META-ANALYSIS: THE ASSOCIATION OF AIRBORNE FUNGI WITH CHILDREN'S HEALTH LEVEL.

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ABSTRACT

Association of concentration of airborne fungi (CFU/m3) among school-age children and their health level was very worrying. They were tempted to stay indoors such as, bedroom, playroom, and classroom. This study focused on how the concentration of airborne fungi (CFU/m3) affect the level of children's health as we know that children tend to be exposed and easy to get pulmonary infection and dysfunction. Even though the children are the most vulnerable to illness, there is less concern about indoor air quality. Owing to the early development of their immune system, lungs, and other organs, children are extremely vulnerable to disease. In general, a nursery is a designated area where infants are cared for. A nursery, on the other hand is described as any facility designed for the purpose of providing care or maintenance for children under the age of six. The 0-1 yearold group and the 2-4 yearold group are the two primary groups of young children. While school where by there's classroom which is classroom is a place where education is provided. When considering the time that children spend there and the activities that they participate in. Meanwhile the residence means a place where someone lives, or the condition of living somewhere. There are two of parameters associated to the concentration of airborne fungi (CFU/m3) and indirectly cause pulmonary problem to the children. They are temperature and humidity. There is also the differentiation of the concentration of airborne fungi (CFU/m3) indoor and outdoor. As conclusion, the concentration of airborne fungi (CFU/m3) are significant to the temperature and relative humidity and the concentration of airborne fungi (CFU/m3) indoor is significant due to poor ventilation and maintenance.

KEYWORDS fungi airborne, children, health effect, pulmonary dysfunction

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INTRODUCTION

Fresh air are essential to all living organism especially to humans. Due to COVID19 pandemic, peoples choose to spend their time at home or indoor. Consequently,

indoor air quality are important to health. The foremost worrying about the fungal airborne infection among children because they are more susceptible to respiratory effects than adults. Dust formation occurs consist of continuous elutriation of airborne organic and inorganic particulate matter emanate from indoor and outdoor. Fungi may adulterate indoor air through few activity include heating, cooking, ventilating and air conditioning system.

Other than that, urban areas contribute divulge uttermost exposure of fungal airborne concentration with the high level of vehicular emissions and industrialization and rise the prevalence allergy among children (P. Karmakar et al, 2020) and in Malaysia, the prevalence of asthma has increased especially in children, from 5.8% among 6 to 7 year old (Idayu et al, 2016). In the nurseries, children spend time almost 10-11 hours/day caused the exposure and transmission of fungal airborne occur among children (Shahidah N. et al, 2016

RESEARCH METHOD

1. Search strategy

Google scholar, PubMed and Dimensions database were searched of the period from July 2015 to March 22, 2021 for relevant studies using the following keyword: (fungal airborne) AND (health effect) AND children and (Fungal airborne) AND (asthma) in all text.

2. Inclusion criteria

Studies were limited to the English language and only full accessed journals were reviewed. Upon preliminary inclusion, the content of studies was read thoroughly for inclusion into the meta-analyses. The eligibility criteria for inclusion are based on the following criteria:

i. Studies were limited to the English language
ii. Full accessed journals were reviewed
iii. Database were searched of the period from July 2014 to March 22, 2021
iv. School-age children
v. Respiratory symptoms including wheezing, allergic rhinitis and asthma adequately.

3. Exclusion Criteria

Certain studies are excluded from meta-analyses as the result are unable to be quantitatively extracted and they did not fit with the objectives of the study. The criteria for exclusion are as of following:

i. Non-research paper, systematic review or articles.
ii. Age less than or more than school-age children
iii. Animal-related studies or case reports

4. Data extraction

The concentration of fungi airborne (CFU/m3) and other following data were extracted directly from the studies that met the inclusion criteria: (1) first author's name and initials, (2) year of publication, (3) language, (4) sample type, (5) level and measure of exposure to fungi airborne, (6) respiratory symptoms / outcomes , (7) analytical method . A third author corrected all inconsistencies in the data extracted.

5. Data analyses

Data were analyzed using the Cochrane Software Review Manager (RevMan) (2020) version 5.4 for meta-analysis. The foremost fascinate was the association between the concentration of fungi airborne with the children's health level. The data extracted by mean and standard deviation and odd ratio with random-effects model was chosen as the method, while heterogeneity test was performed using I-squared (I2) method. The results were

analyzed for sensitivity and publication bias using the funnel plot approaches, respectively. Statistical significance was defined as P<0.05.

RESULT AND DISCUSSION

1. Results

a. Literature search and included studies

The PRISMA flowchart (figure 1) describing the process used to identify the eligible studies for meta-analyses yielded 13,150 records. Eventually, after screening titles and abstracts were excluded, resulting in 121 articles for full assessment. In total, 5 articles that fulfilled all inclusion in the meta-analyses.

b. The correlation between concentration of airborne fungi (CFU/m3) and temperature

Based on the analysis (figure 2) done on the concentration of airborne fungi expose to the location in the four studies (Madureira et.al, (2014); (Bragoszewska et.al, (2016); (Yen et.al (2019); and (Andualem et.al (2019) with a total of 9520 samples, the overall p-value (0.02) is less than α=0.05. In addition, the I2 test shows 100% of heterogeneity.

c. The correlation concentration of airborne fungi (CFU/m3) and relative humidity

Based on the analysis (figure 3) done on the concentration of airborne fungi (CFU/m3) and relative humidity expose to the location in the four studies (Madureira et.al, (2014); (Bragoszewska et.al, (2016); (Yen et.al (2019); and (Andualem et.al (2019) with a total of 5784 samples, the overall p-value (0.0003) is less than α=0.05. In addition, the I2 test shows 100% of heterogeneity.

d. The differentiation of the concentration of airborne fungi (CFU/m3) indoor and outdoor

Based on the analysis (figure 4) done on the concentration of airborne fungi (CFU/m3) indoor and outdoor exposure at the location include residence, schools and nursery in the three studies (Madureira et.al, (2014); (Behbod et.al, (2015); and (Bragoszewska et.al, (2016) with a total of 6632, the overall p-value (0.05) is equal α=0.05. In addition, the I2 test shows 92% of heterogeneity.

2. Discussion

Regarding the concentration of airborne fungi (CFU/m3) with other parameters such as temperature, relative humidity, C02 and indoor either outdoor environment it can affect the children's health level. Nevertheless, but most of the concentration of airborne fungi (CFU/m3) indoor are higher compare to outdoor because the presence of the occupants, poor ventilating, heating and air-conditioning systems. Based on the result on this study, there are statistically significant correlation between concentration of airborne fungi (CFU/m3) and temperature with p-value obtained is less than α=0.05. In regards, it was found in this study that the concentration of airborne fungi was contribute by the temperature as known the optimum temperature for fungi growth rate is 25-30°C. When the temperature getting higher the value of fungi growth rate getting lower. The acceptable range air temperature by Industry Code of Practice on Indoor Air Quality, DOSH (2010) is between 23-26°C.

Considering moisture and water are present across most indoor environments, relative humidity is one of the most important factors associated with fungal growth. According to the US Environmental Protection Agency, indoor relative humidity should be maintained between 30% and 60%, with a maximum restriction of 60%. The forest plot derived from the mean of airborne fungi concentration (CFU/m3) and relative humidity indicates a significant correlation in this study. The indoor moisture level for ventilation systems with dehumidification capability has been specified by ASHRAE, with a maximum relative humidity of 65% and a dew point temperature of 16.8°C to assure occupant comfort. While moisture in buildings is dynamic and difficult to control, it could

pose issues including microbial growth. While, according to Industry Code of Practice on Indoor Air Quality, DOSH (2010), the acceptable range for specific relative humidity around 40-70% to maintain good ventilation and prevent sick building syndrome (SBS) and building related illness (BRI). Furthermore, SBS and BRI can cause health effect due to poor IAQ such as fatigue, cough, rhinitis, nausea, sore throat, Legionnaires ' disease, asthma, hypersensitivity pneumonitis and humidifier fever. Most of the symptoms and diseases can be treated but some may pose serious risks. As mentioned before, indoor environment have higher airborne fungi concentration (CFU/m3) compare to the outdoor. In the indoor, the fungi presence developed by the water accumulating and moist dirty formed molds within the building and may affect human health. Most of them are anamorphic fungi and the fungi spores may able to trigger allergic reactions such as pneumonitis, allergic rhinitis and some types of asthma (D.W.Li, Eckardt 2016). The presence of occupants within time to time also increase the airborne fungi concentration (CFU/m3). Most fungi were found in bathroom, bedroom and play room. It also depends on indoor relative humidity, temperature, ventilation and air-conditioning systems (Kenia et al, 2018). Mold growth can be prevented by using a thermo-hygrometer to measure relative humidity and room temperature on a regular basis, as well as targeted heating and ventilation.

However, fungi formed at the outdoor because the presence of dust mostly occur during summer and autumn while lower during spring and winter (Fang et al, 2005). Apart from this, outdoor fungi possible to be mixed with particulate matter and worsen the asthmatic or pulmonary dysfunction children. Despite, the interactions between outdoor fungi and respiratory status such as pulmonary function and respiratory symptoms were highly depending on the type of fungi. Furthermore, PM that has been contaminated with pollen or fungal spores might modify its biological and physical features. The most frequent fungi airborne particles in outdoor air are Alternaria and Cladosporium (Watanabe et al, 2016). In this study the forest plot derived from the mean of airborne fungi concentration (CFU/m3) between indoor and outdoor are statically significant obtained p-value is equal α=0.05.

3. Limitations

Firstly, for most of the analysis, data are drawn from a small number of studies, although the total numbers of samples across all the studies are larger. This studies are carried out among multiple schools, nurseries and residences across 7 different countries with different place, inner-city, rural, indoor, outdoor and some of them with different season, it should be in large data drawn. Secondly, from all the studies, they lack of good statistic data on children health effect and only mentioned in general. Lastly, this study focused on the concentration of general airborne fungi affect the children's health level but not the concentration of specific fungal genera that worsen their health level.

CONCLUSION

This study looked at the concentrations of airborne fungi in schools, nurseries, and homes across the country, with asthmatic and non-asthmatic children participating. Concentrations of fungi in the air commonly surpassed concentrations and standards connected to respiratory illness, such as asthma aggravation and asthma development. The fungi concentrations varied depending on the age of the building, natural ventilations such as the presence of open windows, indoor air temperature, relative humidity measurement, and other IAQ parameters. The findings of this meta-analysis imply that the above-mentioned structure should view all fungi exposure to be a serious public health concern.

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