

Microbiology of lower respiratory tract infection in workers of garment industry of Kathmandu

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ABSTRACT

OBJECTIVES

This study was designed with the objectives of describing the distribution pattern of microorganisms responsible for causing LRTI in the workers of garment industries.

MATERIALS AND METHODS

A total of 198 cases of suspected person of Lower Respiratory Tract infection (LRTI) were included in this study. This study was conducted between November 2009 to April 2010. Specimen for the study was expectorated sputum. Gram-stain, Ziehl-Neelsen stains and culture were performed.

RESULTS

On direct microscopic examination, 20.51% were Gram positive bacteria, 79.48% were Gram negative bacteria and 4% were smear positive AFB. On culture sensitivity examination, 22% percent showed growth of different bacteria in different culture media. The bacteria isolated from the samples included *Klebsiella pneumoniae* (15.38%), *Proteus mirabilis* (15.38%) and *Citrobacterfreundii* (15.38%). Gram Negative bacteria were found most susceptible to Ciprofloxacin (92.30%, 24/26) and Amikacin (92.30%, 24/26). Similarly, Gram Positive bacteria were found most susceptible to Ciprofloxacin (100%, 8/8) followed by Cloxacillin and Cephalexin (87.5%, 7/8). Smear positive AFB was significantly associated with not using the protective measures (mask) by workers and presence of symptoms (cough for more than two weeks, night sweat, hemoptysis and anorexia) ($p=0.031$). Culture positivity was significantly associated with symptoms like production of purulent sputum ($p=0.045$).

CONCLUSION

There was insignificant association between LRTI and risk factors present in working room of garment industries. Most of the isolates were sensitive to Ciprofloxacin and resistance to Ampicillin and Cephalexin.

Key Words: Lower respiratory tract infection, Garment industries, Sputum and antibiotic susceptibility

INTRODUCTION

Lower respiratory tract infection (LRTI) is defined as the inflammation of the respiratory tract starting from the trachea to the alveoli and subsequent multiplication of an infectious agent.¹ Predisposing factors for LRTI are malnutrition, breast feeding and vitamin A deficiency, increased frequency of low birth weight and prematurity, smoking and alcohols, viral infections, high-risk age groups (children younger than 5 years and adults older than 55-65 years), air pollution and occupational exposure host-related risk factors such as immunosuppression, diabetes, drug therapy, conditions associated with decreased pulmonary clearance functions like asthma, chronic bronchitis, chronic obstructive pulmonary disease etc.² Common causes of community acquired LRTI include *Streptococcus pneumoniae*, *Haemophilus influenzae*, *Mycoplasma pneumoniae*, *Moraxella catarrhalis*, *Chlamydia* spp, *Legionella* spp, *Staphylococcus aureus*, *Klebsiella pneumoniae*, *Mycobacterium* spp, viruses and fungi.³

Occupational diseases are usually defined as diseases arising out of or in the course of employment. They may be grouped as diseases due to physical agents, chemical agents and biological agents.² Among the many types of industries present in Nepal, the manufacturing of carpet is presently leading and occupying 54% of the total export commodity. Untrained manpower, substandard machinery, lack of quality control, lack of health awareness among the workers has direct impact on health of the workers. Frequent respiratory tract infection, skin diseases, sexually transmitted diseases and industrial accidents are some of the health problems noted among the workers of garment industry. People exposed to organic dusts may have a high prevalence of respiratory tract

symptoms which are related to dust exposures and smoking habits.⁴

Acute respiratory infections (ARI) are one of the most important causes of morbidity and mortality throughout the world. Globally, about 4.2 million ALRI deaths are estimated to occur among all age groups.⁵ According to the report of Ministry of Health, Government of Nepal, 3.4% of morbidity is caused by acute RTI. Although occupational safety and health is very important issue at an individual, social and national level, it has not received much attention so far in Nepal. Therefore present study has been designed with an objective to describe distribution pattern and risk factors of LRTI in workers population of garment industries of Kathmandu. Furthermore, antimicrobial susceptibility testing of bacterial isolates has also been described. The study possibly highlights importance of screening of LRTI in workers of garment industry.

METHODS

It was a case control study comprising 198 cases of garment factory workers carried from November 2009 to April 2010. This study was conducted to find out the bacteriological profile and antibiotic susceptibility pattern of isolated bacteria. The study populations were the persons working in seven different garment industries of Kathmandu Valley. Samples were allocated to each center according to population proportionate to its size. We assigned an identification number to the study population starting from one, in an increasing order. First respondent was selected randomly in each center. The other participants were selected in a systematic manner, excluding two persons who lied in consecutive order between two respondents. Consent was taken from individuals for study. All individuals with or without complaint of lower respiratory tract infections were selected purposefully from garment

industries. Information was recorded, by interviewing through a structured questionnaire. Working environment was observed for ventilation, presence of air pollution and adequate passage of light etc were recorded in structured questionnaire. Expecterated morning sputum of individuals was taken as specimen. Triplicate specimen were collected from each individual. Laboratory methods included were macroscopic examination, Microscopic examinations, Cultural examinations, Ziehl-Neelsen staining technique and Antibiotic susceptibility testing. Culture was done on 5% Blood agar (BA), 5% chocolate agar, Mac Conkey agar and Nutrient agar (NA). The isolated bacteria were identified using morphological, microscopy and biochemical tests following standard procedures. Bile solubility and optochin sensitivity tests were performed for the suspected pneumococcal colonies from blood agar. For identification of *H. influenza*, Satellitism Test and identification discs having X and V factor were used. Finally, data management and analysis was done using SPSS 16 version.

RESULTS

From total study population (198), 39.53% (17/43) of males and 60.46% (26/43) of females were sputum culture positive. Workers of age below twenty years showed highest percentage (41.86%) of culture positivity. Different 11 types of bacteria were isolated (table 1), giving presence rate of 19.69% (39/198). 79.48% (31/39) of the organisms isolated were Gram negative bacteria whereas 20.51% (8/39) were Gram positive bacteria. The bacteria isolated from the samples included were *Klebsiella pneumoniae* (15.38%), *Proteus mirabilis* (15.38%), *Citrobacter freundii* (15.38%), *Moraxella catarrhalis* (12.82%),

Streptococcus pneumonia (10.25%), *Staphylococcus aureus* (10.25%), *Yersinia* spp (5.12%), *Enterobacter* spp (5.12%), *Escherichia coli* (5.12%), *Pseudomonas* spp (2.56%), and *Serratia* spp (2.56%) in order of ranking. *Haemophilus influenzae* were not found in the study population. Study population taken for the study were found to have the clinical history like chest pain (87), shortness of breath (60), fever (46), prolonged cough (51), sputum production (137), anorexia (61), night sweat (29) and hemoptysis (17). Some of the workers complained about having backache, joint pain, lower abdominal pain, cancer, old history of Tuberculosis and skin diseases. Of the total study population (198), 4% (8/198) were smear positive AFB and 96% (190/198) were smear negative AFB (figure 1) and 37.5% (3/8) of male and 62.5% (5/8) of female were smear positive AFB. Table 2 shows that smear positive AFB was significantly associated with few symptoms of LRTI (presence of cough for more than two weeks ($p=0.001$), anorexia ($p=0.047$), night sweat ($p=0.000$) hemoptysis ($p=0.000$) and not using protective measures mask ($p=0.031$) by workers. Insignificant association was obtained with risk factors such as smoking habit ($p=0.205$) and alcohol taking habit ($p=0.823$), working room environment and educational status of workers ($p=0.145$). In this study sputum samples obtained from 23 females and 15 male workers were culture positive. Significant association of culture positivity was obtained with symptoms like production of purulent sputum ($p=0.045$) and insignificant association was obtained with other symptoms like chest pain ($p=0.686$), Shortness of breath ($p=0.528$), fever ($p=0.355$) and cough for more than two weeks ($p=0.373$). Association of culture positive was insignificant with educational status ($p=0.785$), working room environment ($p=0.355$), risk

factors like smoking habit ($p=0.089$) and alcohol taking habit ($p=0.422$) and not use of protective measures mask ($p=0.649$) by workers. As shown in table 3, Gram Positive bacteria were found most susceptible to Ciprofloxacin (100%, 8/8) followed by Cloxacillin and Cephalexin (87.5%, 7/8), Erythromycin and Ampicillin (75%, 6/8) respectively. They were least

susceptible to Co-trimoxazole (62.5%, 5/8). As shown in table 4, Gram Negative bacteria were found most susceptible to Ciprofloxacin (92.30%, 24/26) and Amikacin (92.30%, 24/26) followed by Gentamicin (82.75%, 24/29), Ceftazidime (33.33%, 9/27), Cephalexin (25%, 7/28) and Ampicillin (21.42%, 6/28).

Table 1: Distribution of microbial isolates isolated in study population

Organisms	Number of cases	Percentage among corresponding bacterial isolates	Percentage among total isolates
Gram Positive Bacteria			
<i>Streptococcus pneumoniae</i>	4	50	10.25
<i>Staphylococcus aureus</i>	4	50	10.25
Total	8	100	20.51
Gram Negative Bacteria			
<i>Citrobacter freundii</i>	6	19.35	15.38
<i>Proteus mirabilis</i>	6	19.35	15.38
<i>Klebsiella pneumoniae</i>	6	19.35	15.38
<i>Moraxella catarrhalis</i>	5	16.12	12.82
<i>Yersinia</i> spp	2	6.45	5.12
<i>Enterobacter</i> spp	2	6.45	5.12
<i>Escherichia coli</i>	2	6.45	5.12
<i>Pseudomonas</i> spp.	1	3.22	2.56
<i>Serratia</i> spp.	1	3.22	2.56
Total	31	100	79.48

Figure 1: Percentage of AFB positive and AFB negative in sputum sample of study population.

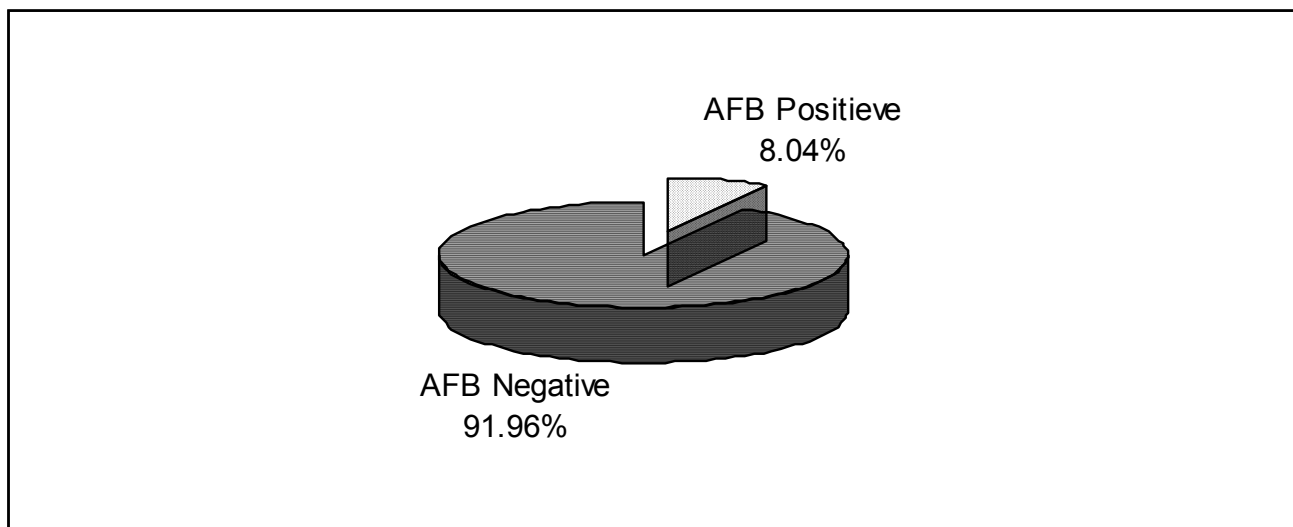


Table 2: Association of smear positive AFB with symptoms of LRTI

Symptoms	AFB		Significance (p-value)
	positive	Negative	
Cough for more than two weeks			
Yes	6	45	0.001
No	2	145	
Anorexia			
Yes	5	56	0.047
No	3	134	
Night sweat			
Yes	6	23	0.000
No	2	167	
Hemoptysis			
Yes	4	13	0.000
No	4	177	
Productive sputum			
Yes	7	130	0.252
No	1	60	
Chest pain			
Yes	6	81	0.71
No	2	109	
Shortness of breath			
Yes	3	57	0.651
No	5	133	
Fever			
Yes	2	44	0.904
No	6	146	

Table 3: Antibiotic pattern of Gram positive bacteria (n=8)

Antibiotics	Sensitive		Resistant	
	No	%	No	%
Ampicillin	6	75	2	25
Ciprofloxacin	8	100	0	0
Cephalexin	7	87.5	1	12.5
Co-trimoxazole	5	62.5	3	37.5
Erythromycin	6	75	2	25
Cloxacillin	7	87.5	1	12.5

Table 4: Antibiotic sensitivity pattern of Gram negative bacteria

Antibiotics	Sensitive		Resistant		Total
	No	%	No	%	
Ampicillin	6	21.42	22	78.57	28
Ciprofloxacin	24	92.30	2	7.69	26
Cephalexin	7	25	21	75	28
Amikacin	24	92.30	2	7.69	26
Gentamicin	24	82.75	5	17.24	29
Ceftazidime	9	33.33	18	66.66	27

DISCUSSION

This study was undertaken to find out the bacteriological profile and the sensitivity pattern of the isolates from the workers of garment industries from Kathmandu valley. In this study, respondents complained of gastritis, urinary tract infection, high blood pressure, lower abdominal pain in female, chest pain and breathing problems, mild fever at night, anorexia, hemoptysis, productive cough, body and joint pain, backache, skin diseases. Among these, the complaints like chest pain, fever, productive cough, breathing problem, hemoptysis, and anorexia were characterized as respiratory tract problems and other cases as health problems. Out of total population 22% were sputum culture positive and 78% were sputum culture negative. Among total population 39.53% male and 60.46% female were sputum culture positive. Of the total population, workers of age below twenty years showed highest percentage (41.86%) of culture positivity. According to study done in garment industries of Bangladesh, most of female workers (over 85%) suffer from malnutrition, ill health, reproductive health problem, anemia, respiratory problem, urine infection etc.⁶ Culture positivity depends on nature of sputum, transportation time and the number of organism present in the sample. Arora, et al 2001 had obtained growth in 72% cases, whereas Dalvi et al 1983 obtained growth in 57% of samples. The yield of sputum culture in this study was low (22%) comparable to other studies which report a 50% yield with sputum cultures.^{7,8} Out of the total study population 4% were AFB positive and 96 % were AFB negative. Among total population 37.5% male and 62.5 % female were AFB positive. Smear AFB positive were equally obtained (25%) in age group below 20, 30-39, 50-59 years and 12.5% in age group 20-29, 40-49 years respectively. Smear AFB positive was obtained in more

number from female in study population (Table 3). This may be because of higher percentage of malnutrition in lower class females in Nepalese context. Eleven different bacteria were isolated, giving a prevalence rate of 19.69%. This consisted of 60.46% from female workers and 39.53% from male workers. The bacteria isolated from the samples included 79.48 % (31/39) Gram negative bacteria whereas 20.51 % (8/39) were Gram positive bacteria. Incidence of *Haemophilus influenzae* was not found in study population this may be due to delayed transport of sample to laboratory which might have cause death of fastidious organism. Gram Negative Bacteria (79.48%) outnumbered the growth of Gram Positive Bacteria. Presence of Gram negative bacilli colonizing the oropharynx increases with severity of underlying respiratory alteration. The proportion of Gram-negative bacteria causing LRTIs was 79.48%, which exceeds to the 63.9% - 68.4% of a report from Germany.⁹ This study was very much related to the similar study carried by Egbagbe et al., 2006 and Christopher et al., 2010 in which *K. pneumoniae* (52.5%) was the most common organisms followed by *S. aureus* (10%). This isolation of *K. pneumoniae* as predominant organism also agreed with another study carried by Okesola et al., 2002-2005 and by Navaneeth et al., 2002. This study is in concordance with that of study carried by Eldeev et al., 2006 where *K. pneumoniae* (11.27%) was most prevalent followed by *P. aeruginosa* (6.26%) among GNB and *S. aureus* (17.71%) as the most prevalent. Similar study carried by Hidron et al., 2008 found *K. pneumoniae* as the most common pathogens. Study done in paper mill industry by Niemela et al., 1985 found that *K. pneumoniae* was responsible for most cases of LRTI. This study shows the prevalence of *K. pneumoniae* as the commonest isolate this could be due to reason

that *K. pneumoniae* is a relatively common cause of pneumonia in persons suffering from alcoholism, as alcohol intake directly inhibits the ability of lung immune cell to kill bacteria. And in this study, most of the workers were alcoholic. The smear positive AFB was insignificantly associated with all symptoms of LRTI. However, AFB was significantly associated with few symptoms of LRTI (presence of cough for more than two weeks [$p = 0.001$], anorexia [$p = 0.047$], night sweat [$p = 0.000$] and hemoptysis [$p = 0.000$]) that were present in the workers. Study carried out by Nesli et al., 1946 reported that one half of the TB patient had developed symptoms like cough, low grade fever, weight loss and fatigue, night sweat, chest pain and one-third of patient had hemoptysis. There was significant as well as insignificant association of sputum culture positivity with symptoms of LRTI in study population. Significant association was obtained in symptom like production of purulent sputum ($p = 0.045$) and insignificant association was obtained in other symptoms like chest pain, SOB, fever and cough. Smoking appears to be an important risk factor for the acquisition of a lower respiratory tract infection (bronchitis, influenza, pneumonia, and tuberculosis). In our study, smoking habit of study population was insignificantly associated with smear positive AFB and culture positivity. Though statistically association was insignificant but there was no greater difference of smear positive AFB and culture positivity cases in smokers and non-smokers in study population. Mark et al., 1982 found that 57% women were smoker and they had acute respiratory tract illness associated with smoking. Alcohol consumption is another risk factor for LRTI. Alcohol consumption is known to affect both systemic and pulmonary immunity, predisposing the patient to pulmonary infections. In study done by Thomas et al., 2006 conclude that alcohol abuse was

associated with an increased risk of LRTI. In our study, most of the respondents were alcoholic and there was insignificant association between alcohol consumption and smear positive AFB and culture positivity. By the use of preventive measures, risk of much communicable disease can be minimized. In this study, very few workers had taken preventive measures to avoid occupational dust exposures. Of the total study population, only 4 workers had used personal protective measures (Mask). Smear positive AFB was obtained in more number in workers not using protective measures mask in working place. But the association was statistically insignificant between sputum culture positivity and use of protective measures. Today, antibiotics remain the front-line therapy for conquering bacterial infections. Antimicrobial agents have provided the way for both physicians and the public perceive bacterial infections and their treatment. Different antibiotics are useful for antibacterial therapy. The therapy is guided by antibiotic susceptibility pattern of isolates. Quinolones were found to be most effective antibiotic against both GNB and GPB. *S. pneumoniae* isolates showed sensitivity to penicillins, macrolides and quinolones. In this study, most of the isolates were sensitive to the quinolones (ciprofloxacin), but poorly sensitive to ampicillin and Cephalexin. High antimicrobial resistances to ampicillin and penicillin have also been reported in France, Germany and Japan.¹⁰ The high rate of resistance to Ampicillin, Cefazidime, Cephalexin, Amikacin observed in this study may reflect the fact that these are the most commonly prescribed antibiotics in the hospital and also the most easily available for community without prescription. Thus from our study it becomes clear that antimicrobial resistance has become significant public health problem even in our set up. It is wise to control this situation before it takes a deadly shape. Following the

recommendation given by summit on antimicrobial resistance, like not indulging patient demands for untreated infection, educating patients about the proper use of antibiotics, identifying the pathogen, choosing short –course, narrow –spectrum antibiotics, completing the full course of therapy, encouraging patients to get vaccinated, improving resistance surveillance systems, will definitely help controlling this situation. Through the efforts by clinicians, microbiologist, patients and public health officials, the antimicrobial resistance can be slowed. In this way, maintenance and prolonged efficacy of existing drugs can be obtained.

CONCLUSION

Lower respiratory tract infection was seen in workers of garment industries of Kathmandu. Presence of LRTI was found more in female workers than male workers. Workers of age below 20 years showed much prevalence towards LRTI. *K. pneumoniae* was mostly predominant organism. There was insignificant association between LRTI and risk factors present in working room of garment industries. Smoking and alcohol taking habits of workers were also insignificantly associated with LRTI. But association was significant between smear positive AFB and not using the protective measures (mask). Most of the isolates were sensitive to Ciprofloxacin and resistance to Ampicillin and Cephalexin.

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