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UNDERSTANDING THE RISK FACTORS INVOLVED IN THE COLONIZATION AND TRANSMISSION OF *STREPTOCOCCUS PNEUMONIAE* IN CHILDREN: A CROSS-SECTIONAL STUDY

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Abstract

The *Streptococcus pneumoniae* (SP) is involve in causing pneumococcal disease such as pneumonia, bacteremia and meningitis globally, specifically in developing countries. This study was planned to investigate the potential risks involve in colonization of the *S. pneumoniae* in children. For the purpose, nasopharyngeal samples were collected from children under 5 years. A pre-designed questionnaire was developed, consist of demographic data such as age, gender, parent's occupation, the risk factors like schooling, siblings living together, exposure to passive smoking. In addition, awareness based questions such as knowledge about pneumococcal disease were also included. Preliminary, analysis revealed that close contact in house and smoking are the key factors in the transmission and carriage of pneumococcal disease. About 27.4% participants were exposed to tobacco smoking. The frequency of living together was higher (39.6%) in participants, 5-6 children living together in a single room. About 60.4% of the guardians or parents had not knowledge about pneumococcal disease. Major number of the children were vaccinated however, 25.4% of the participants were still not vaccinated against pneumococcal disease. Data showed that majority of the participants were from ethnic group of Pashtoon (79.87%). In conclusion, results showed that nasopharynx is an ecological niche for pneumococcal colonization and the described risk factors facilitates *S. pneumoniae* to colonize in the upper respiratory tract and causes disease.

Keywords: Carriage, Colonization, Meningitis, Pneumonia, Risk factors, *Streptococcus pneumoniae*

INTRODUCTION

Streptococcus pneumoniae, is a Gram-positive, non-spore forming, non-motile opportunistic pathogen, belongs to the family Streptococcaceae (1). Till date over 100 serotypes has been determined for *S. pneumoniae* (2). The *S. pneumoniae* colonizes in human in the upper respiratory tract and causes invasive and non-invasive pneumococcal disease, however, most colonized individuals do not develop invasive disease (3). The invasive disease included such as bacteremia, pneumonia, and meningitis in children and elderly individuals (2). The mortality rates for meningitis and pneumonia are estimated to be 16-37% and 10-30%, respectively (4, 5). Notably, *Streptococcus pneumoniae* is one of the leading causes of death in children under the age of 5 years, with five million deaths annually in children due to lower respiratory tract infections (6). Noticeably, Pakistan has been ranked third (3rd) among the fifteen (15) highly burdened countries with a high death rate of children due to *Streptococcus pneumoniae* (7).

The pneumococcal infection can cause 8-15% deaths, and approximately 10-20% of survivors may experience permanent brain damage and hearing loss (8). Nasopharyngeal colonization is mainly associated with pneumococcal infection (4). Factors, such as living in crowded place, more siblings living together, exposure to smoking are the factors involve in casing pneumococcal infection (9). Certain medical



conditions, such as chronic heart disease, lungs and kidney disorders, infection in cerebrospinal fluid, HIV infection, cancer, solid organ transplant, and use immunosuppressive medication, increases individual's risk of pneumococcal disease (10). The World Health Organization (WHO) recommends the use of pneumococcal conjugate vaccines, such as PCV10 and PCV13, as safe and effective measures against *S. pneumoniae* (11, 12). Notably, the prevalence rate of pneumococcal infections has decreased significantly since the introduction of penicillin, from 50% for bacteremia, 80-100% for meningitis, and 20% for pneumonia in the pre-penicillin era to 20%, 30%, and 5%, respectively (13). This study was designed to investigate the risk factors associated in causing pneumococcal carriage in children.

MATERIALS AND METHODS

STUDY POPULATION

This study was conducted at Center for Advance Studies in Vaccinology and Biotechnology (CASVAB), University of Balochistan, Quetta. Nasopharyngeal samples were collected from children less than 5 years for pneumococcal carriage. Samples were collected from a tertiary care hospital, and immunization center Quetta. A pre-designed questionnaire was used to collect demographics parameters, and risk factors involve in pneumococcal carriage in children, less than 5years.

SAMPLE COLLECTION

Paediatric size nasal swabs were used to collect the samples from nasopharyngeal cavity of the children according to the WHO guideline. The swab was inserted through nostril and sample collected from the posterior wall of the nasopharynx. The swab was instantly placed in STGG (Skim-milk Tryptone Glucose Glycerol) transport medium and shifted to the lab for investigations.

LABORATORY PROCEDURES

Swabs were streaked on blood agar media, which was prepared by using 5% sheep blood, after streaking and overnight incubation at 37°C. Small, grey, mucoid, alpha-hemolytic colonies were observed.

STATISTICAL ANALYSIS

The risk factors were thoroughly analyzed using SPSS, and various graphical representations were obtained to visually depict the findings.

RESULTS

CHILDREN EXPOSED TO PASSIVE SMOKING

The passive smoking factor was analyzed expected to be involve in pneumococcal carriage in children less than 5 years. Among the total screen children, a significant proportion that is 27.4% was exposed to smoking whereas 72.6% were not exposed to smoking (Fig. 1).

INCREASE NUMBER OF CHILDREN LIVING TOGETHER IN A ROOM ASSOCIATED WITH PNEUMOCOCCAL CARRIAGE

The data from Fig. 2 indicates that the highest percentage of participants who shared the same room was observed in the group where 5-6 persons were staying together, accounting for 39.6% of the total participants. This was followed by the second category, where 3-4 persons shared the same room, accounting for 34.6% of the total, and the third category where 7-8 persons share the same room, accounting for 25.8% of the total.

AWARENESS ABOUT PNEUMOCOCCAL DISEASE

The awareness about pneumococcal disease (PD) allowed us to assess the individuals or guardians are knowledgeable about pneumococcal disease. Based on the findings from Fig. 3, result showed approximately 39.6% of the participants' guardians were aware of the disease, and significant proportion, that is 60.04% of the participants, were found to be unaware of this disease.



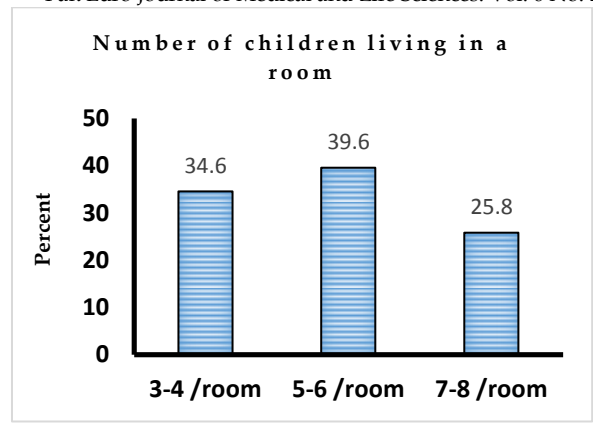
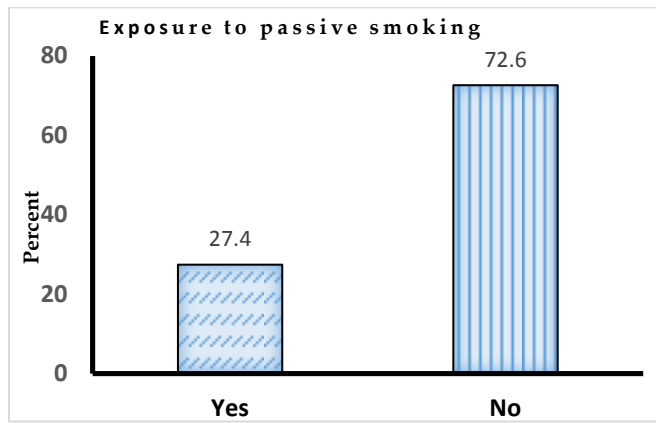


Fig. 1. Relationship between exposure to smoking and incidence of pneumococcal disease

Fig. 2. Number of children living in a room

IMMUNIZATION AGAINST PNEUMOCOCCAL DISEASE

Vaccination in young children is recognized as a crucial global priority due to the potential devastating impact of preventable diseases. This is evident from the data presented, which showed 74.6% of participants have been vaccinated, while 25.4% have not been vaccinated against pneumococcal disease (Fig. 4).

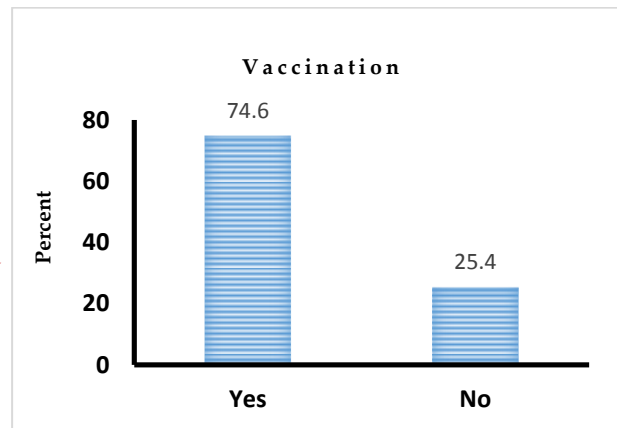
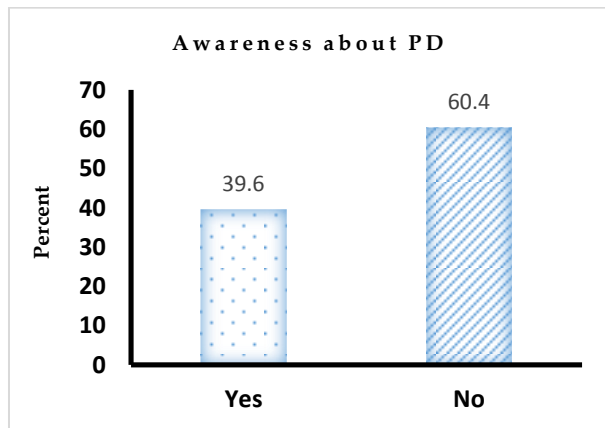


Fig. 3. Awareness about pneumococcal disease (PD) versus percentage of individual

Fig. 4. Number of vaccinated participants and the corresponding percentage

ETHNIC GROUPS

Analysis showed that 40% of the participants identified as Pathan and belonged to the ethnic group "Pashtoon", while 27.64% identified as Baloch. Additionally, 15% of the participants were from the ethnic groups of Punjabi and Hazara communities comprising 10.10% of the participants. The remaining 7.11% of participants identified with other ethnic groups.

DISCUSSION

This study was designed to identify risk factors associated with transmission & colonization of *Streptococcus pneumoniae*. Several reports determined different risk factors involved in the transmission of *S. pneumoniae* in different regions worldwide (13). The major risk factors highlighted in this study are age, siblings, number of persons living in the same place and exposures to the smoking as similar factors are also reported by (13, 14). It was previously determined that 2 or 3 siblings can increase the risk of pneumococcal disease up to 2.5 times (15) and the previous findings are in line with the results of present studies.

This study showed that smoking at home; large household, over-crowded condition is significantly correlated with higher pneumococcal percentage (16). However, in a study in Netherlands, it was determined that no such correlation was obtained regarding the above mentioned risk factors and pneumococcal carriage. According to our study majority of the participants were vaccinated against

pneumococcal vaccine, however enough ratios were not vaccinated and therefore still prone to pneumococcal disease. Noticeably, this study showed that complete vaccination can reduce the risk of colonization.

In a study (17), it was showed a negative correlation of vaccine with pneumococcal disease, they showed agreement to our study and states that young age, living with two or more siblings, exposure to cigarette smoking were positively affected the pneumococcal rate. In a four-year survey (2014-2018) in Matiara, Pakistan, 3140 children were screen for pneumococcal carriage. Study showed 50% decline in pneumococcal disease after vaccine (18). A research was conducted in Toronto, according to their findings invasive pneumococcal disease is directly associated with cigarette smoking and its exposure. They concluded that awareness programs to both smoking and exposure to smoking can reduce the incidence of pneumococcal disease (19), and this finding correlated to our recent studies. However according to another study conducted in England, revealed that parental smoking is linked with respiratory illness (20, 21). Our study determined, linked of exposure to smoking, and adverse health effect. The results of our study showed preventive strategy of pneumococcal disease, reducing the prevalence of smoking can reduce the risk of invasive pneumococcal disease.

CONCLUSION

In conclusion, the study showed risk factors involve in causing pneumococcal carriage among children less than 5 years. These factors include age, exposure to smoking, housing and siblings were associated with transmission of *Streptococcus pneumoniae*.

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Conflict of Interest:

All authors have no conflict of interest.

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