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AIR GERMS PREDICTION FACTORS ANALYSIS FOR ELEMENTARY SCHOOL IN BANYUMAS REGENCY 2020

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Abstract

Background Schools and formal education can be a bridge for airborne disease to spread caused by air germs. Measurement of air germs result, shows that class 4 (9482 CFU/m^3) and class 5(2371 CFU/m^3) in SDN 5 Teluk, Purwokerto Selatan district. The average air gems rate is 1685.33 CFU/m^3 in SDN Karangmangu, Baturaden district. The aims of this study was to analyze predictive factors for air germs number in public elementary schools in Banyumas Regency. **Methods** This research is observational study with cross sectional analytic approach. The independent variables or predictive variables are temperature, humidity, lighting, occupancy density, occupant behavior, cleaning frequency, and ventilation area. The dependent variable is the number of air germs. The sample size was 46 classrooms. The analysis used simple and multiple regression. **Research Resulth** average temperature (29.913^{0}C), humidity (74.087%), lighting (225.304 lux), occupancy density (2.050 m^2 / person), cleaning frequency (2.5 times / day), occupant behavior (53.470% active), ventilation area (9,171%), air germ rate (3425,130 CFU / m^3), wind speed (not detected by tools). Prediction of temperature with the number of air germs, Y = 1026.505 + 80.187 X, R = 0.169, p = 0.262. Prediction of humidity with the number of air germs, Y = 2719.038 + 9.531 X, R = 0.083, p = 0.585. Prediction of exposure with air germ count, Y = 3343.684 + 0.361 X, R = 0.059, p = 0.696. Prediction of occupancy density with air germ numbers, Y = 3959.041 + (-260.389) X, R = - 0.386, p = 0.008. Prediction of cleaning frequency with air germ count, Y = 3204.664 + 88.187 X, R = 0.150, p = 0.320. Prediction of occupant behavior with air germ count, Y = 3632.488 + (-3.878) X, R = - 0.160, p = 0.289. Prediction of ventilation area with air germ count, Y = 3965.421 + (-58.911) X, R = -0.427, p = 0.003. Simultaneously predict temperature, humidity, lighting, occupancy density, cleaning frequency, occupant behavior and ventilation area with air germ count, Y = (-1267.495) + (-194.907) (density p = 0.049) + (-42.019) (Ventilation p = 0.061) + 148.449 (Temperature p = 0.072) + 90.826 (Cleaning p = 0.379) + 12.187 (Humidity p = 0.543) + (-2.205) (Behavior p = 0.561) + 0.111 (Exposure p = 0.913), R = 0.5850. **Conclusion** , predictive factors for occupancy density, ventilation and temperature are significant in predicting the number of airborne germs. **Suggestions** need to regulate the number of students in each class, the availability standard ventilation, and the addition of an Exhauster.

Keywords: *germs count, air, environmental health*

1. Introduction

Schools as a means of formal education in this country should be a comfortable place to study (Rr. Sumiyati, 2015, p. 2). Efforts to improve environmental health in schools are one of the School / Madrasah Health Business (UKS / M) programs which aim to improve the quality of education and learning achievement of students by improving hygiene and healthy living habits and creating a healthy educational environment, thus enabling growth and development. the harmonious learners. Improving environmental health in schools is one of the School / Madrasah Health Business (UKS / M) programs which aim to improve the quality of education and learning achievement of students by improving hygiene and healthy living habits and creating a healthy educational environment, thus enabling growth and development of the harmonious student/learners. An environment which is free from disturbances from elements of liquid waste, solid waste, waste gas, waste that is not processed according to the requirements set by the government, disease-carrying animals, dangerous chemicals, noise that exceeds limits, ionizing and non-ionizing light radiation, water polluted air, polluted air, and contaminated food is a healthy environment (RI Law No. 36 of 2009).

According to the Environmental Protection Agency, Air pollution is ranked 5th in relation to causes of health problems. The European Environment Agency (EEA) states that indoor air pollution is a major problem which causes children health problems. Air parameters are divided into three, namely the physical parameters of air, air chemistry, and air microbiology. The air microbiological parameter that is often used is the number of air germs (Tri Cahyono, 2017).

According to Hadita Deni Ayu Puspitasari research (2018, p.42) classrooms R226, R221, R222, Department of Environmental Health, Health Polytechnic of the Ministry of Health, Semarang, the average number of air germs in R226 was 331.6 colonies / hour / feet2, R221 amounting to 433 colonies / hour / feet2, and R222 at 355.5 colonies / hour / feet2. Sita Imania Barokawati (2019) stated that the results of measuring the number of air germs in the control room of SD Negeri Karangmangu had an average of 10.429.83 CFU / m3.

According to Nayla Kamilia Fithri, Putri Handayani, Gisely Vionalita research (2016), the number of air germs had a relationship between humidity and lighting, but there is no relationship between temperature and air germ count. According to Citra Kusumawardhani Unika Putri (2018 p.81) Physical environmental factors, temperature, humidity, lighting intensity, space density, ventilation, and air circulation facilities do not significantly affect the presence of air germ numbers. Olivia Angraeni Yuliarti (2019, p. 71) stated that there is no relationship between temperature (p = 0.159; R = 0.43), humidity (p = 0.541; R = 0.19), lighting (p = 0.853; R = 0.06) , occupancy density (p = 0.222; R = 0.38), and occupant behavior (p = 0.204; R = 0.39) with the number of air germs.

One room that has the potential to experience air problems, especially the number of air germs, is the classroom in elementary schools, especially in class 6. The classrooms are used for an average of 8 hours per day with all the learning activities and lacking personal hygiene. Observation results of the cleaning process is only done with a sweeping broom and there is no sterilization room. In addition, there are also many pieces of equipment that can be a source of dust and pollution inside the classroom.

Olivia Angraeni Yuliarti (2019) stated that the number of air germs in one of the public elementary schools in the Baturraden 2 Health Center Work Area is an average of 1.685.33 CFU / m3 with an average room area of 49m2. Based on the observation results, the sanitary conditions of classrooms at 11 Public Elementary Schools (SD N) in the Baturraden 2 Community Health Center Work Area had the same conditions, there are rarely opened windows, fans, and ventilation with bad conditions, and the walls are made of permanent.

2. Material and Method

This is an observational study with cross sectional analytic approach. The independent / predictive variables are temperature, humidity, lighting, occupancy density, occupant behavior, cleaning frequency, and ventilation area, the dependent variable is the number of air germs, and the confounding variable is wind direction, wind speed. The sample size was 46 classrooms. The analysis used simple regression and multiple regression.

3. Result

Average temperature (29.9130C), humidity (74.087%), lighting (225.304 lux), occupancy density (2,050 m2 / person), cleaning frequency (2.5 times / day), occupant behavior (53.470% active), ventilation area (9.171%), air germ rate (3425.130 CFU / m3), wind speed (not detected by equipment).

a. Prediction of Temperature Against Air Germ Numbers.

The analysis result shows that p = 0.262, so it can be called that there is an insignificant relationship between temperature and germs count in the air. R Value = 69, then the level of temperature predictions to the number of air germs is included in the very weak relationship category. The correlation test is positive, which means that the higher the air temperature in the classroom, the higher the number of air germs in public elementary school classrooms.The determinant coefficient value is 0.029, which means that temperature contributes to changes in the air germ rate by 2.900%, the rest 97.100% caused by other variables. The equation of the temperature prediction line to the number of air germs shows Y = 1026.505 + 80.187 X

The temperature is not certain in influencing the number of air germs, there is a higher temperature, the higher the air germ count, and there are those whose temperature is higher, the air germ number is lower. Each microorganism has a different optimum temperature for growth and development. The optimum temperature makes microorganisms feel comfortable living their lives (Tri Cahyono, 2016). Each microorganism has a different optimum temperature for growth and development. The optimum temperature makes microorganisms feel comfortable living their lives. Optimum psychrophilic bacteria are at a temperature of 100C – 150C, mesophyll bacteria 250C – 400C and thermophilic bacteria 400C – 800C. In general, the temperature boundary for microbial life is between 00C – 900C (Tri Cahyono, 2017 p. 198).

This research is in accordance with the research conducted by Muhammad Syahrul Ramadhan (2018) he stated that concerning the relationship between the presence of air bacteriology and the room conditions in the lecture room of undergraduate students of the Hasanuddin University Faculty of Public Health, it shows that there is no relationship between room temperature and the presence of bacteria in the lecture hall. In addition, according to this research conducted by Fithri et al. (2016) regarding the factors related to the number of air microorganisms in the 8th floor classroom of Esa Unggul University, it shows that there is no relationship between the physical quality of room air in the form of temperature and the presence of bacterial and fungal colonies and the air in the classroom.

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The results of this study are not in accordance with the research conducted by Didik Agus Nugroho, Budiyono, and Nurjazuli (2016) where the results of their research state that there is a relationship between temperature and the number of air germs.

b. Prediction of Humidity Against Air Germs

The relationship analysis shows that the value of p = 0.585, it was stated that there was an insignificant relationship between humidity and the number of air germs. The value of R = 0.083, then the level of humidity prediction on the number of air germs is included in the very weak relationship category. The correlation test is positive, which means that the higher the humidity in the classroom, the higher the air germ count in public elementary school classrooms. Jemba in Fithri et al (2016) stated that air humidity is a representation of water vapor contained in the air. The higher the humidity, the higher the moisture content in the air. High water vapor plays an important role in bacterial growth, because water vapor is a medium for survival for bacteria in the air.

The determinant coefficient value is 0.007, which means that humidity contributes to the change in the number of air germs by 0.700%, the remaining 99.300% is caused by other variables. The equation for the prediction line for humidity on the number of air germs shows Y = 2719.038 + 9.531 X.

The research is not the same as the research conducted by Anny Vidiyani (2017), the results of her research shows that the physical environment such as humidity affects the number of air germs. The difference between this study and the research conducted by Anny Vidiyani is the location, sample and sample technique. The location of Anny Vidiyani's research was at Bhayangkara H.S Samsoeri Mertojoso Hospital, Surabaya. The samples were in the treatment room, as many as 24 treatment rooms. The results of this study are also inconsistent with the research conducted by Nayla Kamilia Fithri, Putri Handayani, and Gisely Vionalita (2016) where the results of their research shows that there is a relationship between the physical quality of room air in the form of humidity and the presence of bacterial and air fungal colonies in the classroom floor 8 Esa Unggul University.

This research is in accordance with the research conducted by Citra Kusumawardhani Unika Putri (2018) regarding of physical environmental factors related to the number of air germs in the inpatient room of Class I, II, and III RST Wijayakusuma Purwokerto, it shows that there is no significant relationship between humidity and numbers of air germs in the inpatient room. In addition, other research that is in accordance with this research was conducted by Diah Putri Lestiani and Eram Tunggul Pawenang (2018) regarding the physical environment that affects the presence of Aspergillus sp. in the library room at the State University of Semarang shows that there is no relationship between humidity and the presence of Aspergillus sp in the library room at the Semarang State University.

c. Predictions of Exposure to Air Germ Numbers

The results of the analysis showed that the value of p = 0.696, it was stated that there was an insignificant relationship between lighting and the number of air germs. The value of R = 0.059, in conclusion the level of prediction of exposure to air germs is included in the very weak relationship category. The prediction of exposure to air germ counts in this study shows that the higher the lighting in the classroom, the higher the air germ count in public elementary school classrooms. The coefficient determination value is 0.004, which means that lighting contributes to changes in the number of air germs by 0.400%, the remaining 99.600% is caused by other variables. The equation of the prediction line for airborne germs shows Y = 3343.684 + 0.361 X.

According to the theory in Rizka Tiara Vindrahapsari's research (2016), she stated that microorganisms are classified into three groups based on the growth temperature they need, it is psychrophiles, mesophiles, and thermophiles. Thermophilic microorganisms are organisms that can grow at high temperatures. According to Tina Amnah Ningsih, Susi Iravati, and Titik Nuryastuti (2016) light can kill microbes which are unable to photosynthesize or microbes that do not have photosynthetic pigments. The light which is visible to the eye is not so dangerous, which is at 760 mμ, the dangerous one is the one with shorter wavelength (240 mμ - 300 mμ). Close-range radiation can kill bacteria instantly, while long-distance radiation only interferes with cell proliferation or mutations in microbes. The light that enters the room may have long waves and does not reach the microbial cells in the air so that microbial growth is not disturbed.

Research conducted by Tri Purnamasari states that lighting is a risk factor for the growth of germs in the air. Poor lighting is a favorable condition for bacteria, as they do well in dark conditions. Natural lighting from the sun in addition to spreading heat rays to the earth, also emits ultraviolet rays which can kill microbes. Pommerville in Muhammad Syahrul Ramadhan (2018, p. 67) suggests that lighting that can sting bacteria is light from sunlight, lighting from sunlight can inhibit bacterial growth. Light can affect bacterial growth, exposure to light with high intensity ultraviolet (UV) rays can be fatal to bacterial growth, bacteria can experience irradiation which results in abnormalities and death (Rizka Tiara Vindrahapsari, 2016). On the other hand, strong lighting can cause the room to reflect its light back, so that it can have an impact on glare (Tri Cahyono, 2017, p. 102).

This research is in accordance with research conducted by Rizka Tiara Vindrahapsari (2016) regarding the physical condition and the number of airborne bacteria in AC and non-AC rooms in elementary schools, showing that there is no significant relationship between room lighting and the number of bacteria in the room. In addition, other research in accordance with this study was conducted by Vita Wiana Budi Cahya (2016) regarding the factors related to the presence of airborne bacteria in the classrooms of the Semarang Mataram Foundation, showing that there was no significant relationship between lighting and the presence of air bacteria in the classroom.

The results of this study are not in accordance with the research conducted by Muhammad Syahrul Ramadhan (2018) where the results of his research state that there is a relationship between room lighting and the presence of bacteria in the lecture hall.

d. Prediction of Occupancy Density Against Air Germs

Analysis of the relationship shows that the value of p = 0.008, it means that there is a significant relationship between occupancy density and the number of air germs. Obtained the value of R = -0.386, the level of prediction of occupancy density on the number of air germs is included in the medium relationship category. The correlation test is negative, which means that the smaller the occupancy density value (meaning the more dense the space for individuals) in the classroom, the higher the air germ count in public elementary school classrooms. The coefficient of determination of 0.149 means that the density of the occupancy contributes to the change in the number of air germs by 14.900% and the remaining 85.100% is caused by other variables. The equation of the line predicting the occupancy density to the number of air germs shows Y = 3959.041 + (-260.389) X.

The results of this study are the same as research conducted by Diah Putri Lestiani and Eram Tunggul Pawenang (2018), in their research they stated that there is a significant relationship between space density and the presence of Aspergillus sp. The difference between this research and research conducted by Diah Putri Lestiani and Eram Tunggul Pawenang (2018) lies in the location, sample, and data analysis. Research locations of Diah Putri Lestiani and Eram Tunggul Pawenang (2018) at Semarang State University with a sample of the library space.

The results of this study are not in accordance with the research conducted by Evi Wulandari (2013) where the results of his research state that there is no relationship between occupancy density and the presence of Streptococcus in the air of the Bandarharjo Village apartment, Semarang City. According to the theory in Rizka Tiara Vindrahapsari's research (2016) she states that the density of the dwelling affects the temperature and humidity in the room so that it affects the growth of bacteria, the more residents in the room, the hotter the air. In addition, bacteria can also be carried by residents and spread into the air around the room. According to Hans in Evi Wulandari (2013) a narrow building with an appropriate number of occupants can reduce the reduction of O2 in the room and no increase in CO2. Increased CO2 levels cause a decrease in indoor air quality, it means that basically organisms which take their energy by photosynthesis or by oxidizing inorganic compounds can take advantage of CO2 as the main carbon source.

e. Prediction of Cleaning Frequency Against Air Germs Numbers

The relationship analysis showed that the value of p = 0.320, it was stated that there was an insignificant relationship between the frequency of cleaning and the number of air germs. Obtained a value of R = 0.150, then the level of prediction of occupancy density on the number of air germs is included in the weak relationship category. A positive correlation value means that the more frequent cleaning is done, the higher the germ count. This is caused by the cleaning method which is not quite right. Cleaning tends to be done by using the sweeping, which is causing more dust flies, it resulted in the air germ count increasing. The coefficient of determination is 0.022 which means that the frequency of cleaning contributes to the change in the number of air germs by 2.200% and the remaining 97.800% is caused by other variables. The prediction line equation for the frequency of cleaning against the number of air germs shows Y = 3204.664 + 88.187 X.

This research is not the same as the research conducted by Eka Septiana (2018), the results of his research show that there is a significant relationship between room maintenance and the number of air germs. The difference between this study and the research conducted by Eka Septiana (2018) lies in the location and sample. Eka Septiana's research location is the Dungus Madiun Lung Hospital with the sample being studied in the inpatient room.

f. Prediction of Occupant Behavior by Air Germ Numbers

The results showed that the value of p = 0.289, it was stated that there was a significant relationship between occupant behavior and the number of air germs. Value R = -0.160, then the level of prediction of occupant behavior towards air germs is included in the weak relationship category. A negative correlation value means that the more active the behavior, the lower the germ number. The coefficient of determination is 0.026, which means that the behavior of the occupants contributes to the change in the air germ rate by 2.600%, the remaining 97.400% is caused by other variables. The equation of the behavior prediction line for air germ count shows Y = 3632.488 + (-3.878) X.

The results of this study are not the same as the research conducted by Didik Agus Nugroho, Budiyono, and Nurjazuli (2016) who stated that there was no relationship between the patient's personal hygiene conditions and the number of air germs. The differences between this study and Didik Agus Nugroho, Budiyono, and Nurjazuli's research were in the location, sample population, and data analysis. The research location of Didik Agus Nugroho, Budiyono, and Nurjazuli's research was conducted at Dr. Moewardi Surakarta, with a population of inpatient rooms and a sample of three class Jasmine inpatient rooms, while the data analysis used was the chi-square test.

This is in accordance with the theory which states that the more moving activities in the room, the more germs in the air (Tri Cahyono, 2017, p. 200). The presence of humans can affect the number of microorganisms in the room because humans are one of the main sources of microorganisms, where there are many microorganisms in the human respiratory tract that can be released into the air when chatting, coughing, sneezing, and so on (Vita Wiana Budi Cahya, 2016). According to Bryan in Yuliani Setyaningsih et al (1998, p. 5) in Rina Febriani (2017, p.96) droplets act as a source of pathogenic microorganisms in the air. Bacteria and viruses in the mouth that come out from coughing or sneezing can be spread as far as 12 feet, then evaporate when they fall, leaving nuclei droplet that can survive in the air circulation indoors for hours, even days.

The results of this study are in accordance with research conducted by Olivia Anggraeni Yuliarti (2019) where the results of her research state that there is no significant relationship between occupant behavior and air germ count.

g. Prediction of Ventilation Area Against Air Germs

The results of the analysis showed that the value of p = 0.003, it was stated that there was a significant relationship between the area of ventilation and the number of air germs. Value R = -0.427, then the level of prediction of the area of ventilation against air germs is included in the category of moderate relationship. A negative correlation value means that the wider the ventilation, the lower the germ count. The wider the ventilation, the better the air circulation, the better the air exchange of outside and inside air. The saturated concentration of classroom air is replaced with clean air from outside, so that the number of air germs is reduced. The coefficient of determination is 0.182, which means that the behavior of the inhabitants contributes to the change in the air germ rate by 18.200%, the remaining 81.800% is caused by other variables. The equation of the prediction line for airborne germs shows Y = 3965.421 + (-58.911) X.

h. Simultaneously Predict Temperature, Humidity, Lighting, Occupancy Density, Cleaning Frequency, Occupant Behavior and Ventilation Area Against Air Germ Numbers

Obtained a value of R = 0.585, then the level of predictions together with temperature, humidity, lighting, occupancy density, frequency of cleaning, occupant behavior and ventilation area to the number of air germs are included in the strong relationship category. The coefficient of determination of 0.342 means that simultaneously temperature, humidity, lighting, occupancy density, cleaning frequency, occupant behavior and ventilation area contributed to changes in the air germ rate by 34.200% and the remaining 65.800% was caused by other variables. The equation of the prediction line and the significance value together with temperature, humidity, lighting, occupancy density, cleaning frequency, occupant behavior and ventilation area to the air germ count shows Y = (-1267.495) + (-194.907) (density p = 0.049) + (-42.019) (Ventilation p = 0.061) + 148.449 (Temperature p = 0.072) + 90.826 (Cleaning p = 0.379) + 12.187 (Humidity p = 0.543) + (-2.205) (Behavior p = 0.561) + 0.111 (Exposure p = 0.913).

Significant variables in predicting the number of air germs in a sequence starting from the most significant are the following variables: density (p = 0.049), ventilation (p = 0.061), temperature (p = 0.072), cleaning (p = 0.379), humidity (p = 0.543), behavior (p = 0.561) and lighting (p = 0.913).

4. Kesimpulan

Average temperature (29.9130C), humidity (74.087%), lighting (225.304 lux), occupancy density (2.050 m2 / person), cleaning frequency (2.5 times / day), occupant behavior (53.470% active), ventilation area (9.171%), air germ rate (3425.130 CFU / m3), wind speed (not detected by equipment).

Prediction of temperature on the number of air germs, Y = 1026.505 + 80.187 X, R = 0.169, R2 = 0.029, p = 0.262. Humidity prediction of air germ count, Y = 2719.038 + 9.531 X, R = 0.083, R2 = 0.007, p = 0.585. Prediction of exposure to air germ count, Y = 3343.684 + 0.361 X, R = 0.059, R2 = 0.004, p = 0.696. The prediction of occupancy density on the number of air germs, Y = 3959.041 + (-260.389) X, R = - 0.386, R2 = 0.149, p = 0.008. Prediction of cleaning frequency for air germ count, Y = 3204.664 + 88.187 X, R = 0.150, R2 = 0.022, p = 0.320. Prediction of occupant behavior towards air germ numbers, Y = 3632.488 + (-3.878) X, R = -0.160, R2 = 0.026, p = 0.289. Prediction of ventilation area against air germ count, Y = 3965.421 + (-58.911) X, R = -0.427, R2 = 0.182, p = 0.003.

Simultaneously predict temperature, humidity, lighting, occupancy density, cleaning frequency, occupant behavior and ventilation area on air germ count, Y = (-1267.495) + (-194.907) (density p = 0.049) + (-42.019) (Ventilation p = 0.061) + 148.449 (Temperature p = 0.072) + 90.826 (Cleaning p = 0.379) + 12.187 (Humidity p = 0.543) + (-2.205) (Behavior p = 0.561) + 0.111 (Exposure p = 0.913), R = 0.5850, R2 = 0.342.

The need to regulate the number of students at the time of admission of new students. in order to control the density ratio that is in accordance with what is required, namely a minimum of 2.00 m2 / student.

There is a need for the availability of ventilation in accordance with the area of the room, about 20% of the floor area in order to had good air exchange in the classroom, this is done by opening all ventilation holes in the room, both permanent and non-permanent, such as windows and doors at the learning time.

It is necessary to add an Exhauster or fan for a classroom of at least 2 exhausters or fans to be installed on the wall close to a source of clean air or an air exchange place, in order to maximize temperature regulation and so that the humidity in the classroom is in accordance with the specified requirements, because the exhauster functions is to pulls air out when the humidity is high, and vice versa, exhauster can pull air from outside when humidity is low.

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