Short communication

Epidemiological Distinctive Survey Of Children With Acute Respiratory Tract Infections In Some Selected Hospitals Of Katsina Metropolis, Nigeria

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Received: 1-11-2020
Revised: 16-12-2020
Published: 23-12-2020

Keywords:
Distinctive survey, Children;
Risk factors; Acute respiratory tract infections.

Abstract: Acute respiratory tract infections (ARIs) in children under the age group of five (5) years are serious infections, which prevent the normal breathing function in the child's system. The infection usually begins as a viral infection in which it enters the child's system through the nose to the trachea (windpipe) and down to the lungs. This study aimed to identify the distinctive risk factors associated with the respiratory tract infection in which later it can lead the infection to become acute and find out the easy ways toward preventing the infections. The study was performed within the period of six (6) months during the rainy season between the periods of April to September using the human subjects under age group of five (5) years. The data analysis was done in the Bioconductor R package, statistics p-value with associated B-value were obtained from the distribution of the moderated t-statistic after the adjustment for multiple testing with a significance level of (≤ 0.05) using LIMMA method. Pvlust method was also used to generate thousands of bootstrap samples by randomly sampling elements of the data and then compute graphic hierarchical clustering on each bootstrap copy. Distinctive risk factors of (ARTI) were identified, such as malnutrition (MNT), indoor air pollution (IAP), Crowdy and dirty environment (CDE), and parental education (PE) which shows significant influence on the infection. But indoor air pollution (IAP) with the highest level of significant influence to the infections. It is recommended that parents having children should be enlightened by the health personnel experts through different media communication channels and other channels in order to avoid leaving in dirty, crowdy and unventilated environment and to feed from recommended diets with their children.

INTRODUCTION

Children are human being that fall of age between the stage of birth before the stage of puberty. In other words children are human individuals of age between the developmental period of infancy and puberty (Rathus, 2013). In relationship with the biological parents, a child may also refer to as the son or daughter of younger age. Socially, a child can be defined as a human being below the age of 18 years, also the term may also refer to human individual below legally defined age of an adult. A child like other living organisms as human live in their environment which includes physical, chemical and other natural factors (Mosby, 2013). Naturally, human being interacts with their environment and adapts themselves to all the environmental conditions present. The human environment is the complex of physical, chemical and biotic factors which act upon a human being as living organisms and ultimately determine growth and survival. A conducive child's environment is clean with ample space for all human activities and other favorable environmental conditions. Basically, its fellows with healthy food for normal growth that provides a strong foundation for health to prevent children being infected from any infection. Respiratory tract infections (RTIs) in the human system are a number of infectious diseases infecting the respiratory tract system. These infections are categorized into two different clinical forms such as upper respiratory tract infection (URTI) and lower respiratory tract infection (LRTI). Lower respiratory tract infections can cause by different pathogenic species of microorganism while the causative agent of upper respiratory tract infection is almost viruses and...
can easily be transmitted from one person to another through different human interactions, especially of human individual with problems associated with the body immune response system or body immune disorder (Chen et al., November 2017). Lower respiratory tract infections such as pneumonia, bronchitis, bronchiolitis and acute influenza tend to be far more serious severe condition than upper respiratory infections such as the common cold, sinusitis, tonsillitis and laryngitis because the upper respiratory tract infections are generally considered affecting the airway above the glottis or vocal cords (Becker et al., 2015).

Children with acute respiratory tract infections (ARIs) are with serious infections, which prevent the normal breathing function in the child's system. The infection usually begins as a viral infection in which it enters the child's system through the nose to the trachea (windpipe) and down to the lungs (Moriyama et al., 2020). Medically and traditionally because some people have the belief that most of the human respiratory tract infections are self-limiting viral illnesses, that the body immune system will resolve the infection within a short period of time. But conducted study revealed a significant association of this infection with many risk factors can lead to the severe condition of the disease (Martineau et al., 2017). Because of these risk factors, if the infection is not treated on time, especially with children under five years. The infections can spread to the entire respiratory system and became acute preventing the child's body system from getting oxygen and this condition can result in death. However, despite the recent studies in some other study areas but still in this study area children suffering from the severe condition of this infection that why this study aimed to identify the distinctive risk factors associated with the infection in which later it can lead the infection to became acute and find out the easier ways toward preventing the infections.

**MATERIALS AND METHODS**

The study was performed within the period of six (6) months during the rainy season between the periods of April to September. It was carried out in two hospitals located within the metropolis (Katsina General Hospital and Turai Umaru Yar’adua Maternity and Children Hospital Katsina). The data were collected within the interval of two-two weeks, triangulation method of collecting data was employed to enrich this research as it offered using observation, questionnaires and face to face interview for collecting a variety of data sets. The study subjects only include the age group of the child population under-five (5) years, any age group of the child population with six (6) years and above were excluded from this study.

The definite, likely and possible risk factors of acute respiratory tract infections related to children under the age group of five (5) years and the environment that influence the incidence of the infections in the human community were considered also in this study. The data analysis was done in the Bioconductor R package, statistics p-value with associated B-value were obtained from the distribution of the moderated t-statistic after the adjustment for multiple testing with a significance level of (≤ 0.05) using LIMMA method. Pvclust method was also used to generate thousands of bootstrap samples by randomly sampling elements of the data and then compute graphic hierarchical clustering on each bootstrap copy in order to identify the distinctive factors from the risk factors influencing the incidence of Children acute respiratory infections.

**RESULTS AND DISCUSSION**

The totals of five hundred and thirty six (536) cases were identified, but out of which three hundred and fifty one (351) of the subjects were diagnosed and selected in this study with acute respiratory infection (ARI). The majority of about one hundred and ninety six (196) with (55.8%) were female while others of about one hundred and fifty five were male (155) with (44.2%). Most of the children detected with this infection fall between the age group of (0 to 24) months

In table 1 four different clinical forms of children acute respiratory tract infections (ARTIs) such as pneumonia, bronchitis, bronchiolitis and acute influenza were diagnosed with fourteen risk factors associated with this infection. Midpoints of each risk factor across all the different clinical forms and for all the subjects of each clinical form were calculated. Children with acute clinical symptoms of any (ARTI) may include cough, nasal discharge, fever, sore throat, sneezing, expectoration, nausea, headache, diarrhea, tears and muscle aches. Among the different clinical forms of this infection, pneumonia recorded the highest
percentage (%) from the subjects used in this study while bronchiolitis recorded less. Pneumonia in children with less than five years of age group is also considered as the infection with leading cause of death in developing countries. The most common causative agent of this infection is pneumococcal bacteria, *Streptococcus pneumoniae*, it is a dangerous type of lung infection with a mortality rate of around 25% (Kumar *et al.*, 2017).

The Bioconductor project is a free open source development software repository that possesses a wide range of statistical tools developed in the R programming language. Many Bioconductor packages have been developed to meet various data analysis needs. The use of the packages provides a basic understanding of the R programming statistical data analysis and graphical features in R which have a strong computing background and are mostly used by biologists to benefit significantly from their ability to analyze datasets (Chen *et al.*, 2017).
Table 1: Risk factors of four (4) different clinical forms of children acute respiratory infection (ARI)

<table>
<thead>
<tr>
<th>Risk Factors</th>
<th>Pneumonia (%)</th>
<th>Bronchitis (%)</th>
<th>Bronchiolitis (%)</th>
<th>Acute Influenza (%)</th>
<th>Total</th>
<th>Mean</th>
<th>T-test</th>
<th>P-value</th>
<th>B-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Malnutrition</td>
<td>14 (3.99)</td>
<td>10 (2.85)</td>
<td>4 (1.14)</td>
<td>9 (2.56)</td>
<td>37</td>
<td>9.25</td>
<td>-5.83</td>
<td>0.03</td>
<td>5.98</td>
</tr>
<tr>
<td>Low birth weight (≤ 2500 g)</td>
<td>4 (1.14)</td>
<td>5 (1.42)</td>
<td>3 (0.85)</td>
<td>7 (1.99)</td>
<td>19</td>
<td>4.75</td>
<td>-4.79</td>
<td>0.05</td>
<td>2.63</td>
</tr>
<tr>
<td>Lack of immunization</td>
<td>2 (0.57)</td>
<td>2 (0.57)</td>
<td>1 (0.28)</td>
<td>3 (0.85)</td>
<td>8</td>
<td>2.00</td>
<td>-2.31</td>
<td>0.14</td>
<td>1.16</td>
</tr>
<tr>
<td>Indoor air pollution</td>
<td>16 (4.56)</td>
<td>20 (5.70)</td>
<td>12 (3.42)</td>
<td>13 (3.70)</td>
<td>61</td>
<td>15.25</td>
<td>-14.61</td>
<td>0.01</td>
<td>8.17</td>
</tr>
<tr>
<td>Crowding and dirty environment</td>
<td>15 (4.27)</td>
<td>12 (3.42)</td>
<td>11 (3.13)</td>
<td>10 (2.85)</td>
<td>48</td>
<td>12.00</td>
<td>-10.79</td>
<td>0.02</td>
<td>6.78</td>
</tr>
<tr>
<td>Parental smoking</td>
<td>2 (0.57)</td>
<td>3 (0.85)</td>
<td>1 (0.28)</td>
<td>2 (0.57)</td>
<td>8</td>
<td>2.00</td>
<td>-2.31</td>
<td>0.14</td>
<td>1.16</td>
</tr>
<tr>
<td>Zinc deficiency</td>
<td>4 (1.14)</td>
<td>2 (0.57)</td>
<td>2 (0.57)</td>
<td>1 (0.28)</td>
<td>9</td>
<td>2.25</td>
<td>-2.78</td>
<td>0.14</td>
<td>1.31</td>
</tr>
<tr>
<td>Concomitant diseases</td>
<td>7 (1.99)</td>
<td>6 (1.71)</td>
<td>5 (1.42)</td>
<td>4 (1.14)</td>
<td>22</td>
<td>5.50</td>
<td>-5.05</td>
<td>0.05</td>
<td>3.12</td>
</tr>
<tr>
<td>Humidity (rainfall)</td>
<td>8 (2.28)</td>
<td>5 (1.42)</td>
<td>9 (2.56)</td>
<td>3 (0.85)</td>
<td>25</td>
<td>6.25</td>
<td>-5.92</td>
<td>0.05</td>
<td>3.74</td>
</tr>
<tr>
<td>High altitude (cold air)</td>
<td>10 (2.84)</td>
<td>7 (1.99)</td>
<td>4 (1.14)</td>
<td>4 (1.14)</td>
<td>25</td>
<td>6.25</td>
<td>-5.92</td>
<td>0.05</td>
<td>3.74</td>
</tr>
<tr>
<td>Vitamin A deficiency</td>
<td>4 (1.14)</td>
<td>3 (0.85)</td>
<td>5 (1.42)</td>
<td>7 (1.99)</td>
<td>19</td>
<td>4.75</td>
<td>-4.79</td>
<td>0.05</td>
<td>2.63</td>
</tr>
<tr>
<td>Unhygienic labor</td>
<td>3 (0.85)</td>
<td>4 (1.14)</td>
<td>2 (0.57)</td>
<td>3 (0.85)</td>
<td>12</td>
<td>3.00</td>
<td>0.12</td>
<td>1.81</td>
<td></td>
</tr>
<tr>
<td>Outdoor air pollution</td>
<td>6 (1.71)</td>
<td>9 (2.56)</td>
<td>4 (1.14)</td>
<td>7 (1.99)</td>
<td>26</td>
<td>6.30</td>
<td>-5.34</td>
<td>0.05</td>
<td>3.92</td>
</tr>
<tr>
<td>Parental Education</td>
<td>11 (3.13)</td>
<td>7 (1.99)</td>
<td>8 (2.28)</td>
<td>6 (1.71)</td>
<td>32</td>
<td>8.00</td>
<td>-7.14</td>
<td>0.03</td>
<td>5.13</td>
</tr>
<tr>
<td>Total</td>
<td>106</td>
<td>95</td>
<td>71</td>
<td>79</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mean</td>
<td>7.57</td>
<td>6.79</td>
<td>5.07</td>
<td>5.64</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

The Bioconductor R package statistics p-value is obtained from the distribution of the moderated t-statistic after the adjustment for multiple testing in the table above. The significance level of this statistical analysis is defined as when the calculated p-value is less than or equal to (≤ 0.05) of the p-values are considered "significant", the lower the p-value, the stronger the evidence of the results. Also B-statistic (B-values) is based on the Empirical Bayes approach to rank the risk factors and determine the risk factors that are distinctive to acute respiratory tract infections (ARTI) and significantly influenced the infection. The B-statistic is the log-odds that a risk factor is significantly influenced the infection. For instance, in table 1 above risk factors such as Low birth weight (≤ 2500 g) and Vitamin A deficiency were having calculated B-value = 2.63 , the odds of this B-value (2.63) = 7.89, the probability that a risk factor is significantly influenced the infection is 7.89/ (7.89+1) × 100% = 88.8%. In this case there is a 88.8% chance for that risk factor is significantly influenced the infection. At the B-value=0, there is 50% - 50% chances. The introduction of additional replicates with high correlation coefficients tends to produce higher B-values. The higher the B-value, the lower the p-value, the stronger the evidence of the results and the more significant of the result. B-statistic, t-statistic and p-value (probability) are generated by the LIMMA method in the Bioconductor R package (Thomas et al., 2010).
The analysis in figure 1, pvclust tool of the Bioconductor R package was used and allows to assess the uncertainty in hierarchical cluster bootstrap analysis by calculating for each cluster p-values via multiscale bootstrap resampling. The method provides two types of p-values such as the approximately unbiased p-value (AU) and bootstrap probability (BP), which is less accurate than the AU value as p-value. The (AU) is less biased p-value than the (BP) which is computed by normal bootstrap resampling. Pvcust method used to generate thousands of bootstrap samples by randomly sampling elements of the data and then compute hierarchical clustering on each bootstrap copy. For each cluster, it computes the bootstrap probability (BP) value which corresponds to the frequency that the cluster is identified in bootstrap copies and finally it compute the approximately unbiased (AU) probability values (p-values) by multiscale bootstrap resampling (Suzuki et al., 2015).

From the correlation assessment by pvclust package some distinctive risk factors of (ARTI) were identified, such as malnutrition (MNT), indoor air pollution (IAP), crowding and dirty environment (CDE) and parental education (PE) which shows significance influence on the infection. But indoor air pollution (IAP) with the highest level of significant influence, this is because most of the subjects in this study were from crowd environment no proper drainage system. During rainy season people residing in such area cannot afford to use insecticide spray in order to get rid of Mosquito trouble but they can only afford to use Mosquito coil throughout the day time and most of houses does not have good ventilation system that is why this factor influence the respiratory tract infections (RTIs) in children especially those under five (5) years in such houses later leading to acute condition. Apart from the Mosquito coil, some things like parents’ smoking, Mosquito sprays, spray perfume, stick and coil burned perfume can increase indoor air pollution (IAP) in crowdy and unventilated environment.

CONCLUSION
This study highlights the influence of distinctive risk factors on children acute respiratory track infections (ARTIs). Four (4) different clinical forms of this infection such as pneumonia, bronchitis, bronchiolitis and acute influenza were diagnosed from subjects used in this study with fourteen risk factors associated. But among only four (4) risk factors shows a high level of significance, such as indoor air pollution (IAP), crowding and dirty environment (CDE), malnutrition (MNT) and parental education (PE). It is recommended that parents with children under the age group of five (5) years should be educated by the experts through different media communication channels and other channels to avoid leaving in dirty, crowdy and unventilated environment and to eat recommended diets.

REFERENCES


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