Factors Associated with Childhood Pneumonia and Care Seeking Practices in Nepal: Further Analysis of 2019 Nepal Multiple Indicator Cluster Survey

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Abstract

Background: Acute Respiratory Infection (ARI) is still a major public health problem in Nepal. The prevalence of ARI among under five children is 2.1percent in 2019 and many children from marginalized families suffer disproportionally and many of them die without proper care and treatment. The objective for this study was to describe the factors associated with childhood pneumonia and care-seeking practices in Nepal.

Methods: This was an analytical study based on further analysis of Nepal Multiple Indicator Cluster Survey (MICS) 2019. MICS used multi-stage Probability Proportional to Size sampling for the survey. Data from 6,658 children were analyzed using SPSS 22. Chi-square test and logistics regression analysis was conducted with odds ratio and its corresponding 95% confidence interval after adjusting for confounders.

Results: Children among the age group 0 to 23 months had 1.5 times higher odds of pneumonia as compared to age group 24 to 59 months (OR=1.5, CI 1.0 - 2.3) and children from rural area had 1.9 times odds of having pneumonia in comparison to urban area (AOR=1.9, CI 1.2 - 3.2). Underweight Children had 2.3 times greater odds of having pneumonia than normal weight children (AOR=2.3, CI 1.4 - 3.9). The odds of pneumonia was 2.5 higher among the children of currently smoking mothers as compared to children of non-smoker mothers (AOR=2.5, CI 1.1 – 5.7). Only one-fourth of children received treatment from public facilities. Among those who received treatment, less than half of the children did not receive appropriate treatment for pneumonia. One in ten children with pneumonia did not receive any kind of treatment at all.

Conclusions: Pneumonia still kills so many children despite these deaths are preventable with simple interventions. Public health program and treatment services should be targeted to younger children, careful attention should be given to underweight children, and awareness and nutrition related activities should be focused on rural areas. Addressing inequity in access to and utilization of treatment of childhood illnesses should be prioritized by countries to avert these deaths of innocent children.

Background

Nepal is one of the few countries in the world with impressive reduction of under-five mortality, however, the rate is still high at 28 per 1,000 live births(1, 2). Many of these children still die from preventable causes such as diarrhea, pneumonia and other minor illnesses(3). As per the latest 2019 Nepal Multiple Indicator Cluster Survey, 2.1 percent under-five children were suffering from acute respiratory infection (ARI)(1).Many of these children do not seek timely and appropriate care, thus increasing their vulnerability for severe illness and deaths. As Nepal is aiming to reduce under-five mortality to 25 per 1,000 live births by 2030 as part of the Sustainable Development Goals (SDGs)(4), understanding and addressing socio-economic, demographic and underlying causes of childhood illness is important. Therefore, this study was further analysis of Nepal MICS 2019 data to describe determinants of childhood pneumonia and care-seeking practices of their care-takers.

As ARI is a major public health problem in Nepal, the Community-based Integrated Management of Childhood Illnesses (CB-IMCI) program was started in 1995 to manage diseases like pneumonia and other childhood illnesses(5).The program later evolved as Integrated Management of Neonatal and Childhood Illnesses (IMNCI) by integrating newborn components into it(6).CB-IMNCI is one of the priority public health programs of Nepal. The program aims to improve child survival and focuses on treatment of common childhood illness including pneumonia.

Studies from different countries have shown that the factor associated with childhood pneumonia are low birth weight, lack of exclusive breast feeding, crowded household environments and indoor air pollution(7-13). Likewise Other studies shows that socioeconomic status, mothers' education, exposure to household cigarette smoking, children from adolescent mother, poor immunization, malnutrition and area of residence accounted for a significantly higher incidence of pneumonia(8, 11, 12)

This study identified factors associated with childhood pneumonia in Nepal and thus will provide insights to public health managers, policy makers and researchers to improve coverage of effective interventions, and thus to contribute in reduction of under-five mortality and to achieve associated goals.

Considering the burden of pneumonia, associated deaths and potential to avert those deaths, critical review of causes, factors associated and care seeking needs to be identified. There were limited studies exploring these factors therefore this study attempts to contribute in generating necessary evidence on several factors associated with pneumonia and to provide recommendations for national child health programs to improve care and treatment of pneumonia and thus to contribute in child survival.

Methods

Study Design and setting

This study used data from Nepal MICS 2019 which is a. a multi-purpose cross-sectional household survey to collect internationally comparable data on the situation of children and women to monitor progress of health indicators of national development plans, the Sustainable Development Goals (SDGs) and other international commitments. Data in SPSS format (ch.sav, hh.sav, wm.sav) was downloaded from the website (https://mics.unicef.org/surveys). Primarily the data from the interview with mothers or primary caretakers of children under the age of five were utilized.

MICS covered both urban and rural area of all seven provinces of Nepal. To create the sampling frame, MICS carried out the household listing in the enumeration area to identify households with and without children under five years and 25 households with and without under five children were selected in each sample enumeration area using systematic random sampling method. Households with children under five were oversampled. A total sample of 512 enumeration area and 12,800 households was selected for the survey.

Study Population

Study population for this study was under-five children. A total 6658 (unweighted sample 6749) under-five children were eligible to be included in this study, among which 139 had ARI in two weeks prior to the survey.

Study Variables

The outcome variable used in this study was childhood pneumonia. It was categorized as “1” if presence of pneumonia i.e.an illness with a cough with rapid or difficult breathing, and whose symptoms were perceived to be due to a problem in the chest or both a problem in the chest and a blocked or runny nose in a child, as reported by the mother or caretaker for a period over the two-weeks before the day of interview and "0" if no pneumonia. The independent or explanatory variables included in this study are: birth order, , birth weight, age of child, sex of child, place of delivery, exclusive breast feeding, nutritional status includes height for age, weight for age, weight for height, age of mother, maternal smoking, mother's education, place of residence, family size, wealth index, ethnicity, media exposure, fuel use and location of kitchen.

Age of child was categorized as 0 to 23 months and 24 to 59 months, sex was categorized as male and female, birth interval was divided in to two groups (less than 2 years and more than 2 years), birth order was categorized in three groups (first or second, third or fourth and more than fourth), birth weight was categorized as less than 2500gms and equal or more than 2500gms. Likewise place of delivery categorized into two groups (institutional i.e.hospital or health facility which includes public and private health institution, and non-institutional i.e.elsewhere than public or private health institutions), breast feeding divided into two groups (nonexclusive- if baby drink other liquid with or without mother's breast milk and exclusive- Infants receiving breast milk, and not receiving any other fluids or foods, except oral rehydration solution, medicines, vitamins, and mineral supplements). Nutritional status includes height for age categorized as stunting and normal, weight for age categorized as underweight and normal, weight for height categorized as wasting and normal. In mother characteristics, age of mother was classified in to two category (< 20 years and ³20 years) maternal smoking divided into two groups (yes-currently smokes at the time of interview and no-none smoker at that time of interview), Mother's education also categorized into two groups (illiterate- who had no formal education and literate-either primary, secondary, or higher level of education). Similarly in household characteristics, place of residence was divided into rural and urban, Family size was categorized in to two groups (up to 4 members and more than 4 members), Wealth index was categorized in to 5 groups as per MICS did Household wealth status grouped into quantile: 1 = Lowest, 2 = Second3= Middle 4 = Fourth 5 = Highest. MICS calculate the wealth status by include for Principal Component Analysis (PCA) which includes productive assets which include Hand mill, Sickle, Axe, Livestock, Hoe, Tractor, Plough, non- productive assets which include Radio, Refrigerator, TV, Bicycle, Motorbike, Phone/cell phone, Chair, Table, Bed, household utilities and other which include types of water supply, toilet, flooring, wall/house roof, light source, Person sleeping per room, Land ownership, Livestock ownership. Ethnicity was categorized into two groups (0= "Disadvantaged" Individuals who belong to the following castes: Hill Dalit, Terai Dalit, Hill Janajati, Terai Janajati, other Terai Caste, and Muslim1= "Non- disadvantaged" Individuals who belong to the following castes: Hill Brahmin, Hill Chhetri, Terai/Madhesi Brahmin/Chhetri, Newar and Other), Media exposure was categorized into 3 groups (1= Poor access to media (0-3 score, based on the frequency of reading newspaper/magazine, listening radio and watching television on a daily or weekly basis) 2= Moderate access to media (4-6 score) 3= Good access to media (7-9 score)). In household environment related variables, fuel use divided in to 2 groups (1 =Clean and safe (LPG or electric) 2 =Used solid fuel, which includes traditional solid fuel) and location of kitchen was categorized based on available of separate kitchen (0 = House with no separate kitchen 1 =House with separate kitchen in same house or in different building).

Method of Analysis

The downloaded data of MICS 2019were reviewed to understand variables, variable codes, categorization and further recoding needs.

Step 1: Data from website downloaded in SPSS (*.sav) format and appropriate files (hh.sav, wm.sav, ch.sav, bh.sav) were selected

Step 2: Appropriate variables from each file were filtered and merged into the ch.sav file. Following variables were selected from these data files:

hh.sav: HH48 (family size), HC2 (ethnicity), EU1 (fuel use for cooking), EU5 (location of kitchen)

wm.sav: WB4 (age of mother), MN20 (place of delivery), MN34 (birth weight), TA3 (mother's smoking), MT1 (reading magazine), MT2 (listening radio), MT3 (watching television)

bh.sav: brthord (birth order), birthint (birthinterval)

ch.sav: CA16 (child had cough), CA17 (fast or difficulty breathing), CA18 (fast or difficulty breathing due to a problem in chest or a blocked or runny nose), CA20 (advice or treatment for pneumonia), CA21 (place or provider for pneumonia), CA23 (medicines for pneumonia), UB2 (age of child), HL4 (sex of child), BD3-BD8 (24-hr recall on feeding for 0-5 months child), melevel1 (mother's education), HH6 (place of residence), windex5 (wealth quintile), HAZ2 (height for age), WAZ2 (weight for age), WHZ2 (weight for height)

Step 3: Dataset merged using unique identifier (HH1, HH2 in hh.sav and HH1, HH2 and LN in wm.sav and bh.sav) to ch.sav file as per MICS's Guideline for merging data files (14)

Step 4: Variables were recoded or new variables were created as per the need of study objectives and variable definition for the study

Step 5: Frequency distribution, chi-square analysis, bi-variate analysis, and multivariate analysis were conducted. Data were adjusted for sample weight (using chweight variable using SPSS 22) and using complex survey analysis approach (using svy command in Stata 17) during analysis, as guided by MICS methodology. Analysis was guided by the conceptual framework and findings were interpreted in the Results section.

Step 6: Data were analyzed by exclusion of missing value of following variables: family size and ethnicity (1416), media access (879), age of mothers (877), education status of mothers (2), height for age (202), weight for age (36), weight for height (181), fuel use and type of kitchen (1416). These missing values were due to collection of data from household level and nonresponse from the respondents. Birth weight and place of delivery were analyzed among the children age 0 to 23 months and exclusive breast feeding was analyzed among 0 to 5 months children.

Logistic regression analysis between dependent and independent variables were executed. Firstly, bivariate logistic regression was performed followed by multivariate logistic regression based on binary logistic regression model to adjust for the effects of other variables within the model, controlling potential confounders, and to test the strength of an association noticed in the bivariate analysis. Independent variables found to be significant in the bivariate analysis and supported by literature review were included in the multivariate analysis. Hosmer and Lemeshow goodness of fit test was carried out to ensure that the model was fit, considering the test statistic was 0.846 (P> 0.05).

Results

Descriptive Summary

As shown in Table 1, out of total 6,658 children, majority of the children (64.9 percent) were from urban area. Concerning on family size, most of the children had family members of more than four (63 percent). Majority were from disadvantaged ethnicity (65 percent). More than seventy two percent of the family of children had poor access to media, i.e. regular use of radio, Television and magazine. Concerning the maternal characteristics, majority of the mothers of children (70.6 percent) belonged to age group of mothers 20 to 35 years. Most of the mothers were literate (74.2 percent). Majority 97.2 percent of mothers reported that they were not current smokers. Majority were of age 24 to 59 months (61.5 percent), Male children were higher (52.6 percent) than female. In birth order, most of the children were from first birth (80.7 percent). More than 78 percent of babies had birth weight 2500 grams and more than 2500 grams. Nearly three-fourth (74.9 percent) of the children were delivered in health institution. Around two third of the children received exclusive breast feeding. Nearly one quarter (24.5 percent) children were under-weight, nearly one third (31.7 percent) were stunted and one-in-eight (12.3 percent) were wasted. More than half (57.7 percent) of respondent's households used solid fuel as main source of cooking and rest used clean fuel. Concerning the location of the kitchen, 73.8 percent of the households had a separate kitchen within same house or separate building, more than a quarter (26.2 percent) had no separate kitchen.

Table 1

Distribution and prevalence of pneumonia based on household, children’s, mother’s and household environment in Nepal

Variable	Distribution	Children with pneumonia in last two weeks				Chi square (p-value)
	N (%)	Yes		No		
		n	%	n	%	
Household Related Factors						
Place of Residence						
Urban	4318 (64.9)	68	1.6	4250	98.4	15.821 (0.00)
Rural	2340 (35.1)	71	3.0	2269	97.0	
Family Size						
£ 4 members	1940 (37.0)	50	2.6	1890	97.4	5.596 (0.02)
> 4 members	3302 (63.0)	53	1.6	3249	98.4	
Wealth Quintile						
Lowest		47	3.0	1503	97.0	9.466 (0.05)
Second		24	1.8	1342	98.2	
Middle		25	1.9	1320	98.1	
Fourth		22	1.7	1277	98.4	
Highest		21	1.9	1077	98.1	
Ethnicity						
Disadvantaged	3411 (65.1)	56	1.6	3355	98.4	5.882 (0.02)
Non-disadvantaged	1831 (34.9)	48	2.6	1783	97.4	
Media Access						
Poor Access	4198 (72.6)	92	2.2	4106	97.8	2.182 (0.34)
Moderate Access	1368 (23.7)	22	1.6	1346	98.4	
Good Access	213 (3.7)	3	1.4	210	98.6	
Maternal Factors						
Age of Mother (n=5781)						
<20years	543 (9.4)	15	2.8	528	97.2	2.792 (0.248)
20 to 35 years	4084 (70.6)	86	2.1	3998	97.9	
More than 35 years	1154 (20.0)	18	1.5	1136	98.5	
Maternal Smoking (n=6658)						
Yes	188 (2.8)	9	4.8	179	95.2	6.897 (0.01)
No	6470 (97.2)	130	2.0	6340	98.0	
Mother's Education (n=6655)						
Illiterate	1718 (25.8)	33	1.9	1685	98.1	0.322 (0.57)
Literate	4937 (74.2)	104	2.1	4833	97.9	
Child and Birth Related Factors						
Age (n=6658)						
0 – 23 months	2570 (38.6)	70	2.7	2500	97.3	8.283 (0.00)
24 – 59 months	4088 (61.4)	69	1.7	4019	98.3	
Sex (n=6658)						
Male	3502 (52.6)	82	2.3	3420	97.7	2.334 (0.13)
Female	3156 (47.4)	56	1.8	3100	98.2	
Birth order (n=6558)						
1st	5293 (80.7)	104	2.0	5189	98.0	4.961 (0.08)
2nd and 3rd	1254 (19.1)	34	2.7	1220	97.3	

> 3rd	11 (0.2)	0	0.0	11	100	
Birth interval (n=6558)						
First birth	*5305*	104	2.0	5201	98.0	4.629 (0.99)
£ 2	785 (62.7)	18	2.3	767	97.7	
> 2	468 (37.3)	16	3.5	452	96.6	
Birth Weight (n=1616) *						
< 2500 gms	348 (21.6)	10	2.9	338	97.1	0.016 (0.97)
2500 gms and more	1268 (78.4)	36	2.2	1232	97.2	
Place of delivery (n=2147) *						
Non institutional	539 (25.1)	10	1.9	529	98.1	1.945 (0.16)
Institutional	1609 (74.9)	48	3.0	1561	97.0	
Breast Feeding (n=585) **						
Not exclusive	221 (37.9)	8	3.6	213	96.4	5.800 (0.02)
Exclusive	363 (62.1)	3	0.8	360	99.2	
Nutritional Status						
Height for Age (n=6456)						
Stunting	2045 (31.7)	53	2.6	1992	97.4	3.675 (0.05)
Normal	4411 (68.3)	82	1.9	4329	98.1	
Weight for Age (n=6622)						
Underweight	1625 (24.5)	52	3.2	1573	96.8	14.571 (0.00)
Normal	4997 (75.5)	83	1.7	4914	98.3	
Weight for Height (n=6477)						
Wasting	795 (12.3)	27	3.4	768	96.6	6.961 (0.01)
Normal	5682 (87.7)	111	1.9	5571	98.0	
Household Environment Related Factors						
Fuel Use for Cooking (n=5242)						
Clean Fuel	2218 (42.3)	44	2.0	2174	98.0	0.040 (0.84)
Solid Fuel	3024 (57.7)	60	2.0	2964	98.0	
Location of Kitchen (n=5242)						
No separate kitchen	1372 (26.2)	32	2.3	1340	97.7	1.150 (0.28)
Separate kitchen	3870 (73.8)	74	1.9	3796	98.1	

* Among 0-23 months, ** among 0-5 months

Results from Regression analysis

Multivariate analysis of all factor's significance at 95% CI in bivariate analysis was carried out using binary logistic regression. Adjusted odds ratio at 95% confidence intervals was calculated to measure the independent effects of variables.

Before adjusting potential confounder, area of residence, age of child, exclusive breast feeding, children weight for age and maternal smoking were significantly associated with childhood pneumonia. Wealth status of family, ethnicity, mother's education and fuel use for cooking also included in multivariate analysis on the basis of published literature.

Multicollinearity test was done before multivariate analysis. In the test of multi-collinearity, none of them have tolerance <0.1 and Variance Inflation Factor (VIF) >10. The highest value was found to be <10 which ensured that there was no relationship/interdependence between independent variables themselves. The condition index is also not more than 15. The goodness of fit model was assessed by Hosmer and Lemeshow test. The test statistics was 0.846 (>0.05) that showed the model adequacy fits the data. The coefficient of determination (Nagelkerke R square) for the equation was 0.047 which means that 4.3 percent changes in dependent variable was due to independent variables like age of children, children with underweight, smoking habit of mothers and area of residence.

The analysis was fit in logistic regression model:

$$y = \beta 0+\beta 1X1+\beta 2X2+ \beta 3X3……. +\beta i\ Xi$$

Where y is the log odds of the dependent variable, β0 is constant, βi is the regression coefficient and X1-Xi are independent variables. The logistic regression revealed the following equation for childhood pneumonia:

Childhood pneumonia (y) = -3.962 + (0.430) X1 + (0.833) X2 + (0.902) X3 + (0.663) X4+ (-0.515) X5

Where,

Constant (β0) = -3.962

Beta coefficient (β1) = 0.430, X1= Children between age 0 to 23 months

Beta coefficient (β2) = 0.833, X2= Underweight children

Beta coefficient (β3) = 0.902, X3= Mothers who smoke

Beta coefficient (β4) = 0.663, X3= Children from rural areas

Beta coefficient (β5) = -0.515, X4= Children from non-disadvantaged families

The equation for regression line can be depicted as follows:

Childhood pneumonia = Constant (-4.181) + (0.438) Children between age 0 to 23 months + (0.842) Underweight children + (0.652) Children from rural areas+ (-0.495) Children from non-disadvantaged families

In the multivariate logistic regression model, after potential confounder were adjusted; children's age, children weight for age, maternal smoking, area of residence and caste and ethnicity as the independent variable were significantly associated with childhood pneumonia at 95% CI. As shown in Table 2, children among the age group 0 to 23 months had 1.5 times odds of pneumonia as compared to age group 24 to 59 months (OR = 1.5, CI 1.0 - 2.3) and children from rural area had 1.9 times odds of having pneumonia in comparison to urban area (AOR= 1.9, CI 1.2 - 3.2). Underweight Children had 2.3 times odds of having pneumonia than normal weight children (AOR=2.3, CI1.4 -3.9). The odds of pneumonia was 2.5 times higher among the children of currently smoking mothers as compared to children of non-smoker mothers (AOR= 2.5, CI 1.1–5.7) and children from disadvantaged families had 0.6 times protective odds of pneumonia than children from non-disadvantaged families (AOR = 0.6, CI 0.4 - 1.0)

Although some difference on mothers' education, wealth quintile, caste and ethnicity, location of kitchen and fuel use were seen none of those results were statistically significant.

Table 2

Adjusted and unadjusted results from multi-variate regression analysis for childhood pneumonia in Nepal

Variables	Unadjusted			Adjusted		
	OR	95% CI	p-value	AOR	95% CI	p-value
Age of child (months)						
0-23	1.6	1.2 – 2.2	0.00	1.5	1.0 – 2.3	0.03
23-59*						
Weight for Age						
Underweight	2.0	1.3 – 2.9	0.00	2.3	1.4 – 3.9	0.00
Normal*						
Maternal smoking						
Yes	2.5	1.1 – 5.4	0.02	2.5	1.1 – 5.7	0.03
No*						
Mothers' education						
Illiterate	0.9	0.5 – 1.4	0.61	0.8	0.5 – 1.3	0.37
Literate*						
Wealth quintile						
Lowest	1.6	0.5 – 5.4	0.43	1.2	0.3 – 5.7	0.68
Second	0.9	0.3 – 3.3	0.92	1.0	0.2 – 4.8	0.97
Middle	1.0	0.3 – 3.3	0.98	1.0	0.3 – 3.8	0.95
Fourth	0.9	0.3 -3.0	0.82	0.6	0.2 – 2.0	0.38
Highest*						
Place of Residence						
Rural	1.9	1.2 – 3.2	0.01	1.9	1.2 – 3.2	0.01
Urban*						
Ethnicity						
Disadvantaged	0.6	0.3 – 1.1	0.11	0.6	0.4 – 1.0	0.04
Non-disadvantaged*						
Kitchen location						
No separate kitchen	1.2	0.7 – 2.1	0.43	1.2	0.7 – 2.0	0.50
Separate kitchen*						
Fuel Use for Cooking						
Solid Fuel	1.0	0.5 – 1.9	0.95	0.6	0.2 – 1.3	0.16
Clean Fuel*						

* Reference analysis

Health Care Seeking Practices

Among the children with pneumonia (n=139), 12.3 percent of children did not seek any treatment for pneumonia. More than a quarter (26.6 percent) of children received treatment from public health facility, 54.5 percent of children received treatment from private health facility, 5.7 percent children received treatment from private pharmacy, and only a few (0.9 percent) children sought treatment from other sources.

Regarding the appropriate treatment, 40.5 percent of children received the appropriate treatment by antibiotics. Nearly one in ten (9.8 percent) children with pneumonia did not receive any kind of treatment and nearly half (49.7 percent) of children did receive inappropriate treatment for pneumonia.

Table 3

Care seeking practices among children with pneumonia by service providers and treatment in Nepal

Care seeking for pneumonia	Number	Percent	95% Confidence Interval
Health Care Place/Provider			
No treatment sought	17	12.3	7.4 – 19.8
Health Facility – Public	37	26.6	19.6 – 35.1
Health Facility – Private	76	54.5	44.8 – 63.9
Private Pharmacy	8	5.7	3.0 – 10.4
Other Place	1	0.9	0.1 – 6.2
Appropriate Treatment			
No treatment sought	14	9.8	5.5 – 17.0
Treated by Antibiotics	56	40.5	31.0 – 50.8
Not Appropriate	69	49.7	39.8 – 59.5

Discussion

This study showed children from rural area had significantly higher odds of pneumonia. This finding is also supported by the findings made by other studies conducted based on the further analysis of Nepal Demographic and Health Surveys in Nepal (15, 16).The reason behind this finding may be explained as the rural area is associated with other factors like type of home, type of fuel they use during cooking, number of family members staying in same home, socioeconomic status and mothers education which in combination would affect the childhood pneumonia in rural areas.

This study showed that the childhood pneumonia was significantly associated with smoking habit of mother. This finding was similar to the study conducted in India (17), SEAR (18) and consistent with scientific report (19),but not consistent with the findings of study conducted in India (20).

Age of child in this study was statistically significant with childhood pneumonia both in bivariate and multivariate analysis. This finding was similar to the finding from other studies in Nepal (16), and Nigeria (21) which showed that children aged two and above were less likely to have symptoms of ARI compared to children less than age two. Similar finding was also shown in Tanzania (22) and Egypt(12).The reason behind this finding may be due to the small airways and immature defense system of this age group that make them more susceptible to develop pneumonia.

Male child had higher odds of pneumonia than the female child in this study but this result was not statistically significant. Similar findings were reported earlier from Nepal(16) and Egypt(12),but different in findings from Iraq (23) where female child had higher chance of pneumonia than male. Gender variation could be explained by the stronger immune system in girls than boys. There is also evidence that the peripheral airways are narrower during the early years of life in boys, which may predispose them to lower respiratory infections(24).

Significant association was found between childhood pneumonia and exclusive breast feeding up to six months of life in bivariate analysis in this study. This finding was similar to the outcome of another study from Nepal (25) and from Ethiopia(9, 26),Egypt(12) and other developing countries(27). The reason behind this could be explained as breast milk constitutes a variety of immune-protective and nutritious substances that protect the baby since its own immune system is not mature yet.

This study showed that the nutritional status of children was associated with childhood pneumonia. There was higher odds of pneumonia among the stunted, wasted and underweight children in comparison with normal children. Underweight was significantly associated with childhood pneumonia in both binary logistic and multivariate logistic analysis. This finding was consistent with the outcome of the study of India (17),SEAR(18), developing countries (27), Ethiopia (28) and Nigeria (21) where there were higher odds of childhood pneumonia among malnourish children. This may be due to lack of immunity among malnourished child to fight against pneumonia.

The present study did not show any relationships with fuel use for cooking against pneumonia in children in both bivariate and multivariate analysis, however earlier studies conducted in Nepal (13, 15), India (10, 17, 20), SEAR (18), Ethiopia (28, 29), WHO study (11), Global burden of diseases (GBD) (30), study of developing countries (27) showed that the prevalence of childhood pneumonia among households using polluting fuels was higher compared to households using clean fuels.

This study showed that the children who belong to poorer families had higher odds of pneumonia. The odds were double among poorer than those who belongs to richer families, which is a similar findings from other studies from Nepal (15, 16),India(10, 17, 20), Ethiopia (9) and Lancet Series on Childhood Pneumonia and Diarrhea in 2013 (30). However, this finding was not consistent with the findings from study in Dhulikhel Hospital of Nepal (31).

Another finding of this study was the increased odds of pneumonia in children who belonged to those whose homes used kitchen in same building but this finding was not significant in bivariate and multivariate analysis. This finding was supported by studies conducted in Nepal (15, 31), India (17). This may be because cooking in the same room imposed high level of indoor air pollution and suffocation that could increase the incidence of pneumonia among children under five.

This study showed that among the children with pneumonia, 12.3 percent of children did not seek any treatment for pneumonia. This finding was supported by the descriptive study conducted in Lalitpur Nepal(32). Only around a quarter (26.6 percent) of children received treatment from public health facility and

more than half of them received treatment from private health facility. This finding was consistent with the finding of the community based cross sectional study conducted in India which showed that majority of caretaker (70.5 percent) preferred private practitioners for the treatment of pneumonia (33). Another cross-sectional survey conducted in Pokhara Nepal showed that, majority sought treatment from pharmacies (34).

Regarding the appropriate treatment, 40.5 percent of children received an appropriate treatment by antibiotics. This study showed that nearly one in ten (9.8 percent) children with pneumonia did not receive any kind of treatment and almost half of children did receive inappropriate treatment for pneumonia. This finding was not consistent with the study conducted in India which showed that majority of the children received antibiotic for pneumonia (33) and cross-sectional survey conducted in Nepal (34) which also showed that the majority of children received appropriate treatment.

Strength and limitation of this study

The analysis was done after accounting for complex survey design such as sample weight. This study was based on cross-sectional data and is not intended to establish a causal relationship between the dependent and independent variables. Some questions related to the practice might not match with the real scenario as it subject to bias to report expected behavior than a real behavior (reporting bias)

Conclusion

This study described the factors associated with childhood pneumonia and care-seeking practices in Nepal based on the further analysis of 2019 MICS. The survey reported that slightly more than two percent of children suffered from pneumonia in the two-weeks period preceding the survey and many of these illnesses were preventable with appropriate care and treatment.

The factors that was found to be associated with childhood pneumonia were age of children, children with underweight, smoking habit of mother, place of residence and ethnicity. Children of age group 0 to 23 months had higher odds of pneumonia than age group of 24 to 59 months. Underweight children had higher odds of pneumonia than child with normal weight-for-age. Odds of pneumonia was higher among the children whose mothers were currently smoker. Similarly, children from rural areas had higher odds of suffering from pneumonia than those from urban areas. Pneumonia was found to be higher among children from non-disadvantaged families.

Other factors like, wealth status, age and sex of child, birth order, birth interval, birth weight, exclusive breast feeding, wasted and stunted child, media access, age of mother and location of kitchen were also associated with pneumonia, but were not statistically significant. However, place of delivery, immediate new born care practices were not associated with childhood pneumonia. Fuel use for cooking was also not associated with childhood pneumonia.

Caretakers of many of these children did not seek timely and appropriate care, thus increasing the vulnerability for severe illness and deaths for these children. More children received treatment from private health facilities than from public facilities.

Abbreviations

ARI Acute Respiratory Illness

CB-IMNCI Community-based Integrated Management of Neonatal and Childhood Illnesses

CBS Central Bureau of Statistics

CI Confidence Interval

EA Enumeration Area

GBD Global Burden of Diseases

IMNCI Integrated Management of Neonatal and Childhood Illnesses

IOM Institute of Medicine

IRC Institutional Review Committee

LPG Liquified Petroleum Gas

MICS Multiple Indicator Cluster Survey

NDHS Nepal Demographic and Health Survey

PPS Probability Proportional to Size

SDGs Sustainable Development Goals

SNCU Special Neonatal Care Unit

SPSS Statistical Package for Social Sciences

UNICEF United Nation's Children Fund

WHO World Health Organization

Declarations

Ethics approval and consent to participate

The analysis was based on publicly available MICS datasets(http://mics.unicef.org/surveys). The permission to access and use these datasets for this study purpose was obtained from UNICEF/MICS so no further ethical approval was necessary. The MICS survey was approved by Central Bureau of Statistics (CBS)as per the Statistical Act (1958) in September 2018 and followed national and international practice of volunteerism and confidentiality for research ethics and downloaded dataset and omitted any individual identifier. Ethical approval for the further analysis was obtained from Institutional Review Committee (IRC) of Institute of Medicine (IOM).

Consent for publication

Not Applicable

Availability of data and materials

For this study data were used from publicly available data which is accessible from the MICS website (https://mics.unicef.org/surveys) on the request to UNICEF/MICS team.

Competing interests

The authors declare that they have no competing interests.

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Authors' contributions

SD conceptualized and designed the study, extracted data from UNICEF's website, conducted literature review, performed statistical analyses and interpretation of the result. PB and BS reviewed and provided guidance for finalization of research. SD with help from PB prepared the manuscript. PB and BS revised and approved it for submission. All authors read and approved the final manuscript.

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