Comparison of the Comfort Level of Yogyakarta People Before the Pandemic, During the Lockdown, and Post-COVID-19 Transition

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Abstract. The COVID-19 pandemic forced the Indonesian government to implement a lockdown policy or Community Activities Restrictions Enforcement (CARE, also known as PPKM). A comfort level study is necessary as a consideration in regional development for the construction of industry, residential areas, and green open spaces that address the comfort level of the residents. The comfort level can be determined using the Temperature Humidity Index (THI) method. This study aimed to analyze the comparison of the comfort level of the people of Yogyakarta before the pandemic, during the lockdown, and transition post-COVID-19 pandemic, to examine the comparison of Land Surface Temperature (LST) in Yogyakarta before the pandemic, during the lockdown, and transition post COVID-19 pandemic, and to find the relationship between LST and the level of community comfort based on the THI index in Yogyakarta before the pandemic, during the lockdown, and transition post-COVID-19. Identification of the THI method was carried out by implementing temperature and relative humidity data. Temperature data were obtained from Landsat 8 image processing, while relative humidity data were taken from the Sleman Geophysics Station and Yogyakarta Climatology Station. The results showed that during the lockdown, the policy was implemented in May 2020, followed by a decrease in anthropogenic activity. Consequently, people's comfort increased sharply compared to other periods. An increase in the level of community comfort was supplemented by a decrease in the value of LST in the same period. These results indicate that the community comfort level can be affected by changes in LST values.

Keywords: Community comfort level · COVID-19 · anthropogenic activity · remote sensing

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1 Introduction

The COVID-19 pandemic is an infectious disease caused by Severe Acute Respiratory Syndrome Coronavirus 2 or SARS-CoV-19 which began in Wuhan City, Hubei Province, China in December 2019 (Kong et al., 2020). The pandemic outbreak spread quickly across countries. COVID-19 cases infected astonishingly fast to almost every island in Indonesia, including cities in Indonesia. These cities are centers of settlements and socio-economic activities with a high level of population mobility, thus allowing for the rapid spread of the virus.

The COVID-19 pandemic has caused changes in human behavior and activities (Arifin et al., 2021). The increasing expansion of the COVID-19 virus forced the Indonesian government to implement the CARE policy or Community Activities Restrictions Enforcement, which is the enactment of a work-from-home system, online learning, and limitation on the operating hours of economic activities which significantly reduced people's activities and mobility. Social restrictions during the COVID-19 pandemic had an extraordinary global impact that affect psychological states due to limited physical activity and changes in patterns of daily activities (Jassim et al., 2021). According to Nurrohimah & Fatimah (2022), restricting outdoor activities for a long period will make human psychology worsened due to human nature as social beings who need interaction.

Climate change can be influenced by natural factors and human activities such as industrialization, deforestation, and urbanization which have an impact on increasing greenhouse gas emissions, as result it will increase temperature. According to Wahidah & Antriyandarti (2021), the implementation of the lockdown policy has brought about climate change thanks to the reduced intensity of greenhouse gas and carbon dioxide (CO2) emissions. In the opinion of Nuraini et al. (2020), human activities can determine the concentration of air pollution. Parida et al. (2021) state that social restrictions and human activities have resulted in a decrease in aerosols and atmospheric pollutants. Research conducted by Quéré et al. (2020) found that during the COVID-19 pandemic, CO2 emissions from anthropogenic activities had decreased by 17%, of which half came from the transportation, industry, and electricity sectors.

Yogyakarta is an urban area that has higher temperatures than rural areas. This is influenced by the number of vehicles and industrial areas that precipitate atmospheric pollutants, which have an impact on increasing temperatures. According to Andani et al. (2018), temperature changes can alter human comfort levels. In the report of Masitoh & Rusydi (2020), high human activity will hit heat stress conditions in residential areas. Ropo et al. (2017) argue that comfort levels can be decided based on temperature and humidity conditions. The comfort index can be observed using the Temperature Humidity Index (THI) method which utilizes temperature and humidity parameters. Research conducted by Wati & Fatkhuroyan (2017), the comfort level of THI in Jakarta is influenced by the conversion of land into industrial areas, residential areas, offices, and others so that the expansion of dry and hot areas modifies the decreasing comfort levels. Kusuma (2021) explains that heat stress in Yogyakarta is controlled by climatic conditions due to differences in temperature in the wet and dry months, in which high temperatures in the wet months ensue high evaporation rates and rain so these conditions are not suitable for activities.

In addition to improving the pandemic, the Indonesian government implemented a policy of adapting new habits. The community began to carry out activities in various sectors by implementing strict health protocols to prevent and manage COVID-19 cases. The implementation of the new normal policy entails an increase in the intensity of outdoor activities. Aman et al. (2020) found that when the lockdown and community activities were reduced, there was an increase in air quality in several countries. Zannah & Sudarti (2022) state that an increase in temperature can result in a reduced comfort level which will affect human activities since the air conditions are too cold or too hot.

Departing from these problems, a study is required to determine changes in Land Surface Temperature (LST) and Temperature Humidity Index (THI). This research employed Landsat 8 OLI/TIRS remote sensing imagery, which was used for spatial analysis and modeling in estimating conditions before COVID-19 in 2019, during the lockdowns in 2020, and the transition post-COVID-19 in 2021 and 2022. This study aimed to (1) analyze the comparison of the comfort level of the Yogyakarta people before the pandemic, during the lockdown, and the transition post-COVID-19 pandemic; (2) study comparisons of LST in Yogyakarta before the pandemic, during the lockdown, and the transition post-COVID-19 pandemic; (3) find the relationship between LST and the level of community comfort based on the THI index in Yogyakarta before the pandemic, during the lockdown, and the transition post-COVID-19 pandemic.

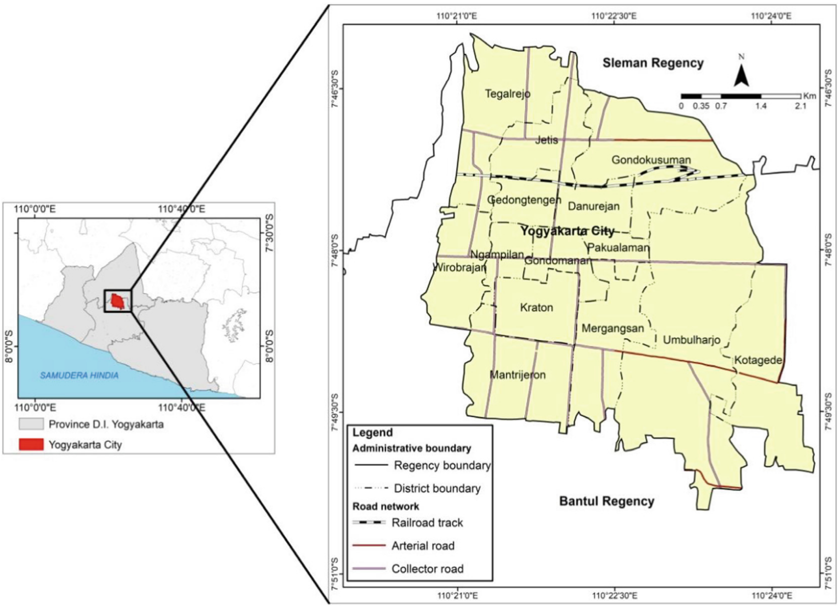

Fig. 1. Research sites

2 Method

2.1 Research Sites

This research was conducted in Yogyakarta, the capital and center of government for the Province of the Special Region of Yogyakarta. Yogyakarta is located at geographical coordinates between 110°24′19″–110°28′53″ East Longitude and 07°15′24″–07°49′26″ South Latitude. The research location is presented in Fig. 1.

2.2 Data Processing Techniques

Data processing in this study was carried out to obtain a classification of people's comfort levels using the Temperature Humidity Index (THI) method. This study used a quantitative descriptive analysis method with a spatial approach and statistical tests for Pearson product-moment correlation analysis and a simple linear regression test. Data processing was conducted in 3 (three) periods; before COVID-19 in 2019, during the lockdown in 2020 and 2021, and post-COVID-19 pandemic in 2022. The comfort index processing would be obtained from the calculation of temperature and relative humidity parameters. Classification of temperature data was collected through Landsat 8 OLI/TIRS image processing, which can be accessed via the official USGS website at https://earthexplorer.usgs.gov. Meanwhile, relative humidity data used data from the Sleman Geophysics Station and Yogyakarta Climatology Station gathered from the official Meteorology, Climatology, and Geophysical Agency (referred to as BMKG) website, namely https://dataonline.bmkg.go.id.

In this research, temperature data processing for comfort level calculations was obtained from LST processing using corrected Landsat 8 band 10 or TIRS 1 imagery. Band 11 or TIRS 2 in Landsat 8 imagery was not included because according to the USGS, band 11 has a significant calibration uncertainty (Advan and Jovanoska, 2016 in Imran et al., 2021). Landsat 8 imagery with the TIRS sensor is a remote sensing technology that can detect the temperature of the earth's surface so that it can distinguish parts of the earth's surface with a hotter temperature than its surrounding. Changes in surface temperature in an area can be obtained by converting digital number values to radian spectral values Kristiningsih et al. (2016). The data processing stages in this study consist of Land Surface Temperature (LST) processing, Temperature Humidity Index (THI) processing, and statistical test processing described as follows.

LST Processing

LST method transformation is described in the equation:

Radiometric Correction

Reflectance correction uses a formula from the USGS (Landsat 8 Data Users Handbook, 2019).

$$P\lambda^{'} = M\,\rho Qcal + A\rho \tag{1}$$

$$\lambda = \frac{p\lambda}{cos(\theta_{sz})} = \frac{p\lambda}{sin(\theta_{sz})} \tag{2}$$

Information:
$P\lambda'$: TOA reflectance without solar angle value
$M\rho$: reflectance_multi_band_x value (from metadata)
$Qcal$: digital number
$A\rho$: reflectance_add_band_x value (from metadata)
θ_{sz}: sun_elevation value(from metadata)

Calculation of the TOA radiance correction uses the following formula from the USGS.

$$L\lambda = ML^{*}Qcal + AL \tag{3}$$

Information:
Lλ: TOA spectral radiance(Watts/m2*srad*µm)
ML: reflectance_multi_band_x value(from metadata)
$Qcal$: digital number
AL: radiance_add_band_x value (from metadata)

Atmospheric Correction

The equation for atmospheric correction uses the following Dark of Subset (DOS) method (Nur & Dewi, 2020).

$$DN\ corrected = DN\ TOA\ reflectan - DN\ minimum \tag{4}$$

Information:
DN: *digital number*

1. Brightness Temperature (BT) Extraction

The algorithm used is sourced from the following USGS.

$$T = \frac{K_2}{In(\frac{K_1}{L_1} + 1)} \tag{5}$$

Information:
T: *top of atmosphere brightness temperature* (Kelvin)
K_1: *band-specific thermal conversion constant from the metadata*
K_2: *band-specific thermal conversion constant from the metadata*
Lλ: TOA *spectral radiance* (Watts/m2*srad*µm)

Normalized Difference Vegetation Index (NDVI)

The transformation of the NDVI method used is taken from the following USGS.

$$NDVI = \frac{NIR - Red}{NIR - Red} \tag{6}$$

Information:
NIR: Near Infrared band

Red: Red band

Proportional of Vegetation (PV)

The PV algorithm equation is calculated using the following formula from (Imran et al., 2021).

$$PV = \left(\frac{NDVI - NDVI_{min}}{NDVI_{max} - NDVI_{min}} \right) 2 \tag{7}$$

Information:
NDVI: vegetation index value
$NDVI_{max}$: maximum vegetation index value
$NDVI_{min}$: minimum vegetation index value

Emissivity

Transformation of emissivity values (Imran et al., 2021).

$$E = 0.004^{*} PV + 0.986 \tag{8}$$

Information:
E: Land surface emissivity
PV: Proportional of Vegetation value
0.004: the mean of emissivity of dense vegetation
0.986: open land standard emissivity value

Land Surface Temperature (LST)

LST is calculated using an algorithm (Imran et al., 2021).

$$T_s = \frac{Tb}{1 + \left(\lambda \frac{Tb}{c2} \right) In(e)} \tag{9}$$

$$T\ Celcius = T\ Kelvin - 273.15 \tag{10}$$

Information:
Ts: LST (Kelvin unit)
Tb: *brightness temperature* (Kelvin unit)
λ: wavelength
e: emissivity
c2: h*c/σ (1.438*10-2mK) 14388 μmK
h: Planck constant (6.636*10–34 Js)
c: speed of light (2.998*108 m/s)
σ: Boltzman constant (1.38–23 J/K)

THI Processing

The algorithm for calculating the comfort index used the THI method according to (Nieuwolt, 1977 in Wati & Fatkhuroyan, 2017) as follows.

$$THI = 0.8 * T + \frac{RH * T}{500} \tag{11}$$

Table 1. Classification of Community Comfort Levels Based on the THI Method

THI value	Classification
21–24	Comfortable
25–27	Quite comfortable
>27	Uncomfortable

Information:
THI: thermal comfort index
T: air temperature (Co)
RH: relative humidity (%)

Classification of comfort levels using the Temperature Humidity Index (THI) method in tropical climates according to Wati & Fatkhuroyan (2017) is presented in Table 1.

Statistical Test Processing

The analysis was carried out to compare LST and THI variables, namely the Pearson product-moment correlation and simple linear regression. The variables in this study consist of independent variables and dependent variables. The independent variable is Land Surface Temperature (LST) and Temperature Humidity Index (THI) is the dependent variable. The statistical test equation is:

Pearson Product-Moment Correlation

The correlation equation using the formula (Yuliara, 2016) is as follows.

$$r_{xy} = \frac{n\sum XY - (\sum X)(\sum Y)}{\sqrt{n\sum_X 2 - \left\{\sum_X 2\right\} - \{n\sum_Y 2 - (\sum_Y 2)\}}} \tag{12}$$

Information:
r_{xy}: Pearson's correlation coefficient
n: number of data
ΣX: number of independent variable
ΣY: number of dependent variable

Simple Linear Regression

The simple linear regression transformation is as follows (Yuliara, 2016).

$$Y = a + bX \tag{13}$$

Information:
Y: dependent variable
a: constant or intercept
b: regression coefficient or slope
X: independent variable

Table 2. Percentage of comfort level in Yogyakarta based on the multitemporal THI index.

THI Value	Classification	Area percentage (%)						
		Before the pandemic		During the lockdown				Post-Covid-19 transition
		2019		2020		2021		2022
		April	August	May	August	May	August	May
21–24	Comfortable	0	0.3	51	0	0	0	0
25–27	Quite comfortable	5.74	5.6	49	0.4	6.5	0.4	2.1
>27	Uncomfortable	94.3	94.1	0.1	99.6	99.6	99.6	97.9

3 Results and Discussion

3.1 Distribution of Community Comfort Levels Before the Pandemic, During the Lockdown, and Post-COVID-19 Transition

The processing of the comfort index in Yogyakarta was carried out using the Temperature Humidity Index (THI) method which is classified into three comfort level categories, namely comfortable, quite comfortable, and uncomfortable. The broad percentage of comfort level in Yogyakarta from a multitemporal perspective is presented in Table 2. Based on the percentage comfort level, it can be inferred that the comfort of the f Yogyakarta community is dominated by the uncomfortable category. The multitemporal distribution of people's comfort levels in the city is displayed in Fig. 2, which shows that almost all subdistricts in Yogyakarta are areas grouped in the uncomfortable comfort level, excluding May 2020. During the implementation of the lockdown policy in May 2020, the comfort level in the City of Yogyakarta experienced a significant increase which was dominated by the comfort level in the comfortable category. Even, in the same month, the comfort level in the quite comfortable category only reached about 0.1% of the entire region.

The comfort level of the community experienced a significant increase when the lockdown policy was implemented, resulting in limited outdoor activities. In the following period, the comfort level in Yogyakarta decreased, which can be observed in urban areas. Regarding the increasing and decreasing categories of comfort levels, the results of this study suggest that the comfort level of people based on the THI index can change every month. An increase in the comfort index can be influenced by limited community activities outside which reduce air pollution.

3.2 Distribution of LST Before the Pandemic, During the Lockdown, and Post-COVID-19 Transition

Processing of the distribution of Land Surface Temperature (LST) was carried out in 2019–2022 to compare the distribution of LST in Yogyakarta before the pandemic, during the lockdown, and post-COVID-19 pandemic. Table 3 presents the descriptive

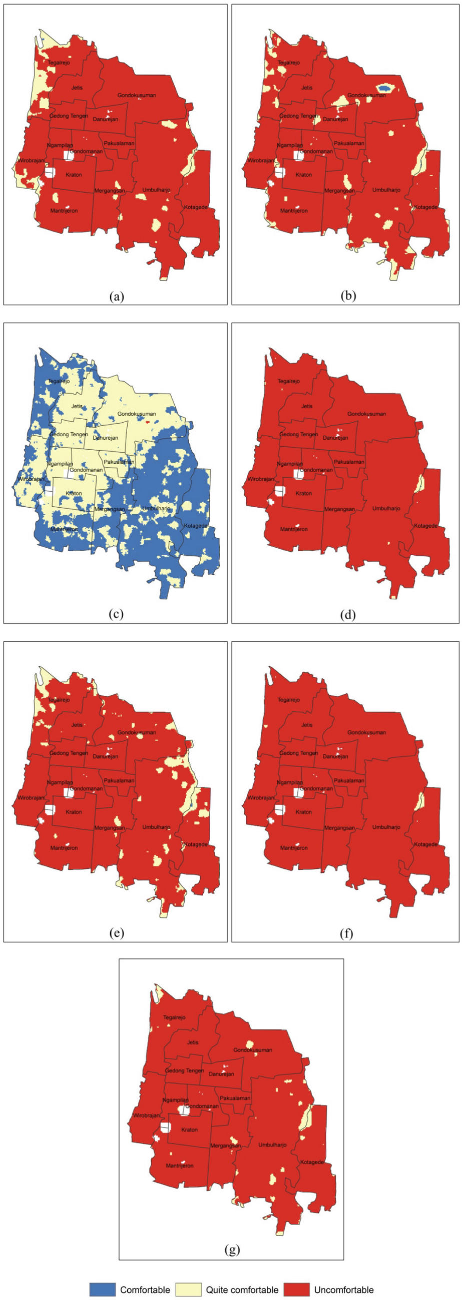

Fig. 2. Distribution of comfort level of Yogyakarta communities based on the multitemporal THI index; (a) April 2019, (b) August 2019, (c) May 2020, (d) August 2020, (e) May 2021, (f) August 2021 and (g) May 2022.

statistical values of the LST of Yogyakarta in a multitemporal manner. In general, the average LST in Yogyakarta City except for May 2020 shows a relatively similar pattern which ranges from 29.50 °C–32.15 °C with a maximum temperature between 31.91 °C–35.88 °C. However, when the lockdown policy was implemented in May 2020, the LST value decreased with a maximum temperature of 28.40 °C and an average LST of 24.78 °C. A multitemporal comparison graph of the minimum, maximum, and mean LST values of Yogyakarta is presented in Fig. 3.

Figure 4 presents a multitemporal LST distribution map of Yogyakarta. LST distribution is classified into 5 temperature classes, namely 21–24 °C, 24.1–27 °C, 27.1–30 °C, 30.1–33 °C, and 33.1–36 °C. Traditionally, the temperature in the centers, namely Ngampilan Subdistrict, Gondomanan Subdistrict, and Kraton Subdistrict, have

Table 3. Descriptive statistics of LST in Yogyakarta before the pandemic, during the lockdown, and post-COVID-19 transition.

Condition	Image recording time	LST (°C)		
		Min	Max	Mean
Before the pandemic	April 2019	24.75	32.96	30.06
	August 2019	22.31	33.83	29.69
During the lockdown	May 2020	22.40	28.40	24.78
	August 2020	26.63	35.65	32.15
	May 2021	24.87	31.91	29.50
	August 2021	26.75	35.88	31.88
Post-Covid-19 transition	May 2022	25.82	33.30	29.86

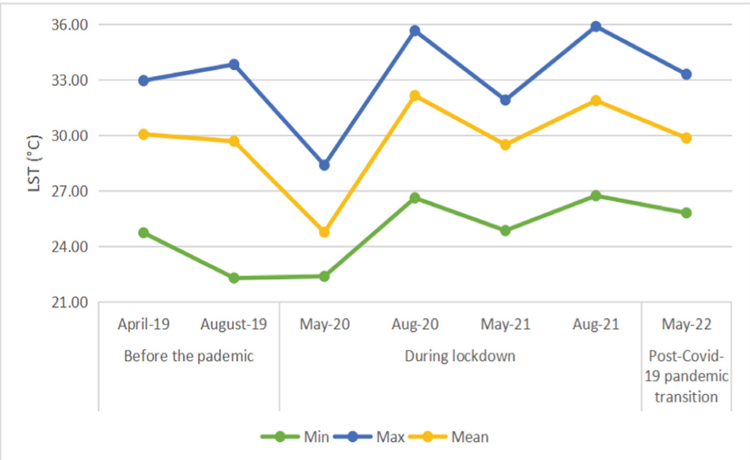

Fig. 3. Graph of multitemporal comparison of minimum, maximum, and mean LST values in Yogyakarta.

a higher temperature than the temperature in the outskirt subdistricts. The temperature of Yogyakarta was dominated by the temperature in a range of 27.1–33 °C, excluding May 2020 with the highest temperature in the range of 27.1–30 °C. In May 2020 when the lockdown policy was implemented, there were only 3 (three) temperature classes which were in the range of 21–30 °C. This range was lower than those of other periods with temperature classes dominated by temperatures in the range of 24.1–27 °C.

3.3 Relationship Between ESG and THI Before the Pandemic, During the Lockdown, and Post-COVID-19 Transition

Pearson Product-Moment Correlation

The multitemporal correlation between LST and THI variables in Yogyakarta is presented in Table 4. Based on Pearson's correlation calculations during the study, a very high correlation coefficient value was obtained in each study period which showed a value of more than 0.975 and a significance value of 0.000, indicating that the LST variable had a very high positive relationship to the THI variable. It can be summarized that the LST and THI variables have a very strong relationship.

The correlation between the LST and THI variables before the COVID-19 pandemic in Yogyakarta was carried out in April and August 2019. According to Pearson's correlation calculation in April 2019, a correlation coefficient value of 0.975 was obtained and a significance of 0.000. It indicates that there was a positive relationship between LST and THI with a very high level of relationship. The correlation coefficient in August 2019 had a value of 0.989 and a significance value of 0.000, meaning that the LST variable had a very high positive correlation with the THI variable.

The results of Pearson's correlation calculations were found between LST and THI during the lockdown in 2020 and 2021. The CARE policy in May 2020 showed a positive relationship between LST and THI with a very high correlation coefficient of 0.985 and a significance value of 0.000. The results of the correlation test in August 2020 show a correlation coefficient of 0.998, which is also categorized as a very high correlation. The same situation was observed in May and August 2021 lockdowns, the correlation coefficient in 2021 showed a very high degree of relationship with values of 0.998 and 0.997.

Correlation calculation test carried out during the post-COVID-19 transition in May 2022 shows the direction of a positive relationship between LST and THI. The correlation coefficient value was 0.990 with a significance value of 0.000. Based on this value, LST and THI show a very high relationship during the post-COVID-19 transition in Yogyakarta.

Simple Linear Regression

Calculation of a simple linear regression between the LST variable and the THI variable in Yogyakarta when multitemporal is presented in Fig. 5. Based on the results of the regression calculation during the research, the value of the coefficient of determination (R^2) was very high exceeding 0.952 or 95.2% in each research period. This implies that the LST variable has a high influence on the THI variable.

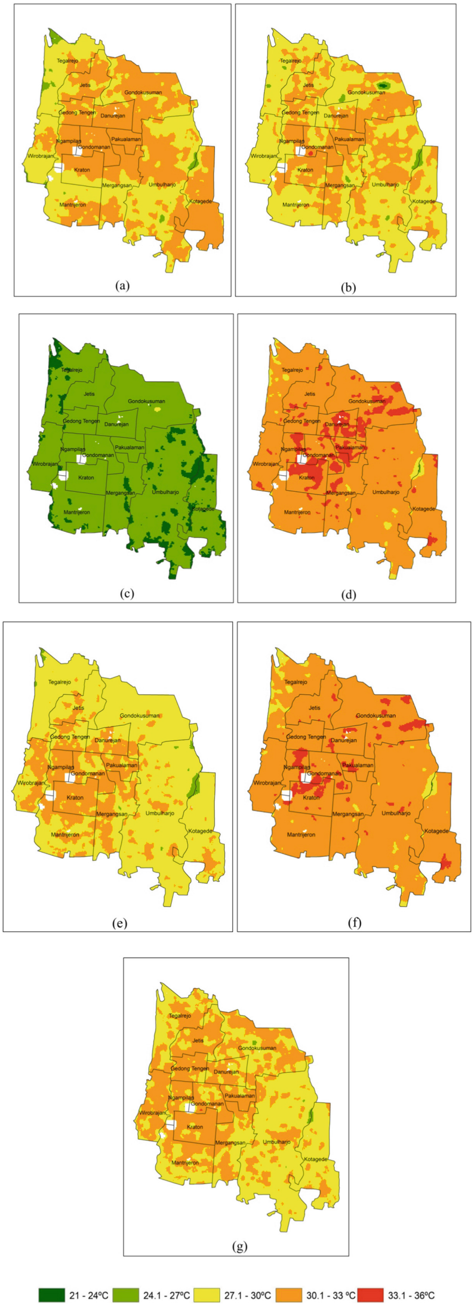

Fig. 4. Multitemporal LST distribution in Yogyakarta; (a) April 2019, (b) August 2019, (c) May 2020, (d) August 2020, (e) May 2021, (f) August 2021 and (g) May 2022.

Table 4. Multitemporal relationship between LST and THI variables in Yogyakarta.

Condition	Research period	Correlation		Variable	
				LST	THI
Before the pandemic	April 2019	LST	Pearson Correlation	1	.975***
			Sig (2-tailed)		.000
			N	70	70
		THI	Pearson Correlation	.975***	1
			Sig (2-tailed)	.000	
			N	70	70
	August 2019	LST	Pearson Correlation	1	.989***
			Sig (2-tailed)		.000
			N	70	70
		THI	Pearson Correlation	.989***	1
			Sig (2-tailed)	.000	
			N	70	70
During the lockdown	May 2020	LST	Pearson Correlation	1	.985***
			Sig (2-tailed)		.000
			N	70	70
		THI	Pearson Correlation	.985***	1
			Sig (2-tailed)	.000	
			N	70	70
	August 2020	LST	Pearson Correlation	1	.998***
			Sig (2-tailed)		.000
			N	70	70
		THI	Pearson Correlation	.998***	1
			Sig (2-tailed)	.000	
			N	70	70
	May 2021	LST	Pearson Correlation	1	.998***
			Sig (2-tailed)		.000
			N	70	70
		THI	Pearson Correlation	.998***	1
			Sig (2-tailed)	.000	
			N	70	70

(*continued*)

Table 4. (*continued*)

Condition	Research period	Correlation		Variable	
				LST	THI
	August 2021	LST	Pearson Correlation	1	.997***
			Sig (2-tailed)		.000
			N	70	70
		THI	Pearson Correlation	.997***	1
			Sig (2-tailed)	.000	
			N	70	70
	May 2022	LST	Pearson Correlation	1	.990***
			Sig (2-tailed)		.000
			N	70	70
		THI	Pearson Correlation	.990***	1
			Sig (2-tailed)	.000	
			N	70	70

**. Correlation is significant at the 0.01 level (2-tailed).

The results of the regression calculation before the COVID-19 pandemic in April 2019 obtained the regression equation y = 0.63 + 0.94x, with a coefficient of determination (R^2) value of 0.952 or 95.2%. It denotes that the THI variable was affected by LST by 95.2%, while 4.8% was influenced by other factors. The results of the regression calculation in August 2019 attained the regression equation y = 1.49 + 0.979x, with a coefficient of determination (R^2) of 0.979 or 97.9%. Based on these estimations, it can be understood that in August 2019, the THI variable was influenced by the LST variable by 97.9% and the remaining 2.1% was modified by other factors.

Regression calculations during the lockdown were carried out in 2020 and 2021. The regression equation y = 0.55 + 0.95x was obtained with a coefficient of determination (R2) value of 0.970 in May 2020. In the next period, August 2020, the regression equation attained y = 0.56 + 0.93x and the value of R^2 was 0.0996. These results demonstrate the high influence of LST on THI. The same goes in 2021, in which in May 2021 a coefficient of determination (R^2) value was 0.996 with the regression equation y = 0.56 + 0.93x. Figure 5 shows that the LST and THI variables show a linear pattern with a positive relationship.

The transitional conditions after COVID-19 were represented in May 2022 with the regression equation attained, namely y = 0.47 + 0.95x and a coefficient of determination (R^2) of 0.098. These results suggest that during the transitional conditions after the COVID-19 pandemic, LST had a high influence on the THI variable. This is reinforced by the linear pattern formed on the LST to THI graph which shows an upward elongated pattern, which denotes a positive relationship between LST and THI.

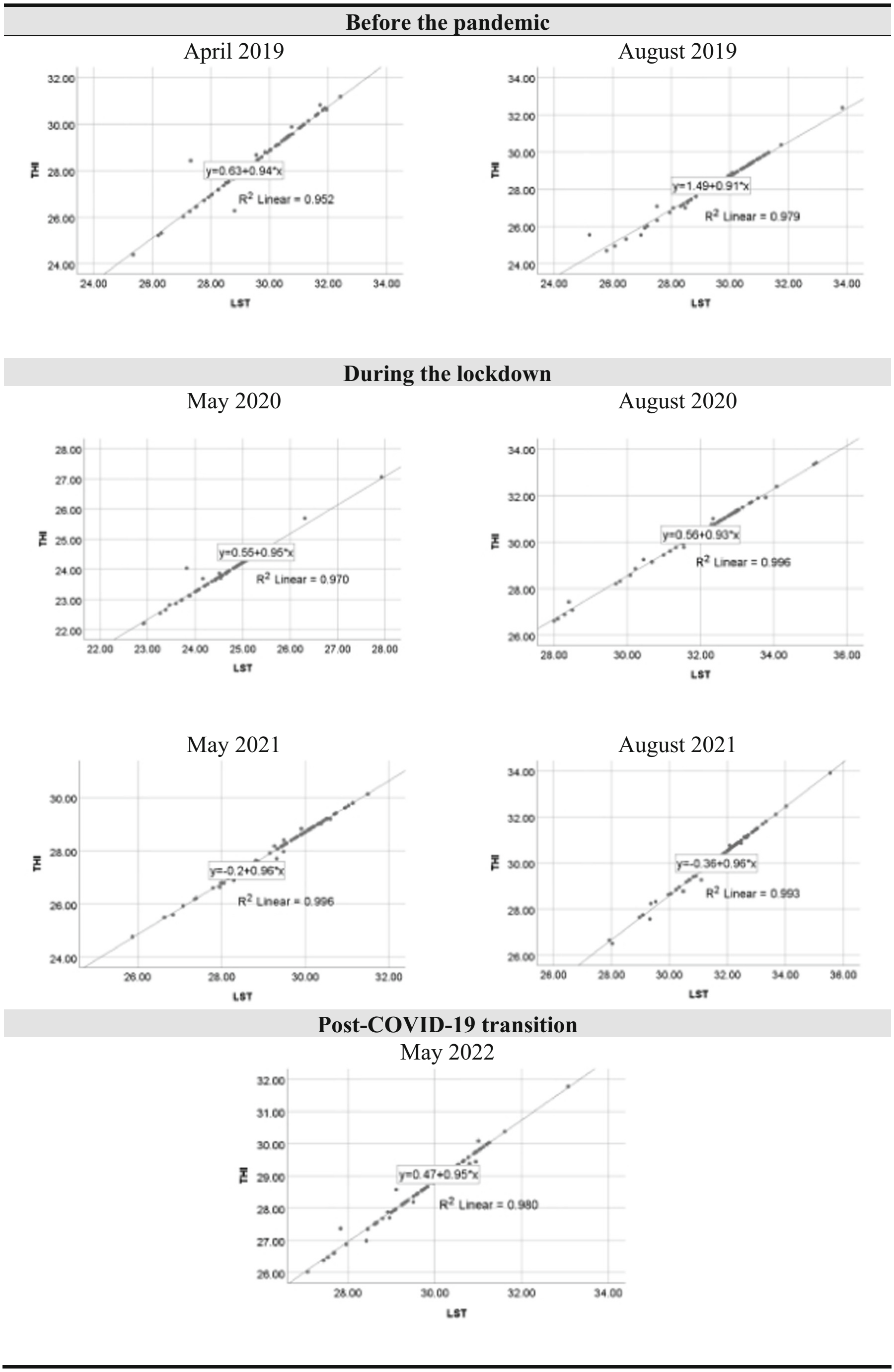

Fig. 5. Multitemporal effect of LST variables on THI in Yogyakarta.

3.4 Discussion

This research signifies the comfort level of the community using the Temperature Humidity Index (THI) method in Yogyakarta before the pandemic, during the lockdown policy, and post-COVID-19 transition. In general, the comfort level of THI did not change significantly besides May 2020. Figure 2 shows that throughout the period except May 2020, the comfort level of Yogyakarta people was dominated by areas with a very uncomfortable category. However, in May 2020 the level based on the THI index experienced a significant increase which was dominated by the comfortable category. These results correspond with the distribution of LST when in May 2020 lockdown there was a decrease in LST which had an impact on increasing the comfort level based on the THI index.

According to Wati & Fatkhuroyan (2017), temperature is a climate parameter that changes can be sensed immediately and affect the level of human comfort. The results of this study corroborate the research of Andani et al. (2018) regarding comfort levels that found decreased surface temperatures could increase comfort levels and vice versa. This is also controlled by land cover and vegetation factors. In research by Kartika et al. (2021), another factor that affects comfort level is resident size; a dense population accompanied by high anthropogenic activity impact increasing air temperature, which subsequently affects comfort levels.

A similar study conducted by Rushayati et al. (2011) suggests that differences in air temperature would determine comfort levels. Changes in LST in Yogyakarta from before the pandemic, during the lockdown, and post-COVID-19 transition experienced LST fluctuations. In general, the average LST in Yogyakarta had a relatively similar pattern. However, when the lockdown policy was implemented in May 2020, the average LST plummeted significantly. The lockdown policy would eventually restrain anthropogenic activities.

Research by Saputra et al. (2022) has a similar phenomenon in Jakarta during the implementation of the lockdown policy. It was found a shift in LST temperatures due to minimal human activity outdoors. Hamidy et al. (2021) state during and before the outbreak of COVID-19, it brought different intensities of anthropogenic activity, which also caused different LST values. Past research by Yoo et al. (2017) showed that the intensity of anthropogenic activities such as urbanization, settlements, transportation, and industry had the potential to increase LST. This is also corroborated by the research of Hadibasyir et al. (2020) that relatively high temperatures in urban areas were not only influenced by land cover factors but also by anthropogenic activities; when human activity declined during the lockdown period it resulted in a decrease in LST.

Based on the research results, it can be shown that the Land Surface Temperature (LST) variable has an influence on the Temperature Humidity Index (THI) variable. Prakoso (2018) suggests that if the air temperature increases, it will decrease in relative humidity, hence the air becomes dry. Or else, when the air temperature decreases, the air will become wet which precipitates an increasing relative humidity. This is reinforced by the results of this study, in which statistical tests showed that LST had a strong influence on THI with a very high coefficient of determination (R2) of more than 0.95 over the entire period.

4 Conclusion

This study compares the comfort level of the people of Yogyakarta using the Temperature Humidity Index (THI) method before the pandemic, during the lockdown, and post-COVID-19 transition. The results showed that the comfort level of Yogyakarta people fluctuated over the period. Significant changes occurred when the lockdown policy was implemented in May 2020, which led to an increase in the community comfort index accompanied by a decrease in the LST value simultaneously. Based on the results of statistical tests, it can be understood that there is a strong relationship and influence between the THI and LST variables.

This study concludes that changes in people's comfort levels based on the THI index can be determined by anthropogenic activities that contribute to changes in LST values. The suggestion for future researchers with similar research topics is to consider adding other variables that can affect comfort levels such as wind, rain, and so on. Data collection for further research can be carried out using higher resolution spatial data and combining weather data from observations in the field to provide a more comprehensive explanation of the phenomenon being studied.

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