DOI: 10.7860/JCDR/2018/31150.11506

Risk Factors of Community Acquired Pneumonia among Adults in Tigray, Ethiopia: A Case-control Study

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ABSTRACT

Introduction: Community Acquired Pneumonia (CAP) is an acute disease which represents a common cause of hospital admission and mortality. However, little is known about the risk factors and other related issues in sub-Saharan Africa including Ethiopia.

Aim: To identify the risk factors of community acquired pneumonia among adults in Tigray, Ethiopia.

Materials and Methods: Unmatched case-control study design was used and 120 cases and 240 controls were participated. Cases were patients with CAP, while controls were patients without the problem. A questionnaire was used to collect the data and analysed by SPSS version 20.0. Associations between variables were determined using bivariate and multivariable logistic regression analysis. Odds Ratios (OR) with 95% confidence interval was calculated to measure the strength of associations.

Result: The results revealed that working in a dusty environment {OR (95% CI); 2 (1.1, 4.1)}, history of respiratory infection {OR (95% CI); 2.3 (1.5, 5.7)}, contact with people who had respiratory infection {OR (95% CI); 2.5 (1.2, 5.3)} and previous history of pneumonia confirmed by radiograph {OR (95% CI); 39 (19.4, 78.6)} were significantly associated variables to CAP.

Conclusion: The common risk factors of CAP included working in a dusty environment, having a history of pneumonia, history of respiratory infection and having contact with people who had respiratory infections as seen in this study. Hence, measures have to be taken to prevent and properly treat the problem.

Keywords: Common risk factors, Determinants, Questionnaire

INTRODUCTION

Pneumonia is a disease in the lungs and it is a common cause of infection related to the mortality that challenges most of health care providers and the community [1]. CAP is widely recognised as a disease common for the elderly (age ≥65 years) and the very young (age <5 years) [2]. However, it can be potentially life threatening in the adult patients with other comorbid diseases, and with poor therapeutic interventions [3].

Globally, the fourth cause of death is Lower Respiratory Tract Infections (LRTIs) including pneumonia [4].

Another study showed that LRTIs, which include CAP, are a leading cause of mortality worldwide, causing 1.6 million deaths annually in adults aged 60 years and above [5].

In the United States (US), four million adults are affected each year of which 20% need hospitalisation for management [6]. Besides, about 50,000 adults in the US die from pneumonia disease every year [7]. Moreover, pneumonia ranks among the top three diagnoses in hospital admissions in sub-Saharan Africa [8]. Though, there is no national study about CAP in Ethiopia, one study from Tigray, regional state of Ethiopia revealed that the magnitude of CAP among adults treated in zonal and tertiary hospitals is 16% of the total population of the area [9].

For the developed countries, several risk factors are recognised for the development of CAP including old age, smoking, alcoholism, immunosuppressive conditions, and condition such as chronic obstructed pulmonary disease, cardiovascular disease, chronic liver or renal disease, diabetes mellitus and dementia [10].

On the other hand, to the best of our knowledge, inadequate measures have been taken to reduce CAP among adults in Ethiopia. The burden will be felt more acutely in the years to come due to environmental pollution, climate change and increment of older people. Hence, conducting a research on the risk factors of CAP in adults in Ethiopia can provide baseline information on the area. This study will also benefit policy makers to design prevention and control mechanisms for CAP. Also, health care professionals will gain a good knowledge on the risk factors for the development of CAP which will enable them provide health education and thus improvement of health seeking behaviour of patients, early treatment and prevention.

MATERIALS AND METHODS

This case-control study was conducted from August 2016 to October 2016 in six zonal hospitals and one tertiary hospital of Tigray region. Based on the 2007 census conducted by the Central Statistical Agency (CSA) of Ethiopia, the region has an estimated total population of 4,314,456 (2,124,853 males and 2,189,603 females), urban inhabitants account for 842,723 (19.53%) of the population. With an estimated area of 50,078.64 square kilometers, the region has an estimated density of 86.15 people per square kilometer. The region is predominantly Tegaru people with 96.55% of the population. In the region there are 712 health posts, 201 health centres and 15 hospitals (six zonal or general hospitals, one referral/tertiary and the remaining are primary hospitals). There are 3, 4, 77, 60, and 50 hospitals, health centers, medium clinics, primary clinics and specialty clinic respectively, owned by private and nongovernmental organisations [11,12].

The study design was unmatched case control. Cases included patients of CAP (having a new pulmonary infiltrate on chest radiograph plus at least one of cough, fever, hypothermia, leukocytosis, or leukopenia).

To label the cases of the study two internists in consultation with a radiologist were appointed, after history taking and diagnostic procedures like sputum, blood and X-ray examination. Controls were patients who visited the hospitals for any other reason but without CAP.

All CAP patients aged 18 years and above, in both males and females, receiving treatment during the data collection period in the government zonal hospitals and Ayder Referral Hospital were

included in the study. Those patients who had history of hospital admission 14 days before the data collection period, patients who developed pneumonia 48 hours following admission, patients with Tuberculosis (TB) or previous chest X-ray which might conflict with diagnosis of CAP, chronically debilitated patients and patients with lung cancer and asthma were excluded from the study.

The sample size for the study was calculated using two proportion formula. Assuming, 26% exposure to smoking has twice risk (OR=2) for CAP, with power of 80% and significance level of 5%, a case to control ratio of 1 to 2, the required sample size was found to be 120 cases and 240 controls [13].

A semi-structured, interviewer-administered questionnaire was adapted from different literatures and organisations [14-26].

The questionnaire included structured information on the sociodemographic characteristics, life styles and habits, medical history and environmental conditions of both cases and controls. The questionnaire was prepared in English and translated into Tigrigna, and back-translated to ensure consistency in phrasing of questions. The face and content validity of the questionnaire were done by different experts in the area.

Moreover, to assure the quality of the research the adapted questionnaire was prepared using a simple and easily understandable language. Standardisation on translation was given emphasis during training. A pre-test was conducted on 10% of the study subjects to evaluate the completeness and consistency of the tools. Moreover, the stability of the measures, internal consistency of the measurement instrument, and inter-rater reliability of the instrument were assessed to maintain the higher levels of reliability of the study. Accordingly, appropriate modification and corrections were made.

Data collectors and supervisors involved were nurses and health officers. Training was given for the data collectors and supervisors for three days on the objective of the study, data collection tools and procedures to ensure consistency of interviewing and high-quality data.

At the end of every data collection day, each questionnaire was examined and necessary feedback was given to the data collectors and supervisor. Data entry was carried out using Epi info 2002 by an experienced data entry clerk with close supervision by the principal investigator. Data cleaning was done by the principal investigator and the finalised questionnaire was kept locked in a secured cabinet.

Ethical clearance was obtained from Institutional Review Board (IRB) of Addis-Ababa University, College of Health Sciences. Letter of agreement was secured from Tigray regional health bureau. All participants were informed about the purpose of the study and an individual written informed consent was solicited from the selected respondents at the time of data collection, the data collectors and the principal investigator were blinded about the cases and controls of CAP, only the physicians in charge were aware of the distribution because they were to provide all necessary management in relation to CAP. Respondents were not identified by name; they were also informed that they had the right of participation and to withdraw any time they like during the study. Furthermore, health education about prevention and treatment of CAP had been provided.

STATISTICAL ANALYSIS

After cleaning the data, it was exported from Epi info 2002 to SPSS version 20.0 for analysis. Frequency tables, graphs and proportions were used to present the results. In addition, the associations between the exposure and outcome variables were determined using bivariable and multivariate logistic regression analysis. Odds ratios with 95% confidence intervals and p-value were calculated to measure the strength of associations.

RESULTS

Community Acquired Pneumonia by Sociodemographic Characteristics Factors

Among the sociodemographic variables, age and education are significantly associated factors in the two sample t-test analysis and univariate logistic regression analysis: Mean difference is observed among the cases and controls based on their age, t(df), p, (t(358)= -2.2, p=0.03). Moreover, those with no formal educational status were 1.8 times more likely to develop community acquired pneumonia as compared to those who are educated, OR (95% CI), 1.8 (1.1,2.8) [Table/Fig-1].

Characteristics		Cases n=120 (%)	Controls n=240 (%)	COR (95%CI), t(df), p-value
Age in years (mean±SD)	Uncategorised	37.2±14.4	33.8±13.6	t(358)= -2.2, 0.03**
Sex	Male	56 (46.7)	130 (54.2)	1.3 (0.87,2.1), 0.31
	Female	64 (53.3)	110 (45.8)	1
Level of education	No formal education	49 (40.8)	67 (27.9)	1.8 (1.1,2.8), 0.02**
	Educated	71 (59.2)	173 (72.1)	1
Marital status	Single	41 (34.2)	99 (41.3)	2.4 (0.93, 6.23), 0.25
	Currently married	62 (51.7)	120 (50)	1.9 (0.76, 4.89), 0.39
	Divorced	7 (5.8)	11 (4.6)	1.5 (0.43, 5.71), 0.95
	Widowed	10 (8.3)	10 (4.2)	1
Number of people live in a household	One	13 (10.8)	32 (13.3)	0.79 (0.39,1.5), 0.79
	More than one	107 (89.2)	208 (86.7)	1
Number of people use/sleep in a single room	One	17 (14.2)	49 (20.4)	0.64 (0.35,1.2), 0.18
	Two and above	103 (85.8)	191 (79.6)	1
Presence of windows in the room	No	7 (5.8)	13 (5.42)	1.1 (0.42, 2.8), 0.67
	Yes	113 (94.2)	227 (94.58)	1
BMI	Uncategorised	20.99±2.965	21.45±2.782	t(358)= 1.5, 0.15

[Table/Fig-1]: Community acquired pneumonia by sociodemographic characteristics, 2016 (n=360).
SD: Standard deviation; COR: Crude odds ratio, CI: Confidence interval, df: degree of freedom; BMI: Body mass index; p-value is significant at <0.05

Community Acquired Pneumonia by Lifestyle and Habits

None of the lifestyle or habit related variables were associated with CAP in the univariate logistic regression analysis [Table/Fig-2].

Lifestyle/Habit	Category	Cases n=120 (%)	Controls n=240 (%)	COR (95%CI), p-value
Currently smoke products containing tobacco	Yes	7 (5.8)	12 (5)	0.85 (0.32,2.22), 0.88
	No	113 (94.2)	228 (95)	1
Ever consumed an alcoholic drink	Yes	92 (76.7)	179 (74.6)	0.89 (0.53, 1.49), 0.81
	No	28 (23.3)	61 (25.4)	1
Involved in vigorous-intensity activities that cause major increase in breathing or heart rate	Yes	32 (26.7)	68 (28.3)	1.08 (0.66, 1.78), 0.66
	No	88 (73.3)	172 (71.7)	1
Involved in moderate-intensity activity, that cause minor increase in breathing or heart rate	Yes	42 (35)	85 (35.4)	1.02 (0.64, 1.61), 0.31
	No	78 (65)	155 (64.6)	1
Walk or use a bicycle (pedal cycle) for at least 10 minutes continuously to travel	Yes	111 (92.5)	222 (92.5)	1.0 (0.43, 2.29), 0.52
	No	9 (7.5)	18 (7.5)	1
Involved in any vigorous-intensity sports, fitness or recreational (leisure) activities that cause major increase in breathing or heart rate	Yes	15 (12.5)	34 (14.2)	1.15 (0.60, 2.22), 0.71
	No	105 (87.5)	206 (85.8)	1
Involved in any moderate-intensity sports, fitness or recreational (leisure) activities that causes a small increase in breathing or heart rate	Yes	12 (10)	43 (18)	0.51 (0.26, 1.0), 0.45
	No	108 (90)	197 (82)	1

[Table/Fig-2]: Community acquired pneumonia by lifestyle and habits of study participants (n=360).
COR: Crude odds ratio; CI: Confidence interval; p-value is significant at <0.05

Community Acquired Pneumonia by Medical History

According to the univariate logistic regression analysis, those who had upper air way problem were two times more likely to develop CAP as compared to their counter parts, COR (95% CI), 2.1 (1.3,3.3). Likewise, the odds of developing CAP among those who had history of tonsillectomy was 3.4 as compared to those who did not have same history, COR (95% CI), 3.4 (1.1,10.5). On the other hand, those who had contact with persons who had respiratory infection were 2.6 times more likely to develop CAP as compared to their counterparts, COR (95% CI), 2.6 (1.5,4.6). Moreover, the odds of developing CAP among those who had history of confirmed pneumonia was 34 as compared to those who did not have confirmed pneumonia COR (95% CI), 34 (17.9, 64.6). Those who had history of pulmonary tuberculosis were two times more likely to develop CAP as compared with those who did not have same history, COR (95% CI), 2.2 (1.1,4.4) [Table/Fig-3].

Community Acquired Pneumonia by Environmental Factors

Those who had history of contact with pets were 1.7 times more likely to develop CAP as compared to their counter parts, OR (95% CI),1.7 (1.1, 2.7). Likewise, the odds of developing CAP among those who had history of working in dusty environment was 1.8 as compared to those we didn't have same history, COR (95% CI),1.8 (1.2,2.8) [Table/Fig-4].

History	Category	Cases n=120 (%)	Controls n=240 (%)	COR (95%CI), p-value
Have been admitted to a hospital in the last five years	Yes	51 (42.5)	86 (35.8)	0.75 (0.48, 1.18), 0.72
	No	69 (57.7)	154 (64.2)	1
Have been bedridden in a hospital in the last three months	Yes	26 (21.7)	43 (18)	0.78 (.45, 1.36), 0.84
	No	94 (78.3)	197 (82)	1
Have had upper air respiratory tract infection in the past year	Yes	71 (59.2)	98 (40.8)	2.1 (1.3, 3.3)**, 0.001
	No	49 (40.8)	142 (59.2)	
Have a history of tonsillectomy	Yes	8 (6.7)	5 (2.1)	3.4 (1.1, 10.5)**0.03
	No	112 (93.3)	235 (97.9)	1
Have had a dental problem last month	Yes	11 (9.2)	30 (12.5)	1.41 (0.68, 2.93), 0.52
	No	109 (90.8)	210 (87.5)	1
Have received a vaccination for influenza	Yes	0 (0)	1 (0.4)	0.0 (0.0), 0.93
	No	120 (100)	239 (99.6)	1
Have received a vaccination for any respiratory infection last year	Yes	2 (1.7)	6 (2.5)	0.6 (0.1, 3), 0.26
	No	118 (98.3)	234 (97.5)	1
Have had any respiratory infection last year	Yes	59 (49.2)	51 (21.3)	3.6 (2.2, 5.8), 0.001**
	No	61 (50.8)	189 (78.7)	1
Have been in contact with people who had a respiratory infection	Yes	32 (26.7)	29 (12.1)	2.6 (1.5, 4.6), 0.02**
	No	88 (73.3)	211 (87.9)	1
Previous history of pneumonia confirmed by radiograph	Yes	85 (70.8)	16 (6.7)	34 (17.9, 64.6), 0.01**
	No	35 (29.2)	224 (93.3)	1
History of diabetes	Yes	8 (6.7)	18 (7.5)	1.13 (0.48, 2.69), 0.90
	No	112 (93.3)	222 (92.5)	1
History of cardiopathy	Yes	9 (7.5)	23 (9.6)	1.3 (0.58, 2.92), 0.42
	No	111 (92.5)	217 (90.4)	1
History of chronic bronchitis	Yes	4 (3.3)	13 (5.4)	0.6 (0.2, 1.9), 0.90
	No	116 (96.7)	227 (94.6)	1
History of diagnosed asthma	Yes	5 (4.2)	18 (7.5)	1.86 (0.67, 5.15), 0.23
	No	115 (95.8)	222 (92.5)	1
History of pulmonary tuberculosis	Yes	18 (15)	18 (7.5)	2.2 (1.1, 4.4), 0.02**
	No	102 (85)	222 (92.5)	1
History of gastric diseases	Yes	61 (50.8)	129 (53.8)	0.9 (0.6, 1.4), 0.42
	No	59 (49.2)	111 (46.2)	1
History of chronic liver disease	Yes	4 (3.3)	7 (2.9)	1.1 (0.3, 4.0), 0.32
	No	116 (96.6)	233 (97.1)	1

[Table/Fig-3]: Community acquired pneumonia by medical history of study participants, (n=360).
COR: Crude odds ratio; CI: Confidence interval; p-value is significant at <0.05

In the multivariable logistic regression model, we included variables that were significantly associated with CAP at the univariate analysis, and found that only four of the variables were having statistically significant association with CAP. As shown in [Table/Fig-5], the odds of developing CAP among those working in a dusty environment

Variable	Category	Cases n=120 (%)	Controls n=240 (%)	COR (95% CI), p-value
History of contact with children	Yes	93 (77.5)	175 (73)	1.2 (0.8, 2.1), 0.63
	No	27 (22.5)	65 (27)	1
History of contact with birds	Yes	32 (26.7)	51 (21.2)	1.4 (0.8, 2.2), 0.81
	No	88 (73.3)	189 (78.8)	1
History of contact with animals	Yes	42 (35)	82 (34.2)	1 (0.7, 1.6), 0.06
	No	78 (65)	158 (65.8)	1
History of contact with pets	Yes	70 (58.3)	107 (44.6)	1.7 (1.1, 2.7), 0.001**
	No	50 (41.7)	133 (55.4)	1
History of working in a dusty environment	Yes	73 (60.8)	111 (46.3)	1.8 (1.2, 2.8), 0.001**
	No	47 (39.2)	129 (53.7)	1
Use of cooking fuel	Electric stove	16 (13.3)	48 (20)	1
	Wood	67 (55.8)	118 (49.2)	1.3 (0.62, 2.74), 0.20
	Electric, coal and wood	13 (10.8)	19 (7.9)	0.76 (0.43, 1.35), 0.40
	Electric, coal and kerosene	24 (20)	55 (22.9)	0.64 (0.27, 1.49), 0.35

[Table/Fig-4]: Community acquired pneumonia by environmental factors of study participants, (n=360).
COR: Crude Odds Ratio, CI: Confidence Interval, p-value is significant at <0.05

Variable	Category	Cases n=120 (%)	Controls n=240 (%)	AOR (95%CI), p-value
Age	Uncategorized			0.9 (0.9,1.0), 0.57
Educational level	No formal edu	49 (40.8)	67 (27.9)	1.7 (0.8,3.9), 0.14
	Educated	71 (59.2)	173 (72.1)	1
Contact with pets	Yes	70 (58.3)	107 (44.6)	1.3 (0.7,2.4), 0.34
	No	50 (41.6)	133 (55.4)	1
History of working in a dusty environment	Yes	73 (60.8)	111 (46.3)	2.0 (1.1,4.1), 0.026**
	No	47 (39.2)	129 (53.7)	1
Had upper air way problem last year	Yes	71 (59.2)	98 (40.8)	1.6 (0.8,3.2), 0.29
	No	49 (40.8)	142 (59.2)	1
Had history of tonsillectomy	Yes	8 (6.7)	5 (2.1)	0.7 (0.14, 3.3),0.62
	No	112 ((93.3)	235 (97.9)	1
Have had any respiratory infection last year	Yes	59 (49.2)	51 (21.3)	2.3 (1.5,5.7), 0.001**
	No	61 (50.8)	189 (78.7)	1
Have a history of contact with people who had respiratory infection	Yes	32 (26.7)	29 (12.1)	2.5 (1.2,5.3), 0.017**
	No	88 (73.3)	211 (87.9)	1
Have had pneumonia confirmed by radiograph	Yes	85 (70.8)	16 (6.7)	39 (19.4,78.6), 0.001**
	No	35 (29.2)	224 (93.3)	1
History of pulmonary tuberculosis	Yes	18 (15)	18 (7.5)	0.9 (0.3,2.6), 0.87
	No	102 (85)	222 (92.5)	1

[Table/Fig-5]: Potential risk factors for community acquired pneumonia among the study participants (n=360).
AOR: Adjusted odds ratio, CI: Confidence interval, p-value is significant at <0.05

was two times higher as compared to their counterparts {AOR=2.0, 95% CI 1.1-4.1)}, the odds of developing CAP among those who had history of contact with people who had respiratory infection was 2.5 times higher as compared to those who did not have history of contact {AOR=2.5, 95% CI 1. 2-5.3}, those who had history of respiratory infection were about twice more likely to develop community acquired pneumonia than those who did not have the same history {AOR=2.3, 95% CI 1.5-5.7} and the odds of developing pneumonia among those who had history of pneumonia confirmed by radiography was 39 times higher compared to those who had not {AOR=39, 95% CI 19.4-78.6} [Table/Fig-5].

DISCUSSION

The study has attempted to determine potential risk factors for CAP in the hospital setting of Tigray region in Ethiopia.

Present finding showed no significant association between smoking and CAP, while other studies conducted in different countries reported that smoking as one risk factor for the development of community acquired pneumonia [14-20]. Perhaps, only few (n=19) of present study participants reported to have been smokers which may be a small number to give a significant information.

Although, some studies have reported that alcohol consumption as being a risk factor for developing CAP, present study showed no significant association between alcohol consumption and CAP [20-22]. Similar to present study, there are findings that revealed alcohol consumption is not a risk factor for CAP [14,15,18,19]. This could be justified by difference in the number of alcohol users, type, amount and frequency of the alcohol consumption.

Having a history of respiratory infections and contact with people who had respiratory infection were found to be risk factors for the development of CAP which was in line with Almirall J et al., Almirall J et al., Teepe J et al., Antoni T et al., Rose RM et al., and Schoor M et al., [14,17,18,20,23,24]. Similar to previous findings by Almirall J et al., Almirall J et al., Shcnoor M et al., Hedlund J et al. and Hedlund J, the current study showed that patients with a history of pneumonia confirmed by radiograph had higher risk of a subsequent CAP [14,17,24-26].

In line with a study from Great Britain, working in a dusty environment was identified in present study as one of the major risk factors of community acquired pneumonia [15]. However, contrary results were also reported by others [17]. This dissimilarity could be because of different working environment, difference in exposure and the nature of the dust.

History of diabetes and heart disease were not significantly associated with CAP in this study, which was also reported by many other studies [14-16,21], however, other studies from different countries reported that heart disease and diabetes being significant risk factors for CAP [15,17,20]. These differences may be due to that many of our respondents might have not known their status or not diagnosed for diabetes and heart diseases.

Chronic bronchitis, diagnosed asthma and pulmonary TB were not associated with CAP in the current study as was also reported by others [14,16]. However, findings by Almirall J et al., Farr BM et al., Almirall J et al., and Teepe J et al., showed that chronic bronchitis, diagnosed asthma and pulmonary TB are risk factors for community acquired pneumonia among adults [14,15,17,18].

Similar to a finding by Schnoor M et al., contact with birds and pets were not significantly associated with CAP when adjusted by other variables in the present study [24], but Almirall J et al., reported that contact with birds and pets as being a risk factor for the development of CAP [17].

LIMITATION

Since, the present study is hospital based it might not be generalised to the whole community in the region. In addition, there

might be selection bias as the cases in the study had been enrolled continuously until the required sample size was met. Moreover, there might be a recall bias of the exposures in the controls as the cases might be able to recall the exposures in a better way.

CONCLUSION

In conclusion, working in a dusty environment, having a history of pneumonia, history of respiratory infection and having contact with people who had respiratory infections are confirmed as the risk factors of community acquired pneumonia in the current study. Hence, much has to be done to prevent community acquired pneumonia through health education and awareness raising interventions. On the other hand, to minimise the risk of developing community acquired pneumonia safety measures like personal protective equipments should be used when there is contact with patients having respiratory tract infections.

Whenever respiratory tract infections including pneumonia occur, proper management using standardised treatment guideline should be given so that subsequent infections or complications could be minimised. Moreover, larger studies are also needed to assess the effect of some risk factors in the general population.

ACKNOWLEDGEMENTS

We would like to extend our gratitude to Mekelle University and Addis Abeba University for funding the study, Tigray Health Bureau and zonal hospitals administration bodies, the study participants, data collectors, supervisors.

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FINANCIAL OR OTHER COMPETING INTERESTS: None.

Date of Submission: **Jun 26, 2017**
Date of Peer Review: **Aug 09, 2017**
Date of Acceptance: **Mar 05, 2018**
Date of Publishing: **May 01, 2018**