




Spatial Patterns of Residential Fragmentation and Quality of Life in Nairobi City, Kenya

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Abstract

Residential fragmentation undermines integration by physically excluding some urban dwellers through walling, fencing and use of barriers limiting interactions. Research has shown that many cities in the Global South are experiencing spatial fragmentation issues associated with increasing inequalities, social exclusion and proliferation of gated communities. This results in distinct residential fragments with limited interactions and unequal quality of life (QoL) conditions of the residents of the fragments. The aim of this paper is to describe the association between residential fragmentation and QoL based on three residential fragments in the city of Nairobi (Kenia). A mixed method approach was applied to understand fragmentation in the city and analyse integration and QoL satisfaction in the fragments. Household surveys and key informant interviews were main data collection methods. Data analysis methods used included descriptive statistics, spatial and content analysis. The results show, as expected, slum residents felt the least integrated symbolically compared to the planned non-gated and gated community residents. Similarly, gated community residents have higher QoL satisfaction compared to other types of fragments. There is a strong positive correlation between symbolic integration and QoL domains related to housing and safety in the slum, indicating that people who are satisfied with housing also have a sense of belonging to their neighbourhood. In contrast, community integration has a negative correlation with safety in the gated community implying that when the residents are satisfied with safety, they tend to have low social networks. Based on the empirical evidence, fragmentation is related to specific domains of QoL as it is associated with spatial exclusion through barriers and gating and marginalization of the poor making it harder for them to feel integrated. The residential fragments reflect the intense divides in Global South cities in terms of QoL conditions and access to services.

Keywords Residential fragmentation · Quality of life · Symbolic integration · Community integration · Functional integration · Nairobi · Kenya

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Introduction

Residential fragmentation in contemporary cities is closely associated with intra-urban inequality and variations in QoL conditions (Martinez 2016; Veiga 2012). The fragmentation processes are perceived to be aligned with increasing inequalities (Caldeira 1996, 2000) and spatial seclusion between urban population groups weakening integration. As a consequence of these spatial disparities, low-income residents are more affected negatively evidenced by worsening social problems like insecurity, perilous housing and absence of social protection in cities (Caldeira 1996; Sabatini and Salcedo 2007; Veiga 2012). Residential fragmentation is more prominent in Global South cities where differences between better-off and deprived in the society are evident through differential access to services (e.g. public transport, recreation areas, schools, water, electricity) (Jemmali and Amara 2018; Smets and Salman 2016). It reflects the social exclusion experienced in the cities and reveals the gaps in wealth possession and socio-status inequality (de Jeude et al. 2016; Jemmali and Amara 2018). Davids and Gouws (2013) acknowledge residential fragmentation as the main agent to the proliferation of informal settlements, squatters and slums while Roitman and Phelps (2011) state that it is a result of gated communities.

Many studies have been focusing on issues that affect the QoL or factors that influence fragmentation and integration such as gated communities in order to solve problems facing cities. However, limited studies have been undertaken to associate fragmentation and QoL. For instance, it is unclear how QoL domains (e.g. housing, safety, infrastructure services) are associated with the integration of residential fragments. It is also unclear as to whether barriers such as gating and fences are the best ways to solve safety issues in the cities or they create other associated problems. This paper, therefore, contributes to empirical research advancement by studying which indicators of QoL domains associate with dimensions of integration. It is also timely research since it contributes to the on-going discussions on fragmentation and inequalities in urban areas especially in Global South cities and the role of gating. The study underpins the need to explore the relationship between residential fragmentation and QoL. This is operationalised by studying three residential fragments (slum, planned non-gated and gated community) in Nairobi City.

Residential Fragmentation in Cities

Fragmentation is a multidimensional concept with different characteristics (Harrison et al. 2003). Different terms and concepts are used as either synonym or as notions that are closely related to fragmentation such as spatial segregation; spatial separation; spatial polarization; social-spatial exclusion and disconnected cities (Landman 2011). Terms like the city of fragments, microstates, dual city, disconnected city, illegal and informal city, divided city and fortified cities and city of walls are also used to describe fragmentation (Balbo 1993; Balbo & Navez-Bouchanine 1995; Caldeira 2000; Madrazo & Van Kempen 2012; O Connor 1983; Veiga 2012). Burgess (2005 p.22) states that 'Urban fragmentation is associated with physical obstacles and enclosure with lines drawn around spaces that matter'. It is 'a spatial phenomenon that results from the act of breaking up, breaking off from, or disjointing the pre-existing form and structure of the city and systems of cities' (Burgess 2005 p.1). In this study,

residential fragmentation corresponds to residential developments that cause physical and social spaces to break up into bits that seem independent and detached from each other with less or no interaction (Balbo 1993; Landman and Badenhorst 2012; Shawish 2015).

Residential fragmentation can be viewed in different ways based on the nature of its characteristics. First as a direct outcome of post-colonial residential planning especially in cities of the Global South such as Delhi and Cape town (Balbo 1993; Dupont and Houssay-Holzschuch 2005). Second, as a result of urbanization, globalization and rising urban insecurities leading to segregated homes of the poor and fortified homes of the rich that affect nature of social relations between social groups (Balbo 1993; Landman and Schonteich 2002; Rodgers 2004) as experienced in USA cities (Roitman and Phelps 2011) and Latin American cities (Borsdorf and Hidalgo 2010). Finally, as residential development characterized by formal and informal residential patterns, poor land use planning, discriminatory economic opportunities and unequal social stratifications as experienced in Lima-Peru among other cities (Peters and Skop 2007). Sabatini and Salcedo (2007) state that fragmentation is concerned with the opposing forces of integration and exclusion. It socially and physically excludes some urban residents from interactions hence affecting both their QoL and integration (Levitas et al. 2007).

Nairobi city experiences high spatial disparity and inequalities characterized by differing urban form, housing typologies, access to public services and infrastructure. The upper and middle-income population live in well planned and fully serviced neighbourhoods with infrastructure and services while the poor live in dilapidated, congested, high-density neighbourhoods with inadequate or poor public services. Demand for gated communities has been increasing in the city since the elite prefers to live in neighbourhoods with privatized services such as security, solid waste management, infrastructure and children playgrounds among other amenities (Mbogo 2017; Muiga and Rukwaro 2016). The city has grown from a population of 11,512 (1906) to 3.1 million by 2009. Currently, its administrative units comprise of 27 divisions, 64 locations and 135 sub locations (KNBS 2015).

The residential fragmentation in Nairobi can be traced from the onset of its establishment as a transportation centre by British settlers (K'Akumu and Olima 2007; Mwaniki 2017; Olima 2001). Initially, the spatial arrangement of residential settlements was based on employment classes with top employees/employers (British), middle class (Asians) and Africans (natives) (ETH Studio Basel 2008; K'Akumu and Olima 2007; Mwaniki 2017). During the colonial period planning, racial lines defined residential zoning with British settlers residing in the best parts (Kileleshwa, Lavington, Loresho, Kilimani), the Asians occupying Nairobi west, Parklands, South C, South B and the Africans in Eastlands (K'Akumu and Olima 2007; Olima 2001). The British zones were thoroughly planned with designs and aesthetics conforming to the acceptable standards and densities but the African zones were left to develop unconsciously with the provision of reasonable standard infrastructure (Olima 2001). After independence, the development of residential zones shifted from race to socio-economic classes. The British zones were inherited by high income, educated and successful African businesspersons; middle-income Africans joined the Asians while low-income residents were constrained to informal settlements or became squatters.

Today, Nairobi's residential patterns are shaped by income status with 60% of residents living in either slums or informal settlements (K'Akumu and Olima 2007; Olima 2001). It is a typical representation of general characteristics of a fragmented city evidenced by the dualism of informal and formal developments (see Figs. 1 and 2). 52% of the residential developments are constructed to a substandard level which has seen frequent collapsing of residential buildings causing deaths (Wafula 2016). Most of the wealthy neighbourhoods share a border with slums such as Kibera slums bordering Langata, Otiende, Ngumo, Golf course and Southlands estates.

Study Area

This study was undertaken in three sub-locations of Kibera division as shown in Fig. 3. The study area selection included a two-stage purposive sampling. In the first stage, Kibera division was selected out of the 27 divisions in Nairobi city based on the characteristics and presence of diverse fragments. In the second stage, three sub-locations (Silanga, Nyayo Highrise and Mugumoini) within Kibera division were picked purposively ensuring slum, planned non-gated fragment and gated community strata were represented. These three sub-locations (fragments) border each other but have differing characteristics. *Silanga fragment* is part of the large Kibera slums and it is in its eastern part. Low-income residents from all parts of the country live in this slum (Mutisya and Yarime 2011). It borders some of the richest residential neighbourhoods. It is characterized by a lack of proper housing, adequate access to clean water and sanitation, proper public services and solid waste management (Mutisya and Yarime 2011; Mwaniki 2017). *Nyayo Highrise* is a planned non-gated fragment located in the northern part of the division. It borders Mbangathi highway to the east. The sub-location consists of both a slum area (Soweto Village) and flat residential developments for middle income. It has a barricade with no-restriction entrance and is open to non-residents. *Mugumoini* is a gated community fragment and the largest of the three selected fragments. It is composed of many gated estates with restricted entrance for non-residents.

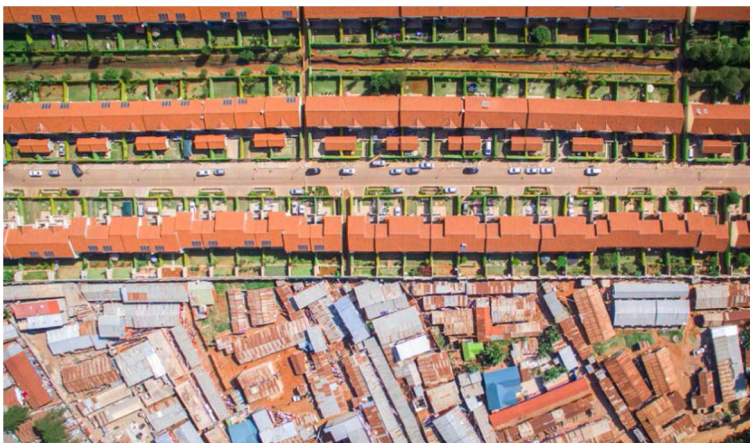


Fig. 1 Slum bordering gated community in Loresho Nairobi (Miller 2016)

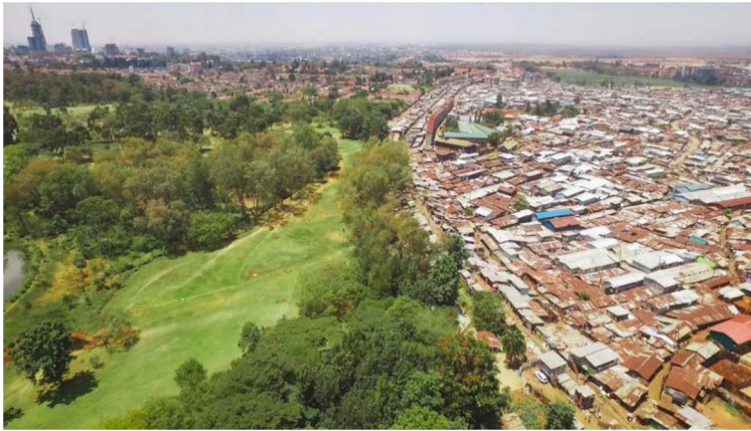


Fig. 2 Kibera slums next Nairobi Golf Club (Miller 2016)

Methods

A mixed-method (QUAN-QUAL) approach was used for data collection and analysis to enable triangulation and development of a strong argumentation on the undertaken study (Bryman 2012; Martinez et al. 2016; Tonon 2015). Figure 4 shows a flow chart of the main steps used for this mixed method approach. Household questionnaires and key informant interviews were the main primary data collection methods.

Household Questionnaire

The questionnaire had both closed and open-ended questions. The closed questions included a 5-point Likert scale to evaluate the satisfaction and level of integration where 1 represented very dissatisfied or low integration to 5 representing very satisfied

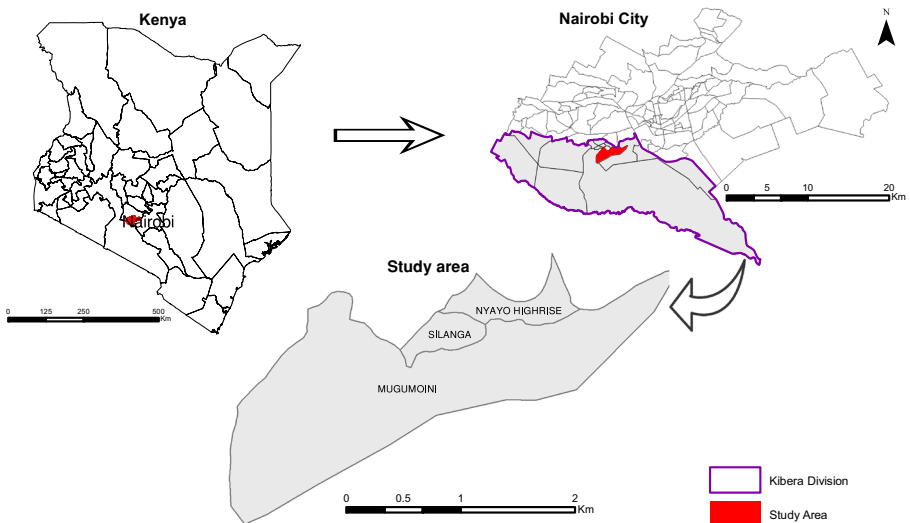


Fig. 3 The three selected fragments for the study

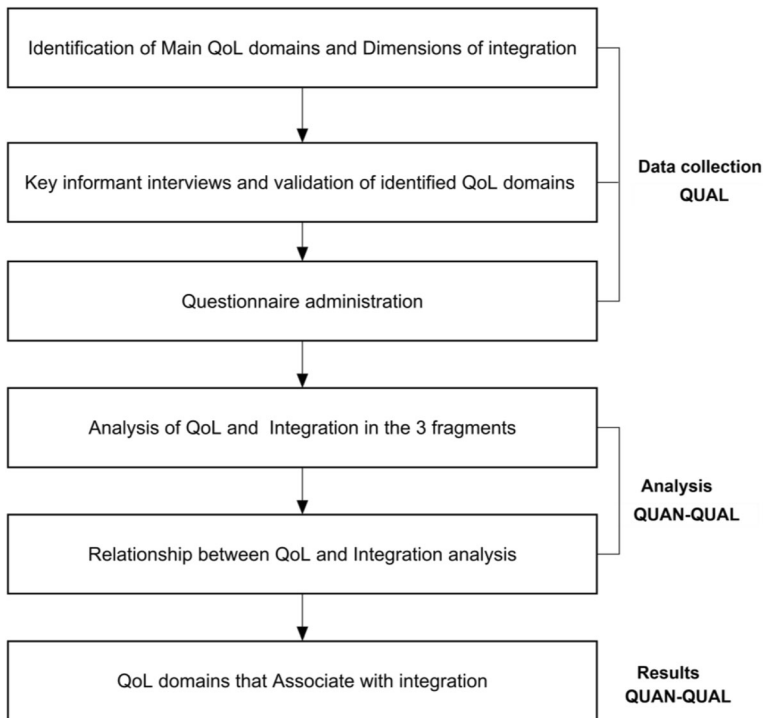


Fig. 4 The main mixed method approach steps for the study

or high integration. Each closed question had a follow up open-ended question for explanations of the satisfaction/dissatisfaction or the integration. The questionnaire comprised of three sections. First, the *integration section* (measure of fragmentation). This section comprised questions on functional, symbolic and community dimensions adopted from Sabatini and Salcedo (2007) that related to other studies (Krellenberg et al. 2016; Ruiz-Tagle 2013). *Symbolic integration* (Sense of belonging) in this study is the attachment residents feel towards their residence. It explains identification with a shared ground, the feeling of being established as members of a community (Ruiz-Tagle 2013). *Community integration* (Social networks) relates to non-hierarchical interactions and contacts with different social groups (Ruiz-Tagle 2013). They are social ties created and expressed through friendship and networks as well as recognizing or being recognized to be an equal member of the neighbourhood surpassing privacy and borders. *Functional integration* (Access to public services/facilities) measures access to opportunities and services within neighbourhoods and uses distance to opportunity, quality of the opportunities, access to services and the availability of public and private institutions as indicators (Ruiz-Tagle 2013). Functional integration refers to the ease of access to opportunities and facilities that exist within cities (Landman 2006). Each of the three dimensions of integration had several indicators as shown in Table 1.

Second, the *QoL* section assessed the satisfaction of the residents in their fragment (neighbourhood) with the selected QoL domains identified from the literature and validated by the key informants. Quality of Life for this study is defined as “the relation

Table 1 Integration dimensions and indicators

Dimension of Integration	Indicators
Symbolic (sense of belonging)	Neighbourhood friendliness, Feeling at home, Sense of pride and Feeling belonging to the neighbourhood.
Community (social networks)	Interaction with neighbours from in the fragment, Asking for help from the neighbours, Neighbours asking help and Social interaction with adjacent neighbourhood residents
Functional (access to public services and urban facilities)	Sports areas, Recreational facilities, Kindergarten services, Primary education services, Health services, Connection to electricity, and Access to drinking water.

between perceptions and the feelings of people, and their experiences within the space they live in" (Senlier et al. 2008 p.215). It explains the relationship between people and the daily urban environment (Pacione 2003). Urban QoL is measured using objective and subjective conditions. Objective QoL assessment uses observable indicator conditions such as housing, sufficient provision of water, access to public facilities as schools and availability of green spaces (Berhe et al. 2014; Martinez et al. 2016; Tesfazghi et al. 2010). Subjective QoL conditions, on the other hand, are the perceived, self-expressed needs or satisfaction/dissatisfaction with certain domains of life using Likert scale (Santos et al. 2007; Senlier et al. 2008; Shumi et al. 2015; Sirgy et al. 2008). Association of both objective and subjective QoL establishes four QoL states namely wellbeing, deprivation, adaptation and dissonance (Berhe et al. 2014; Craglia et al. 2004; Tesfazghi et al. 2010). Only subjective QoL was used for this study. Five domains of QoL and sixteen attributes were used as shown in Table 2. The physical and built environment is considered vital for urban QoL since it affects the perception of personal conditions (Sirgy et al. 2008) as well as helping in assessing the quality of neighbourhoods (Khaef and Zebardast 2015). Access to public and infrastructure services such as education, water, electricity, public transport and solid waste management contributes positively to overall well-being (Jemmali and Amara 2018; Sirgy et al. 2008). Socio-economic attributes such as safety, income, relationships and support from family are believed to affect urban QoL (Senlier et al. 2008; Sirgy et al. 2008).

The last section provided *respondents' background information* based on gender, age, employment status, the highest level of education obtained and marital status. The questionnaire was transferred to an electronic data collection software, Epicollect 5 to ensure geotagged information was collected (Imperial College London 2018).

Key Informant Interviews

Three in-depth interviews were conducted to validate the domains of QoL and provide additional information. The interviews involved a senior lecturer and researcher in the University of Nairobi, director of development management and regularization Nairobi City County and a senior private practicing planner. Additional information, especially on the historical patterns of fragmentation in Nairobi and drivers of residential fragmentation in the city, was revealed during these interviews. The semi-structured interview guide was used and the discussions were audio recorded and transcribed for content analysis.

Table 2 Quality of Life domains and attributes

Domains	Attributes
Physical and built environment	Housing quality Availability of green spaces Recreational facilities Sports facilities Children playgrounds
Public services	Kindergarten school services Primary schools' services Access to public transport (bus stops)
Infrastructure services	Water provision Electricity connection Solid waste management
Socio-economic	Safety in the neighbourhood Relationships with family and friends in the neighbourhood Support received from family and friends in the neighbourhoods Family income adequacy
Institutional services	City-county provision of public facilities and services City-county management and maintenance of infrastructure

Sampling and Participants

Within the three sub-locations, and due to lack of a sampling frame in the slum area and full access to the gated community, quota sampling was employed for the selection of respondents. This sampling method is suitable for interviewing groups of people especially for a case study design with different characteristics that are clustered under one group or community (Neuman 2014). Based on population density in the fragments, a final sample of 449 respondents was targeted which composed of 220, 102, and 127 questionnaires in the slum, planned non-gated fragment and the gated community respectively. The different sample sizes reflected on the different population density characteristics of the fragments and were representative. The statistical tests for the three fragments were complemented with the data collected by the open-ended questions and the in-depth key-informant interviews. This enabled triangulation and development of stronger argumentations for each test.

To select the respondents, a slightly different approach of the quota sampling was adapted depending on the characteristics of each fragment. This was to ensure the spatial distribution of the respondents and proportional number of males and females per fragment. In the slum area, one participant per structure in every 8th household was selected along the walkways. In the planned non-gated fragment, which is composed of densely populated flats, 2–4 respondents, were interviewed per flat. Finally, in the gated community, interviews were conducted in estates where the researcher was granted access. The researcher interviewed the occupants of the selected households by knocking at their doors and requesting informed consent for their participation. However, 415 out of the targeted 449 questionnaires were administered since the

researcher was denied access in some of the gated community estates and no replacement was possible.

All the respondents were adults above 18 years and resident in the fragments. A total of 415 respondents where 52% were females and 48% males. The majority were between 26 and 44 years old ($n = 257$; 62%). 35% had the highest level of education completed as university undergraduates and postgraduates mostly in the gated community and non-planned fragments. 5% have no education skills from the slum fragment. 64% of the respondents had lived in their neighbourhoods for over 6 years.

Data Analysis

The filled questionnaires in Epicollect5 were exported to SPSS for analysis. Mean and standard deviations together with descriptive statistics (percentages and cumulative percentages) of the respondents were used for QoL satisfaction and integration analysis (Boone and Boone 2012; Turksever and Atalik 2001). Aggregated mean enabled ranking the three fragments per QoL domain and integration dimension and compute overall satisfaction and integration per fragment. GIS software was used to visualize the responses in the fragments. To analyse and compare the relationship between integration and QoL, a nonparametric correlation was computed using the mean scores of integration dimensions and the 16 QoL attributes. The statistically significant QoL attributes at a confidence interval of 99% with either moderate (coefficient between 0.3 and 0.49) or strong (0.5 and 1) correlation (Cohen et al. 2003) were selected to be correlated across the three fragments.

Results

Quality of Life Satisfaction

Overall satisfaction per domain presenting the mean and standard deviation are displayed in Table 3. As expected, the majority of the gated community respondents have higher QoL satisfaction compared to the other fragments. Some levels of satisfaction to QoL attributes were as expected (e.g. housing, green spaces, children playgrounds, electricity, solid waste management, family income and provision of services) while others were unanticipated (e.g. primary schools, water and safety) per fragment see Appendix 1.

As shown in Fig. 5, the majority of the respondents in the planned non-gated fragment and gated community were satisfied with housing explaining that the houses in their neighbourhoods are in good condition, permanent and spacious. A gated community resident expressed “*The type of the houses here are modern, spacious, have good design and secure*”. Another in the planned non-gated fragment, pointing at the slum area, indicated, “*Our houses are well constructed, in good condition and better quality than the neighbourhood across*”. However, the majority of the slum respondents were dissatisfied stating that the houses have little space for living, leaking roofs, poor living conditions, flooding during the rainy season and lack of power connection. This is similar to other studies that indicate that insufficient and shortage of housing and housing needs are more evident in deprived neighbourhoods compared

Table 3 Mean scores of QoL satisfaction per domain

Domain		Slum (n = 220)	Planned non-gated (n = 102)	Gated community(n = 93)
Built environment	Mean	3.11	3.39	3.89
	Std. Deviation	0.67	0.78	0.53
Public services	Mean	3.93	3.77	4.21
	Std. Deviation	0.71	0.56	0.59
Infrastructure	Mean	3.27	4.06	3.85
	Std. Deviation	0.82	0.63	0.38
Socio-economic	Mean	3.41	3.92	4.02
	Std. Deviation	0.70	0.60	0.43
Institutional	Mean	2.74	3.39	3.59
	Std. Deviation	0.86	0.89	0.72
Overall QoL	Mean	3.28	3.68	3.93
	Std. Deviation	0.52	0.48	0.34

to well-off neighbourhoods (Martinez 2016). Zulaica and Oriolani (2018) state that dwellings in gated communities have high habitability conditions and the residents have high QoL satisfaction compared to other neighbourhoods.

The majority of the slum respondents feel dissatisfied with safety (Figs. 5 and 6). Their reasons for the dissatisfaction are insecurity during the night due to lack of street lighting; very narrow streets leading to crime rates and muggings. This situation has made the residents in the slums to adopt security strategies such as gating and the informal formation of residential enclaves by fencing (40–60 households with common

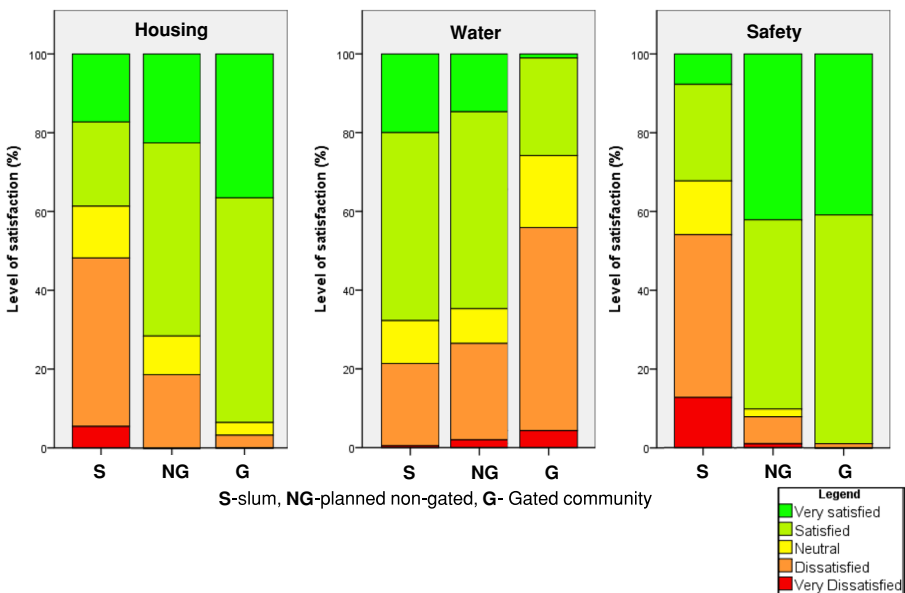


Fig. 5 Satisfaction with housing, water and safety in the fragments

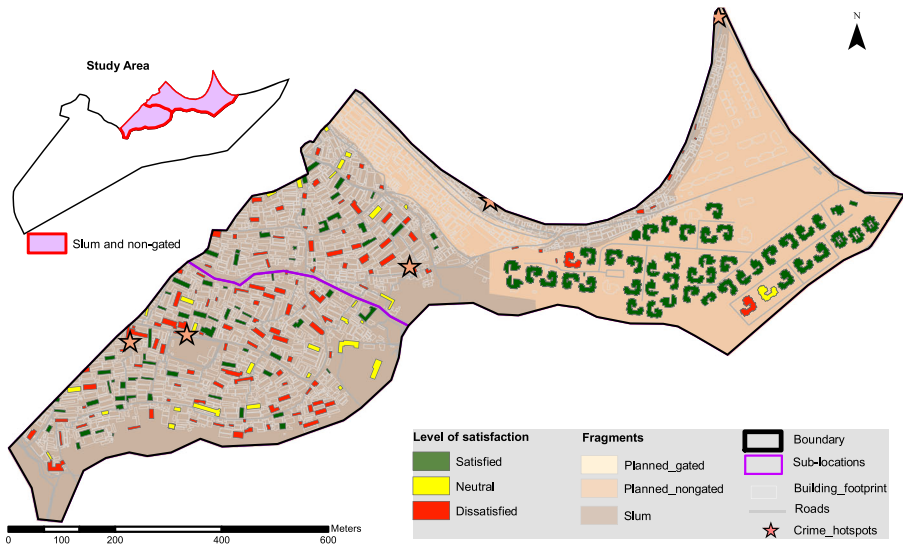


Fig. 6 Satisfaction with safety within slum and planned-non gated fragments

entrance) to prevent throughways within their quarters and agree on opening and closing hours (Fig. 7a, b). The development of gating is to mainly lock out intruders who might participate in crime within the fragment contrary to findings by Sabatini and Salcedo (2007) where the poor aspire gated lifestyle. Nairobi case seems similar to Lima (Ploger 2012) where the residents develop bottom-up gated *barriadas* in response to urban insecurity. Figure 8 shows that the majority in the gated community residents are very satisfied with safety giving reasons that the neighbourhood is walled, gated and secure from crime incidences. One reported, “*This is a gated community with proper security officers who monitor everyone who enters*”.

An unanticipated high percentage of respondents were dissatisfied with access to water in the gated community (although the highest percentage of households were connected to piped water into the dwelling)¹ while in the slum, the majority were satisfied (though highest percent rely on water from vending points)² (Figs. 9 & 10). This is because, during the data collection period, the city had experienced major water shortages and frequent water rationing (twice or thrice a week) (Daily Nation 2017; Koech 2017; Otieno 2017; Watson 2017). It is also worth noting that the gated community and planned non-gated residents consume an average in Nairobi of 200–300 l of water per capita per day (lpcd) against 15 lpcd by the slum residents (Mwaniki 2017). With the rationing and high consumption rate, the gated community residents incur more expenses explaining their dissonance due to seeking alternative sources of water especially the ones with no boreholes. However, the slum residents seem to have adapted to the water shortages hence high percentage satisfied (Fig. 5). One respondent in the slum expressed, “*I am satisfied. Rationing is the problem, but we are used to buying water from vendors who are always available.*”

¹ Source: (KNBS 2009)

² Source (KNBS 2009)



Fig. 7 a Informal formation of slum residential enclaves by fencing and (b) gate in the slum showing agreed opening and closing time

Level of Integration

Table 4 shows the overall mean scores of integration analysis in the fragments after aggregating respective indicators for each dimension in Appendix 2. Comparing symbolic integration on fragment friendliness, feeling at home, sense of pride and sense of belonging (Appendix 2), the findings show that the majority of respondents in the slum expressed worst feeling on symbolic integration than in the planned non-gated and gated community fragments. One of the slum residents expressed, “*This is a bad neighbourhood for upbringing children, I hate the place not safe and people are not friendly*”. This differs from Sabatini and Salcedo (2007) study that revealed that gated communities created a sense of pride among the poor neighbourhoods residents to desire to make their homes better. For Nairobi, the slum residents feel bad because of their poor conditions and their main concerns is for their conditions to be improved. Development of slums adjacent to well-off neighbourhoods in Nairobi is mainly to provide casual jobs and informally/illegally self-connect to services (e.g. electricity and water) (Karisa 2011). This tends to increase the feeling of stigmatization and

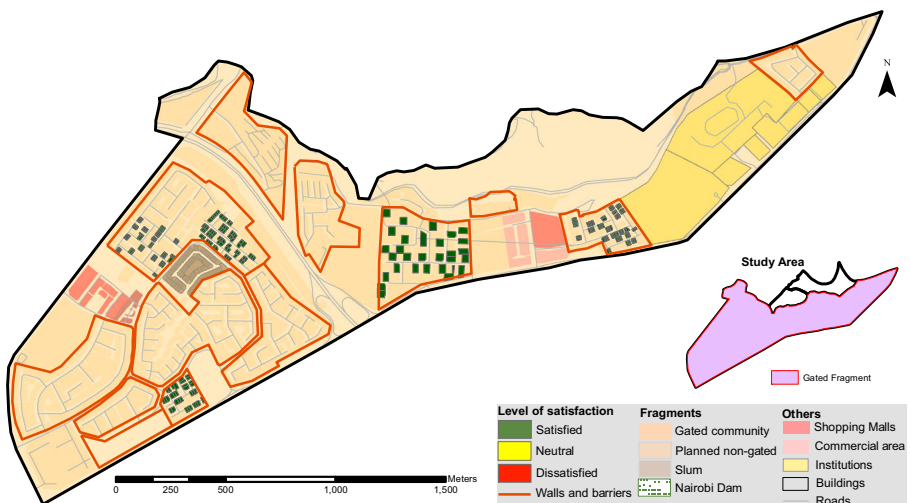


Fig. 8 Satisfaction with safety within gated community fragment

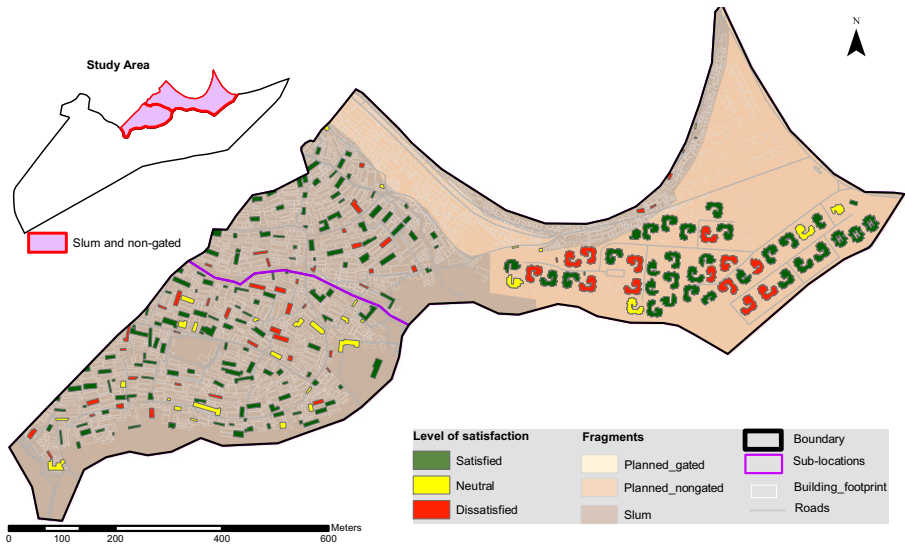


Fig. 9 Satisfaction with water within the slum and planned-non-gated fragments

marginalization of the slum residents as some reported hence undermining their sense of belonging. Studies have shown that the coexistence of extreme neighbourhoods makes it hard for the marginalized to recognize opportunities to develop their social prestige making their social mobility hard to achieve (Morgan 2013).

The gated community residents on average have lower community integration (Table 4) compared to the slum and planned non-gated fragments evidenced by the mean scores especially on socializing with residents on adjacent neighbourhoods, asking neighbours for help and neighbours asking help (Appendix 2). One of the key informants stated, *“In the gated communities you’ll find people are contained within their boundaries, the walls they’ve built. They hardly interact.*

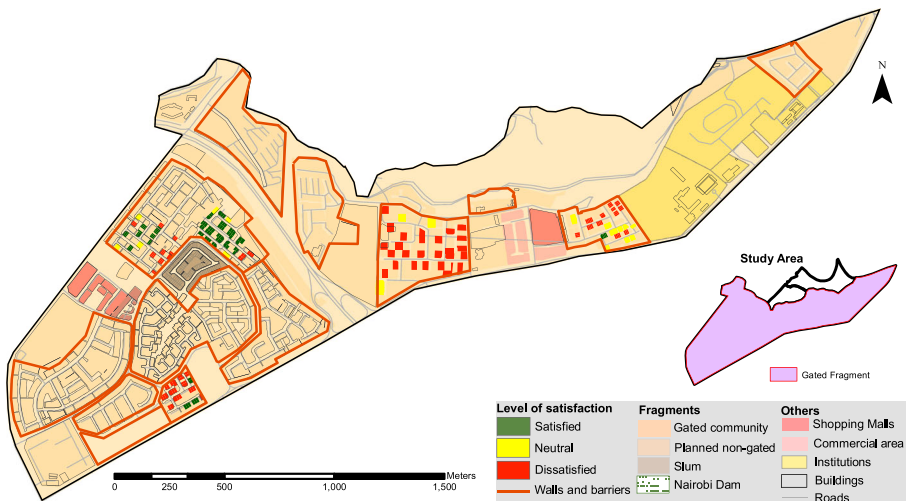


Fig. 10 Satisfaction with water within the gated community fragment

Table 4 Mean scores of integration dimensions in the fragments

Dimension		Slum	Planned non-gated	Gated community
Symbolic integration (SI)	Mean	3.59	4.13	4.41
	<i>Std. Deviation</i>	<i>1.02</i>	<i>0.85</i>	<i>0.59</i>
Community integration (CI)	Mean	3.53	3.65	3.41
	<i>Std. Deviation</i>	<i>0.72</i>	<i>0.72</i>	<i>0.64</i>
Functional integration (FI)	Mean	4.15	3.93	4.17
	<i>Std. Deviation</i>	<i>0.61</i>	<i>0.64</i>	<i>0.39</i>
Overall integration	Mean	3.82	3.90	4.02
	<i>Std. Deviation</i>	<i>0.61</i>	<i>0.53</i>	<i>0.37</i>

When people come from their houses, they get into their cars and the next thing is they're out...". Physical barriers such as gating and walling tend to isolate people from each other, limit social interactions and prevent the development of social networks as reported in the literature (Blakely and Snyder 1997; Jacobs 1961; Landman and Schonteich 2002; Legeby 2010; Low 2001).

In the gated community and the slum fragment, the residents feel relatively highly integrated functionally (ease access to opportunities and services) compared to the planned non-gated (Table 4 and Appendix 2). The high integration in the slums can also be related to the community-based initiatives, NGO and Faith-based organization programs that aid in providing services such as health, education and water. Also, the slum residents informally connect themselves to services meant for the gated community or planned non-gated fragments.

Association of Quality of Life with Types of Integration in the Fragments

Table 5 shows the correlation between QoL attributes and symbolic integration across the three fragments. The findings reveal that housing has a strong positive correlation with symbolic integration across the three fragments hence the higher the satisfaction with housing, the higher the mean score of symbolic integration. This relates to the study by Sabatini and Salcedo (2007) that people feel a sense of pride if the areas that they reside look better explaining the least symbolic integration by slum respondents (Table 5) as well as dissatisfaction with housing (Fig. 5). The infrastructure domain (electricity and solid waste management) have a strong significant correlation in the gated community. This may be explained by the key role electricity plays in security provision which is the main reason people move to live in the gated communities (UN-HABITAT 2006).

Similarly, an effective solid waste management system improves public health, ambiance and general aesthetics of the neighbourhood. People prefer living in gated communities to get these services (Mbogo 2017) thus satisfaction with solid waste management and electricity connection tend to increase symbolic integration in the gated community. Safety and relationships in the neighbourhoods are positively correlated with the symbolic integration across the three fragments. However, they have a strong correlation (+0.512 and +0.511) in the slum fragment hence the higher the satisfaction with safety and relationships the more they feel symbolically integrated.

Table 5 Correlation of symbolic integration and QoL attributes (bold strong correlations)

QoL attributes	Spearman's rho Correlations	Slum	Planned non-gated	Gated community
Mean SI	Correlation Coefficient	1		
	Sig. (2-tailed)	.		
Housing satisfaction	Correlation Coefficient	.570**	.522**	.537**
	Sig. (2-tailed)	.000	.000	.000
Satisfaction with green spaces	Correlation Coefficient	-.062	.237*	.300**
	Sig. (2-tailed)	.364	.016	.003
Recreational areas	Correlation Coefficient	.289**	.247*	.491**
	Sig. (2-tailed)	.000	.012	.000
Satisfaction with sports facilities	Correlation Coefficient	.051	.354**	.289**
	Sig. (2-tailed)	.453	.000	.005
Children play grounds	Correlation Coefficient	.114	.288**	.345**
	Sig. (2-tailed)	.091	.003	.001
Kindergarten school facilities	Correlation Coefficient	.120	.478**	.272**
	Sig. (2-tailed)	.077	.000	.008
Primary school facilities	Correlation Coefficient	.217**	-.013	.423**
	Sig. (2-tailed)	.001	.898	.000
Public transportation	Correlation Coefficient	.139*	.175	.461**
	Sig. (2-tailed)	.039	.078	.000
Water provision	Correlation Coefficient	.317**	.115	-.042
	Sig. (2-tailed)	.000	.249	.693
Electricity connection	Correlation Coefficient	.300**	.390**	.572**
	Sig. (2-tailed)	.000	.000	.000
Solid waste management	Correlation Coefficient	.256**	.303**	.557**
	Sig. (2-tailed)	.000	.002	.000
Safety	Correlation Coefficient	.512**	.287**	.406**
	Sig. (2-tailed)	.000	.003	.000
Relationships within the neighbourhood	Correlation Coefficient	.511**	.554**	.321**
	Sig. (2-tailed)	.000	.000	.002

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

*. Correlation is significant at the 0.05 level (2-tailed)

The correlation of the QoL attributes and community integration are displayed in Table 6. The results show that there is a negative correlation between community integration and safety in the gated community. This indicates that the more the residents self-segregate themselves in the gated communities; their perception of safety tend to improve which in return tend to weaken social networking and interactions with the other fragments especially due to the physical barriers. This agrees with other studies that gated communities make the residents feel secure but the physical boundaries, barriers and gates tend to limit and reduce social networks and integration (Blakely and Snyder 1997; Caldeira 2000; Jacobs 1961; Landman 2000, 2002, 2004; Morgan 2013).

Table 6 Correlation of community integration and QoL attributes (bold moderate and strong correlations)

QoL attributes	Spearman's rho Correlations	Slum	Planned non-gated	Gated community
Mean SI	Correlation Coefficient	1		
	Sig. (2-tailed)	.		
Housing satisfaction	Correlation Coefficient	.446**	.316**	-.108
	Sig. (2-tailed)	.000	.001	.302
Recreational areas	Correlation Coefficient	.319**	.079	-.091
	Sig. (2-tailed)	.000	.429	.385
Safety	Correlation Coefficient	.274**	.139	-.359**
	Sig. (2-tailed)	.000	.163	.000
Relationships within the neighbourhood	Correlation Coefficient	.576**	.531**	.334**
	Sig. (2-tailed)	.000	.000	.001
County management and maintenance of infrastructure	Correlation Coefficient	.147*	.024	.311**
	Sig. (2-tailed)	.029	.807	.002

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

*. Correlation is significant at the 0.05 level (2-tailed)

Relationships within the neighbourhood have a strong positive correlation with the community integration in the slum and the non-gated fragments.

Functional integration and QoL correlation showed a strong positive relationship with many attributes across the three fragments as shown in Table 7. Regarding water, there is a strong positive correlation only in the slum fragment but not significant in the other fragments. This suggests that satisfaction with the provision of water in the slum is key for the residents to feel functionally integrated especially on ease of access to drinking water (Appendix 2). Green spaces have a strong correlation with functional integration only in the planned non-gated fragment hence the higher the satisfaction with green spaces, the higher the mean of functional integration. The more correlations of QoL domain satisfaction with functional integration show that the more the ease of access to opportunities and services residents feel the more their satisfaction to QoL domains. This is echoes the study by MacKillop and Boudreau (2008) that public service and infrastructure play a major role in the development of strong policy tools for reducing fragmentation and spatial and social inequalities.

Discussion

The study shows counterintuitive findings on water satisfaction with dissonance in the gated community and adaptation in the slum fragment (Figs. 5, 9 & 10). Although during the data collection there was a prolonged period of water shortage in the city, the slum residents seemed to have coped with the shortages compared to the gated community residents which explain their high satisfaction. Availability, affordability and differing rate of consumption of water explain the reason for adaptation and dissonance in the fragments. Availability of water vendors as the alternative source is

Table 7 Correlation of functional integration and QoL attributes (bold strong correlations)

QoL attributes	Spearman's rho Correlations	Functional integration		
		Slum	Planned non-gated	Gated community
Mean symbolic integration (SI)	Correlation Coefficient	1	1	1
	Sig. (2-tailed)	.	.	.
Housing satisfaction	Correlation Coefficient	.364**	.424**	.375**
	Sig. (2-tailed)	.000	.000	.000
Satisfaction with green spaces	Correlation Coefficient	-.079	.541**	.258*
	Sig. (2-tailed)	.246	.000	.013
Recreational areas	Correlation Coefficient	.433**	.641**	.457**
	Sig. (2-tailed)	.000	.000	.000
Satisfaction with sports facilities	Correlation Coefficient	.276**	.419**	.336**
	Sig. (2-tailed)	.000	.000	.001
Children play grounds	Correlation Coefficient	.216**	.534**	.526**
	Sig. (2-tailed)	.001	.000	.000
Kindergarten school facilities	Correlation Coefficient	.510**	.310**	.514**
	Sig. (2-tailed)	.000	.002	.000
Primary school facilities	Correlation Coefficient	.555**	.390**	.507**
	Sig. (2-tailed)	.000	.000	.000
Public transportation	Correlation Coefficient	.401**	.211*	.617**
	Sig. (2-tailed)	.000	.033	.000
Water provision	Correlation Coefficient	.597**	-.004	-.063
	Sig. (2-tailed)	.000	.967	.553
Electricity connection	Correlation Coefficient	.662**	.505**	.636**
	Sig. (2-tailed)	.000	.000	.000
Solid waste management	Correlation Coefficient	.118	.418**	.643**
	Sig. (2-tailed)	.082	.000	.000
Safety	Correlation Coefficient	.346**	.435**	.398**
	Sig. (2-tailed)	.000	.000	.000
Relationships within the neighbourhood	Correlation Coefficient	.427**	.357**	.435**
	Sig. (2-tailed)	.000	.000	.000
Family income	Correlation Coefficient	.315**	.280**	.248*
	Sig. (2-tailed)	.000	.004	.017

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

* . Correlation is significant at the 0.05 level (2-tailed)

a reason for adaptation for the slum residents but for the gated community residents is the reason for dissonance. The slum residents are accustomed to buying water from vending points and consume low quantities per day while the gated community residents during rationing they have to buy water from the vendors hence incur more expenses due to their high consumption rate, hence their dissonance.

The majority of the residents in the slum were very dissatisfied with safety while the gated community residents were very satisfied (Figs. 5, 6 & 8). Insecurity and crimes are major hindrances to inclusive development in most of the Global South cities and a major contributor to the proliferation of gated communities in Nairobi. Although several reasons are identified for gated community development -e.g. desired sense of belonging, status, lifestyle and growing inequalities (UN-HABITAT 2006), in the case of Nairobi, insecurity supersedes other reasons. This explains why many people opt to live in the gated community in Nairobi as well as why some slum residents have adopted informal gating strategies. The slum residents have adapted the gating concept (Fig. 7a, b) as an aftermath requirement due to insecurities forming informal quarters (40–60 households) or “fragments” within the larger slum fragment. A situation Jacobs (1961) calls “islands within the city” or “Cities within the city” type of development. One of the key informants reported, “*The social reality for us is that security is a problem...So, to a very large extent, our neighbourhoods are very gated even public institutions.*” Apart from insecurity, other reasons for people opting to live in a gated community in Nairobi is lifestyle and status especially for the wealthy residents who want to segregate themselves to neighbourhoods with privatized high-quality services. The findings resonate with other empirical studies (Coy 2006; Fears 1992; Mohd et al. 2016; Ploger 2012) that identify insecurity being a driving factor to the development of gating communities and a major factor for the residents choice of housing among other causes.

The gated community residents feel least integrated (social networking and interaction) compared to the other fragments aligning with the study by Sabatini and Salcedo (2007) where community integration performed poorly among the gated community residents. Also, the correlation analysis in the present study revealed a negative correlation between safety and community integration in the gated community fragment. This shows that gating tends to limit social networks with different social groups and residents of the other fragments (community integration). It agrees with the literature on gated communities (Blakely and Snyder 1997; Caldeira 2000; Landman 2000, 2002, 2004; Morgan 2013) that creating territorial spaces, gating, building fences and walls and personalizing the environment could reduce the fear of crime and increase the feeling of safety but undermines the development of social networks and interactions. However, it is worth noting that these interactions are between residents in the gated community with residents in other fragments (slums and planned non-gated). Studies in Johannesburg (Duca 2013; Landman and Badenhorst 2012) indicate that residents of a gated neighbourhood interact more with their fellow residents especially due to rules and regulations set by Homeowners Association (HOA) who intend to create a harmonious lifestyle for the like-minded inhabitants living in a demarcated neighbourhood. This differs from our findings since our study was focusing on inter-fragment interactions rather than intra-fragment interactions.

The study identifies which domains of QoL are associated with the types of integration pertaining to each specific fragment. Based on this empirical analysis, fragmentation is related to some QoL domains (e.g. housing, safety). The strong positive correlation between symbolic integration and QoL domains related to the built environment (housing) and socio-economic domain (safety) indicate that people who are satisfied with housing in their neighbourhood also feel a sense of belonging. Contrary, community integration negatively correlates with safety in the gated community indicating that gating limits community

integration. Gated communities negatively contribute to fragmentation in the cities leading to differing patterns of residential fragments, social exclusion and social inequalities (Dear and Flusty 2002).

Finally, the findings revealed two perspectives of interactions experienced between the slum and the gated community fragments (Karisa 2011). From the perspective of the gated community residents, slums provide (cheap) labour as gardeners, housekeeping and security guards. Likewise, from the perspective of the slum, the residents benefit parasitically from the gated community through (informal) connections to services (e.g. water and electricity). The constant “siphoning” through informal connections redirect up to 40% of the utility services supplied to the gated communities. Thus, the gated community have to endure disruptions due to extreme pressure on the existing utilities (ibid). According to planning regulations, only planned areas can be provided with services hence this exclusionary planning only favours the gated community and planned non-gated fragments leaving the slum and low-income residents at mercies of NGOs and Faith-based organizations. This explains why slum residents illegally self-connect to services and reflects the intense urban divide on the provision to basic services leading to differing QoL conditions among urban fragments in Nairobi. Residential fragmentation for the city of Nairobi can only be solved if the government addresses the social objective of the poor in the city. The lack of social welfare system in the country and neglecting the urban poor results to poor living in unplanned settlements leading to illegal settlements and fragmentation.

Conclusion

Residential fragmentation is an increasing phenomenon globally and is linked to the increasing inequalities, social and spatial exclusion. Gating communities also tend to reinforce the fragmentation hence negatively impacting on the QoL of the urban dwellers. This phenomenon, therefore, calls for a holistic and integrated approach towards making the cities more inclusive especially not only accounting for parts but giving importance to QoL domains that relate to the integration of residential neighbourhoods. This study revealed that fragmentation impact on the QoL of urban dwellers. Gated communities tend to increase QoL satisfaction of residents because they have adequate services while the physical barriers, on the other hand, tend to increase dissatisfaction of QoL of non-gated and slum dwellers since they feel excluded. Residential fragmentation exacerbated by fencing strategies in both the slum and gated communities makes it harder for the residents to interact and integrate with residents in other fragments. The raises several critical questions and concerns such as; is gating the best solution to insecurity in cities since they tend to limit integration? What if it is the only solution? What if broader crime prevention strategies are not effective anymore? Does it then raise questions about whether fragmentation can be self-created for security reasons and if so, what does this means for the ideals of greater integration in cities? However, naïve these questions seem, the possible answers enable establishing future scenarios and stimulating discussions and inspire future empirical research especially on fragmentation and integration. These findings should also help direct new urban policies and strategies to foster integration and improve QoL conditions for all urban dwellers.

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Compliance with Ethical Standards

Informed Consent Informed consent was obtained from all individual respondents included in the study.

Conflict of Interests The authors report no conflict of interests.

Appendix 1

Table 8 QoL satisfaction in the fragments

Domains	Attributes		Slum	Planned Non-gated	Gated community
Built environment	Housing	Mean	3.02	3.76	4.27
		Std. Deviation	1.25	1.01	0.68
	Green spaces	Mean	2.60	3.17	3.67
		Std. Deviation	0.87	1.15	0.86
	Recreational areas	Mean	3.69	3.56	4.24
		Std. Deviation	1.08	1.09	0.74
	Sports	Mean	3.14	3.20	3.55
		Std. Deviation	1.09	1.05	0.84
	Children playgrounds	Mean	3.12	3.27	3.71
		Std. Deviation	1.24	1.08	0.94
Public services	Kindergarten	Mean	3.75	4.13	4.01
		Std. Deviation	1.03	0.85	0.88
	Primary school	Mean	3.91	2.99	4.29
		Std. Deviation	0.96	1.06	0.58
	Public transportation	Mean	4.13	4.18	4.32
		Std. Deviation	0.80	0.80	0.73
Infrastructure	Water provision	Mean	3.66	3.51	2.67
		Std. Deviation	1.04	1.08	0.94
	Electricity connection	Mean	3.78	4.44	4.50
		Std. Deviation	1.18	0.59	0.52
	Solid waste management	Mean	2.38	4.23	4.38
		Std. Deviation	1.22	0.89	0.61
Socio-economic	Safety	Mean	2.73	4.24	4.39
		Std. Deviation	1.19	0.87	0.55
	Relationships in the neighbourhood	Mean	3.86	4.00	4.00
		Std. Deviation	0.95	0.86	0.78
	Family income	Mean	3.19	3.45	3.75
		Std. Deviation	1.08	0.92	0.78

Table 8 (continued)

Domains	Attributes		Slum	Planned Non-gated	Gated community
Institutional	City-County management and maintenance of infrastructure	Mean	2.71	3.62	3.45
		Std. Deviation	1.07	0.99	0.97
	City-County provision of public facilities and services	Mean	2.77	3.17	3.72
		Std. Deviation	1.00	1.04	0.88

Appendix 2

Table 9 Symbolic, Community and functional integration in the fragments

Dimension	Indicators		Slum	Non-gated	Gated community
Symbolic integration	Neighbourhood friendliness	Mean	3.50	4.19	4.48
		Standard deviation	1.24	0.95	0.65
	Feeling at home	Mean	3.83	4.21	4.42
		Standard deviation	1.11	0.97	0.67
	Sense of pride feeling	Mean	3.38	4.06	4.37
		Standard deviation	1.29	0.97	0.75
	Feeling belonging	Mean	3.66	4.07	4.40
		Standard deviation	1.16	1.04	0.71
Community integration	Interaction with neighbours in the fragment	Mean	3.84	4.08	4.15
		Standard deviation	0.96	0.90	0.72
	Social interaction with adjacent fragment residents	Mean	3.31	3.46	3.19
		Standard deviation	0.80	0.75	0.77
	Neighbours asking for help	Mean	3.48	3.53	3.15
		Standard deviation	1.02	1.03	0.91
	Asking help from neighbours	Mean	3.47	3.52	3.15
		Standard deviation	1.03	1.02	0.87
Functional integration	Sports facilities	Mean	3.74	3.49	4.06
		Standard deviation	1.13	1.17	0.93
	Recreation services	Mean	4.06	3.57	4.18
		Standard deviation	0.97	0.99	0.88
	Kindergarten education	Mean	4.15	4.39	4.29
		Standard deviation	0.85	0.71	0.65
	Primary education	Mean	4.33	3.54	4.32
		Standard deviation	0.62	1.16	0.51
Health facilities	Mean	4.35	3.97	4.33	

Table 9 (continued)

Dimension	Indicators	Slum	Non-gated	Gated community	
		Standard deviation	0.69	1.03	0.52
	Electricity connection	Mean	4.26	4.45	4.57
		Standard deviation	0.77	0.59	0.50
	Drinking water	Mean	4.06	3.73	3.26
		Standard deviation	0.79	0.96	0.92

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