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Factors influencing residents' attitude towards urban green infrastructure in Lagos Metropolis, Nigeria

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Abstract
Understanding public attitudes towards the environment and factors influencing it is very important in predicting pro-environmental behaviour of citizens. However, in many cities in sub-Saharan Africa, where rapid urbanisation has come with diverse environmental sustainability challenges, there are very few studies that provide insight into the attitude of citizens towards urban green infrastructure (UGI) and the factors influencing it. This study investigated residents' attitude towards UGI and the factors influencing it in Lagos Metropolis, Nigeria. The data were collected through a questionnaire survey of 1560 participants and physical observations in selected neighbourhoods in the study area. The data were analysed using descriptive statistics, multiple regression and content analyses. It was observed that the most common UGI in the study area were parks, gardens, grasses, sport fields and street trees and that around 67% of the participants demonstrated good attitude towards UGI in their respective neighbourhoods. In addition, around 47% of the variance in R^2 was explained by the regression model with residents' perceived role of UGI in fostering social cohesion and health benefits and quality of neighbourhood UGI emerging as the top three factors that influenced residents' attitude towards green infrastructure. This study implies that adequate knowledge of the social and health benefits and quality of GI are vital to developing positive attitudes towards GI among urban population.

Keywords Environmental attitude · Environmental sustainability · Green infrastructure · Lagos · Urban areas · Survey

1 Introduction

The increasing impacts of environmental challenges on cities and their inhabitants have intensified the need to integrate green infrastructure into urban built environments. Green infrastructure refers to a network of natural and semi-natural landscape and features (Kumar et al. 2019; Dipeolu and Ibem 2020) including public parks and gardens, greenways, street verges, gardens, green roofs and walls, squares and plazas, natural green space,

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and open spaces, streams, wetlands, riparian corridor, street trees, hedges, bushes, sports and recreational facilities in the built environment (Ely and Pitman 2014; Adegun 2019; Chiabai et al. 2020). The existing studies (Bowler et al. 2010; Dipeolu 2017; Adegun 2018) have shown that the integration of UGI in the built environment brings several benefits. Consequently, research on the different aspects of UGI is on the increase globally, except perhaps in countries in sub-Saharan Africa where du Toit et al. (2018) reported a lack of adequate research.

Although several aspects of UGI such as public preferences (Larsen and Harlan 2006; Zhang et al. 2013), perception (Özgüner and Kendle 2006) and benefits of UGI (Stigsdotter et al. 2010; Bowler et al. 2010; Dipeolu 2017; Adegun 2018) have received enormous research attention, one aspect of UGI that is yet to be adequately researched, especially in less developed countries in Africa, is public attitude towards UGI. Environmental attitude deals with the way people generally think about and relate with the environment (Eilam and Trop 2012), and it has been recognised as having a strong link with ecological behaviour (Gifford and Sussman 2012). In the context of this study, attitude towards UGI refers to the way urban population think about the role of the different forms of UGI and relate with them.

The review of literature reveals that several authors (Balram and Dragicevi 2005; Lee and Kim 2015; Tsantopoulos et al. 2018) have explored attitude towards UGI in the developed countries. Aggregate findings of these studies indicate that people had generally shown different attitudes towards GI, and that this has been influenced by a wide range of personal and non-personal factors and that the links between green spaces and humans are complex with differences existing across cultures and countries (Kovács et al. 2014; World Health Organisation (WHO) 2016).

From the African context, few studies on UGI exist in South Africa (Shackleton et al. 2014; Adegun 2017a, b, 2018, 2019), Ghana (Mensah 2014), Tanzania (Roy et al. 2018) and Nigeria (Oluwafeyikemi and Julie 2015; Dipeolu and Ibem 2020), but these studies failed to provide understanding of public attitudes towards UGI in these countries. As a result, Ogunbode et al. (2020) reported that low knowledge of public attitudes towards the ecological environment has continuously marred the development and implementation of appropriate environmental protection and management policies and programmes in many countries in sub-Saharan Africa. The foregoing suggests that the findings of existing studies on public attitude towards UGI in the developed countries are inconclusive and cannot be generalised as the true situation in countries in sub-Saharan Africa. Hence, more studies that reflect the context of countries in sub-Saharan Africa are needed.

It was against this background that this study sought to investigate residents' attitude towards green infrastructure and the factors influencing this in residential neighbourhoods in Lagos Metropolis, Nigeria. The specific objectives were to:

(1) Identify the different types of green infrastructure in selected residential neighbourhoods in Lagos Metropolis;
(2) Examine residents' general attitude towards the existing urban green infrastructure in the study area; and
(3) Determine the factors that influenced residents' attitude towards urban green infrastructure in selected residential neighbourhoods in Lagos Metropolis.

This study makes contribution to knowledge by improving understanding of how residents' in the study area think about the existing stock of UGI in their neighbourhoods and

the key factors that significantly influenced this. It also improves understanding of the strategies for ensuring that urban population develop more favourable attitude towards GI. In view of the fact that adequate understanding of public attitude towards the environment is essential in developing and implementing context-specific environmental protection and management policies and programmes, the findings of this study are expected to inform policy decisions and practice in developing effective management strategies for UGI in Lagos and other cities in sub-Saharan Africa.

2 Literature review

2.1 Urban green infrastructure (UGI) and its benefits

In the research literature, terms such as urban green infrastructure (Tzoulas et al. 2007; Shackleton et al. 2017; Adegun 2019), green space (Fratini and Marone 2011; Arnberger and Eder 2012), natural ecosystems (Swanwick et al. 2003) and green structures (Mensah 2014) have been used interchangeably to describe all forms of natural, semi-natural and artificial networks of multifunctional ecological systems within urban areas, including parks, soft surfaces such as soil, grass, shrubs and street trees, domestic and communal gardens and water bodies, riparian corridors, cycle paths, cemetery, sports fields and others. This seems to be in line with the views by authors, indicating that the different terms used to describe GI often depend on the contexts in which they are used (Kumar et al. 2019) and the background of authors (Idiata 2016).

Previous authors (Roy et al. 2012; Wolch et al. 2014; Adegun 2018; Dipeolu and Ibem 2020) have shown that UGI can be classified into four basic forms/categories based on their characteristics and functions. These include: (1) GI with green features; (2) GI with tree features; (3) GI with water features; and (4) other GI that cannot be classified under any of the aforementioned categories. These categories of UGI are known to have several benefits including reduction of the rate of natural resources depletion, loss of habitats and biodiversity (Ely and Pitman 2014; Zhang et al. 2013), green spaces (Lee et al. 2005; Roy et al. 2018; Zhang et al. 2013), and environmental deterioration and pollution (Escobedo et al. 2011; Alaimo et al. 2016; Kumar et al. 2019) and global warming (Alexandri and Jones 2008; Rowe 2011; Oluwafeyikemi and Julie 2015 Idiata 2016; Wesam et al. 2016; Dipeolu and Ibem 2020). They also help to improve the health (Tzoulas et al. 2007; Lee and Maheswaram 2010; Alaimo, Crawford and Snyder 2016; Kumar et al. 2019; Chiabai et al. 2020) and spiritual well-being of the people (Bowler et al. 2010; Schipperijn et al. 2010; Venter et al. 2020), foster inclusion and social integration (Francis et al. 2012; Arnberger and Eder 2012) and in runoff attenuation, flood management and water purification (Adegun 2017a, 2018, 2019).

It was on this premise that the Countryside Agency (2006) concluded that UGI is multifunctional and contributes to protecting natural habitats and biodiversity, enabling response to climate change issues and other biosphere changes, promoting more sustainable and healthier urban environment and lifestyles as well as the quality of life of the population.

2.2 Concept of environmental attitude and its measurement

Evidence in the literature (Dunlap and Jones 2002; Gifford and Sussman 2012) indicates that environmental attitude (EA), environment concern and environmental behaviour have

been used to describe peoples' attitude towards their physical environment. However, Milfont and Duckitt (2004) noted that EA was the preferred term in most human–environmental related debates because environmental concern and behaviour are general human attitudes, while the American Psychological Association (2001) described EA as the psychological index generally used to measure environmental concern and behaviour. It was for this reason Eilam and Trop (2012) explained that environmental sustainability experts have continuously used EA to explore how pro-environmental behaviours can be achieved among the population.

Environmental attitude has been variously defined as "*the collection of beliefs, affect, and behavioural intentions a person holds regarding environmentally related activities or issues*" (Schultz et al. 2004:31); the psychological tendency for individuals to evaluate the environment with some degree of favour or disfavour (Milfont and Duckitt 2010) and the way people think about the existence and characters of the environment, which determine their predisposition to respond in a consistently favourable or unfavourable manner towards it (Eilam and Trop 2012). These definitions suggest that individuals can have favourable or unfavourable or positive or negative attitudes towards the environment based on how they like and dislike the components and features of the environment (Abun and Racoma 2017). Since UGI is usually part of built environment, in the context of this study, attitude towards UGI refers to the way people think about the role and benefits of UGI within the ecological environment.

Literature survey also revealed that although several models and frameworks such as the environmental knowledge, environmental values and ecological behaviour intention framework (Kaiser et al. 1999), the Campbell model (Ogunbode et al. 2020) and technology acceptance, diffusion of innovation and organizational theories (Carlet 2015) have been used in previous studies on EA, the environmental knowledge, values and ecological behaviour intention framework have been extensively used in EA measurement research (Milfont and Duckitt 2010; Yapici et al. 2017). This framework measures EA based on one or combination of three key facets: affective (emotional response), cognitive (knowledge and beliefs) and behavioural (Gifford and Sussman 2012; Santiago et al. 2015; Yapici et al. 2017). The cognitive facet deals with what people know and believe about the environment (Kovács et al. 2014; Rosa and Collado 2019); the affective is concerned with perception of the values and benefits associated with the environment (Barnhill and Smardon 2012), while their behavioural response refers to peoples' behaviour towards the environment in terms of showing concern, protecting, preserving/conserving or exploiting/exploiting the environment (Gifford and Sussman 2012; Hedlund-de Witt et al. 2014).

Notably, environmental psychologists have consistently used knowledge of the environment to assess people's attitude towards it. This is because knowledge is a product of several factors including people's value of the physical environment (Poortinga et al. 2004; Steg and Vlek 2009; Schultz et al. 2004), which plays an important role in determining how they think about and relates with it (Kovács et al. 2014). Moreover, the submission by Abun and Racoma (2017) indicates that the environmental knowledge, values and ecological behaviour intention framework can be used to predict ecological behaviour, which is of interest to the current research. Based on the foregoing, attitude towards UGI environmental is viewed as a multidimensional concept influenced by affective, cognitive and behavioural factors, and thus, this framework is considered relevant to this study.

Based on the environmental knowledge, values and ecological behaviour intention framework, Gifford and Sussman (2012) revealed that a number of environmental attitudes measurement scales exist. These include the Maloney–Ward Ecology Inventory scale which measures EA based on cognitive and conative components; the new environmental

paradigm scale, which measures the degree to which people believe the environment is sacred and deserves protection; and the environmentalism scale that measures attitude towards the severity of environmental problems; and three scales that measure: environmentally responsible behaviour, pro-environmental behaviour and attitude towards particular and several specific environmental issue. It was however, found that the integration–opposition measurement scale developed by Carrus et al. (2004) was most suited for the current research because it is specific for UGI and draws on the appreciation of human–nature interactions (Bonnes et al. 2010). It has 10 items that capture both positive and negative attitudes towards UGI, which in turn influence how people use and/or behave towards the environment. Hence, this measurement scale was used in this study.

2.3 Attitude towards urban green infrastructure and its predictors

The survey of empirical literature shows that there are several studies on environmental attitude but very few on attitude towards UGI. The existing studies on environmental attitude have generally highlighted the importance of understanding human–environment interactions, factors that can influence pro-environmental behaviours (Larson et al. 2015) and the fact that environmental attitudes vary across cultures and nations (Cox et al. 2017). Among the few studies on attitude towards UGI identified include that by Jim and Chen (2006), which reported that most of the 340 residents of Guangzhou, China, sampled showed positive attitude towards urban green spaces but did not identify the socio-economic factors that influenced the residents' attitude towards urban green spaces in that city. There is also the study by Santiago et al. (2015), which found that like the residents in Guangzhou, China, residents of San Juan in Puerto Rico showed strong affective orientation towards green infrastructure in the Convalecencia Square. That study was, however, focused only on the Convalecencia Square, and thus, the findings cannot be generalised for all the GI sites in that city. Another is the study in Gyeongsan City, Republic of Korea by Lee and Kim (2015), which also observed that the citizens demonstrated favourable attitude in visiting pocket parks around home for relaxation and walking but preferred having relaxation parks close to natural rivers. The study was limited to parks and green spaces and did not consider other forms of UGI. In the USA, Carlet (2015) reported that perceived usefulness, compatibility, internal readiness and ease of use of green infrastructure had a significant influence on 256 municipal officials' attitudes towards UGI. Since that study was on attitude to adoption of UGI by municipal officials, the findings have no implication for ecological behaviour of the population towards UGI in the study area. Elsewhere in Athens, Greece, is yet another study by Tsantopoulos et al. (2018) which also found that most of the citizens sampled shown positive attitude towards the installation of green roof trellis or vertical garden on their buildings. Although the findings of that study provide great insight, they are limited to green roof trellis or vertical garden on buildings, and thus cannot be applied to other public-managed UGI in that city.

As it relates to the factors that influence environmental attitude, several studies have shown that socio-economic variables such as socio-economic status (Bronfman et al. 2015), gender (Schumm and Bogner 2016; Yapici et al. 2017), age, religious and political affiliations (Gifford and Sussman 2012), environmental knowledge and environmental value (Gifford and Sussman 2012) and educational attainment (Reyes 2014) and others as the predictors of environmental attitude. For UGI, Larsen and Harlan (2006) reported that residents' preference for front yard landscape type of lawn, desert and oasis was related to their income level. In a study in the UK, Campbell et al. (2007) identified health of

residents, income and relationships with family and friends as the most important socio-demographic factors that influenced their use of green spaces, while in Syracuse, New York, Barnhil and Smardon (2012) reported that knowledge of what GI is and the associated benefits had a significant influence on peoples' attitude towards UGI. In China, Zhang et al. (2013) identified personal characteristics: gender, education, monthly income and dwelling location as the key determinants of residents' attitude towards landscape elements in urban green space. Also in a survey involving Americans and Hungarians, Kovács et al. (2014) reported that although environmental-friendly behaviours were positively correlated, there were significant differences in environmental behaviour across the two cultures, suggesting that environmental attitude can be influenced by culture.

From the literature reviewed here, it can be seen that a majority of the existing studies were done outside African countries and are based on questionnaire survey. The studies are also focused mainly on urban green infrastructure with green and tree features leaving out the other categories of UGI. In view of these, the current study investigated all forms of UGI. Similarly, the studies reviewed here also reveal that peoples' socio-economic characteristics are both predictors of environmental attitudes and attitude towards UGI. Going by the paucity of empirical studies on the factors that influence peoples' attitude towards UGI in sub-Saharan Africa, the current research investigated the influence of socio-economic and other factors on attitude towards UGI.

3 Methodology

The data used in this research were obtained from a bigger research project designed to assess the impact of GI on environmental sustainability in selected neighbourhoods in Lagos Metropolis southwest Nigeria. The research design adopted a cross-sectional survey. The choice of this research design was informed by the nature of the research objectives and the evidence in the literature showing that most of the previous studies on this subject were based on cross-sectional surveys (see for examples Jim and Chen 2006; Santiago et al. 2015; Lee and Kim 2015; Yapici et al. 2017; Tsantopoulos et al. 2018). Although the research population comprised residents of the 16 Local Government Areas (LGAs), the sample size was drawn from residents of randomly selected four Local Government Areas (LGAs) in Lagos Metropolis: Kosofe, Ikeja, Lagos Island and Surulere. These constitute 25% of the 16 LGAs that make up Lagos Metropolis. Figure 1 shows the maps of Nigeria, Lagos State and the selected four LGAs.

The existing records in the Lagos State Office of the National Population Commission (NPC) revealed that 17 Enumeration Areas (EAs) existed across the four selected Local Government Areas in Lagos Metropolis. Specifically, Ikeja LGA has three EAs, Kosofe and Surulere LGAs had five each, while Lagos Island had four EAs. In these EAs, 6283 households comprising 1591 households in Ikeja, 1852 households in Kosofe LGA, 1402 households in Lagos Island LGA and 1438 households in Surulere LGAs were identified for selection in the survey. Since not all the households identified could be included in the survey, there was a need to determine an acceptable sample size of participants that will be representative of the research population. The formula presented by Turner (2003) and given in Eq. 1 was considered appropriate for this. The choice of this formula was based on the fact that it allowed the determination of the sample size with specific levels of precision and confidential level. In addition, it also took into consideration some peculiarities, like household size in a developing country like Nigeria.

Fig. 1 Maps showing the location of Lagos State in Nigeria and the LGAs investigated. *Sources*: Lagos State Ministry of Environment & Ministry of Environment Abuja

$$n = \frac{(Z_\alpha)^2 r(1-r)fk}{phe^2} \tag{1}$$

In this formula, n is the minimum sample size for the survey $Z_\alpha = 1.96$ is the critical value of the normal distribution obtained in the table of standard normal distribution at 95% confidence level, $r = 50\%$ is estimate of the proportion of individuals assumed to have different attitudes towards urban green infrastructure in the neighbourhoods, and $f=4$ is the design effect, while $k=20\%$ represents non-response rate, $p=0.03 \times 18 = 0.54$ is the proportion of the total population accounted for by the target population and upon which the parameter, r is based. As a rule of thumb, Turner (2003) suggested the adoption of 0.03 for each year of age that the target population represents, and $h=6$ as the average number of persons per household, which is often considered to be about six persons in most developing countries, while $e=0.05$ is the margin of error or level of precision set at 5% of r. Equation 2 shows how the minimum sample size was estimated using the Turner's (2003) formula

$$n = \frac{(1.96^2 \times 0.5 \times 0.5 \times 4 \times 0.2)}{[0.54 \times 6 \times (0.05 \times 0.5)^2]} = 379.4 \approx 380 \tag{2}$$

A minimum of 380 participants for each of the four LGAs was obtained from Eq. 2. This means that at least 1520 participants will be adequate for the survey.

Two data collection instruments were used in this research. First was a semi-structured questionnaire designed by the researchers. The questions in the questionnaire were derived from the findings of the review of literature and were arranged into sections. The first section was used to collect data on the participants' personal socio-economic and demographic characteristics such as gender, age, marital status, household size, ethnic origin, highest level of education, religion, profession, and employment status and others. The second section of the questionnaire had questions that required the participants to rate the quality, health benefits and role of UGI in social cohesion; the types of GI site visited and

the reasons for visiting them; their involvement in greening programme and interest in GI education. The third section was used to extract data on the residents' attitudes towards the identified UGI within their neighbourhoods. In collecting data on this, the participants were asked to complete a 10-item *attitude towards green infrastructure* (ATGI) scale developed by Carrus et al. (2004) as previously explained under Sect. 2.2 of this manuscript. Specifically, the items used to measure attitude towards UGI in this study were: (1) the need for UGI nature for restoration in the city, (2) the effect on peoples' life of the presence of GI in the city, (3) effect of watching UGI on reduction of tensions in the city, (4) stress reduction effect of contact with nature in the city, (5) cost of development of UGI on citizens, (6) cost of maintenance of urban green area on the citizens, (7) role of trees in preventing too much light from reaching buildings, (8) the disadvantages of trees in creating problems in the city, (9) visual obstruction experienced in city due to street trees and (10) the role of UGI in fostering social relationships and cohesion among residents in the city. Each participant was asked to indicate the extent to which he/she agrees or disagrees with the statements that capture the role of UGI in the city using a 5-point Likert type scale ranging from 1 = S*trongly Disagree* to 5 = *Strongly Agree.* Similarly, the same scale of measurement was used to assess residents' perceived quality and social cohesion benefits of UGI. However, the self-perceived health benefits of UGI were assessed using the scale of general health questionnaire, which is a 4-point scale of *1 = Less than usual, 2 = No more than usual, 3 = Rather more than usual and 4 = Much more than usual)* developed by Goldberg (1992). The reliability of the questionnaire instrument in measuring attitude towards urban green infrastructure was assessed using Cronbach's Alpha coefficient test with resulting being 0.79 for the 10 items investigated. This is more than 0.7 recommended by Pallant (2011), suggesting that the scale of measurement used in assessing attitude towards UGI in the survey is reliable.

The second set of data collection instruments used comprised observation schedule and photographic materials which were used to record observations made during the field work. The observation schedule was used to record the different types of UGI identified in the neighbourhoods investigated. The types of GI identified from the literature review were used to benchmark the existing UGI identified in the study area. The GI facilities were categorised into four groups, namely: (1) green spaces green infrastructure (GSGI), (2) tree features green infrastructure (TFGI), (3) water features green infrastructure (WFGI) and (4) other spaces green infrastructure (OSGI) (i.e. the green infrastructure that cannot be categorised under any of the first three groups) (please see Dipeolu and Ibem 2020).

The survey took place in the study area between March and July of 2017. Prior to the main survey, a pilot survey was conducted to pre-test the questionnaire in an unselected Local Government Area in Lagos Metropolis, and the feedback was incorporated into the final version of the questionnaire administered to the residents. In the selection of participants in the survey, households were systematically selected from the list of numbered houses in each EA until the required number for each EA was achieved. Since the minimum sample size calculated for each LGA was 380, to further take care of non-response additional 20 questionnaires were added to the calculated minimum sample size for each LGA. Therefore, the allocated sample size for each LGA was 400 participants. In selecting the houses where participants were actually recruited, the first (1st) house at the nodal point within each EA was chosen, while subsequent houses were systematically selected using a predetermined sampling interval (**k**) for each of the four LGAs sampled. The sampling interval was determined by diving the number of households in all the EAs selected by 400. Consequently, the sampling interval for Kosofe LGA was every 5th house, while that for each of the other three LGAs was every 4th house. One copy of the questionnaire

was administered by hand to randomly selected household heads or adult representatives met in each of the houses visited during the survey. In all, 1600 copies of the questionnaire were administered by the researchers to the residents, but 1560 copies were retrieved and found to have been correctly filled by the participants in the survey. This represents around 97.5% response rate.

The data collected via the questionnaire were analysed using the Statistical Package for the Social Sciences (SPSS) software package Version 20. Three types of analyses were conducted. The first was descriptive statistics, which were used to compute the frequencies and percentages of the variables used in describing the socio-demographic characteristics of the respondents, the mean attitude score for each item (MASI) for the ten variables used to measure attitude towards GI (ATGI) which is the overall attitude with each of the 10 attitude items by all the 1560 residents and mean attitude score (MAS), which is the overall attitude with all the 10 attitude items used to assess attitude towards UGI put together by all the respondents. These analyses were used to address research objective 2, and the results are presented in Tables 1 and 3. The second type of analysis conducted was content analysis. This analysis was used to analyse the data collected using the observation schedule showing the different types of UGI identified in the neighbourhoods of the selected four LGAs investigated. This analysis was used to address research objective 2, and the results are presented in Table 2.

The last type of analysis, which was used to address research objective 3, was the categorical regression analysis (otherwise known as CATREG in SPSS) with optimal scaling technique. This analysis was used to examine the variance explained by R^2, identify and compare the relative strengths of the factors that influenced residents' attitudes towards UGI in the survey. The choice of this analysis was informed by the fact that the data collected in the survey are mixture of nominal, ordinal and numerical/interval data, and CATREG is suitable in dealing with this type of dataset (Shrestha 2009). In carrying out the CATREG, mean attitude score (MAS) was the criterion variable, while the nine socio-economic variables and the scores for another nine variables listed in Table 4 were the independent variables.

4 Findings

4.1 Participants' socio-economic and demographic characteristics

The results in Table 1 show the participants' socio-economic and demographic characteristics. From the results (Table 1), it is evident that a majority of the participants in the survey were male, married, more than 30 years old, with household size of more than two persons and of Yoruba ethnic group. The results also show that most of the participants are highly educated and employed Christians of middle- and high-income groups. Based on these results, it can be inferred that the participants in the survey are qualified to provide reliable data for this research.

4.2 Availability of urban green infrastructure in the neighbourhoods

Table 2 shows the results of the different types of UGI identified in the neighbourhoods investigated. The data in Table 2 are meant to show the different types of UGI that were available and most commonly found in the study area. However, the percentage availability

Table 1 Socio-demographics characteristics of respondents $N = 1560$

Variables	Frequency	Percentage (%)
Sex		
Male	914	58.6
Female	646	41.4
Current age		
< 30	598	36.3
30–49	813	49.3
>=50	204	12.4
Not reported	34	2.1
Marital status		
Never married (single)	608	36.9
Married	966	58.6
Previously married	65	3.9
Not reported	10	0.6
Household size		
One person	168	10.2
Two-four persons	769	46.6
More than four person	701	42.5
Not reported	11	0.7
Religious affiliations		
Christianity	1065	64.6
Islam	497	30.1
Others	81	4.9
Not reported	6	0.4
Ethnic group		
Yoruba	1168	70.8
Others	479	29.0
Not reported	2	0.1
Highest level of educational attainment		
No formal education	84	5.1
Primary education	109	6.6
Secondary/technical education	396	24.0
Tertiary education	1055	64.0
Not reported	5	0.3
Employment status		
Unemployed	175	10.6
Self-employed	706	42.8
Private/public employee	518	31.4
Students and others	250	15.2
Income group		
Low-income	437	26.5
Middle-income	249	15.1
High-income	507	30.7
Not reported	456	27.7

Table 2 Availability of GI in the neighbourhoods sampled

S/N	Types of GI	Local Govt. Area of Neighbourhoods Sampled			
		Ikeja	Kosofe	Lagos Island	Surulere
A	*GI with green features*				
1	Green roofs	×	×	×	×
2	City crop farms (urban agriculture)	×	×	×	×
3	Grasses	√	√	√	√
4	Sport Fields	√	√	√	√
5	Green parks	√	√	√	√
6	Green gardens	√	√	√	√
B	*GI with tree features*				
7	Forest	×	×	×	×
8	Street trees	√	√	√	√
9	Horticulture	×	×	×	×
10	Woodland	×	×	×	×
11	Community forest	×	×	×	×
C	*GI with water features*				
12	Flood plains/wetland	×	×	×	×
13	Streams	×	×	×	×
14	Rivers	×	×	×	×
15	Lakes	×	×	×	×
16	Ponds	×	×	×	×
17	Fountains	×	×	×	×
D	*Other categories of GI*				
18	Other open spaces	×	×	×	×
19	Non-green parks	×	×	×	×
20	School yard	×	×	×	×
21	Wildlife habitat	×	×	×	×
22	Cemetery	×	×	×	×

√ Available

× Not available

of the UGI is outside the scope of this paper as it has previously been described in a different paper.

It is evident from the results in Table 2 that of the six UGI with green features identified in the study area, four, namely: green garden, green parks, grasses and sport fields were found to be more prevalent than others in all the four LGAs sampled (see Figs. 2, 3, 4, 5). The results further show that the highest proportion of UGI with green features identified was green parks and green gardens. Of the five identified UGI with tree features, only street trees were found to be very common in the study area. However, UGI with water features and the other categories of UGI were very scarce in the neighbourhoods investigated. In sum, of the 22 elements of UGI identified in the study area, five: green garden, green parks, grasses, street trees and sport fields were found to be more prevalent than others in the four LGAs surveyed. It was also observed that in terms of spread, neighbourhoods in Ikeja LGA had the highest distributions of the UGI in the study area.

Fig. 2 Pictorial view of a recreational garden, Surulere LGA

Fig. 3 Pictorial view of a recreational garden, Ikeja LGA

4.3 Residents' attitude towards urban green infrastructure

The results on the participants' attitude towards green infrastructure within and around their residential neighbourhoods in the study area are shown in Table 3. As previously explained, this was measured using 10 items identified from the review of literature.

From the results in Table 3, it is evident that the participants generally thought that UGI serves a wide range of purposes and provides different services in the city such as restoring nature, making people feel lively, reducing tension and stress in human beings, fostering

Fig. 4 Pictorial view of street trees along CMS Road, Lagos Island LGA

Fig. 5 Pictorial view of Gani Fawehinmi park, Kosofe LGA

social relationships, checking the effects of urban heat island by preventing the overheating of buildings, and that trees are not sources of problems and visual obstructions in the city. They, however, felt that the development and maintenance of GI in the city constituted a huge financial burden on the citizens. These results suggest that most of the participants in the survey have good/positive attitude towards UGI within their neighbourhoods.

To segregate the participants into groups according to their attitude towards UGI in the survey, the data were further analysed using frequencies and percentages and the results are presented in Fig. 6.

Table 3 Descriptive statistics of residents' attitude towards UGI

Descriptive statistics			
Variables for measuring attitude towards GI	*N*	Mean score	SD
People need nature for restoration in the city	1560	4.05	0.96
The presence of green in the city makes us feel more alive	1560	3.97	1.02
One can ease tensions just by watching a green area in the city	1560	3.95	1.06
Green areas in the city can help people improve the relationships with others	1560	3.86	1.10
Having contact with nature in the city makes one feel less stress	1560	3.84	1.19
Development of urban green areas is too expensive for citizens	1560	3.27	1.08
Maintenance of a large part of urban green area is very expensive for citizens.	1559	3.06	1.20
The trees in the city often prevent too much light from reaching buildings	1560	2.49	1.29
Trees often do not bring advantages but create problems in the city	1560	2.16	1.29
It is often difficult to see anything from the windows because of the trees in the street.	1560	2.15	1.19

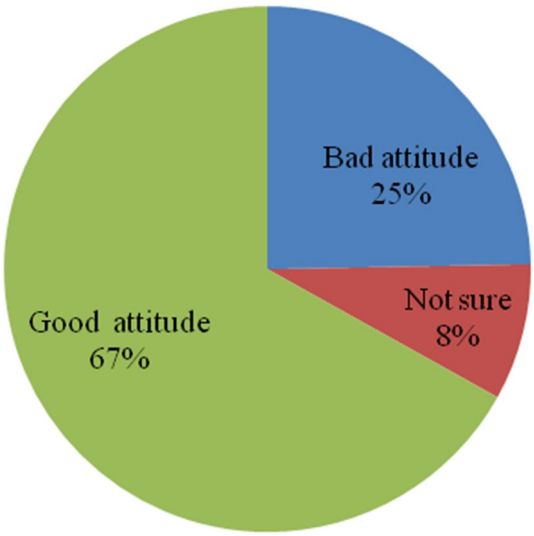

Fig. 6 Residents' attitude towards the use of green infrastructure

Examination of the results in Fig. 6 reveals that most (67%) of the respondents indicated good (positive) attitude towards UGI, around 25% had bad (negative) attitude, while 8% were not sure of their disposition towards UGI in their neighbourhoods. This finding further supports the results in Table 3, indicating that many of the participants in the survey have good/positive attitude towards UGI in the study area.

4.4 Factors influencing residents' attitudes towards urban green infrastructure

The results in Table 4 show that a combination of the variables describing the residents' socio-economic characteristics and their evaluation of different aspects of UGI influenced their attitudes towards UGI in the study area. Having F (738.761,

Table 4 Regression analysis of predictors of residents' attitude towards urban green infrastructure

Independent variables/predictors	Standardised coefficients		*df*	*f*	*p*
	Beta	Estimate of standard error			
Gender of respondents	0.033	0.014	1	5.743	0.017*
Age of respondents	0.053	0.019	2	7.713	0.000*
Marital status	0.027	0.015	2	3.177	0.042*
Household size	0.003	0.016	2	0.039	0.962
Religious affiliation	0.028	0.015	2	3.279	0.038*
Ethnic origin	0.022	0.016	1	1.899	0.168
Highest educational qualification	0.020	0.025	3	0.653	0.581
Income group	0.036	0.018	3	4.030	0.007*
Employment status	0.030	0.016	2	3.533	0.029*
Type of green infrastructure patronised	0.037	0.018	2	4.437	0.012*
Distance of GI to respondent's residence	0.028	0.026	4	4.345	0.356
Reasons for visiting green infrastructure sites	0.032	0.023	2	2.001	0.136
Participation in G.I programmes	0.004	0.009	1	0.230	0.632
Interest in green infrastructure education	0.036	0.016	1	5.207	0.023*
Housing type occupied by the resident	0.049	0.025	5	3.899	0.002*
Perceived quality of neighbourhood GI	0.401	0.203	39	3.898	0.000*
Perceived health benefit of GI	0.189	0.030	3	8.954	0.000*
Perceived role of GI in social cohesion	0.435	0.211	39	4.254	0.000*

*Significant predictors ($p \leq 0.05$)

821.239) = 11.850, $p < 0.000$ and R^2 value (0.474), the results of the CATREG analysis indicate that around 47% of the variance in attitude towards UGI is explained by the regression model.

From the p values in the sixth column of Table 4, it is evident that 12 of the 18 variables investigated emerged as significant predictors of attitude towards UGI in the survey. The significant predictors identified were: participants' gender ($p = 0.017$), age ($p = 0.000$), marital status ($p = 0.042$), religious affiliation ($p = 0.038$), employment status ($p = 0.007$) and income group ($p = 0.029$). Others were the type of UGI patronised by the participants ($p = 0.012$), participants' interest in GI education ($p = 0.023$), housing type occupied by the participants ($p = 0.002$), their perceived quality ($p = 0.000$), and health benefits of UGI ($p = 0.000$) and role of UGI in fostering social cohesion ($p = 0.000$). It can also be seen from the β coefficients in Table 4 that the role of UGI in fostering social cohesion in the study area has the highest β coefficient of 0.435 followed by perceived quality of neighbourhood UGI ($\beta = 0.401$), perceived health benefit of UGI ($\beta = 0.189$) and age of respondents ($\beta = 0.053$), respectively. For the top four predictors for examples, the results mean that there will be a change in attitude by 0.435, 0.401, 0.189 and 0.053 times per unit increase in standard deviation in the role of UGI in fostering social cohesion in the city, perceived quality and health benefits of UGI, and age of the respondents, respectively. Therefore, these are the top four factors with positive influence on residents' attitude towards UGI in the study area.

5 Discussion

Based on the three objectives of this study as outlined in the introductory section of this paper, three key findings have been identified for further discussion. First, the study found that of the 22 different types and four categories of UGI investigated, UGI with green features were the most prevalent in the study area. The most common UGI with green features identified were green parks, green gardens, grasses and sport fields, while the most common UGI with tree features identified were street trees. These findings appear to be similar to those by Adegun (2017a) who reported that the most common GI in Kya Sands in Johannesburg, South Africa, were vegetated outdoor spaces and domestic gardens. Interestingly, it was also observed that in spite of the fact that Lagos State is known for its aquatic environment, the presence of UGI with water features was very minimal in the neighbourhoods sampled. Although this result appears to contradict the finding by Adegun (2017a) indicating that UGI with water features such as stream featured prominently among the UGI in that study in South Africa, this particular finding of the current study appears to be consistent with that by Lee and Kim (2015) in Gyeongsan City, Republic of Korea, where the citizens reported the absence of relaxation parks close to water bodies like natural rivers.

Second, in support of previous studies as highlighted earlier in the literature review (see for examples Jim and Chen 2006; Santiago et al. 2015; Lee and Kim 2015; Tsantopoulos et al. 2018), this study also found that the participants in the survey generally showed good/positive attitude towards UGI in the study area. In fact, the results in Table 3 show that the respondents demonstrated understanding of the positive role UGI plays in the lives of people in the city, and previous studies (Balram and Dragicevi 2005; Bowler et al. 2010; Adegun 2017a) have noted that the level of knowledge about the environment can lead to either positive or negative attitude. Moreover, it is also possible that a majority of the population sampled in the survey showed good or positive attitude towards UGI because they recognised that the natural ecosystem in the city is under serious threats, and thus, there was a need for people to show empathy as suggested by previous authors (Hedlund-de Witt et al. 2014; Steg and Vlek 2009).

Furthermore, the results in Fig. 6 showing that although a high majority of the participants indicated good (positive) attitude, about one-quarter of them still showed bad (negative) attitude towards UGI in the study area can also be explained based on the evidence in the literature, suggesting that people tend to show different attitudes towards the environment due to differences in their way of life, belief system and knowledge base (Kovács et al. 2014) and value they attach to the environment (Poortinga et al. 2004; Schultz et al. 2004; Steg and Vlek 2009). This suggests that the result showing that around 25% of those sampled showed bad (negative) attitude towards UGI might be due to poor knowledge of the role of GI in the city or lack of value for it. Based on the established link between positive environmental attitude and pro-environmental behaviours as evident in the literature (see Balram and Dragicevi 2005; Steg and Vlek 2009; Gifford and Sussman 2012; Eilam and Trop 2012; Hedlund-de Witt et al. 2014; Bronfman et al. 2015), what these results mean is that most of the participants in the survey who indicated a positive attitude towards UGI are most likely to show favourable disposition towards UGI or pro-urban green infrastructure behaviour, while the others may manifest unfavourable disposition towards UGI in the study area.

Third, further analysis of the results shows that in line with evidence in the literature (Gifford and Sussman 2012; Reyes 2014; Bronfman et al. 2015; Schumm and Bogner 2016;

Yapici et al. 2017) both the participants' socio-demographic characteristics and their evaluation of the health, social and environmental benefits of UGI influenced their attitude towards UGI in the study area. Specifically, in line with previous studies, socio-economic characteristics such as income group (Larsen and Harlan 2006; Campbell et al. 2007; Zhang et al. 2013), gender (Schumm and Bogner 2016; Yapici et al. 2017), age and religion (Gifford and Sussman 2012) emerged as factors that influenced residents' attitude towards UGI in the study. Other socio-economic variables that also emerged as factors with significant influence on attitude towards UGI were marital status, employment status and house type occupied. Again, in line with the submission by Abun and Racoma (2017) that environmental education plays important role in environmental attitude, participants' interest in GI education also emerged as one of the factors that influenced their attitude towards UGI in the survey. However, in contrast to the evidence in the literature (Zhang et al. 2013; Reyes 2014) showing that educational attainment has significant influence on environmental attitude, in the current study, highest educational attainment did not emerge as factor with significant influence on residents' attitudes towards UGI in the survey.

Besides the socio-economic and demographic variables, the other key factors that influenced attitude towards UGI identified in the survey were the role of urban green infrastructure in fostering social cohesion and the associated health benefits. Notably, these findings appear to provide support to those of previous studies indicating that peoples' attitude towards GI can be influenced by their understanding of what GI is and the associated benefits (Barnhill and Smardon 2012) and the perceived usefulness (Carlet 2015) or value of UGI (Poortinga et al. 2004; Steg and Vlek 2009; Schultz et al. 2004). Specifically, the emergence of participants' perceived health benefits of UGI and its role in promoting social cohesion as significant factors that influenced attitude towards UGI in the survey can be linked to the results in Table 3 showing that the participants understood the health benefits of UGI and its role in promoting interrelationship among people in the city.

These specific findings on non-socio-economic factors that influenced residents' attitude towards UGI did not come as a surprise going by the evidence in the literature on the various health benefits of UGI (Tzoulas et al. 2007; Lee and Maheswaram 2010; Grahn and Stigsdotter 2010; Alaimo et al. 2016; Kumar et al. 2019; Chiabai et al. 2020) and its role in fostering social cohesion by providing places for physical activities and social interactions in the community (Francis et al. 2012; Arnberger and Eder 2012; Kirkpatrick et al. 2013). Similarly, the identification of the participants' perceived quality of UGI as the second most important factor that influenced their attitude towards UGI was also well expected because a recent study by Dipeolu and Ibem (2020) as previously highlighted in the review of literature section of this paper revealed that the quality of GI plays a vital role in mitigating urban environmental challenges. Therefore, the ability of the participants to understand the various physical attributes of the different forms of UGI within their neighbourhoods and their roles, might help to explain why the quality attributes of UGI had a strong influence on the participants' attitude towards UGI in this study. In sum, as previously highlighted by previous authors (Gifford and Sussman 2012; Hedlund-de Witt et al. 2014), the findings of this study provide support to the view that residents' socio-economic characteristics and their affective evaluation of the values and benefits of UGI are the main factors that can influence their attitudes towards UGI in residential neighbourhoods.

6 Conclusions, implications and recommendations

The overall purpose of this research was to examine residents' attitude towards urban green infrastructure and the factors that influenced this using a survey data obtained from participants selected from residential neighbourhoods in four Local Government Areas of Lagos Metropolis, Nigeria. Based on the findings, the following can be considered as the key contributions of this study to scientific knowledge. First, the study has shown that the most common UGI in Lagos Metropolis are those with green features such as green parks, green gardens, grasses and sport fields. This is an indication that the focus of the Lagos State Parks and Gardens Agency (LASPARK) responsible for developing and maintaining urban infrastructure sites in the study area is more on GI with green features than other forms of UGI identified. In view of the fact that all forms of UGI are important as each type seems to appeal to the different categories of residents and plays specific roles in the city, there is a need to ensure a balance in the provision of different forms of UGI by giving priority attention to the other forms of green infrastructure other than those with green features in the study area. In the light of evidence in this study indicating the dearth of green infrastructure with water features in all the neighbourhoods investigated, it is imperative that stakeholders in urban greening projects leverage the aquatic environment of Lagos State to significantly improve the availability of UGI with water features in the study area.

Second, the study has also revealed that the population has good (positive) attitude towards UGI in the study area. This implies that there is a higher tendency for them to show pro-UGI behaviours such as emotional affinity for UGI, willingness to conserve urban greenspaces and pay for UGI services, willingness to support policies or programmes that seek to increase the green content of their neighbourhoods as well as make effective use of UGI in the study area. In view of these, it is suggested that urban managers take advantage of these findings to initiate policies and programmes that will ensure that the residents get actively involved in the installation and management of UGI in the study area. For examples, environmental education in the form of public enlightenment campaigns via the mass media, churches and mosques and community based organisations (CBOs) and others is needed to improve citizens' knowledge base on the roles and benefits of GI in urban environments thereby reducing the proportion of the population with bad or negative attitude towards UGI in the study area.

Third, the study also makes contribution to knowledge by revealing that the role of UGI in fostering social cohesion, the attributes and health benefits of UGI are the three most important factors that influenced attitude of the population towards UGI in the study area. Notably, these findings imply that the residents with positive attitude towards UGI will by extension show pro-urban green infrastructure behaviours if adequate provisions of rich and well-furnished UGI sites are made available and accessible to the citizens within urban neighbourhoods and the residents have adequate understanding or experience of the social cohesion and health benefits of UGI. To this end, urban managers need to take steps to ensure regular upgrading of the quality of facilities and services in UGI sites, and at the same time develop strategies for effective communication to the residents of the values and multiple-dimensional benefits of UGI.

Another novel contribution of this research is that 12 factors account for around 47% of the factors that influenced residents' attitude towards UGI in the study area. Since the regression model did not account for 100% of the factors that influenced residents' attitude towards UGI in the survey, it is therefore recommended that further study be conducted to identify the factors that account for the remaining 53% of factors that

influenced residents' attitude towards UGI in the study area. In addition, future studies that include more variables and neighbourhoods are required for a better understanding of peoples' attitude towards green infrastructure in Lagos State in particular and Nigeria in general.

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