

Original Article

## ***Relationship between Building Manager Behavior and Building Conditions with the Level of Cockroach Density at Soekarno Hatta Airport***

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### **ABSTRACT**

*Cockroaches have a role as mechanical vectors for several diseases so they must be controlled so as not to interfere with human health. The purpose of this study is to determine the relationship between the behavior of building managers and building conditions with cockroach density. Soekarno Hatta Airport in Tangerang City which is one of the busiest airports in the world. The sample in this study amounted to 100 people in 100 buildings. This study used an analytical observational design with a cross-sectional design. The variables studied are the behavior of building managers in the form of knowledge, attitudes, and actions whose data is taken through questionnaires, and variables of building conditions in the form of building sanitation, types of buildings, and building construction whose data is taken through observation and measurement in the field. Based on the results of the Chi-Square analysis, shows that the behavior of building managers in the form of knowledge ( $p = 0.021$ ), attitudes ( $p = 0.014$ ), and action ( $p = 0.035$ ) with the level of cockroach density has a significant relationship. The variable of building condition has a Chi-Square test value on building sanitation ( $p = 0.012$ ) which means it has a significant relationship. Building managers should be given the understanding to improve the value of behavior and improve building sanitation by keeping cockroach density levels low regularly.*

**Keywords:** Behavioral, Building Manager, Building Condition, Vectors, Cockroach Density

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## **INTRODUCTION**

Changes during their evolutionary history, cockroaches are categorized as archaic insects that became extinct approximately 200-300 million years ago. This geological epoch is occasionally referred to as the Era of Cockroaches because to the copious population of cockroaches. During that period, the Earth's environment was characterized by warm and humid circumstances, which were highly conducive to the survival and proliferation of cockroaches. Despite the current colder and more humid climatic circumstances, the contemporary species of cockroaches closely resemble the fossils discovered from earlier

periods<sup>1</sup>. Currently, over 3500 species of cockroaches have been discovered worldwide, and it is estimated that an additional 5000 species remain undescribed according to experts<sup>2</sup>. Only a few related to human health, namely members of the family Blattidae<sup>3</sup>.

Cockroaches are considered health nuisances because they generally breed foraging in dirty areas such as trash cans, sewers, and septic tanks. Cockroach food is from food that is still eaten by humans. Cockroaches prefer dark and warm areas, resting in crevices and various other man-made hiding places<sup>4</sup>. They are usually nocturnal, agile, and live in colonies. Dirty habits and indiscriminate movement between feces and

food make cockroaches highly efficient vectors of human pathogens<sup>5</sup>. In addition to causing phobias, feces and parts of the body that are excreted are sources of allergens that trigger asthma symptoms in sensitive individuals and can increase the risk of allergic sensitization. These allergens are proteins found in cockroach droppings, saliva, eggs, and cuticles, which are then introduced into dust and household surfaces<sup>6,7</sup>

Cockroaches act as vectors of disease and are close to humans. They have a role as mechanical vectors for some pathogenic microorganisms, as intermediate hosts for some worm species, causing allergic reactions such as itching and swelling in the corners of the eyes<sup>8</sup>. Some diseases caused by cockroaches include cholera, typhus, dysentery, diarrhea, and diseases caused by poor sanitary conditions. Cockroaches can also move some pathogenic microorganisms, among others, *Streptococcus*, and *Salmonella*. Cockroaches are one of the vectors of disease that must be controlled so as not to interfere with human health<sup>9</sup>.

A research described cockroach infestations based on habitat where people reported majority of cockroach infestations in private homes, restaurants and toilets beside schools, offices, hospitals and trash cans. On the other hand, homes surveyed reported cockroach infestations, with a high prevalence in older homes compared to newly built ones<sup>10</sup>.

Cockroach population distribution was evaluated at various places in Benha University Hospital, Egypt, using sticky paper traps. According to the results, "*Blattella germanica*" was the most commonly caught species, followed by the American cockroaches "*Periplaneta americana*" and "*Periplaneta brunnea*". German and American cockroaches were found in all areas of the hospital, while brown cockroaches were only caught in kitchens, outpatient clinics, and hospital medical supply warehouses. The cockroach population density in hospitals recorded higher cockroach counts and infestation rates in kitchens than anywhere else in 2014. Meanwhile, the highest number of cockroaches and infestation rate were recorded in outpatient polyclinics compared to other places in 2019<sup>11</sup>. In Indonesia, there is also still *Blatta orientalis*, a cockroach similar to *Periplaneta americana*, but its body size is smaller. Although small, the bacteria carried as vectors are also the same,

namely *Pseudomonas*, *Escherichia coli*, *Staphylococcus*, *Enterobacter*, and *Bacillus*<sup>12</sup>.

Behavior is the second-largest factor after environmental factors that affect the health of individuals, groups, or communities. Humans act on certain motives. Health behavior starts with knowledge, one's intentions, social support, the presence or absence of information, and situations that allow for action. The discovery of cockroach vectors in the Dumai Port Canteen is caused by the low behavior of food handlers toward cockroach vectors<sup>13</sup>. The Indonesian Ministry of Health requires port and airport areas to be free from vectors of disease transmission under the provisions of international law, which in this case is the International Health Regulation of 2005. For cockroach vectors themselves, the Minister of Health Regulation Number 2 of 2023 requires the density of cockroaches to be  $< 2$ .

Soekarno Hatta International Airport is included among the top 10 busiest airports in the world, and in 2020 it will serve the number of passengers arriving and departing as many as 16,261,858 passengers and 179,247 flights (Internet access). Seeing the high activity at Soekarno Hatta International Airport will increase the risk of disease transmission both through people and planes in and out of the airport environment. Based on a preliminary survey conducted by researchers in the Soekarno Hatta airport area, Tangerang City, in September 2022, 50 traps were installed at 35 checkpoints carried out in the afternoon. From the results of the trapping installation carried out for three days, cockroaches were found with a total of 330 heads, all of which were of the type *Blattella germanica*, and obtained results with an average density of 6.6. Based on these results, when compared with the Regulation of the Minister of Health of the Republic of Indonesia number 2 of 2023, the results are above the established quality standards. To determine the relationship between the behavior of building managers and building conditions and cockroach density at Soekarno Hatta Airport in Tangerang City, Indonesia.

## METHOD

The type of research used in this study is with analytical observational methods in July to September 2023. The research design uses a cross sectional study design, which is research to study the dynamics of correlation between

risk factors and effects by means of observation or data collection at once at a time (point time approach), with the number of samples in this study as many as 100 people in 100 buildings, which were taken by simple random sampling.

In detail, the population of the study is 372 of the managers in the airport. The representative sample size is 100 which is calculated from the formula:

$$n = \frac{372}{1 + 372 (0,1^2)}$$

$$n = \frac{372}{3,73}$$

$$n = 99.73 (100)$$

The criteria for sample inclusion in this study are all managers of buildings and buildings at Soekarno Hatta airport and are willing to be informants. The exclusion criterion is the building that was open at the time of the study and the building manager refused to conduct research.

Data collection techniques are carried out by conducting interviews using questionnaires that have been tested for validity and reliability. The research data obtained was then processed and analyzed using the SPSS version 24 software. The independent variables are the behavior of the building manager and the condition of the building. The building manager behavior consists of knowledge (good/poor), Attitude (good/poor), and practice (good/poor). The building condition consists of building sanitation (good/poor), and building type (permanent/non-permanent), and construction (close to insect/ not adjacent to insect). The dependent variable is the level of cockroach density which uses the cockroach population index formula. The cockroach intensity index was categorized into low and high (dummy). The data analyses are bivariate relationship test and the Chi-Square test where to determine among the variables. This current study using primary data has been approved by the Universitas Diponegoro Ethical Committee office.

## RESULTS

Based on table 1 shows the characteristics of people based on age, gender, education, and length of service of people at Soekarno Hatta airport in Tangerang City. shows the age distribution of people at

Soekarno Hatta airport, which is the most is at the age of 26-30 years as many as 53 people (53%) and at least at the age of 36-40 years as many as 3 people (3%), the majority of people are men as many as 73 people (73%) and women as many as 27 people (27%). The last level of education of the most people is high school 78 people (78%), diplomas 13 people (13%), and bachelors as many as 9 people (9%). For the most working period in the Soekarno Hatta airport area is in the 2-5 years category, which is 54 people (54%) and at least in the > 10 years working category.

**Table 1. General characteristics of respondents**

Variables	Frequency	%
<b>Age</b>		
< 25 years	19	19.0
26 - 30 years	53	53.0
31 - 35 years	18	18.0
36 – 40 years	3	3.0
> 41 years	7	7.0
<b>Gender</b>		
Male	73	74.0
Female	27	26.0
<b>Education</b>		
High School	78	78.0
Diploma	13	13.0
Bachelor	9	9.0
<b>Period of Work</b>		
< 2 years	19	19.0
2 – 5 years	54	54.0
6 – 10 years	16	16.0
> 10 years	11	11.0

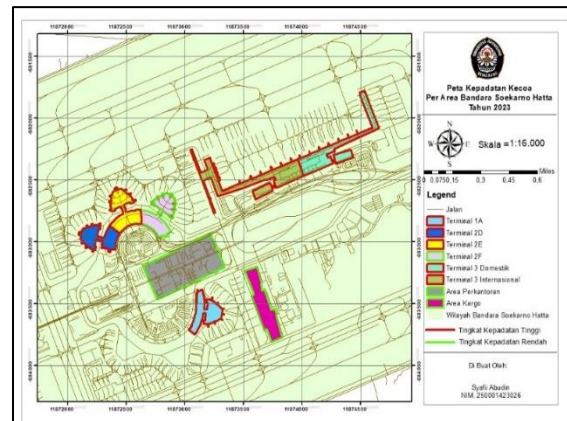
Based on table 2 below, it can be seen that the results of measuring the behavior variables of building managers are poor knowledge about cockroaches (56%), poor good attitudes (50%), and poor action about cockroach density (45%). While the variable building condition consists of good building sanitation (58%) permanent building type.

**Table 2. Distribution of building manager behavior, and building conditions**

Variables	Frequency	%
<b>Building Manager Behavior</b>		
<i>Knowledge</i>		
Good	44	44.0
Poor	56	56.0
<i>Attitude</i>		
Good	50	50.0
Poor	50	50.0
<i>Action</i>		
Good	55	55.0

Poor	45	45.0
<b>Building Condition</b>		
<i>Sanitation</i>		
Good	58	58.0
Poor	42	42.0
<i>Building Type</i>		
Permanent	90	90.0
Non-permanent	10	10.0
<i>Building Construction</i>		
Insect meeting	69	69.0
Not dense insects	31	31.0

Based on figure 1 below, it can be seen that the measurement location point at Soekarno Hatta Airport in Tangerang city has the results obtained mapped in two categories, namely the low density level of three areas (37.5%), namely the 2F terminal area, office area, and cargo area, and the high density level of five areas (62.5%), namely in the terminal 1A area, terminal 2D, terminal 2E, domestic terminal 3 and international terminal 3.



**Figure 1. Spatial distribution of cockroach density at Soekarno Hatta airport**

Based on the results of the analysis, the behavioral variables of building managers have three sub-variables which are divided into two categories good and poor. The results of the analysis are presented in Table 3.

**Table 3. The Relationship of Building Manager Behavior with Cockroach Density Level**

Variables	Cockroaches density level				p-Value	OR
	Low		High			
	f	%	f	%		
<b>Building Manager Behavior</b>						
<b>Knowledge</b>						
Good	9	5.3	35	38.7	0.021	4.543 (1.149 – 7960)
Poor	3	6.7	53	49.3		
<b>Attitude</b>						
Good	10	6.0	40	44.0	0.014	6.000 (1.242 – 8.987)
Poor	2	6.0	48	44.0		
<b>Practice</b>						
Good	10	6.6	45	48.4	0.035	4.778 (989 – 23.073)
Poor	2	5.4	43	39.6		
<b>Building Condition</b>						
<b>Building Sanitation</b>						
Good	11	7.0	47	51.0	0.012	9.596 (1.187 – 7.544)
Poor	1	5.0	41	37.0		
<b>Building Type</b>						
Permanent	9	10.8	81	79.2	0.098	0.259 (0.057 – 1.183)
Non-permanent	3	1.2	7	8.8		
<b>Construction</b>						
Close to Insects	8	8.3	61	60.7	1.000	0.885 (0.245 – 3.193)
Not adjacent to Insects	4	3.7	27	27.3		

Based on Table 3, it can be seen that the attitude of building managers toward cockroach density levels based on chi-square tests, the relationship between building manager behavior variables and cockroach density levels at Soekarno Hatta Airport, Tangerang City, shows that knowledge of cockroach density levels based on chi-square tests with p-value = 0.021 has a significant relationship with the risk results are OR = 4.543 which means that building managers who have poor knowledge about Cockroach density has a risk of increasing cockroach density 4.543 times greater than managers Building with a value of p = 0.014 has a significant relationship with the risk result is OR = 6.000 which means that building managers who have a poor attitude about cockroach density have a risk of increasing cockroach density 6.000 times greater than building managers with good attitudes about cockroach density. The action of building managers with cockroach density levels based on chi-square tests with p-value = 0.035 has a significant relationship with the risk results are OR = 4.778 which means that building managers who have poor action about cockroach density have a risk of increasing cockroach density 4.778 times greater than building managers with good actions about cockroach density. the relationship between the variable of building conditions and the level of cockroach density at Soekarno Hatta airport, Tangerang City shows only sanitation sub-variables that have a relationship based on the results of the chi-square test where the value of p = 0.012 which means it has a significant relationship with the risk results is OR = 9.596 which means that buildings that have poor sanitary conditions have a risk of increasing cockroach density 9.596 times greater compared to Buildings with good knowledge of good sanitary cockroach density.

## DISCUSSION

The presence of cockroaches in buildings is influenced by various factors such as cracks and gaps in the building structure<sup>14</sup>. Understanding occupant behaviors and their interactions with buildings is crucial for building managers to effectively manage and control cockroach density<sup>15</sup>. Research has shown that the density of cockroaches in buildings, particularly in food stalls, can be high, posing significant challenges for building

managers in maintaining hygiene and sanitation standards<sup>14,16</sup>. Additionally, the impact of human behavior on building technologies and operations has been extensively studied over the past 40 years, emphasizing the need for a comprehensive understanding of occupant behaviors in buildings<sup>17,18</sup>.

Furthermore, the relationship between housing conditions and the density of pests, including cockroaches, has been established, highlighting the importance of building maintenance and management in controlling pest infestations<sup>19</sup>. Studies have also indicated that the behavior of building managers and occupants significantly influences energy consumption and operational efficiency in buildings<sup>20,21</sup>. Therefore, it is essential for building managers to consider occupant behaviors and their potential impact on pest control and energy management strategies.

In addressing the challenges posed by cockroach density, building managers can leverage research on behavioral interventions and management strategies. Understanding the coercive cycle and related developmental constructs can inform effective behavioral interventions, which may apply to both parent-child interactions and building occupant behaviors<sup>22,23</sup>. Additionally, the use of dynamic simulation models that account for realistic occupancy and management behaviors can aid in predicting and managing realistic energy consumption levels in buildings<sup>24</sup>.

The density of cockroaches in buildings is influenced by various factors related to building conditions and maintenance. Factors such as building type, level of disrepair, and poor sanitation ratings are associated with increased cockroach infestations<sup>25-27</sup>. Some studies mentioned that multi-unit buildings can increase the density of cockroaches<sup>28,29</sup>. Additionally, the modification building also plays a significant role as a cockroach habitat<sup>28,29</sup>. Additionally, housing disrepair indicators have been linked to cockroach and rodent infestations, highlighting the impact of building conditions on pest presence<sup>26,27</sup>. Integrated pest management is more effective in reducing cockroach infestations compared to routine chemical interventions, emphasizing the importance of proactive building maintenance and pest control strategies<sup>30</sup>.

Understanding the determinants of cockroach infestations in buildings is crucial for developing effective management tactics.

Building managers should prioritize building maintenance and repair to address factors associated with increased cockroach density. Additionally, implementing integrated pest management strategies can significantly reduce cockroach infestations, promoting healthier indoor environments. By considering the impact of building conditions on cockroach density and implementing effective pest management strategies, building managers can create healthier and more sustainable built environments.

## CONCLUSION

Based on the results of the study, it was concluded that there was a relationship between the behavior of building managers and the level of cockroach density at Soekarno Hatta Airport where knowledge, attitude, and density were significantly associated with cockroach density. For the building conditions and density levels, there is one sub-variable that has a significant relationship (building sanitation). Building managers should be given the understanding to improve the value of behavior and improve building sanitation by keeping cockroach density levels low regularly. The findings of this study cannot be generalized to other study settings and time frames. Future studies can include a qualitative study and or add more related variables with multivariate analysis.

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## CONFLICTS OF INTEREST

The authors declare no conflict of interest.

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