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Distribution Mapping Of House Type, House Age And Sick Building Syndrome Among Work-From-Home Workers By Using A GIS-based Approach

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Abstract

Sick Building Syndrome (SBS) is a condition that commonly affects building occupants, and it is characterized by various symptoms related to the indoor climate, including indoor air quality, inadequate lighting, maintenance efficiency, and ventilation. This study aims to create distribution maps of housing infrastructure in Kuantan based on house type and house age and determine the prevalence of SBS among work-from-home (WFH) workers in the Kuantan study areas. A geospatial-based approach was employed to visualize the distribution of the general SBS symptoms among 112 WFH workers using a questionnaire that combined the Swedish MM040 and ICOP2010 questionnaires. The results obtained from the geospatial distribution maps revealed that a significant number of WFH workers in Kuantan experienced SBS symptoms, and most of them resided in terrace houses that were more than ten years old.

Keywords: *sick building syndrome, house, geospatial, work-from-home workers*

INTRODUCTION

Most modern buildings are designed with a focus on human comfort, incorporating features that provide control over the indoor environment, such as regulating the air temperature, lighting, sound levels, humidity, odors, and airflow. These characteristics aim to mitigate symptoms associated with sick building syndrome (SBS) and protect occupants. Research suggests that approximately one out of every five building occupants experiences SBS-related symptoms in their workplace, influenced by factors including the location, temperature, building systems, construction materials, building dampness, pollutant sources, and occupant activities (Saijo et al., 2019).

Epidemiological studies indicate that the estimated prevalence of home SBS in homes varies depending on the circumstances experienced by building occupants experience it (Aziz et al., 2023). Acute health and comfort impacts appear to be linked to the duration of time spent in a particular dwelling (Saijo et al., 2019). Therefore, this study will employ a geographic information system GIS-based approach to map and analyze the distribution of sick building syndrome symptoms, using specific parameters as records for distribution mapping purposes.

Given the distinct effects of factors influencing indoor environmental quality on occupants in different settings, the prevalence of SBS may increase (Dhungana & Chalise, 2020).

METHODOLOGY

Research
⬇
Sampling Method (Purposive)
⬇
Data Collection (Questionnaire)
⬇
Descriptive analysis
⬇
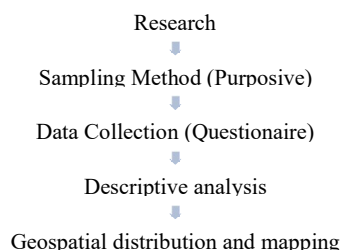Geospatial distribution and mapping

Figure 1. Flowchart of mapping distribution

This study involves creating a distribution map of SBS in Kuantan using a questionnaire to collect data. The collected data will be processed using GIS application software, specifically QGIS, to perform the delineation processes for this study (see Figure 1).

Study Area and Sampling Population

The study area for this research is the Kuantan district. A convenience sampling technique, a non-probability sampling method, was used to select the participants for this study. A total of 112 samples were collected from respondents who were available and willing to participate in the study.

Questionnaire

In this study, data on the frequency of the SBS symptoms among Work-From-Home (WFH) individuals were collected using a conventional self-administered questionnaire. The questionnaire consisted of six sections: Part 1: General Information (the respondent's background information of the respondent); Part 2: Occupation Type; Part 3: Work Environment; Part 4: Past/Present Symptoms; Part 5: Present Symptoms; and Part 6: Complementary Questions. The symptoms of SBS were categorized into general, mucosal, and skin symptoms. Respondents had the option to complete the questionnaire either face-to-face or using an online, with the majority of respondents opting for the online method due to its convenience.

Descriptive Analysis

The SBS symptoms were identified using descriptive statistics. Tables 1 and 2 indicated the house types and ages of 112 participating respondents in frequency and percentage. Table 3 indicates the prevalence of general symptoms of SBS experienced by participating respondents. The data analysis instrument was SPSS statistical software (IBM SPSS Statistic, Version 22).

Geospatial Distribution Map

The data on the location, house type, house age, and SBS symptoms of the Work-From-Home (WFH) workers will be used to create distribution maps of residences in Kuantan, Pahang. To facilitate this, the software tools QGIS and Google Earth Pro will be utilized. The WFH workers' location data will be imported into Google Earth Pro using a data spreadsheet, allowing the points to be plotted as a layer on the map. A vector shapefile (.shp) will be created to store the layer, and it will be added to QGIS. By utilizing the QGIS application, the geospatial distribution map of SBS in the Kuantan, Pahang area can be visualized, aiding relevant stakeholders in identifying SBS-affected buildings.

RESULT AND DISCUSSION

This study focuses on examining the home environment of respondents while working from home, as well as the type of homes they reside in. The data collected from the 112 participants reveals the most common housing types in Kuantan. Table 1 presents the distribution of respondents across different housing types. It can be concluded that out of the 112 respondents, 78 individuals (69.6%) reside in terraced houses, indicating that terraced houses are the predominant type of residence among the selected respondents in Kuantan. Additionally, 22 respondents (19.6%) live in two-story houses, 10 respondents (8.9%) reside in bungalow houses, and two respondents (1.8%) live in apartments.

Table 1. House type of the WFH workers in Kuantan.

House Type	Frequency	Percent (%)
Terrace House	78	69.6
Bungalow	10	8.9
Apartment	2	1.8
Two-Storey House	22	19.6
Total	112	100.0

The map distribution of house type and design is illustrated in Figure 2. It shows that most houses in Kuantan are terrace-type.
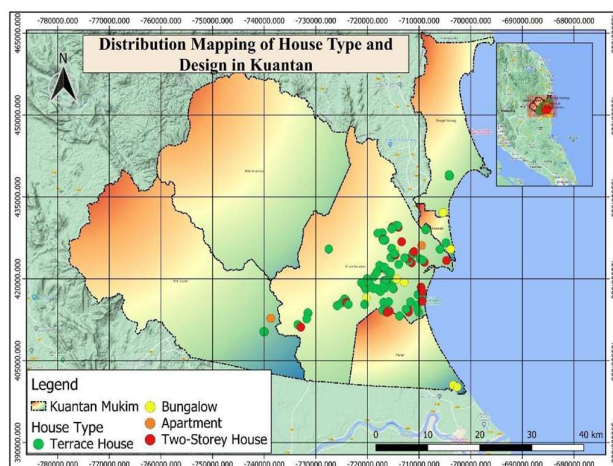

Figure 2. Distribution map of house type and design in Kuantan

The age of the buildings is an important factor in assessing their condition and potential impact on the occupants. Table 2 provides an overview of the building ages in the study location. It can be observed that the majority of the houses (n=46, 41.1%) fall within the age range of 10 to 19 years. This is followed by houses with an age range of 5 to 9 years (n=31, 27.7%), less than 5 years (n=21, 18.8%), and more than 20 years (n=14, 12.5%). The study area, being a developed region with a diverse range of buildings, is characterized by a significant number of houses that are between 10 to 19 years old.

Table 2. House age of the WFH workers in Kuantan.

House Age (years)	Frequency	Percent (%)
<5	21	18.8
5-9	31	27.7
10-19	46	41.1
>20	14	12.5
Total	112	100.0

The map distribution of house age is shown in Figure 3. It shows that most houses in Kuantan are between 10 to 19 years of age.
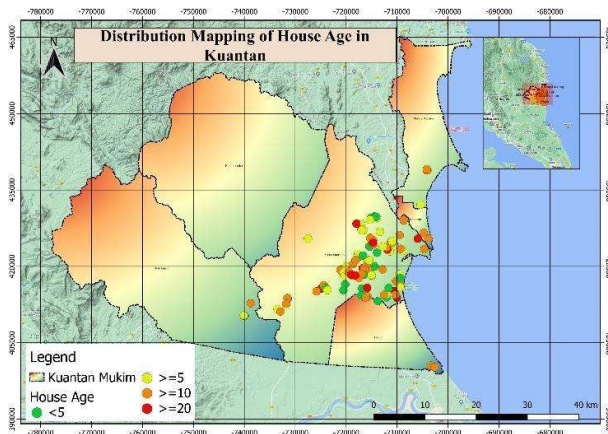
Figure 3. Distribution map of house age in Kuantan

Table 3 presents the prevalence of general SBS symptoms among Work-From-Home (WFH) workers. Based on the mapping Figure 3, out of the 112 respondents, a majority of 102 respondents (91.1%) reported experiencing general SBS symptoms while working from home. Only 10 respondents (8.9%) did not experience any symptoms of SBS. These findings indicate that a significant proportion of WFH workers in Kuantan have encountered general SBS symptoms during their work activities.

Table 3. General symptoms of SBS among WFH workers in Kuantan.

General Symptoms	Frequency	Percent (%)
Yes	102	91.1
No	10	8.9
Total	112	100.0

The map distribution of general SBS symptoms is depicted in Figure 4. It shows that most WFH workers in Kuantan experienced general SBS symptoms.
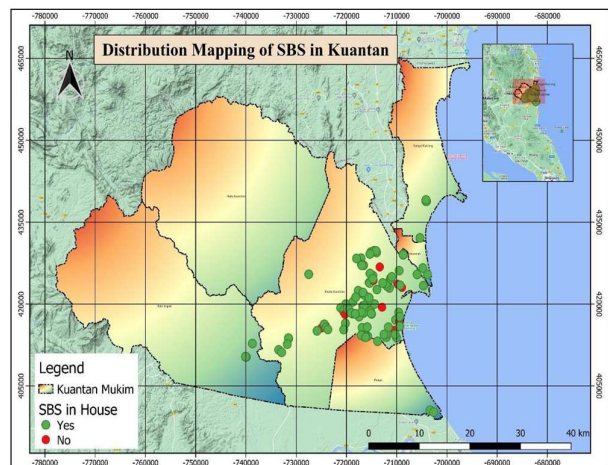

Figure 4. Mapping of sick building syndrome in Kuantan

This study concludes that a significant proportion of WFH workers in Kuantan, specifically 91.1%, have experienced general SBS symptoms. The majority of these workers reside in terrace houses, and their houses are predominantly between 10 to 19 years old. The geospatial distribution maps generated in this study provide valuable insights for relevant stakeholders, including the State Government, housing developers, and employers, to develop improved policies and procedures for WFH arrangements that prioritize the well-being of workers. However, further analysis is required to examine the relationship between house age, house type, and the prevalence of SBS symptoms among WFH workers.

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CONCLUSION