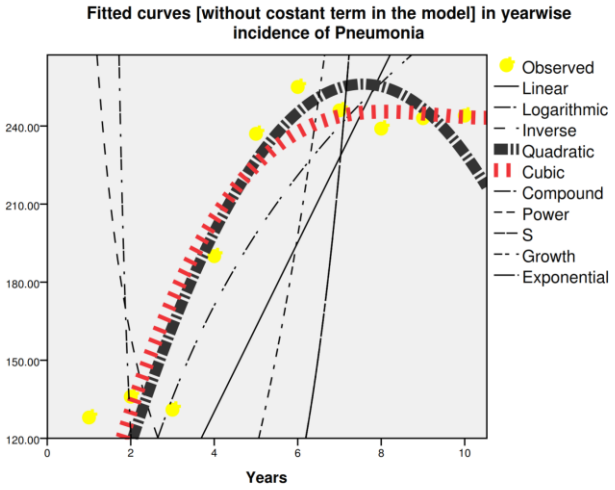

Figure 2. Fitted Curves without Constant Term in The Model in Year Wise Incidence of Pneumonia (Mild + Severe) Per 1,000 Children Under Five Years (New Visits) From 2005 to 2014

Table 5. Forecasted Year Wise Incidence of Pneumonia (Mild + Severe) Per 1,000 Children Under Five Years (New Visits) from 2005 to 2020

Year	Estimated cases	Predicted cases	95% Confidence Interval	
			Lower Limit	Upper Limit
2005	128	73	2	144
2006	136	130	55	206
2007	131	173	98	249
2008	190	204	131	278
2009	237	225	152	298
2010	255	238	164	312
2011	246	244	168	319
2012	239	246	170	321
2013	243	245	169	320
2014	244	243	155	332
2015	-	243	111	376
2016	-	247	35	459
2017	-	255	0	584
2018	-	271	0	754
2019	-	296	0	976
2020	-	331	0	1000

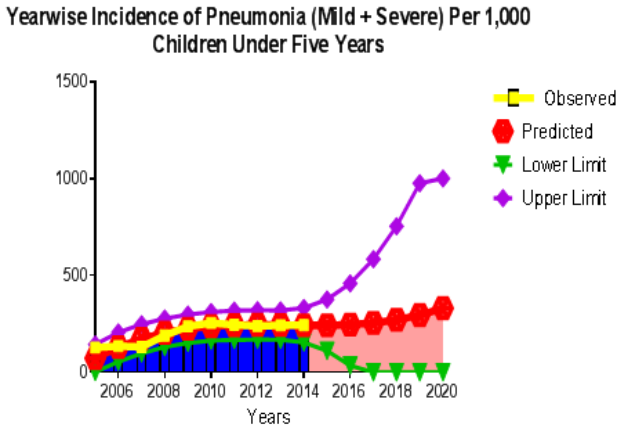

Figure 3. Year Wise Incidence of Pneumonia (Mild + Severe) Per 1,000 Children Under Five Years (New Visits) From 2005 to 2020

5. Discussions

In the Curve fitting method, collected data were plotted in a graph to find out the relationship between dependent variable and time by connecting the `points' with a line. Then the next step to find out the best fitted model to the observed data. Once the model is selected then it would be used to forecast the trend of the dependent variable for a time variable [13,14]. Sathian B et al. has done several studies using curve fitting method to predict the trends in non communicable and communicable diseases in Nepal [13-18]. This study hereby launches the suitability of statistical modelling in forecasting the year wise incidence of Pneumonia (mild + severe) per 1,000 children under five years (new visits) in the Nepalese context.

This study showed a increasing trend in pneumonia in under five children which is supported by the studies done in Bangladesh [19] and Taiwan [20]. The main reason for this is because children are more vulnerable to general and viral infections [21,22,23].

The WHO and UNICEF started a program to hasten pneumonia control with a blend of interventions to treat, prevent and protect Pneumonia in children and named it as Integrated Global Action Plan for Pneumonia and Diarrhea (GAPPD) [1]. Prevention program should focus mainly on Immunization against Hib, Measles, Pneumococcus and Whooping Cough (Pertussis).

6. Conclusion

Year wise incidence of Pneumonia (mild + severe) per 1,000 children under five years (new visits) in Nepal is having an increasing trend. The findings of this study will be helpful for the policy makers, stakeholders and all health care providers to recognize the circumstances of Pneumonia among children under five years. Furthermore, the result provide reference data for organizing, planning, and evaluation of childhood pneumonia control program. Strengthening health care delivery system and community-based prevention strategies and case management will facilitate to trim down pneumonia cases and the overall burden of this public health threat.

Declaration of Conflicting Interests

The authors declare that there is no potential conflicts of interest with respect to the research, authorship and /or publication of this article

Funding

The authors received no financial support for the research, authorship and/or publication of this article

References

[1] WHO | Pneumonia [Internet]. WHO.[cited 2015 Jun 13]. Available from: http://www.who.int/mediacentre/factsheets/fs331/en/

[2] Annual Report 2070/71 (2013/2014). 2014; 15. Department of Health Services [Internet]. [cited 2015 Jun 1]. Available from: http://dohs.gov.np/

[3] Dorrington R, Bradshaw D, Budlender D, Bourne D. The current state and future projections of the HIV/AIDS epidemic in South Africa. J South Afr Dent Assoc Tydskr Van Suid-Afr Tandheelkd Ver. 2002; 57 (11): 449-50.

[4] Hall H, Song R, Rhodes P, Prejean J, An Q, Lee L, et al. Estimation of HIV incidence in the United States. J Am Med Assoc. 2008; 300 (5): 520-9.

[5] Aalen O, Farewell V, De Angelis D, Day N, Gill O. A Markov model for HIV disease progression including the effect of HIV diagnosis and treatment: application to AIDS prediction in England and Wales. Stat Med. 1997; 16 (19): 2191-210.

[6] Annual Report 2069/70 (2012/2013). 2013; 10-15. Department of Health Services [Internet].[cited 2015 Jun 1]. Available from: http://dohs.gov.np/

[7] Annual Report 2068/69 (2011/2012). 2012; 10-20. Department of Health Services [Internet]. [cited 2015 Jun 2]. Available from: http://dohs.gov.np/

[8] Annual Report 2067/68 (2010/2011). 2011; 10-21. Department of Health Services [Internet]. [cited 2015 Jun 3]. Available from: http://dohs.gov.np/

[9] Annual Report 2066/67 (2009/2010). 2010; 9-19. Department of Health Services [Internet]. [cited 2015 Jun 4]. Available from: http://dohs.gov.np/

[10] Annual Report 2065/66 (2008/2009). 2009; 8-18. Department of Health Services [Internet]. [cited 2015 Jun 5]. Available from: http://dohs.gov.np/

[11] Annual Report 2064/65 (2007/2008). 2008; 7-19. Department of Health Services [Internet]. [cited 2015 Jun 6]. Available from: http://dohs.gov.np/

[12] Annual Report 2063/64 (2006/2007). 2007; 6-19. Department of Health Services [Internet]. [cited 2015 Jun 7]. Available from: http://dohs.gov.np/

[13] Sathian B, Fazil A, Sreedharan J, Pant S, Kakria A, Sharan K, Rajesh E, Vishrutha K V, Shetty SB, Shahnavaz S, Rao JH, Marakala V. Statistical modelling and forecasting of cervix cancer cases in radiation oncology treatment: a hospital based study from Western Nepal. Asian Pacific journal of cancer prevention. 2013; 14 (3): 2097-100.

[14] Sathian B, Bhatt C R, Jayadevan S, Ninan J, Baboo NS, Sandeep G. Prediction of cancer cases for a hospital in Nepal: a statistical modelling. Asian Pacific journal of cancer prevention. 2010; 11 (2): 441-5.

[15] Sathian B. Statistical Modelling of HIV/AIDS in Nepal: A Necessary Enquiry. Nepal Journal of Epidemiology. 2011; 1 (3): 74-76.

[16] Sathian B, Sreedharan J, Sharan K, Suresh BN, Ninan J, Joy T, Abhilash ES. Forecasting Breast Cancer Cases requiring Radiotherapy at a Teaching Hospital in Nepal. Journal of Clinical and Diagnostic Research. 2010; 4: 2378-83.

[17] Sathian B, Sreedharan J, Sharan K, Baboo NS, Chawla R, Chandrasekharan N, Rajesh E, Shah RK, Baniya R, Dixit SB. Statistical Modelling Technique in Forecasting of Palliative Oncotherapy Load in Hospitals. Nepal Journal of Epidemiology. 2010; 1 (1): 38-43.

[18] Sathian B, Sreedharan J, Mittal A, Baboo S N, Chandrasekharan N, Abhilash ES, Rajesh E, Dixit S B. Statistical Modelling and Forecasting of Reported HIV Cases in Nepal. Nepal Journal of Epidemiology. 2011; 1 (3): 106-10.

[19] Wahed MA, Islam MA, Khondakar P, Hague MA. Effect of micronutrients on morbidity and duration of hospital stay in childhood pneumonia. ORION Medical Journal. 2008; 29: 519-23.

[20] Wu PS, Chang IS, Tsai FY, Hsieh YC, Shao PL, et al. Epidemiology and impacts of children hospitalized with pneumonia from 1997 to 2004 in Taiwan. Pediatr Pulmonol 2009; 44: 162-66.

[21] Michelow IC, Olsen K, Lozano J, Rollins NK, Duffy LB, et al. Epidemiology and clinical characteristics of community-acquired pneumonia in hospitalized children. Pediatrics 2004; 113: 701-7.

[22] Madhi SA, Levine OS, Hajjeh R, Mansoor OD, Cherian T. Vaccines to prevent pneumonia and improve child survival. Bull World Health Organ 2008; 86: 365-72.

[23] Tsai HP, Kuo PH, Liu CC, Wang JR. Respiratory Viral Infections among pediatric Inpatients and outpatients in Taiwan from 1997 to 1999. 2001; J Clin Microbiol 39: 111-18.