

Acute Lower Respiratory Tract Infections and Associated Factors Among Under-five Children Visiting Wolaita Sodo University Teaching and Referral Hospital: A Cross-sectional Study

Birhanu Wondimeneh Demissie

Wolaita Sodo University

Esayas Aydiko Amele

Wolaita Sodo University

Yibeltal Asmamaw Yitayew (✉ yibeltal.asmamaw@wu.edu.et)

Wollo University <https://orcid.org/0000-0003-4161-3500>

Zemen Mengesha Yalew

Wollo University

Research

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Abstract

Background: Lower respiratory tract infections are a leading cause of morbidity and mortality worldwide, particularly in children younger than five years. Even if the burden of lower respiratory tract infections in children under-five years had decreased dramatically in the last ten years, it is still the main cause of morbidity and mortality in under five years old children in developing countries. So, this study was aimed to assess lower respiratory tract infections and associated factors among under-five children visiting Wolaita Sodo University Teaching and Referral Hospital.

Methods: A cross-sectional study was conducted from April 1-30, 2019, among under-five children attended the Pediatrics outpatient department of Wolaita Sodo University Teaching and Referral Hospital. The data was collected using a semi-structured pre-tested interviewer guided questionnaire. Epi-info (version 7.1.2.0) was used for data entry, and Statistical Package for Social Sciences version 20 was used for analysis. Bivariate and multivariate logistic regression, crude and adjusted odds ratio with their 95% confidence interval were computed. Finally, p-value <0.05 was used to identify variables that had a significant association with acute lower respiratory tract infection.

Result: The prevalence of acute lower respiratory tract infections among under-five children was 40.3% (95%CI: 35.7%- 44.9%). Unvaccinated children (AOR: 2, 95% CI, (1.27-3.16)), non-exclusive/replacement feeding (AOR: 1.85, 95% CI, (1.18-2.91)), households mainly used unclean fuel for cooking (AOR: 2.12, 95% CI, (1.07-4.19)), absence of separate kitchen (AOR: 1.7, 95% CI, (1.09-2.65)), and absence of window in the kitchen room (AOR: 1.69, 95% CI, (1.07-2.68)) showed significant association with acute lower respiratory tract infection.

Conclusion: The prevalence of acute lower respiratory tract infections was 40.3%. Unvaccinated children, non-exclusive/replacement feeding, households mainly used unclean fuel for cooking, absence of a separate kitchen, and absence of window in the kitchen room showed significant association with acute lower respiratory tract infection. Therefore, special attention should be given for the environmental sanitation and family health component of the health extension packages.

Introduction

Acute lower respiratory tract infections (ALRTs) are any infections in the lungs or below the voice box, which include pneumonia, bronchitis, and bronchiolitis [1]. So far, pneumonia is the most common type of lower respiratory tract infection (LRTIs), and globally, 150 million new episodes of pneumonia are identified per year worldwide, and more than 90% of which occur in developing countries[2, 3]. Viruses are the most common cause of pneumonia in infants and young children, and the most frequent symptoms and signs are coughs, increased respiratory rate, fever, breathing difficulty, runny nose, and chest wall indrawing in more severe disease [3–6].

Lower respiratory tract infections (LRTIs) are a leading cause of morbidity and mortality worldwide, particularly in children younger than five years[7, 8]. Globally, LRTIs cause 704 000 deaths, and the highest under-five LRTI mortalities were in sub-Saharan Africa. Even if the burden of LRTIs in under five-children has decreased dramatically in the last ten years, it is still the main cause of death in developing countries [8–10]. Each year, more than 2 million under five-children died due to pneumonia in the developing world, and 43% of global under-five death of ALRTIs occurs in India, Nigeria, the Democratic Republic Congo and Ethiopia[11]. In Ethiopia in 2015, 25,970 under-five children were dead due to LRTIs, and 14,148.3 was caused by Pneumococcal pneumonia[8].

Different factors were identified for the increased risk of LRTIs in children. Of these, poverty, restricted family income, low parental education level, low birth weight, malnutrition, lack of breastfeeding, maternal literacy, smoking, cow dung use for fuel, low socio-demographic status, solid fuels for cooking and heating, immune impaired populations, improved toilet facilities, season, and residence [8, 10, 12, 13]. Similarly, the risk of death from LRTIs will be determined by very severe pneumonia, age below two months, diagnosis of *Pneumocystis Carinii*, chronic underlying diseases including HIV/ AIDS, severe malnutrition, young maternal age, low maternal education, low socioeconomic status, second-hand smoke exposure, and indoor air pollution[14].

Widespread immunization against influenza, measles, bacilli Calmette-Guerin (BCG), and now pneumococcus have been related to the decline of the LRTIs in children [3]. Likewise, vaccines prevent an estimated 2.5 million deaths among children under five every year. Yet one child dies every 20 seconds from a disease that could have been prevented by a vaccine[15]. Ethiopian children suffer four to eight episodes of ARTI on average every year, with the highest occurrence in urban areas in overcrowded living conditions[7]. In Ethiopia, only 39% received all vaccinations at some time, and 22% were vaccinated by the appropriate age [16]. This low immunization coverage will result in an increased risk of LRTIs morbidity and mortality.

Even if Ethiopia has achieved millennium development goals (MDG) 4 by 2013, LRIs are one of the most common causes of under-five children mortality [17]. Therefore, to achieve the sustainable development goal (SDG) 3 of ending preventable deaths of new-borns and under-five children by 2030, efforts to reduce deaths due to lower respiratory tract infection should remain a top priority[18, 19]. So this study was aimed to assess lower respiratory tract infections and associated factors among under-five children visiting Wolaita Sodo University Teaching and Referral Hospital (WSUTRH), 2019.

Methods

Study design, area and period

An institution-based cross-sectional study was conducted from April 1–30, 2019, at Wolaita Sodo University Teaching and Referral Hospital (WSUTRH). Wolaita Sodo University Teaching and Referral Hospital is found at Sodo town, which is located 157 Km from the regional capital city, Hawassa, and

327 Km from the capital city of Ethiopia, Addis Ababa. According to the Wolaita Zone Health Department information 2019, the estimated population of Wolaita Zone is about 2,020,386 from this, about 983,991 are males, and 1,030,396 are females. The hospital gives service to nearly 3 million peoples in the catchment area, had 350 inpatient beds, and 450–500 patients visited the hospital per-day[20].

Populations

Source population

All under five children/mother or caretaker pair visiting WSUTRH pediatric outpatient department (OPD)

Study population

Randomly selected under five-children/mother or caretaker pair visited WSUTRH pediatric outpatient department (OPD) from April 1–30, 2019

Sample size determination and procedure

The sample size was calculated using a single population proportion formula with the assumption of 50% under-five prevalence of ALRTIs to get the largest sample size, with a 95% confidence interval and 5% marginal error.

The sample size calculated as follows;

$$N_i = (Z_{\alpha/2})^2 \times p(1-p)/W^2$$

$$N_i = (1.96)^2 \times (0.5) \times (0.5) / (0.0025) = 384$$

Where:

n_i = initial sample size

α = confidence interval

p = prevalence LRIs

W = margin of error

By considering a 10% none response rate, the final sample size was 422 child/mother pairs. The estimated number of child/mother or care taker pair visited under five OPD in the study period was 1050 based on the last six months of patient flow. Then participants were selected using a systematic random sampling technique ($k = 2$) until the required sample size was obtained.

Data collection instrument

A face-to-face interview was conducted using a structured questionnaire that was adopted and modified from previous researches [21–27]. The questionnaire comprises socio-demographic factors, maternal and child factors, environmental factors, and the outcome variable (ALRTIs). Length board (< 2 years) or portable stadiometer (≥ 2 years) and portable digital weight scale were used to measure the height and weight of the child, respectively.

Data collection procedure and quality control

The data were collected by four BSc nurses and supervised by two MSc paediatrics and child health nurse professionals. The training was given for data collectors and supervisors for two days, and a pre-test was conducted in 5% (21) of the final sample size in Sodo Christian hospital. Both supervisors and data collectors were closely followed for the data collection process, and all filled questionnaires were checked every day, and errors were corrected accordingly. The weight of the child was measured using a well-calibrated, portable digital weight scale without shoes and wearing light clothes. Moreover, the reliability of the weight scale was checked before each measurement.

Data entry and analysis

The collected data were checked for completeness, consistency, and accuracy, then entered into EPI data version 3.1 and exported to Statistical Package for Social Sciences version (SPSS) 22.0 for data analysis. Descriptive statistics with percentages, frequency distributions, measures of central tendency, and dispersion were used to describing the data. Bivariate logistic regression was used to check variables having an association with ALRTIs, and those variables found to have a p-value of < 0.2 were further analyzed using multiple logistic regressions. Odds ratio (OR) with 95%CI was computed, and variables with a p-value < 0.05 were considered as a significant variable. The model fitness was checked with the Hosmer and Lemeshow goodness of fit test, which was $p = 0.767$.

Operational definitions

Acute lower respiratory tract infections

A child presented with cough, fever, rapid or difficulty of breathing in the last two weeks and diagnosed as ALRTIs (pneumonia, acute bronchitis, and bronchiolitis) by the physician.

Main cooking fuel:

Unclean fuel

using wood, animal dung, charcoal, crop wastes, kerosene stove and kerosene lamp [28]

Clean fuel

use of electricity, gas, ethanol, and solar[28]

Breast feeding:

Exclusive breast feeding

infants receive only breast milk for the first six months or receive only breast milk until the time of assessment for infants < six months

Non-exclusive/replacement feeding

Giving food or fluid (milk) alone or in addition to breast milk for the infants < six months

Immunization status:

Immunized for age

Took all vaccines appropriate for age based on the immunization schedule

Incomplete

defaulters or those who were not vaccinated based on the immunization schedule

Not vaccinated

a child who didn't take the vaccine at all

Result

Socio demographic characteristics

A total of 414 child/mother or caretaker pairs had participated in the study, which resulted in a 98.1% response rate. The mean age and standard deviation of children and mothers were 21.3 ± 14.13 months and 29 ± 5.8 years, respectively. Nearly half (46.4%) of children were age ≥ 24 months, the majority (54.6%) of children were male, and 59.4% were urban dwellers. Nearly half of the respondents (49%) were protestant in religion, 32.6% were unable to read and write, and 57.7% were housewives in occupation. Nearly all (93%) children's parents lived together, and the average monthly income of the family was 2356 ± 1316 Ethiopian birr (Table 1).

Table 1
 Socio-demographic characteristics of acute lower respiratory tract infections among under-five children/mother or caretaker pair attended at WSUTRH, 2019(n=414)

Variable N=414	Categories	Frequency (N)	Percent %
Age of the child	2-5 months	44	10.6%
	6-11 months	77	18.6%
	12-23 months	101	24.4%
	24-59 months	192	46.4%
Sex of the child	Male	226	54.6%
	Female	188	45.4%
Age of the mother	≤24	85	20.5%
	25-34	264	63.8%
	≥35	65	15.7%
Residence	Urban	246	59.4%
	Rural	168	40.65%
Religion of the respondent	Protestant	203	49%
	Orthodox	122	29.5%
	Catholic	46	11.1%
	Muslim	43	10.4%
Educational status of mother	Unable to read and write	135	32.6%
	Able to write and read	130	31.4%
	Primary school	79	19.1%
	Secondary school	41	9.9%
	Diploma and above	29	7%
Occupation of the mother	House wife	293	57.7%
	Government employ	31	7.5%
	Private business	33	8%
	Student	3	0.7%
	Farmer	29	7%
	Daily labor	79	19.1%
Does parents live together	Yes	385	93%
	No	29	7%
Family income	≤1999 ETB	149	36
	2000-3499 ETB	189	45.7
	≥3500ETB	76	18.4

Maternal and child factors

The mean and standard deviation of children's weight and height were 10.2±2.9 kg and 78.4±12.4 cm, respectively. The majority (58.2%) of children didn't have a history of upper respiratory tract infection (URTI), and 34.1% of children didn't take immunization at all. Over two-thirds of children (70.5%) were exclusively breastfeed in the first six months, 29% of children took Vitamin A in the last months, and 4.1% of children had severe wasting. Only 3.4% of children had parents with chronic illness, 59.4% of mothers took iron folate, 64.5% of mothers took extra food during pregnancy, and 4.1% of mothers had sexually transmitted infections (STI) during pregnancy (Table 2).

Table 2

Maternal and child factors of acute lower respiratory tract infections among under-five children attended at WSUTRH, 2019(n=414)

Variable N=414	Categories	Frequency (N)	Percent %
History of URTI within 2 weeks	Yes	173	41.8%
	No	241	58.2%
Immunization	Immunized	232	56%
	Incomplete	41	9.9%
	Not vaccinated	141	34.1%
Breast feeding in the first 6 months (current for <6 months)	Exclusive breast feeding	292	70.5%
	Non-exclusive/ replacement feeding	122	29.5%
Vitamin A supplementation	Yes	120	29%
	No	250	60.4%
	Not eligible	44	10.6%
Nutritional status of the child	Sever acute malnutrition	17	4.1%
	Moderate acute malnutrition	30	7.2%
	Mild/normal	367	88.7%
Parental chronic illness	Yes	14	3.4%
	No	400	96.6%
Maternal iron folate intake	Yes	246	59.4%
	No	168	40.6%
Take extra meal during pregnancy	Yes	267	64.5%
	No	147	35.5%
STI during pregnancy	Yes	17	4.1%
	No	397	95.9%

Environmental factors

Half of the respondents (49.5%) had a family size of ≤ 4 people, there was a smoker in 6% of the households, and 82.4% of children were cared for by their mothers. The majority of households (67.4%) had a separate kitchen, 71% of cooking areas had windows, and 76.2% of households used unclean fuel for cooking (Table 3).

Table 3
Environmental factors of acute lower respiratory tract infections among under-five children attended at WSUTRH, 2019(n=414)

Variable N=414	Categories	Frequency (N)	Percent %
Family size	≤4	205	49.5%
	≥5	209	50.5%
Is there smoker in the house	Yes	25	6%
	No	389	94%
Who give care for the child	Mother	341	82.4%
	House maker	73	17.6%
Is there separate kitchen	Yes	279	67.4%
	No	135	32.6%
Does the cooking area(kitchen) had window	Yes	294	71%
	No	120	29%
Main household fuel type	Unclean fuel	357	76.2%
	Clean fuel	57	13.8%

Prevalence of acute lower respiratory tract infections

The prevalence of ALRTIs was 40.3% (95%CI: 35.7%-44.9%), and pneumonia accounts for 90.4% of the diagnosis (Fig 1 & 2).

Factors associated with acute lower respiratory tract infections

In the bivariate analysis, parents living together, history of URTI, vaccination status, breastfeeding in the first six months, a person who cared for the child, main cooking fuel type, a smoker in the house, a separate kitchen, a window for the kitchen, and nutritional status of the child were factors those had a p-value <0.2. Variables that had a p-value of < 0.2 in the bivariate analysis were further analyzed using multivariate logistic regression. The result of this analysis showed that immunization status, breastfeeding in the first six months, main cooking fuel, separate kitchen, and window for the kitchen were significantly associated variables with ALRTIs.

Unvaccinated children were 2 times more likely to be affected by ALRTIs compared with immunized children ($p = 0.003$, AOR = 2, 95%CI: 1.27-3.16). Non-exclusively/replacement feeding children were 1.85 times more likely to be affected by ALRTIs compared with exclusively breastfeeding children ($p = 0.008$, AOR = 1.85, 95%CI: 1.18-2.91). Similarly, children living in households mainly cooking with unclean fuel had 2.12 times higher odds of developing ALRTIs compared with children living in houses mainly cooking with clean fuel ($p = 0.031$, AOR = 2.12, 95%CI: 1.07-4.19). Additionally, the absence of a separate kitchen had 1.7 times higher odds of ALRTIs in children than having a separate kitchen ($p = 0.021$, AOR = 1.7, 95%CI: 1.09-2.65). Finally, children lived in households which had no window in the cooking room (kitchen) were 1.69 times more likely to be affected by ALRTIs compared with those children lived in houses which had a window in the cooking room (kitchen) ($p = 0.025$, AOR = 1.69, 95%CI: 1.07-2.68).

Table 4
Factors associated with acute lower respiratory tract infections among under five children attended at WSUTRH, 2019(n=414)

Variables	Acute lower respiratory tract infection		COR(95%CI)	AOR(95%CI)	P-value	
	Yes	No				
Parents live together	Yes	151 (36.5%)	234 (56.5%)	1	1	
	No	16(3.9%)	13 (3.1%)	1.9(0.9, 4.1)	2.22(0.99-5.01)	0.054
History of URTI	Yes	81 (19.6%)	92 (22.2%)	1.59(1.07,2.36)	1.44(0.94-2.21)	0.095
	No	86 (20.8%)	155 (37.4%)	1	1	
Immunization status	Immunized for age	80 (19.3%)	152 (36.7%)	1	1	
	In completed	16(3.9%)	25 (6%)	1.22(0.61,2.41)	1.12(0.54-2.35)	0.762
	Not vaccinated	71(17.1%)	70(16.9%)	1.93(1.26,2.95)	2(1.27-3.16)*	0.003
Breast feeding	Exclusive BF	104 (25.1%)	188 (45.4%)	1	1	
	Non-exclusive BF/ replacement	63 (15.2%)	59 (14.3%)	1.93(1.26,2.96)	1.85(1.18-2.91)*	0.008
Who care for the child	Mother	131(31.6%)	210(50.7%)	1	1	
	Home maker	36 (8.7%)	37 (8.9%)	1.56(0.94, 2.59)	1.64(0.95-2.84)	0.078
Main cooking fuel	Unclean fuel	153 (36.9%)	204 (49.3%)	2.3(1.22-4.36)	2.12(1.07-4.19)*	0.031
	Clean fuel	14 (3.4%)	43 (10.4%)	1	1	
Smoker in the house	Yes	14(3.4%)	11 (2.7%)	1.96(0.9, 4.44)	1.81(0.75-4.33)	0.185
	No	153(36.9%)	236(57%)	1	1	
Separate kitchen	Yes	100 (24.2%)	179 (43.2%)	1	1	
	No	67 (16.2%)	68 (16.4%)	1.76(1.16,2.68)	1.7(1.09-2.65)*	0.021
Window for the kitchen	Yes	104 (25.1%)	190 (45.9%)	1	1	
	No	63 (15.2%)	57 (13.8%)	2(1.3, 3.1)	1.69(1.07-2.68)*	0.025
Nutritional status	SAM	10 (2.4%)	7 (1.7%)	1.7 (0.65, 4.57)	2.54(0.88-7.39)	0.087
	MAM	12 (2.9%)	18 (4.3%)	1.17 (0.55,2.48)	1.15(0.5-2.61)	0.747
	Mild/normal	145 (35%)	222 (53.6%)	1	1	

Discussion

This study showed that the prevalence of ALRTIs among children who attended at WSUTRH was 40.3% (95%CI: 35.7%-44.9%). The finding of this research is comparable with the demographic and health survey report of Congo (39.8%) and Gabon (38.1%)[12]. However, this finding is higher compared with studies conducted in South West, Ethiopia(28.1%)[22], Wondo Genet district, Ethiopia (33.5%)[21], the overall ALRTIs of sub-Saharan Africa (25.3)[12], the Rio Grande do Sul State, Brazil(23.9%)[29], Rwanda (5%)[13]. The possible reason might be the difference in the study setting and type of lower respiratory tract infection included. This study was conducted in a health facility and includes other ALRTIs in addition to pneumonia. But the above studies were conducted in a community setting or include only pneumonia, which will result in a lower prevalence.

In this study, unvaccinated children were 2 times more likely to be affected by ALRTIs compared with vaccinated for age children. Widespread immunizations have been related to the decline of the LRTIs in children [3, 30, 31]. Similar findings were reported from studies in Gamo Gofa Zone, Ethiopia[22], Southern Ethiopia [23], and a systematic review and meta-analysis from the UK[32].

Non-exclusive breast/replacement feed children were 1.85 times more likely to be affected by ALRTIs compared with exclusively breastfeeding children. Breast milk contains antibodies that help children fight viruses and bacteria. Additionally, children who are breastfed exclusively for the first six months had a lower risk of acute otitis media, lower respiratory tract infections, gastroenteritis and diarrhea, and asthma [33, 34]. Other studies conducted in Northwest Ethiopia[24], Achefer district, Ethiopia[35], Kersa district, Ethiopia[25], Gamo Gofa Zone, South West of Ethiopia[22], Southern Ethiopia[23], a systematic review and meta-analysis from UK[32] showed similar findings.

Children living in households mainly cooking with unclean fuel had 2.12 times higher odds of developing ALRTIs compared with children living in houses mainly cooked with clean fuel. The use of unclean fuel might produce high levels of household air pollution, including small soot particles that will penetrate deep into the lungs. Deposited particulate matters may alter airway reactivity and will affect the ability of the lungs to fight pathogens. The

exposure is high among women and young children, and as a result, it doubles the risk for childhood pneumonia [36–38]. Studies conducted in South West of Ethiopia[22], Gondar city of Ethiopia[26], Wolaita-Sodo, Ethiopia[27]and, Pakistan[39] had reported similar findings.

The absence of a separate kitchen had 1.7 times higher odds of childhood ALRTIs compared with having a separate kitchen. Cooking in the household will result in a higher level of particulate matter concentration, and young children had increased vulnerability to household air pollution due to the longer indoor stay[39]. Similar findings were observed from the study conducted in Wondo Genet district, Ethiopia [21], South West of Ethiopia[22], and Pakistan[39].

Finally, children who lived in households that had no window in the cooking room (kitchen) were 1.69 times more likely to be affected with ALRTIs compared with those children who lived in houses that had a window in the cooking room. The kitchen without a window had limited ventilation, and it will increase the exposure of pollutants, particularly for young children who spend much of their time in the kitchen with their mother. This finding is supported by studies conducted in Wolaita Sodo, Ethiopia[27], Wondo Genet district, Ethiopia[21], Gondar, Ethiopia[26], and South West of Ethiopia[22].

Limitation Of The Study

This study will be subjected to recall bias, didn't consider seasonal variation, and the diagnosis for ALRTIs was made based on physician assessment.

Conclusion

The prevalence of ALRTIs among under-five children attended at WSUTRH was 40.3%. Unvaccinated children, non-exclusive/replacement feeding, households mainly cooking with unclean fuel, absence of a separate kitchen, and absence of window in the kitchen room showed significant association with ALRTIs. Therefore, strengthening the environmental sanitation (healthy home environment) and family health (child nutrition, immunization) component of the health extension packages will have a significant contribution to the reduction of under-five ALRTIs.

List Of Abbreviations

AOR: Adjusted odds ration; ALRTIs: acute lower respiratory tract infections; BSc: Bachelors of Science; COR: crude odds ratio; LRTI: lower respiratory tract infection; MDG: millennium development goal; MSc: Masters of Science; OPD: outpatient department; SDG: sustainable development goals; SPSS: Statistical Package for Social Sciences; WSUTRH: Wolaita Sodo University teaching and referral hospital

Declarations

Ethics approval and consent to participate

Ethical clearance and approval were obtained from the Institutional Research Ethical and Review Committee of Wolaita Sodo University. An official letter was submitted, and permission was obtained from WSUTRH to conduct the research. Informed written consent was obtained from all study participants after explaining the objectives of the study in detail.

Consent for publication

Not applicable.

Availability of data and materials

Data will be available upon request from the corresponding author.

Competing interests

The authors declare that they have no competing interests.

Funding

Wolaita Sodo University had covered the cost for data collection, entry, and supervision.

Authors' contributions

BW and EA were involved in the conception, design, analysis, interpretation, and report and manuscript writing. YA and ZM have participated in the design, analysis, interpretation, and report and manuscript writing. All authors have read and approved the final manuscript.

Authors' information

Birhanu wondimeneh Demissie is an assistant professor in the Department of Paediatrics and Neonatal Nursing, College of Medicine and Health Science, Wolaita Sodo University, Wolaita Sodo, Ethiopia

Esayas Aydiko is a lecturer in the Department of Pediatrics and Neonatal Nursing, College of Medicine and Health Science, Wolaita Sodo University, Wolaita Sodo, Ethiopia.

Yibeltal Asmamaw Yitayew is a lecturer in the Department of Paediatrics and Child Health Nursing, College of Medicine and Health science, Wollo University, Dessie, Ethiopia

Zemen Mengesha Yalew is a lecturer in the Department of Comprehensive Nursing, College of Medicine and Health science, Wollo University, Dessie, Ethiopia

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Figures

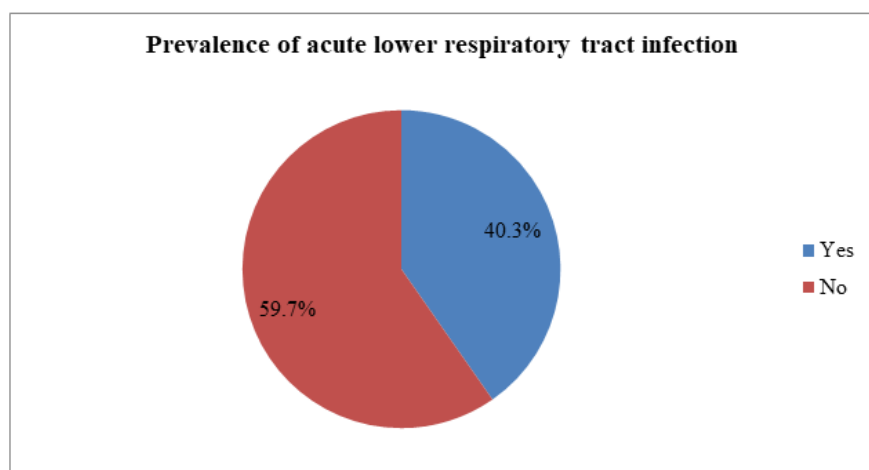


Figure 1

Prevalence of acute lower respiratory tract infections among under-five children attended at WSUTRH, 2019(n=414)

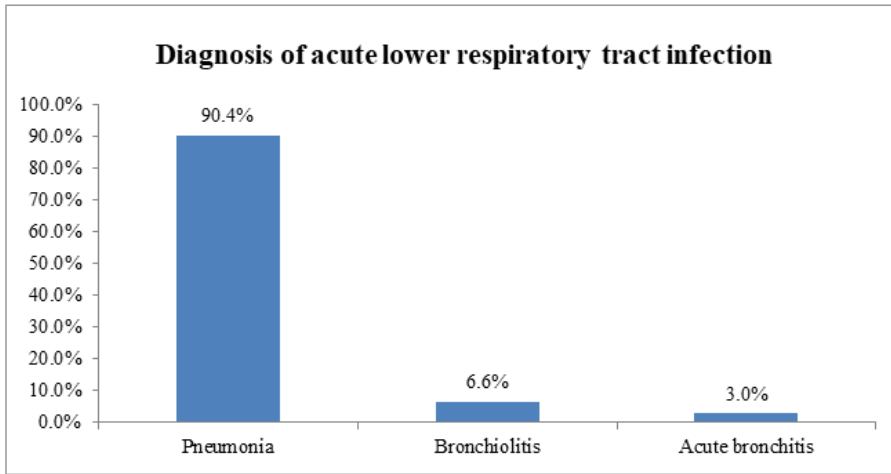


Figure 2

Diagnosis of acute lower respiratory tract infections among under-five children attended at WSUTRH, 2019(n=414)