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CASE STUDY

Urban green space during the Coronavirus disease pandemic with regard to the socioeconomic characteristics

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ABSTRACT

BACKGROUND AND OBJECTIVES: The spread of Coronavirus disease limited the activities of humans in the globe in 2020 with Jakarta reported to have also struggled with the virus. The pandemic stopped humans from visiting public amenities such as urban green spaces which are one of the key components of sustainable and livable cities and have the ability to reduce the negative impact on mental health. However, there are limited studies on the behaviors and perceptions of humans toward the usage of urban green spaces during the pandemic. Therefore, this study was conducted to determine the changes in the behaviors, perceptions, and visitation of residents towards the urban green space during the pandemic based on the socioeconomic aspects as well as the access and proximity to the parks and urban forests.
METHODS: A questionnaire was distributed through an online survey on social media for approximately two months, from March to April 2021, and the last data recorded showed there were 1,660 respondents. The attention was on their perceptions and visitation to the urban green spaces spread across administrative cities in Jakarta, representing 42 districts and 239 sub-districts. Data obtained were analyzed empirically using the partial least square structural equation approach and SmartPLS 3.0 software to determine the relationship between the respondents' characteristics and proximity to urban green space visitation.
FINDINGS: The results showed that almost half of the respondents perceived changes in the urban green spaces and the majority believed the spaces were more useful during the pandemic. It was also discovered that the socioeconomic characteristics of the respondents including age, education level, occupational status, and average monthly income differed statistically significantly from the criteria associated with the visitation to urban green spaces during the pandemic. The findings indicated that education was substantially associated with the decision to exercise and engage in outdoor recreation in urban green spaces. Meanwhile, not all houses close to the parks and urban forests have a statistically significant impact on their usage and this is the explanation for the non-correlation and non-causation.
CONCLUSION: This study showed that the perception of urban green space by the people changed during the pandemic but its usage was reduced due to the closures and restriction policies implemented. It was also discovered that socioeconomic characteristics have a significant influence on visitation but not all accessibility factors were significantly affected and this is different from the findings of previous studies. Moreover, this study discussed and shared empirical evidence that depicts urban green space as a resilient urban infrastructure during the pandemic. This means it is necessary to promote sustainable urban planning through the development of urban green spaces to manage the medium and long-term crises.

NUMBER OF REFERENCES	NUMBER OF FIGURES	NUMBER OF TABLES
56	5	6

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INTRODUCTION

Corona Virus Disease 2019 (COVID-19) first appeared in Wuhan, China, and was later declared an outbreak an international public health emergency on January 30, 2020 by the World Health Organization (WHO). The primary step implemented to suppress the spread was to reduce social contact in the community. Several countries also set quarantine policies and social restrictions to prevent infection and ensured health supervision. The pandemic affected all the countries in the globe, including Indonesia. It was discovered from the government data published that there were 6,708,737 cases, with 160,384 deaths in the country as of December 17, 2022 and this was the highest in Southeast Asia. As the capital city of Indonesia, Jakarta has the highest number of cases with 1,425,915 which is 22,2 Percent (%) of the total recorded in the country. This led the Jakarta Capital City Government (JCCG) to issue a Large-Scale Social Restriction policy to limit the spread, of the virus and this involved the restrictions placed on urban green spaces (UGS). It was also noted that exercise and recreational activities were limited and reduced (Giustino *et al.*, 2020). However, it was reported in a previous study that the closure of UGS is not the right solution for communities (Lopez *et al.*, 2020). This was associated with the ability of these spaces to positively influence mental health, specifically during a pandemic (Brooks *et al.*, 2020) considering the possibility of the social restrictions causing depression in humans (Fitzpatrick *et al.*, 2020). The advantages of the UGS include its ability to deliver ecological services, enhance the quality of life, improve the community's physical and mental health, and ensure urban sustainability. Fascinating investigations have been conducted on the link between UGS and human well-being and it was reported that the relationship between these concepts is vital for urban planning (Haq, 2011). This is due to the ability of the UGS to provide environmental services, ecology, social facilities, psychological benefits for society and human life (Chiesura, 2004), ecosystem services to urban residents (Larondelle *et al.,* 2014), ecological and economic value (Wu *et al.*, 2015), social benefits, contribution to public health (Wolch *et al.*, 2014) and an improvement in the quality of urban life and public welfare (Villanueva *et al.*, 2015). It was also believed to be an essential component of complex ecosystems (Brown *et al.*, 2014). Moreover, a previous study indicated the need to investigate the relationship between green infrastructure, ecosystems, and public health in the context of sustainable development (Khoshnava *et al.,* 2020). It has been recommended that urban planners should consider the management of UGS in meeting the needs and expectations of communities and this indicates its importance in regional development. Law Number 26 of 2007 concerning Spatial Planning requires UGS to cover at least 30% of the urban area in Indonesia. This was observed to have led the JCCG to project the development of 30% UGS in 2030 as stated in the Jakarta Spatial Planning 2030. The latest regulation on planning is the Governor Regulation Number 31 of 2022 concerning Detailed Spatial Plans for Planning Areas in Jakarta Province and was observed to have reduced the percentage of built-up area for the UGS zone to 4,804.89 ha or 7.56% from the figure stated in the previous regulation. Jakarta is Indonesia's most populated city and this means there were unique hurdles to preventing the spread of the virus. This was supported by previous findings that a high population density multiplies the effects of pandemic spread (Stier *et al*., 2020; Sobral *et al*., 2020). Therefore, UGS was considered an important factor in determining the quality of urbanization (Carpentieri *et al*., 2020). This is important because the pandemic affected air pollution in urban areas (Masum and Pal, 2020) as well as air quality parameters (Abu-Qdais *et al.,* 2020). It was also noted by Naderipour *et al.* (2020) that the social restriction policies implemented during the period reduced carbon footprint, carbon dioxide (CO_2) emissions, and improved energy savings. The pandemic threatened human mental and physical health with severe psychological consequences for humans (Bavel *et al*. 2020). This is in addition to the fact that the rapid economic growth and urbanization in developing countries have increased public environmental awareness (Oryani *et al*., 2022). The phenomenon has spurred previous studies to better understand the different planning priorities between the equity of social justice, economy, and environmental protection using the triangular model (Campbell, 2016). It has been discovered that urban development often comes at the expense of green areas and this has created challenges for planners and policymakers to protect open spaces (Bengston *et al*., 2004). A previous study showed that the efforts and policy initiatives of the JCCG to improve public parks, protect urban forests, and develop public green spaces are insufficient due to

an increase in the city population (Hwang *et al*. 2020). For example, the land use changes in the Jabodetabek area are dominated by an annual increase in the conversion to concentrated urban activities (Rustiadi *et al*., 2015). A geographic information system study also showed that the UGS in Jakarta decreased by 342.40 hectares (ha) from 2011 to 2018 with the highest recorded in the green belt zone (Setiowati *et al*., 2019). The UGS area in the city has also been ranked lowest compared to other big cities in the country and the globe (Setiowati *et al*., 2018). Furthermore, the data from Jakarta Satu showed that the highest and lowest distribution of UGS were 31.15% and 8.8% in East and West Jakarta, respectively. Kabisch and Haase (2014) reported that recreation in UGS has the ability to improve the quality of life. It was discovered by De Kleyn *et al.* (2020) that the activity mostly conducted in these spaces by communities during the pandemic was exercise. Therefore, the high conversion of UGS into built-up land in Jakarta possibly influenced the perceptions of the residents, specifically during the pandemic when there is an increase in the need for its usage. It is important to note that UGS planning and implementation are usually based on the incorporation of the values and lifestyles of the community. This means there is a need for more studies on the application and preference of UGS in rapidly urbanizing cities of developing countries (Wendel *et al*., 2011; Willemse, 2010). This also shows it is important to analyze perceptions of urban residents in order to improve the planning and management of UGS in times of crisis. Several studies have been conducted on the function of UGS but there was no focus on its usefulness during the pandemic. Therefore, this study was conducted based on the previous studies conducted in relation to the changes in behavior and attitudes towards the visitation to UGS during the COVID-19 pandemic as observed in Lopez *et al.* (2020) in New York, United States, and Ugolini *et al.* (2020) in six European countries using different analytical methods. A combination of non-physical (socio-economics) and physical factors (accessibility to UGS) was considered in this present study using a partial least-squares structural equation modeling (PLS-SEM) techniques to determine the impact of community visits to UGS during pandemics in densely populated cities of developing countries. The findings are expected to serve as recommendations for the government to manage UGS in the "new normal"

period and review policies set during the pandemic. They are also to provide an insight to urban planners and stakeholders that UGS is part of the green infrastructure resilience required in future crises. It is important to note that this is the first study to investigate the relationship between respondents' socioeconomic characteristics and proximity to UGS visits during a pandemic in Indonesia. The aims of the study are to 1) investigate the perception and behavior of residents' towards UGS during the pandemic, 2) analyze UGS visitations based on the socioeconomic characteristics of the residents during the pandemic, and 3) analyze UGS visitations during the pandemic based on residential proximity to UGS. This study was conducted in Jakarta, the capital of Indonesia, during the 2021 pandemic.

MATERIALS AND METHODS

Study area

Jakarta is the capital city of Indonesia with a land area of 662.33-kilometer square (km^2) and an ocean area of 6,977.5 km^2 as indicated in Fig. 1. The Province is divided into 5 administrative cities, 1 administrative district, and 44 sub-districts, 267 sub-districts, 2,731 residential units, and 30,417 neighborhood units. There are also 261 urban villages in South, North, East, West, and Central Jakarta. The 2021 Population Census conducted showed that there 10,562,088 people in the province with an annual population growth rate of 0.92 and a density is 14,555 people/square kilometer (people/km^2). This means it is the densest city in the country. Moreover, Jakarta is bordered to the north of the coast by approximately 35 kilometers (km) with nine rivers and two canals flow surrounding the Java Sea, to the south and east by West Java Province, and to the west by Banten Province. The city is located in the lowlands with an average elevation of 7 meters (m) above sea level and approximately 40% of its area is plains with a land surface 1–1.5 m below sea level. The hydrological conditions of Jakarta are represented by sub-watersheds (Central Bureau of Statistics, 2022). It also has two watersheds which include the Cisadane and Ciliwung River basins. The Ciliwung River has an estuary at Mount Pangrango, flows through Bogor, Depok, to Jakarta, and is considered the longest river in the city with a length of 46,200 m. It is pertinent to state that Jakarta has 13 rivers, 2 canals, and 2 floodways including the West and East Flood Canals designed to deal with flooding.
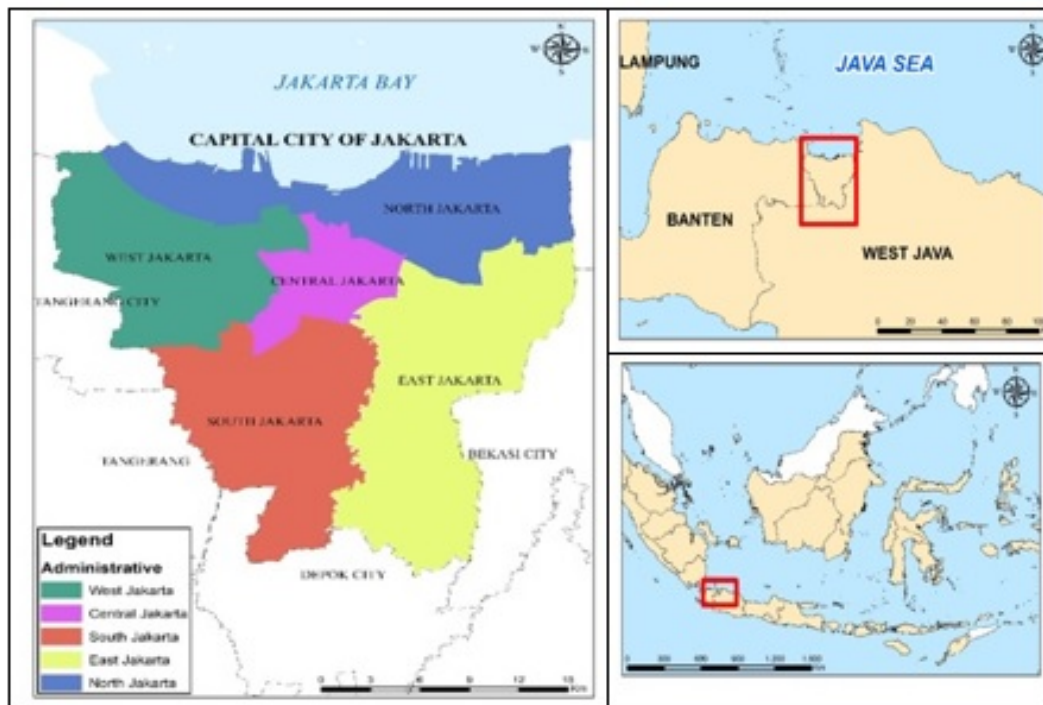
Fig. 1: Geographic location of the study area in Jakarta Capital City, Indonesia (Setiowati *et al.,* 2018)

Analysis of data
Data collection

Data were collected through a questionnaire circulated through an online survey on social media for approximately two months, from March to April 2021, and the data last recorded showed that there were 1,660 respondents representing 239 urban villages. It was discovered from the final results that there were 22 sub-districts without respondents including 6 in South Jakarta, 6 in East Jakarta, 4 in Central Jakarta, and 6 in West Jakarta. The questionnaire contained information on the characteristics of the respondents including the residential location, education level, occupational status, average monthly income, and age were obtained. Some key questions were also asked such as the perception of the respondents concerning UGS, proximity to UGS (park and urban forest) from their residential location, and visitation frequency for outdoor recreation and exercise activities during the COVID-19 pandemic.

Data analysis

This study analyzed the changes in the perceptions of people concerning UGS during the COVID-19 pandemic. It was based on the report of previous studies that the residents perceived the UGS to be more useful during the period because the facilities were resilient. The public perceptions were analyzed using descriptive analysis of the data obtained through a questionnaire. The PLS-SEM technique was applied to predict the perception and use of UGS during the pandemic and the conceptual framework model was observed to be complex as indicated in Fig. 3. It is important to note that SEM is a technique normally used to evaluate complex theoretical relationships between several variables, specifically when conducting social science study (Hair and Alamer, 2022). The two fundamental SEM methods are covariance-based structural equation modeling and PLS-SEM which are discovered to have been applied more frequently in recent times due to the shift in the attention of researchers to these methods (Ringle *et al.,* 2015). It has been previously reported that PLS-SEM supports external validity when the data assumption is non-normal and requires a better understanding of the theoretical model (Hair and Alamer, 2022). It normally uses the mean, median,
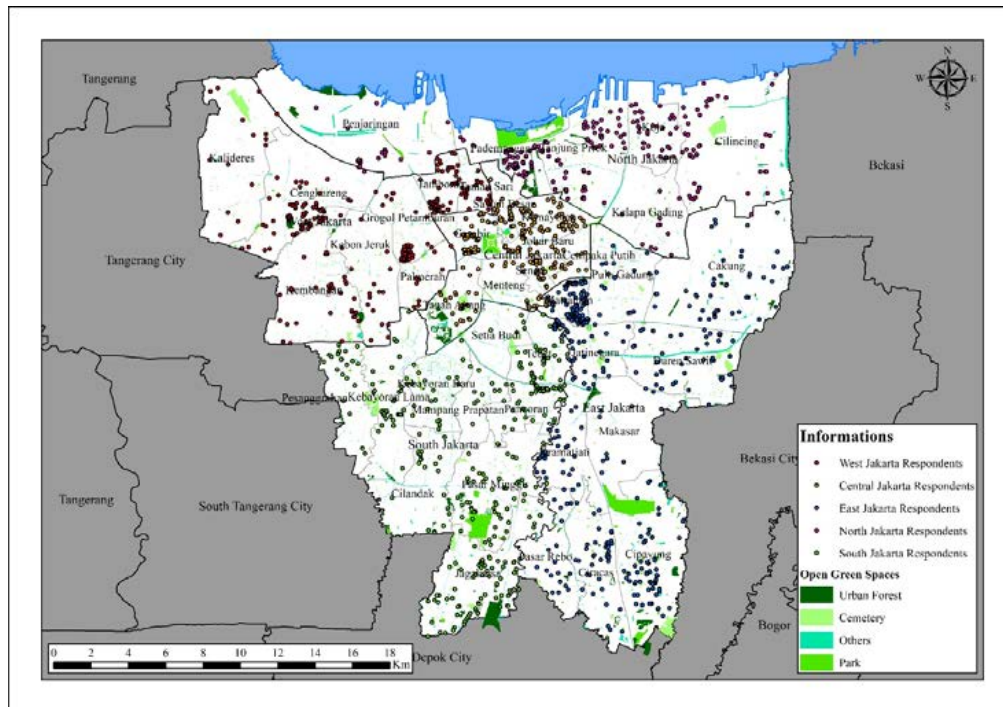
Fig. 2: Distribution of respondents and UGS in Jakarta Province, Indonesia

and standard deviation (SD) to compare two or more data sets to determine the difference in data (Yen *et al.,* 2017). Methodologically, PLS-SEM is a structured path estimation and essential multivariate analysis method to estimate the relationship between latent variables in SEM and is usually completed using Smart Partial Least Square (SmartPLS) software (Ringle *et al.,* 2015). The software was used to determine the relationship between respondent characteristics and UGS visits based on the data from the questionnaire. Meanwhile, the PLS-SEM determined the significance of the characteristics of respondents and the proximity of the UGS to their houses. The path coefficients of the structural model were determined using PLS algorithms based on the criteria that the significant path at P (Probability) ≤ 0.05 at a 95% confidence level and P ≤ 0.01 at a 99% confidence level. This means the three main steps applied in this study include a literature review, an open-ended questionnaire, and data analysis.

RESULTS AND DISCUSSION

Respondents' characteristics

A total of 1,660 responses were obtained from 44 sub-districts and 239 urban villages in Jakarta as presented in Fig. 2. It was discovered that 94.1% of respondents were in the productive age of 20–60 years old, 3.67% were elderly, and 2.23% were less than 20 years old. The findings also showed that 60.54% obtained a high school degree and 38.86% had a university-level one certificate. The percentage is high compared to other provinces in Indonesia because Jakarta has the highest level of education enrollment. Moreover, most respondents were unemployed and made an income below the Jakarta Provincial Minimum Wage of 297.20 United States Dollars (USD) in 2022 followed by those with 297.20 – 660.42 USD. It was also discovered that they have different occupational statuses with 422 (25.42%) found to be working in the government/ private sectors, 24.82% were unemployed, and 5.72% were blue-collar laborers while the others, 34.16%, had other occupations outside the previously mentioned categories. The summary of these socioeconomic characteristics is presented in the following Table 1.

The correlation between the respondents' residence proximity to UGS facilities such as parks and urban forests and visitation during the pandemic was also analyzed. The findings showed that the percentage

Characteristics of respondents

UGS visitation

- Age
- Education
- Occupation
- Income

- Just started
- Just started
- Exercise routine
- Recreation routine
- Exercise frequency
- Recreation
- Exercise location
- Recreational
- Travelling outside Jakarta

Proximity to UGS

UGS visitation

- Distance from residence to urban forest < 500 m
- Distance from residence to urban forest 500–1,000 m
- Distance from residence to park
- Distance from residence to park

- Just started exercising
- Just started
- Exercise routine
- Recreation routine
- Exercise frequency
- Recreation
- Exercise location
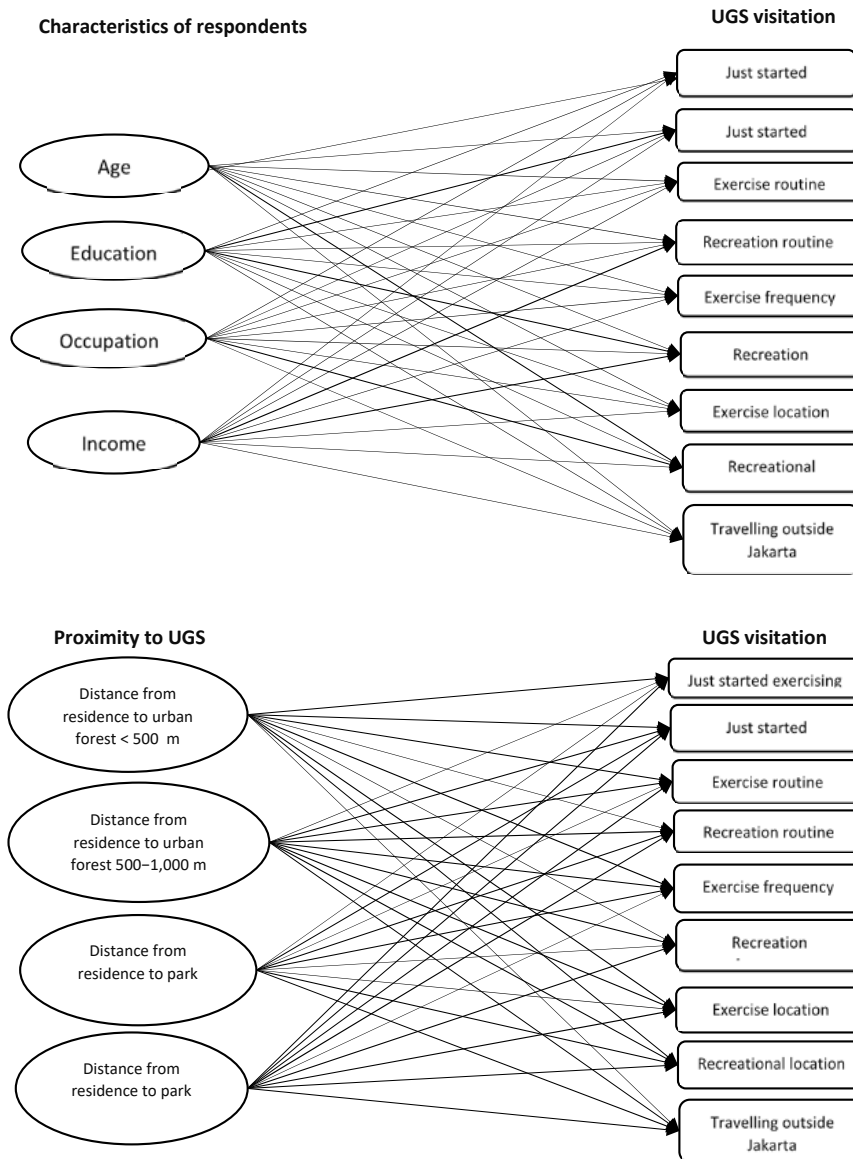- Recreational location
- Travelling outside Jakarta

Fig. 3: The conceptual framework

of visitation by those living less than 500 was only 11.27% while those within 500–1,000 had 21.08%. It was also discovered that visitation to parks was higher than to urban forests. This was indicated by the fact that the percentage of visitation to the park during the pandemic was 25.12% and 33.55%, respectively, for the two locations. Moreover, the percentage of people engaged in exercises and recreation routines reduced during the pandemic by 74.4% and 79.58%, respectively as previously explained by Setiowati et al. (2022). This empirically means some people still engaged in recreational and exercise activities at the time despite the restriction policies made by the government to close the parks and forests. A total of 26.63% and 21.08% were discovered to have just started visiting UGS during the pandemic for exercise and recreation activities respectively. This is in line with the findings of Setiowati et al. (2022) that

10.4% and 11.27% were motivated to visit parks for recreational and exercise activities respectively due to health reasons and to reduce stress and boredom caused by negative deviations from conditions before and during the pandemic. The data analysis also showed that 10.60% of respondents less than 20 years and within the productive age of 20-60 years visited urban forests located < 500 m while only 0.42% of the elderly respondents > 60 years visited. Meanwhile, the figures for the proximity within 500–1,000 m for < 20 years, 20-60 years, and > 60 years was recorded to be 18.67%, 19.76%, and 0.84%, respectively. It was also discovered that there were more visits to the parks within a radius of < 500 m compared to urban forests for respondents < 20 years, 20-60 years, and > 60 years with 23.49%, 23.19%, and 1.08%, respectively. The values for the 500–1,000 m distance were recorded to be 30.24%, 32.05%, and 0.96%, respectively, and these are believed to be higher than the other accessible options. It is important to note that those < 20 years and 20–60 years had similar visit trends to UGS during the pandemic. Furthermore, the results showed that 24.70% of 20–60-year-old respondents started exercising, 19.94% engaged in outdoor recreation, and 25.66% traveled outside Jakarta solely to conduct activities at UGS during the pandemic. This confirmed the opinion of a previous study that UGS was used for recreational and exercise activities in Jakarta during the pandemic (Ugolini *et al.*, 2020). The study further showed that the motivation of the respondents studied was reduced to the decrease in the UGS visits despite the importance of these spaces in providing a place for relaxation, rest, and exercise. This is in line

with the findings of this study that some respondents perceived the presence of UGS as necessary during the pandemic as indicated by 19.64% and 17.05% that did not change their exercise and recreation habits respectively. The summary of these findings is presented in Table 2 while the conceptual framework designed to assess the patterns of direct correlations between the characteristics of the respondents and their motivations to visit UGS as well as between residential proximity and motivations for visitation is indicated in Fig. 3.

Respondents' perception of UGS

The differences in individual values concerning infrastructure and institutions have been discovered to be based on relationship dimensions, knowledge, demographics, socioeconomic status, value orientation, learning interviews, and questionnaires (Allen and Cochrane, 2010; Silver *et al.*, 2010). The equitable and inclusive distribution of UGS to achieve sustainability in Jakarta is a challenge for JCCG and this is the reason it is important to discuss the changes in the perception of the residents. Indonesia struggled with the COVID-19 pandemic and has the highest cases in Southeast Asia while Jakarta was found to be the province with the highest in the country. This motivated the JCCG and National Government to issue a policy for social restriction, including closing parks and urban forests, in 2020. These news policies and changes in plans were required during the period due to the emergence of new behaviors and needs caused by the pandemic (Honey-Rosés *et al.*, 2020). The findings from the survey conducted showed that

Table 1: Socioeconomic characteristics of respondents

Variable	Sub-variable	Frequency	Percentage
Age	< 20 Years old	37	2.23
	20–60 Years old	1,562	94.1
	> 60 Years old	61	3.67
Education level	Non-educated/non-degree	10	0.6
	Graduated from high schools	1,005	60.54
	College graduates	645	38.86
Occupational status	Unemployed	412	24.82
	Government/private sectors	422	25.42
	Entrepreneur	164	9.88
	Blue-collar laborer	95	5.72
	Others	567	34.16
Average monthly income	IDR < 297.20 USD	1,134	68.31
	IDR 297.20 – 660.42 USD	264	15.9
	IDR 660.43 – 1,320.87 USD	89	5.36
	IDR > 1,320.87 USD	173	10.42

the people perceived a change in UGS during the pandemic. Most of them said that the space provided more assistance. This means UGS is beneficial for both the mental and physical health (Ugolini *et al.*, 2020) caused by the social restrictions and quarantine normally imposed in times of crisis. The results are believed to be a response to the recommendations made by Willemse (2010) and Wendel *et al.* (2011) to study the usage and preferences of UGS in cities experiencing rapid urbanization in developing countries such as Jakarta. Geng *et al.* (2021) also reported that green spaces served as a source of resilience during the pandemic partly due to their positive effects on the psychological, physical, and social cohesion of humans. Meanwhile, Wendel *et al.*

(2011) stated that the lack of assessment regarding the distribution and accessibility factors has reduced the lands allocated for UGS. It was also discovered that the urbanization in Jakarta is suppressing the quantity of UGS and this led to the discussion on the preferences of the residents in line with the quality of the activities being conducted in these spaces (Van Oijstaeijen *et al.*, 2020). Another study also showed that there is a change in the behavior of communities towards UGS during the pandemic with some people reported to be visiting these spaces for exercise and relaxation despite the social restrictions imposed (Ugolini *et al.*, 2020). The findings of this study showed that the highest change in the perception of the people at the time was recorded in Central Jakarta at 47.55% while the lowest

Table 2: Proximity to UGS and motivation for visitation

Questions	Answers	Frequency	Percentage
The distance of the residence from the urban forest < 500 m	No	1,473	88.73
	Yes	187	11.27
The distance of the residence from the urban forest 500–1,000 m	No	1,310	78.92
	Yes	350	21.08
The distance of the residence from the park < 500 m	No	1,243	74.88
	Yes	417	25.12
The distance of the residence from the park 500–1,000 m	No	1,103	66.45
	Yes	557	33.55
During the COVID-19 pandemic, did you just start exercising at UGS?	No	1,218	73.37
	Yes	442	26.63
During the COVID-19 pandemic, did you just start recreation at UGS?	No	1,310	78.92
	Yes	350	21.08
During the COVID-19 pandemic, how was your exercise routine at UGS?	Decreased	1,235	74.4
	Same as Before/No Change	326	19.64
	Increased	99	5.96
During the COVID-19 pandemic, how was your recreation routine at UGS?	Decreased	1,321	79.58
	Same as Before/No Change	283	17.05
	Increased	56	3.37
During the COVID-19 pandemic, how often did you exercise at UGS?	Once a week	196	11.81
	Once a month	399	24.04
	Not a routine	67	4.04
	Never	998	60.12
During the COVID-19 pandemic, how often did you have recreation at UGS?	Once a week	109	10.4
	Once a month	257	24.52
	Not a routine	99	9.45
	Never	583	55.63
During the COVID-19 pandemic, where was the UGS location you go for exercise?	Jakarta	977	58.86
	Outside Jakarta	35	2.11
	Jakarta and Outside Jakarta	126	7.59
	Never	522	31.45
During the COVID-19 pandemic, where was the UGS location you go for recreation?	Jakarta	781	47.05
	Outside Jakarta	63	3.8
	Jakarta and Outside Jakarta	181	10.9
	Never	635	38.25
During the COVID-19 pandemic, have you ever traveled outside Jakarta solely to carry out activities at UGS?	No	1,211	72.95
	Yes	449	27.05

was in South Jakarta at 44.71%. Moreover, a positive shift was recorded in the disposition of the people to these spaces as observed from the agreement of 73.24%–76.22% that the UGS was more beneficial during the pandemic with the highest found in Central Jakarta and the lowest in South Jakarta as presented in the following Table 3.

Visitation to urban green space

An interesting finding was that the respondents had started recreational and exercise activities because they considered UGS more useful during the pandemic and this indicates the ability of the green spaces to maintain physical and mental health. The awareness of these benefits influenced the behavioral intentions of the residents toward the usage of the UGS (Yen *et al.,* 2017). This is in line with the findings of another study that cultural differences influence user expectations and demands for UGS (Jim and Shan, 2013). Furthermore, access to the environmental benefits of UGS has emerged as an important concept in environmental justice. Previous studies identified accessibility as one of the main factors influencing the usage of UGS. For example, Byrne *et al.* (2009) showed that ease of access was an important reason for UGS visits and Wang *et al.* (2015a) identified it as a main factor influencing park utilization. Meanwhile, Douglas *et al.* (2020) reported that the initial response to worldwide restrictions was an increase in the usage of UGS for exercise and outdoor recreation. This shows that the people created a diversion and protected themselves from stress during the pandemic by visiting the UGS to experience urban nature. It was also discovered that the pandemic spurred the need to allot more green spaces in urban areas in the future as reported by Kleinschroth and Kowarik (2020) and Venter *et al.* (2020). The respondents' perceptions of UGS visitation during the pandemic were evaluated and the findings are presented in the following Table 4. It was discovered that 27% traveled outside Jakarta to

visit UGS despite the restrictions on people's mobility. Moreover, the highest percentage of those willing to travel during the period was found to be 29.91% in East Jakarta while the lowest was 21.78% in West Jakarta. It is important to note that community preferences are likely to be influenced by the distribution, quality, and accessibility of UGS. This is the reason the behavioral transformation of the people during the COVID-19 pandemic promoted them to visit UGS, thereby leading to an increase in demand. There is a need for further studies related to the usage of UGS, specifically due to the changes observed during the COVID-19 pandemic, in order to enrich the findings of this study.

Table 4 shows that exercise-related activities were conducted more than recreational activities during the pandemic. It was also observed that most recreational activities were in East Jakarta and North Jakarta while the lowest were in South Jakarta. Moreover, some respondents indicated the willingness to travel outside the city for the sole purpose of engaging in UGS activities despite the social restrictions. This was observed to be in line with the findings of Venter *et al.* (2020) that the increasing positive relationship between UGS and the remoteness of its location indirectly reduced the spread of COVID-19. It was discovered that the location of residences close to the parks and urban forests influenced the willingness to visit these green spaces to exercise or engaged in recreation. A previous study also showed that several urban residents do not have the opportunity to live close to open spaces, even though it is essential for their health (de Kleyn *et al.*, 2020). Dempsey and Dobson (2021) further indicated that the increase in the number of people exercising at the time showed the importance of the presence of UGS. Moreover, Slater *et al.* (2020) provided short and long-term recommendations to encourage access to the UGS limited by physical distance. Another study by Lopez *et al.* (2020) explained that the usage of UGS was considered more important for mental and physical health. The other factors associated with the usage

Table 3: Respondents' perceptions of UGS during the COVID-19 pandemic

No.	Administrative City	Transformation in the perception of UGS (%)		UGS is more useful (%)	
		'No'	'Yes'	'No'	'Yes'
1.	East Jakarta	52,90	47,10	25,22	74,78
2.	South Jakarta	55,29	44,71	26,76	73,24
3.	Center Jakarta	52,45	47,55	23,78	76,22
4.	West Jakarta	54,29	45,71	24,54	75,46
5.	North Jakarta	54,62	45,38	25,77	74,23

Table 4: Respondents' perceptions of UGS visitation during the COVID-19 pandemic in Jakarta

No.	Administrative City	Start recreation activities at UGS (%)		Start exercising at UGS (%)		Willingness to travel outside Jakarta to visit UGS (%)	
		No	Yes	No	Yes	No	Yes
1	East Jakarta	77,23	22,77	72,54	27,46	70,09	29,91
2	South Jakarta	82,06	17,94	75,29	24,71	70,29	29,71
3	Center Jakarta	77,62	22,38	73,08	26,92	73,78	26,22
4	West Jakarta	78,83	21,17	74,23	25,77	78,22	21,78
5	North Jakarta	79,23	20,77	71,54	28,46	73,85	26,15

of these spaces include the availability of leisure time (Lee, 2016) and income (Jim and Shan, 2013). However, the focus of this present study is on the relationship between socioeconomic characteristics variables and UGS visits with emphasis on 8 sub-variables including age, educational level, occupational status, average monthly income, less than 500 m and 500–1,000 m distance from the residential area to an urban forest or a park. Meanwhile, there were 9 sub-variables for the UGS visits and these include just started exercising at UGS during the COVID-19 pandemic, just started recreation activities during the COVID-19 pandemic, exercise routine, recreation activities routine, exercise frequency, recreation frequency, exercise location, recreational location, and willingness to travel outside Jakarta solely to conductive activities in UGS. It is important to note that urban planners are required to evaluate UGS by analyzing visitor profiles and preferences (Kabisch and Haase, 2014). There is also the need for the public sector to observe the dynamics and survey community needs (Panjaitan *et al*., 2022). This is necessary because the flow of ecosystem services benefits is normally influenced by interactions between green infrastructure, blue infrastructure, built areas, regulatory and institutional governance, perceptions, and individual values (Andersson *et al*., 2019). It is pertinent to reiterate that the perception of individuals as beneficiaries affected ecosystem services. Therefore, the PLS-SEM software applied in this study showed statistically significant relationships between the four socioeconomic characteristics of respondents and the nine sub-variables of UGS visits. This was confirmed by the fact that 7 out of the 36 hypotheses developed were supported at a significance of P = 0.001 level and 2 at P = 0.05 as presented in Table 5 and Fig. 4. It was discovered that the age criterion was positive and significantly related to the behavioral intention to travel outside Jakarta solely for activities

in UGS as indicated by the significant path coefficient with mean = -0.048, T = 2.181, SD = 0.022, and p < 0.05. Furthermore, education criteria were positively and significantly related to just started exercising and recreation activities constructs of the UGS as presented by the path coefficient for the "just started exercising" with mean = -0.083, T = 2.867, SD = 0.029, and p < 0.01 and just started recreation activities with mean = -0.088, T = 3.197, SD = 0.027, and p < 0.01. The findings also showed that occupational status had a positive and significant relationship with exercise frequency, recreation frequency, and recreational location with p < 0.01. Moreover, the average monthly income was also found to be positively and significantly related to exercise routine, recreation routine, and traveling outside Jakarta solely for UGS activities with path coefficient (Mean = 0.101, T = 3.273, SD = 0.031, p < 0.01), (Mean = 0.077, T = 2.566, SD = 0.031, p < 0.05), and (Mean = 0.087, T = 2.634, SD = 0.033, p < 0.01), respectively.

Table 5 shows the relationship between respondents' characteristics and UGS visitation which was assessed using SmartPLS software at 95% and 99% confidence levels. It was discovered that the age variable only had a significant influence on the willingness to travel outside Jakarta for UGS activities. There was also a substantial correlation between the education level and the initiatives to start exercising and recreational activities in UGS during the pandemic. Moreover, occupational status had three significant correlations with exercise frequency, recreation frequency, and recreational location. The average monthly income was also observed to have a significant relationship with exercise frequency, recreation frequency, and willingness to travel outside Jakarta for UGS activities during the period. It is important to note that aligning the role and accessibility of UGS with institutions, perceptions, and stakeholder interests is the main

Table 5: The relationship between characteristics of respondents and visitation to UGS using PLS-SEM

No.	Characteristics of respondents	Visitation to UGS	Mean	SD	T Statistics	*p* Values
1.	Age	Just started exercising	-0.034	0.024	1.361	0.174
		Just started recreation	-0.034	0.022	1.511	0.131
		Exercise routine	0.001	0.023	0.031	0.975
		Recreation routine	0.022	0.024	0.880	0.379
		Exercise frequency	0.018	0.024	0.702	0.483
		Recreation frequency	0.012	0.027	0.421	0.674
		Exercise location	0.037	0.022	1.592	0.112
		Recreational location	0.030	0.024	1.201	0.230
		Traveling outside Jakarta solely for activities in UGS	-0.048	0.022	2.181	0.030**
2.	Educational level	Just started exercising	-0.083	0.029	2.867	0.004***
		Just started recreation	-0.088	0.027	3.197	0.001***
		Exercise routine	0.005	0.029	0.258	0.796
		Recreation routine	0.020	0.028	0.718	0.473
		Exercise frequency	0.013	0.031	0.368	0.713
		Recreation frequency	0.001	0.030	0.016	0.987
		Exercise location	0.006	0.031	0.160	0.873
		Recreational location	0.017	0.030	0.596	0.552
		Traveling outside Jakarta solely for activities in UGS	0.020	0.028	0.712	0.477
3.	Occupational status	Just started exercising	0.006	0.025	0.221	0.825
		Just started recreation	0.006	0.024	0.300	0.764
		Exercise routine	0.041	0.025	1.661	0.097
		Recreation routine	0.048	0.026	1.867	0.062
		Exercise frequency	-0.061	0.023	2.634	0.009***
		Recreation frequency	-0.093	0.023	4.003	0.000***
		Exercise location	-0.033	0.025	1.337	0.182
		Recreational location	-0.088	0.025	3.494	0.001***
		Traveling outside Jakarta solely for activities in UGS	-0.033	0.024	1.351	0.177
4.	Average monthly income	Just started exercising	0.033	0.029	1.121	0.263
		Just started recreation	0.046	0.029	1.541	0.124
		Exercise routine	0.101	0.031	3.273	0.001***
		Recreation routine	0.077	0.030	2.566	0.011**
		Exercise frequency	-0.057	0.031	1.807	0.071
		Recreation frequency	-0.029	0.030	0.909	0.364
		Exercise location	0.000	0.029	0.031	0.975
		Recreational location	-0.008	0.030	0.250	0.803
		Traveling outside Jakarta solely for activities in UGS	0.087	0.033	2.634	0.009***

Note: **indicates p ≤ 0.05; *** indicates p ≤ 0.01

challenge to its utilization. This was confirmed by the findings of Payne *et al*. (2002) that age had a strong influence on the preference and behavior of people in UGS. It was further stated that people with higher educational levels had more understanding of the need to prioritize health improvement during the COVID-19 pandemic. It was stated in previous studies found that UGS has the ability to reduce stress and also offers different psychological and emotional benefits during health crises. This can be stated to be the reason most respondents traveled outside Jakarta to enjoy UGS in the suburbs despite social restrictions and the trend was found to have been influenced by age and average monthly income. Furthermore, the patterns of direct correlations between the characteristics of respondents and their motivations for UGS visitation are presented in Fig. 4. It was discovered that UGS visitation was encouraged by the educational level as indicated by the percentage of those that started exercising and recreation at these spaces at the
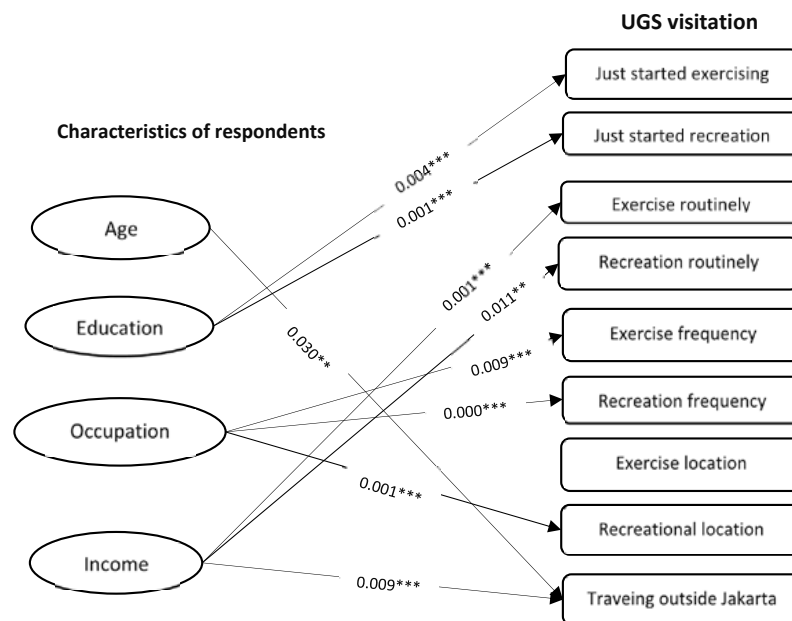
Fig. 4: The patterns of direct correlations between the characteristics of respondents and motivations for UGS visitation (** p < 0.05; *** p < 0.01)

time. Age and education level also had a significant influence on the willingness to travel outside Jakarta solely to visit UGS as well as to start exercising and engaging in recreational activities. Meanwhile, the occupational status sub-variable had three significant correlations with exercise frequency, recreation frequency, and recreational location. The average income level also had a strong effect on exercise frequency, recreation frequency, and willingness to travel outside Jakarta solely to visit UGS. The findings also showed that respondents within the productive age started exercising, engaging in outdoor recreation, and traveling outside Jakarta to visit UGS during the COVID-19 pandemic.

The PLS-SEM software applied for data analysis showed statistically significant relationships between the proximity of residential areas to UGS with three criteria out of nine associated with UGS visits, except for the distance of 500–1,000 m from the residential area to the park. It was also noted that only 1 out of the 36 hypotheses developed was supported by significant relationships at P = 0.001 level and 2 at P = 0.05 as indicated in Table 6 and Fig. 5. Moreover, the < 500 m distance from residence to an urban forest was observed to have a positive and significant influence on only the visitation to a recreational location with

the path coefficient recorded to be mean = -0.052, T = 2.106, SD = 0.024, and p < 0.05. The 500–1,000 m distance from residence to an urban forest was also discovered to have a positive and significant effect on the "just started exercising" variable of the UGS visitation with the path coefficient reported to be mean = -0.069, T = 3.108, SD = 0.022, and p < 0.01. It was also discovered that the < 500 m distance from the residence to the park positively and significantly affected the recreation frequency with a path coefficient of mean = 0.068, T = 2.404, SD = 0.028, and p < 0.05. Table 6 shows the relationship between the proximity of the residential areas to the UGS and the visitation tendency using PLS-SEM software at 95% and 99% confidence levels. It was discovered that the respondents living less than 500 m and 500–1,000 m to the urban forest had a significant correlation with recreational locations and to start exercising when they visit UGS. The findings further showed that those living less than 500 m from the park also had a significant correlation with exercising location but those at 500–1,000 m did not. Another observation showed that the respondents in residence located less than 500 m from the urban forest significantly correlated with UGS's recreational activities while those within a radius of 500–1,000 m had a better substantial relationship with
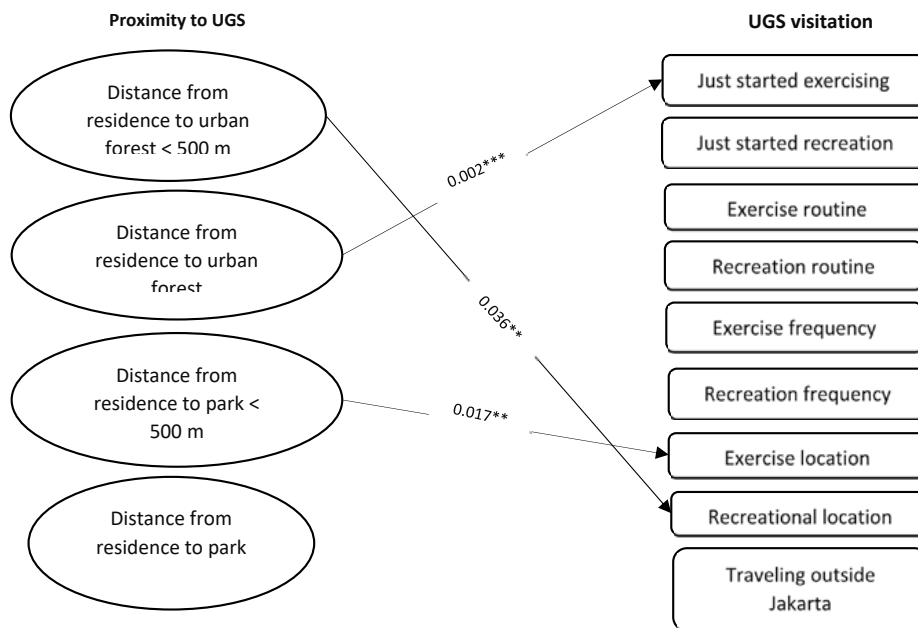
Proximity to UGS   **UGS visitation**

Fig. 5: The patterns of direct correlations between residential proximity to UGS and motivations for UGS visitation (** p < 0.05; *** p < 0.01)

the initiative to start exercising during their visits to UGS. The findings showed that those residing less than 500 m from the park had a significant correlation with a visit to exercise locations but those within 500–1,000 m had none. These findings differ from the observation of Lopez *et al.* (2020) that visitors were motivated to visit New York's green spaces due to social distance and accessibility. Meanwhile, it was discovered that the proximity to parks and urban forests in Jakarta barely correlated with the motivation to visit as indicated in Fig. 5. This means accessibility is not a significant factor in utilizing UGS in Jakarta. This is similar to the findings of Yen *et al.* (2017) that accessibility is not significant to the usage of UGS through a study conducted in Phnom Penh, Cambodia, a developing country, using PLS-SEM. However, it is contrary to the results presented by Andersson *et al.* (2019) and Honey-Rosés *et al.* (2020) that accessibility has a psychological relationship with the perceptions of users. It is also different from the findings of Wang *et al.* (2015a), Koohsari *et al.* (2013), Wang *et al.* (2015b), and Byrne *et al.* (2009) that one of the factors influencing behavioral intention to use UGS is accessibility.

There was a decrease in activity at UGS during the pandemic compared to the pre-pandemic period (Setiowati *et al.,* 2022) but there was an increase in

the number of visits during the post-pandemic period because the parks and urban forests previously closed were opened as observed in Tebet Eco Park. This park is under the management of JCCG in Tebet District, South Jakarta, and has become the favorite for residents and visitors from outside Jakarta since the beginning of the "new normal". It was discovered that the residents had a very high enthusiasm after Eid as observed from the City Parks and Forestry Agency data that the number of visitors on May 8, 2022 reached 47,052 people and this was higher than the figures before the COVID-19 pandemic. It is pertinent to note that the UGS in Jakarta, such as parks and urban forests, were re-opened by JCCG on October 23, 2021 in line with the reduction of the social restrictions to level 2 based on Governor Decree Number 1245 of 2021. President Joko Widodo also officially lifted the social restriction policy in Indonesia on December 30, 2022. Meanwhile, it was discovered that there was an increase in the number of visits to UGS during post COVID-19 pandemic because the parks and urban forests were opened but there is a need for further study on this trend. Previous study showed that the restriction policy affected the standard of living of the people in Jakarta (Pribadi *et al.*, 2020). This is indicated by the reduction in their purchasing power which led to the provision of social assistance

Table 6: The relationship between proximity to UGS and visitation to UGS using PLS-SEM

No.	Proximity to UGS	Visitation to UGS	Mean	SD	T Statistics	p Values
1.	Distance from residence to urban forest < 500 m	Just started exercising	0.034	0.026	1.355	0.176
		Just started recreation	0.025	0.025	0.986	0.324
		Exercise routine	0.019	0.025	0.787	0.431
		Recreation routine	-0.004	0.023	0.111	0.911
		Exercise frequency	-0.041	0.025	1.622	0.105
		Recreation frequency	-0.044	0.026	1.739	0.083
		Exercise location	-0.021	0.024	0.842	0.400
		Recreational location	-0.052	0.024	2.106	0.036**
		Traveling outside Jakarta solely for activities in UGS	0.005	0.026	0.149	0.881
2.	Distance from residence to urban forest 500–1,000 m	Just started exercising	-0.069	0.022	3.108	0.002***
		Just started recreation	-0.034	0.023	1.487	0.138
		Exercise routine	0.030	0.027	1.187	0.236
		Recreation routine	0.016	0.027	0.680	0.497
		Exercise frequency	0.018	0.026	0.734	0.463
		Recreation frequency	-0.003	0.026	0.068	0.946
		Exercise location	0.009	0.025	0.438	0.662
		Recreational location	-0.002	0.026	0.081	0.935
		Traveling outside Jakarta solely for activities in UGS	-0.024	0.026	1.051	0.294
3.	Distance from residence to park < 500 m	Just started exercising	-0.043	-0.043	-0.043	-0.043
		Just started recreation	-0.017	0.024	0.699	0.485
		Exercise routine	0.000	0.027	0.018	0.986
		Recreation routine	-0.002	0.029	0.098	0.922
		Exercise frequency	0.052	0.027	1.929	0.054
		Recreation frequency	0.047	0.026	1.706	0.089
		Exercise location	0.068	0.028	2.404	0.017**
		Recreational location	0.023	0.026	0.829	0.407
		Traveling outside Jakarta only for activities in UGS	-0.045	0.026	1.687	0.092
4.	Distance from residence to park 500–1,000 m	Just started exercising	-0.008	0.028	0.282	0.778
		Just started recreation	-0.006	0.027	0.126	0.900
		Exercise routine	-0.003	0.027	0.153	0.878
		Recreation routine	-0.002	0.026	0.135	0.893
		Exercise frequency	0.016	0.028	0.561	0.575
		Recreation frequency	0.037	0.027	1.341	0.180
		Exercise location	0.039	0.027	1.468	0.143
		Recreational location	0.045	0.026	1.693	0.091
		Traveling outside Jakarta solely for activities in UGS	-0.014	0.029	0.501	0.617

Note: **indicates $p \leq 0.05$; *** indicates $p \leq 0.01$

by the government because of the declining national income and slow economic growth. The policy also led to the closure of all UGS in Jakarta and drew much criticism because several people were still commuting and most companies were still operating. The study conducted by Caraka *et al.* (2020) showed significant differences in the mobility of the population before and during the COVID-19 pandemic in Indonesia. It was reported that there were severe economic losses and real disruption of activities in all walks of life due to large-scale restrictions. Moreover, the information in the mass media showed the emergence of a new habit in Jakarta which was in the form of an increase in the number of cyclists during the pandemic but the trend has reduced recently. Venter *et al.* (2020) also reported a similar situation in Oslo, Norway, with the visits to UGS for recreation and sports observed to increase during the lockdown by 291% and 324%, respectively. This means the social restrictions policy implemented in Jakarta to reduce the usage of UGS did not stop the motivation of some people to engage in recreational and exercise activities in these spaces.

A previous study showed that knowledge, practice, identity, beliefs, views, literature, and art influence the design of UGS planning (Kenter, 2016). It was also noted that subjective perception is an interpretation of the benefits of ecosystem services shaped by culture and institutions (Andersson *et al.*, 2019). This simply showed that social and cultural characteristics influence the perceptions and preferences of visitors to UGS in Jakarta. Therefore, the city government needs to conduct an evaluation and assessment of UGS management in order to accommodate the needs and expectations of the users in the planning design. This is necessary because public space is one of the urban elements that give character and identity to a city and also provides socioeconomic, environmental, and cultural functions to communities.

CONCLUSION

Jakarta has been dealing with the COVID-19 pandemic for roughly three years and the social restrictions and UGS closure policy implemented discouraged visitation to the green spaces in the city. It was discovered that there is no study on the usage of public UGS during the pandemic based on the socioeconomic attributes of the residents and the distance of their residence to parks and urban forests in Indonesia, specifically on a regional scale such as Jakarta Province, despite the fact that the behavior of the people in relation to UGS visitation changed during the period. Therefore, this study applied PLS-SEM analysis to determine the relationship between socioeconomic characteristics and access to UGS to provide empirical evidence needed by city planners in designing parks and urban forests. The results showed that there are substantial and functioning UGS in Jakarta and they were perceived by the residents to be more useful during the COVID-19 pandemic. The same homogenous preferences were also perceived by the community at the administrative city level in Jakarta. The factors observed to be influencing public use of UGS in the city were discovered to include the socio-demographic characteristics of the users and access to the facilities. These characteristics include age, education level, occupational status, and average monthly income level. This study statistically showed that the accessibility to parks and urban forests had only 3 out of the 36 significant associations relates to the utilization of UGS. The finding is contrary to related studies in other countries that accessibility is an important reason for UGS visits. This shows the need to analyze the change in the behavior of people visiting UGS during the COVID-19 pandemic in order to plan and make appropriate policies to ensure sustainable urban development. UGS was empirically confirmed to be a resilient urban infrastructure during a pandemic but Jakarta policymakers and city planners need to further improve the quality of the current UGS to ensure better accessibility and excellent activities. This study only provided the perception of UGS by the residents of Jakarta which is the capital city of Indonesia and this means the results cannot be generalized to other provinces of the country. Therefore, there is a need to conduct further investigation on the use of UGS during the post-pandemic period in Jakarta and other provinces using additional variables. The limitation of this study is the usage of only four variables to represent the socioeconomic characteristics of the respondents and determine their tendency to visit UGS. It is recommended for future studies to focus on analyzing UGS visits using more varied characteristics such as gender and marital status with attention placed on the comprehensive analysis of each factor. The characteristics of public UGS can also be analyzed based on the area, categories, and quality. These are necessary to promote sustainable urban planning and develop resilient UGS in responding to the long-term crisis of the COVID-19 pandemic.

AUTHOR CONTRIBUTIONS

R. Setiowati conducted all the experiments and wrote the manuscript. R.H. Koestoer as the corresponding autor as well, participated in the interpretation of the results and revised the manuscript, K. Mizuno revised the manuscript, and H.S. Hasibuan contributed to the data analysis and revised the manuscript.

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CONFLICT OF INTEREST

The author declares that there is no conflict of interest regarding the publication of this manuscript. In addition, the ethical issues, including plagiarism,

informed consent, misconduct, data fabrication and/ or falsification, double publication and/or submission, and redundancy have been completely observed by the authors.

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ABBREVIATIONS

%	Percent
COVID-19	Corona virus disease 2019
CO_2	Carbon dioxide
ha	Hectare
JCCG	Jakarta Capital City Government
km	Kilometers
km^2	Kilometer square
No.	Number
m	Meters
m^2	Meter square
p	Probability
people/km^2	People/ square kilometer
PLS-SEM	The partial least square structural equation model
SD	Standard deviation
SmartPLS	Smart partial least square
T	T Statistic
UGS	Urban green space
USD	United States Dollar
WHO	World Health Organization

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