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Looking beyond household income status: exploring the interplay of income and other drivers of neighbourhood satisfaction in the Gauteng Province of South Africa

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Historic inequalities among different income groups remain a contentious issue affecting neighbourhood sustainability, particularly in South Africa. Prior studies frequently focused on the separate influence of income and other variables of neighbourhood satisfaction, failing to thoroughly explore how these variables intersect and interact with one another. The key objective of this study is to examine the interplay of income and other drivers of neighbourhood satisfaction in the Gauteng Province of South Africa to determine the net importance of household income on one's neighbourhood satisfaction. The study analyses a sample of 8996 adult respondents interviewed in the Quality of Life 6 Survey (2020/21) conducted in the highly urbanised Gauteng province of South Africa. Bivariate and multivariable statistical techniques are employed to estimate the magnitude of the association between household income and neighbourhood satisfaction. The results show a strong association between household income and individuals' neighbourhood satisfaction. However, neighbourhood satisfaction based on income alone does not offset the adverse roles of other non-monetary factors as individual and contextual factors. It is imperative to comprehensively understand the interactions between income and other drivers of neighbourhood satisfaction to address various disparities and inequities among income groups and create customised interventions to enhance good housing outcomes and neighbourhood satisfaction in Gauteng.

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Introduction

An interest in sustainable human settlements at the city, town, neighbourhood, or village level has evolved significantly worldwide during the past two decades (Department of Human Settlements DHS (2019), p. 2). City governments in both developed and developing countries are grappling with ways to respond to the compounding urban crises to ensure that ‘...cities and human settlements are inclusive/equitable, safe, resilient and sustainable’ (United Nations General Assembly (UN), 2015). Some scholars (Abrahams and Everatt, 2019; Baffoe, 2019; Baffoe et al., 2020; Msuya et al., 2021; Hammann, 2024) shed some light on the fact that in the global South, the challenges facing cities and neighbourhoods are even more pronounced due to rapid urbanisation, informal settlements and other diverse sociocultural dynamics. Moreover, the existence of historic spatial inequalities is also acknowledged to be among the many impediments to achieving this sustainability goal, particularly in relation to the global South (Ogu (2002); Westaway, 2009; Lynge et al., 2022; Westman et al., 2022). These inequalities are further fuelled by more reactive rather than proactive urban planning and management responses coupled with other socio-economic and environmental challenges, and these have disparately affected people’s perceptions about their neighbourhoods (UN, 2015; DHS (2019); Lynge et al., 2022).

Often, the type of neighbourhood an individual resides in is a function of the household income level to which they belong. In South Africa, neighbourhood typologies are typically categorised as low-income, middle-income and high-income (Lynge et al., 2022, p. 619). This makes household income an integral component of understanding neighbourhood satisfaction, as confirmed by several studies (Ogu (2002); Lovejoy et al., 2010; Buys and Miller, 2012; Mohit et al., 2014; Ibem et al., 2015; Abass and Tucker, 2018; Fattah et al., 2021; Kutor et al. (2022); Wang and Wang, 2016). These studies on neighbourhood satisfaction also confirm the importance of using multifaceted determinants in analysing contextual factors that influence neighbourhood satisfaction. Nevertheless, a research gap in analysing how these other determinants intersect and interact with income in shaping neighbourhood satisfaction to comprehensively address housing inequalities and urban residents’ overall quality of life is apparent. The key objective of this study is to examine the intersection and interaction of income and other drivers of neighbourhood satisfaction in the Gauteng Province of South Africa to determine the net importance of household income on one’s neighbourhood satisfaction.

The intersectional assessment of neighbourhood satisfaction helps identify the specific services and amenities required by residents with various income groups. It also creates a platform to identify areas that require regeneration or upgrading, proper channelling funds and setting public policies (Ibem et al., 2015; Ogu (2002); Westaway, 2009). Despite mounting criticisms of technocratic, top-down approaches to housing and infrastructure development in developing countries, an intersectional study on neighbourhood satisfaction provides alternative bottom-up and decision-making approaches (Ogu (2002), p. 37; Permentier et al., 2011). This is so because it reconciles the disparate perceptions that different income groups hold as they experience and are affected by their neighbourhood environment.

Baffoe and Kintrea (2023, p.7) argue that there is a paucity of information about neighbourhood satisfaction and associated drivers among different socio-economic groups in the global South context. Baffoe (2019) argues that studies focussing on neighbourhoods in the global South need to consider neighbourhoods’ localised and context-specific nature, recognising that traditional Western models of neighbourhoods may not fully capture the complexities of urban environments in regions like

Africa and Asia. This is against the context that most neighbourhoods in the global South struggle to meet the growing demands for housing supply, infrastructure and urban services (Baffoe et al., 2020; Msuya et al., 2021). Most of the neighbourhoods lack quality health and education facilities, adequate urban greens, quality neighbourhood-level services and poor housing that affects the quality of life and even leads to spatially segregated communities (Roy and Sowgat, 2024). Moreover, a significant number of the neighbourhoods function as spaces of both social interaction and governance, especially in the context of informal settlements where state involvement might be minimal or inconsistent (Abrahams and Everatt, 2019; Baffoe, 2019; Msuya et al., 2021; Scheba et al., 2021). Ibem et al., 2015 also concede that there appears to be a need for more empirical evidence regarding the differential experience of people living in different types of neighbourhoods in the global South. Lynge et al. (2022) argue that there is still a gap in localised studies that provide a systematic analysis of neighbourhood types spanning the entire income spectrum in the context of South Africa. Understanding these nuances is critical for developing policies that promote equitable urban development and improve the quality of life in rapidly urbanising areas. Dlamini et al. (2022, p. 35) concur that there needs to be more research regarding the analysis of neighbourhood satisfaction and its determinants in spatially heterogeneous and emerging societies such as Gauteng province in South Africa.

This study is organised into six main sections. The second section is about the theoretical framing of the study and literature review. The description of the case study and methods sections then follow. Fifth is the presentation and discussion of findings and last is the conclusion section.

Neighbourhood satisfaction and the key theoretical underpinnings

The concept of a neighbourhood is a significant landmark of urban planning of the 20th century (Patricios, 2002, p. 21). The ideas of the neighbourhood and a neighbourhood unit were first published in 1920’s by urban designers such as Clarence Stein and, Henry Wright, Clarence Perry and Ebenezer Howard (Patricios, 2002; Baffoe, 2019). Neighbourhood planning intended to address the urban planning challenges that industrialised nations faced during the time, namely; congestion, working conditions, crowded living and unfavourable environments through design. The fundamental principles in the design of the neighbourhoods were ensuring mixed-use planning, maintaining walkable distances to schools and social conveniences, pedestrian-oriented road patterns, parks and recreation and architectural qualities (Perry, 1929; Stein, 1949). Similarly, in the context of the global South and with specific reference to South Africa, most of these challenges still prevail and can be better articulated by zooming in to the neighbourhood scale (Katumba and Everatt, 2021; Scheba et al., 2021). These challenges can be attributed to several factors, such as a combination of high population increases, migration and urban sprawl, particularly in peri-urban areas (Msuya et al. 2021). The DHS Department of South Africa cites several challenges in South African human settlements challenges, such as sprawling, low-density and mono-functional neighbourhoods on the one hand and poorer neighbourhoods characterised by a lack of adequate infrastructure, facilities and amenities, low levels of service and few or undesirable public spaces on the other (DHS (2019), p. 16). The DHS further argues that more research is required to understand the form, structure and nature of various types of neighbourhoods in the country post-apartheid and the diverse perceptions of residents living

there. This is the study gap that this research seeks to fill by exploring the interaction and the intersection of income with other determinants of neighbourhood satisfaction in the Gauteng City Region (GCR).

There is no universally accepted definition of what constitutes a neighbourhood, which can result in inadequate application of the term in both academic research and urban planning (Baffoe, 2019). It is interpreted in various ways, such as a geographical area, a social community, or a unit of policy-making (Baffoe, 2019). A neighbourhood environment is defined as the surrounding physical, social and economic setting in which residential units are located (Ibem et al., 2015, p. 734). People evaluate their neighbourhood environments based on how they believe they facilitate achieving their life goals (Mohit et al., 2014). Neighbourhood satisfaction deals with how residents assess their neighbourhood environment. Neighbourhood satisfaction is regarded as a global or multidimensional concept since it results from assessments of various quality of life aspects relevant to the social, physical, economic and geographic space within which people live (Westaway, 2009, p. 448). Fattah et al. (2021:41) describe it as a complex concept measured in multi-context views, derived by combining different attributes within explicative models and relationships between sets of predictors or criteria.

Baffoe et al. (2020) identify three neighbourhood typologies in Kigali, Rwanda: planned, informal and mixed Neighbourhoods. The research highlights the essential function of informal and mixed neighbourhoods as experimental sites for social initiatives, promoting the development of well-serviced mixed neighbourhoods to foster a robust sense of community and inclusive planning for every resident. Similarly, in South Africa, some of the low-income neighbourhoods are characterised by extreme poverty and vulnerability and are often found in informal settlements, while others are transitional areas with poor living conditions and backyard dwellings (Lynge et al., 2022).

Satisfaction is measured by the difference or gap between the residents' housing conditions and their desired dwelling and neighbourhood environment. Abass and Tucker (2018:38) define neighbourhood satisfaction as the degree between residents' ideal neighbourhood aspirations and actual residential environments. It is also defined as the extent to which people are happy or discontented with their dwelling units' surrounding physical, social and economic environment (Ogu (2002); Ibem et al., 2015). Morris and Winter's (1978) housing deficit theory and Galster's (1985) psychological construct theory are the critical theoretical lenses through which neighbourhood satisfaction is explored in this study. According to the housing deficit theory, the type of neighbourhood remains a significant independent predictor of neighbourhood dissatisfaction. Individuals judge their neighbourhood satisfaction based on some criteria/norms such as 1) the primary land uses in the area, (ii) accessibility to institutional facilities, (iii) the quality of streets and roads and (iv) social class, race and ethnic group. Any gap between the actual and expected norms results in dissatisfaction, which leads to some form of housing adjustment, either through residential mobility or modification of the housing condition (Mohit et al., 2014). Similar to the housing deficit theory, the psychological construct theory by Galster (1985) postulates that individuals place a perceived meaning or 'reference condition' (ideal situation) on their residential situation (Mohit et al., 2014). Neighbourhood satisfaction prevails when a small gap exists between the current neighbourhood environment and this reference situation, while dissatisfaction is experienced when there is incongruence with the reference situation, resulting in either the individuals choosing to adapt to the status quo or to modify their residential buildings.

Literature review

Research around the neighbourhood concept and residential or neighbourhood satisfaction is primarily skewed towards the Global North. China stands out as the domain of neighbourhood scholarship in the Global South, with only a handful of similar research conducted elsewhere (Baffoe, 2019; Kutor et al., 2022). The studies highlight the importance of various factors in determining residents' neighbourhood satisfaction and mobility intentions in different contexts. The factors include housing design (Buys and Miller, 2012); neighbourhood qualities (Ibem et al., 2015; Fattah et al., 2021; Msuya et al., 2021; Lynge et al., 2022; Baffoe and Kintrea, 2023); social and cultural perceptions (Permentier et al., 2011; Wang and Wang, 2016); income levels (Wang and Wang, 2016; Lynge et al., 2022; Roy and Sowgat, 2024); social interactions with neighbours (Abass and Tucker, 2018; Kutor et al., 2022); racial and income desegregation (Scheba et al., 2021; Lynge et al., 2022; Hamann, 2024) and individuals' place attachment (Li and Wu, 2013; Dlamini et al., 2022; Kutor et al., 2022; İnal-Çekiç et al., 2023). Some studies also highlight the need to develop active partnerships between planners, urban developers and local communities to improve planning for enhanced neighbourhood satisfaction (Abrahams and Everatt 2019; Katumba and Everatt, 2021; Scheba et al., 2021; Hamann, 2024; Roy and Sowgat, 2024).

Buys and Miller's (2012) study in Brisbane, Australia, highlighted the importance of dwelling design, neighbourhood characteristics and social interaction with neighbours as specific features that predict residential satisfaction in inner urban higher-density neighbourhoods. They also expressed that higher density is frequently imagined as harmful and undesirable. Thus, active partnerships are required between those who design inner urban high-density developments and the local communities. Another study by Abass and Tucker (2018, p. 38) in Australian low-density suburbs confirmed that greater satisfaction is correlated with increased social interaction. Fattah et al. (2021) also established that neighbourhood interaction and attachment, dwelling features, neighbourhood environment and neighbourhood facilities are the key factors significantly influencing residential mobility intention in Penang Island, Malaysia. In a study on the residents' attitudes towards the state-led urban redevelopment process in Okmeydanı, Turkey, İnal-Çekiç et al. (2023) found that one's attachment to and identification with a place and identification both have an effect towards neighbourhood spatial changes and mobility. Li and Wu (2013), in evaluating residential satisfaction of informal settlements in Beijing, Shanghai and Guangzhou, argue that one's social attachment to a neighbourhood, rather than an individual's socio-economic background or the quality of the built environment, has the most significant impact on influencing residential satisfaction. These findings are similar to Kutor et al.'s (2022) study but in a different context. Kutor et al. (2022) found that strong social networks and high place attachment are the other main predictors of residential satisfaction in informal settlements in Harare, Zimbabwe.

Permentier et al. (2011, p. 979) compare the differences in the determinants of neighbourhood satisfaction and the perceived reputation of the neighbourhood in Utrecht, Netherlands. They argue that to improve the well-being of residents in deprived neighbourhoods and reduce mobility, policies should also seek to improve the factors that residents think harm the reputation of their neighbourhood. Wang and Wang (2016) in Beijing, China, argue that even at a city level, there exist intra-city differences in satisfaction perceptions as people from different cultures and with different income levels tend to have divergent components of life satisfaction (Wang and Wang, 2016, p. 15). Ibem et al. (2015) study on public housing satisfaction in Ogun State, Nigeria, reveals that the respondents were generally dissatisfied with the

neighbourhood environment in the housing estates. Noise and poor access to services and infrastructure were the primary sources of dissatisfaction. They argue that the physical, social and economic environments significantly influence residents' satisfaction. Another study by Ogu (2002) on urban residential satisfaction in Benin City, Nigeria, identified inadequate environmental infrastructure services as a significant cause of neighbourhood dissatisfaction.

A study by Roy and Sowgat (2024) with case studies of 13 cities from the global South (including some African cities such as Kigali (Rwanda), Cape Town and Johannesburg (South Africa), Dar es Salaam and Dodoma (Tanzania) and Huye (Rwanda), among those from Asia), shows the significance of planning neighbourhoods that promote both mental and physical health by providing access to green spaces, walkability and community resources. The study highlights the need for inclusive infrastructure to address socio-economic disparities, encourage social cohesion and integrate health-conscious urban design to enhance overall well-being. These aspects create healthier and more equitable neighbourhoods, ultimately improving neighbourhood satisfaction.

Some local studies in South Africa also examine neighbourhood-related issues (Abrahams and Everatt, 2019; Katumba and Everatt, 2021; Scheba et al., 2021; Dlamini et al., 2022; Lynge et al., 2022). Lynge et al., 2022 study reveals the persistent nature of socio-economic inequalities and residential segregation in various cities in South Africa that may result in neighbourhood dissatisfaction. According to Lynge et al. (2022), there is seemingly a shift from race- to class-based segregation post-apartheid in South African neighbourhoods. Similarly, Hamman's (2024) study in Gauteng also reveals that the dynamics of space and socio-economic class in Gauteng have mainly remained consistent since the end of apartheid, as the patterns of residential growth continue to reflect the racial demographics of the original areas from which they have developed. Desegregation, which can result in neighbourhood satisfaction, can be attained if various players (i.e., public and private) collaborate to ensure that urban growth is deliberate and planned rather than unregulated. This can include combining housing for different income brackets (providing diverse housing options within existing urban areas) and creating inclusive, mixed-use spaces that create opportunities for people from different socio-economic backgrounds to engage in shared activities (Hamann, 2024).

A study by Scheba et al. (2021) found that socioeconomic factors can exacerbate neighbourhood segregation and worsen urban management challenges. The study reveals that densification in Cape Town's neighbourhoods is irregular, as socio-economic disparities influence it. In poorer neighbourhoods, the densification process is often a result of necessity rather than planning, leading to overcrowding and a strain on infrastructure in these neighbourhoods. On the other hand, affluent neighbourhoods experience more structured densification through formal development, improving access to amenities and maintaining urban quality, improving their liveability and vibrancy. Lessons from Cape Town show that it is essential to address specific socio-economic drivers to encourage the development of more equitable and dense urban forms. These consequently lead to more neighbourhood satisfaction.

The studies on neighbourhood satisfaction discussed above show that the determinants of neighbourhood satisfaction vary according to many factors. Therefore, context-specific studies that target relevant neighbourhood policies are important so that the correct issues in the proper localities are tackled. Lynge et al. (2022) propose taking extraordinary policy and political measures in different types of neighbourhoods. This research focuses on

Gauteng Province in South Africa, known for its socioeconomic and demographic diversity (Abrahams and Everatt, 2019; Katumba and Everatt, 2021; Dlamini et al., 2022).

Case study

The Gauteng Province (Fig. 1) is the smallest of the nine provinces in South Africa, although it constitutes almost 25% of its total population (Statistics South Africa, 2023). This province is famous for being the most socially diverse in South Africa, but just like the other provinces, it is characterised by high inequality (Dlamini et al., 2022). The province has nine municipalities; three are metros with a population of more than 500,000 (Ekurhuleni, Johannesburg and Tshwane), and the remaining six are smaller local municipalities. It is in this province that the city of Johannesburg, renowned for its economic and spatial inequalities, is found (Westaway, 2009, p. 448). The country's capital city, Pretoria (Tshwane), is also found in this province. The 2022 census data indicates that Tshwane has a 3% annual compound growth trend, while Johannesburg's is 0.7%. Emfuleni, a municipality known for its slow population growth since the last census, has seen a 31% increase in population (Götz et al., 2023; Statistics South Africa, 2023). Over the last 10 years, Gauteng's population has increased by about a quarter (23%) of its own previously estimated size of 12.7 million to ~15.1 million (Götz et al., 2023). The racial makeup of the Gauteng population has changed significantly. Comprising 84.6% of the population, Black Africans, 2.9%; Indians, 2.2%; Whites, 10%; and others, 2% (Statistics South Africa, 2023). In a country such as South Africa, which has a history of social, physical, economic and geographic inequalities (Dlamini et al., 2022; Lynge et al., 2022), the most crucial way to address compounding challenges of urban inequality is through genuinely learning about peoples' experiences by creating a dialogue with those affected by a crisis (Westman et al., 2022, p. 1410). In this study, the perceptions about residents' neighbourhood satisfaction address the compounding challenge of inequitable housing in the Gauteng province.

Lynge et al. (2022) provided a comprehensive historical perspective on the segregation of neighbourhoods in South Africa. Communities predominantly composed of Black Africans were often situated in peripheral locations or transitional zones, characterised by inadequate access to resources, substandard infrastructure and distinct administrative frameworks. As urban development progressed, the authorities established additional townships to accommodate black residents and address informal settlements. The design of these townships was intentionally developed as dormitory areas with inadequate amenities and limited transport connectivity. The seemingly current lack of spatial transformation in some neighbourhoods highlights post-apartheid urban policy's limited success in promoting racial integration (Lynge, et al., 2022; Hamann, 2024).

The neighbourhoods that make up the GCR have developed disjointedly, frequently influenced by racial tensions, socio-economic inequality and poor infrastructure (Abrahams and Everatt, 2019; Lynge et al., 2022; Hamann, 2024). A study by Lynge et al. (2022) expands on neighbourhood typologies in South Africa beyond the typical categories of low-income, middle-income and high-income and identifies eight typologies. Type 1 neighbourhoods are affluent, while Type 2 neighbourhoods are home to the emerging middle class. Type 3 neighbourhoods are places where affluent pensioners reside, and Type 4 neighbourhoods are characterised as racial enclaves or the township middle class. Type 5 neighbourhoods are areas with high unemployment or large established townships. Type 6 neighbourhoods are transitional areas with poor living conditions and backyard dwellings. Type 7 neighbourhoods consist of

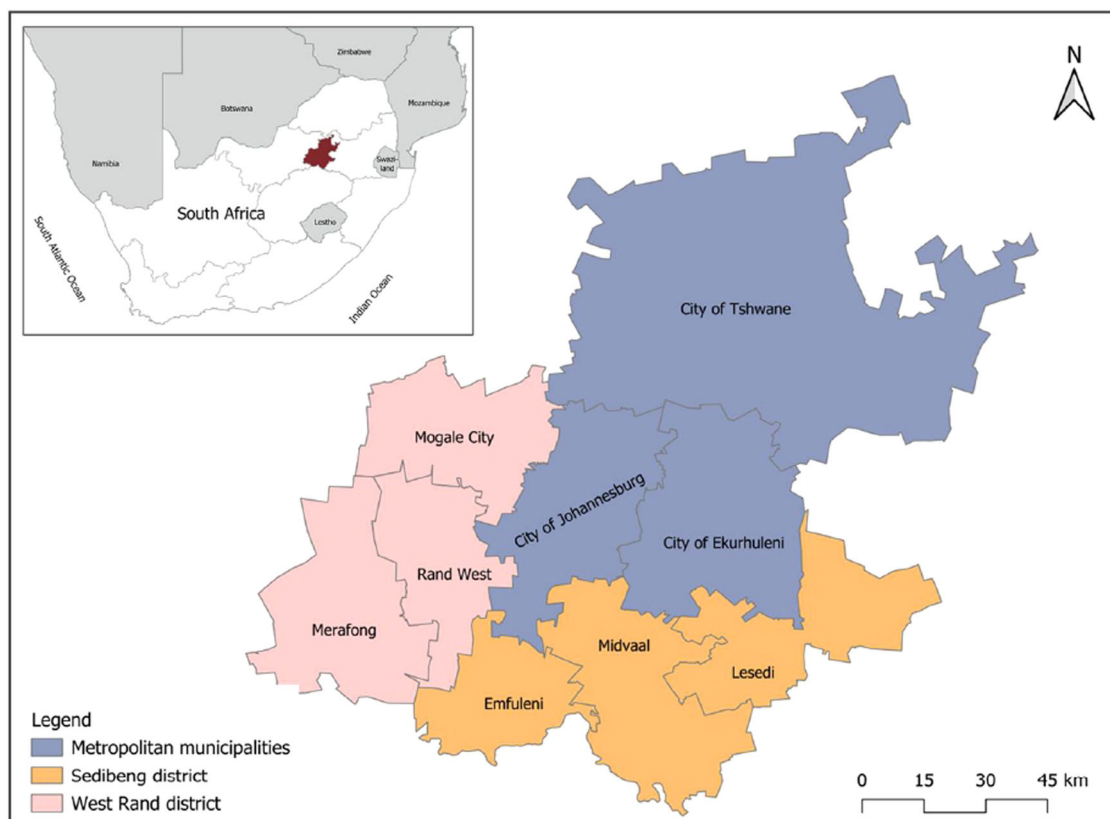


Fig. 1 Map of Gauteng Province of South Africa.

entrenched poverty and peri-urban traditional settlements, while Type 8 neighbourhoods are characterised by extreme poverty and vulnerability, often found in informal settlements. By comparing these neighbourhood types, the study reveals the multi-dimensional and persistent nature of socio-economic inequalities and residential segregation in South Africa. This points towards the need for more implementation of policy initiatives that promote socio-spatial inclusivity. Figure 2 shows images that exemplify some of the neighbourhood typologies in the GCR.

The GCR has notably complicated planning and urban management because of its expansive geography and the existence of informal settlements, which impede service delivery and complicate governance. Katumba and Everatt (2021) attribute the rapid expansion of formal and informal settlements in the GCR to high population growth driven by migration and natural increase. The GCR faces difficulties in managing urbanisation due more profound challenges such as addressing the legacy of spatial planning from the apartheid era, striking a balance between economic growth and sustainability, political reluctance to curb sprawl and the surmounting pressure to meet housing demands and managing informal settlements (Abraham and Everatt, 2019; Katumba and Everatt, 2021).

Methods

This study aims to examine the interplay of income and other drivers of neighbourhood satisfaction in the Gauteng Province of South Africa in order to determine the net importance of household income on one's neighbourhood satisfaction. The data for this study were obtained from the Quality of Life (QoL) VI Survey (2020/21) conducted with 13,616 adult respondents aged 18 years and older in the Gauteng province of South Africa. The QoL VI Survey (2020/21) was conducted by the Gauteng City-Region Observatory (GCRO) with fieldwork running from

October 2020 to May 2021. The survey is the sixth in a series of iterations conducted every 2 years in the Gauteng Province starting in 2009. The QoL VI Survey was an in-person household-based survey, the only one in a series of such surveys conducted during a disease pandemic - the COVID-19 pandemic. The trained multilingual fieldworkers would use whichever language the respondents were comfortable using. The interviews for the QoL VI Survey were conducted in all the 529 wards of the Gauteng province. A ward, the boundaries of which are determined by the Municipal Demarcation Board, is a geopolitical subdivision within a municipality. The QoL VI Survey employed a multistage sampling process with randomisation at cluster, dwelling unit and individual levels. Of the total 13 616 respondents in the survey, 8 996 provided data about their household monthly income, the primary predictor variable for the current study and these formed the sample for this study.

Secondary sources of information include reports from government ministries, the SA Neighbourhood Planning Redbook, online journals and books. The key determinants/ drivers used in this study have been consistently associated with residents' satisfaction with the neighbourhood environment in various studies. Ibem et al. (2015) assert that the use of determinants for the analysis of neighbourhood satisfaction should not be fixed to a certain number, however, it needs to be adjustable according to the objectives of the studies. Only those variables captured in the Quality-of-Life survey were adopted in this study, as highlighted in Table 1.

Data analysis. The statistical analysis for this study followed three phases. The first phase involved estimating the spatial distribution of neighbourhood satisfaction levels using the ward as the unit of analysis. In South Africa, wards are geopolitically defined subdivisions of municipalities. There are 529 wards in the Gauteng



Fig. 2 Some neighbourhood typologies in the GCR. **a** An informal settlement in the GCR. **b** An informal neighbourhood adjacent to an affluent neighbourhood in the GCR. **c** An affluent neighbourhood in the GCR. **d** Transitional areas with poor living conditions and backyard dwellings in the GCR.

Table 1 Variables adopted from the Quality of Life Survey.	
Determinants/Drivers of Neighbourhood Satisfaction	Questions from the Quality of Life Survey
Physical factors/Dwelling type, and design	1. Which type of dwelling does this household occupy? 2. How satisfied are you with the dwelling that you are currently living in?
Environmental service variables/Neighbourhood characteristics	1. Would you say the water you receive is always clean? 2. In the past 12 months, how often, if ever, did you experience water interruptions? 3. How satisfied are you with the roads where you live? 4. How satisfied are you with the streetlights where you live? 5. Environmental factors, like air and water pollution or dumping sites, have harmed me or my family 6. How satisfied are you with the area or neighbourhood where you live now?
Economic factors	1. What is the total amount of money brought into the household per month by all household members?
Socio-demographic predictors	1. To which population group does the respondent belong? 2. How is the dwelling owned? 3. How old are you?
Social/ Community type	1. During the past year, has the crime situation improved, stayed the same or worsened? 2. Have you been a victim of crime in the past year?

province. The analysis estimated the proportions of respondents in each ward who reported being satisfied with their neighbourhood. The results of this estimation were exported to QGIS for spatial mapping. The second analysis phase was the bivariate estimation of the levels of neighbourhood satisfaction by the categories of each predictor variable. This analysis was conducted to obtain unadjusted relationships between neighbourhood satisfaction and each of the predictor variables. The third data analysis phase explored a multivariable hierarchical logit model with interactions between household income and each control factor. After running the regression model, Stata post-estimation commands - *margins* and *margins plots* were employed to transform regression coefficients into predicted probabilities of

neighbourhood satisfaction for a more straightforward presentation and interpretation.

Results and discussion

This section presents and discusses findings from the bivariate and multi-variable statistical analysis.

Sample distribution. The study sample comprised 8996 individuals born between 1940 and 2003. Table 2 presents the distribution of the study sample. Except for the first row, N, which reports row percentages, the sample distribution is reported in column format for all three columns: unsatisfied, satisfied and

Table 2 The distribution of the study sample.

	Neighbourhood satisfaction		
	Not satisfied	Satisfied	Total
N	3011 (33.5%)	5985 (66.5%)	8996 (100.0%)
Household income			
Low	2482 (82.4%)	4290 (71.7%)	6772 (75.3%)
Medium	529 (17.6%)	1695 (28.3%)	2224 (24.7%)
Dwelling type			
Formal	2299 (76.3%)	5279 (88.2%)	7578 (84.2%)
Informal	660 (21.9%)	665 (11.1%)	1325 (14.7%)
Other	52 (1.7%)	41 (0.7%)	93 (1.0%)
Dwelling ownership			
Not owned	1104 (36.7%)	2063 (34.5%)	3167 (35.2%)
Owned	1907 (63.3%)	3922 (65.5%)	5828 (64.8%)
Neighbourhood income			
Low income	2482 (82.6%)	4253 (71.8%)	6735 (75.4%)
Medium	524 (17.4%)	1672 (28.2%)	2196 (24.6%)
Government security			
Not satisfied	2552 (84.8%)	4155 (69.4%)	6707 (74.6%)
Satisfied	459 (15.2%)	1830 (30.6%)	2289 (25.4%)
Roads satisfaction			
Not satisfied	2119 (70.4%)	2868 (47.9%)	4988 (55.4%)
Satisfied	892 (29.6%)	3116 (52.1%)	4008 (44.6%)
Streetlights			
Not satisfied	2241 (74.4%)	3215 (53.7%)	5457 (60.7%)
Satisfied	770 (25.6%)	2770 (46.3%)	3539 (39.3%)
Crime situation			
Improved	491 (16.3%)	1356 (22.7%)	1847 (20.5%)
Same	884 (29.3%)	2243 (37.5%)	3127 (34.8%)
Worsened	1636 (54.3%)	2386 (39.9%)	4022 (44.7%)
Crime victim			
No	2253 (74.8%)	4977 (83.2%)	7230 (80.4%)
Yes	758 (25.2%)	1008 (16.8%)	1766 (19.6%)
Water satisfaction			
Not satisfied	756 (25.1%)	671 (11.2%)	1427 (15.9%)
Satisfied	2255 (74.9%)	5314 (88.8%)	7569 (84.1%)
Water interruptions			
Never	763 (25.4%)	1951 (32.6%)	2715 (30.2%)
Twice a year	1048 (34.8%)	2010 (33.6%)	3058 (34.0%)
Every month	849 (28.2%)	1486 (24.8%)	2335 (26.0%)
Every week	351 (11.7%)	538 (9.0%)	889 (9.9%)
Birth cohort			
1940–1969	541 (18.0%)	1709 (28.6%)	2250 (25.0%)
1970–1979	470 (15.6%)	1072 (17.9%)	1542 (17.1%)
1980–1989	841 (27.9%)	1577 (26.3%)	2418 (26.9%)
1990–1999	905 (30.1%)	1317 (22.0%)	2222 (24.7%)
2000–2003	254 (8.4%)	310 (5.2%)	565 (6.3%)
Sex of respondent			
Male	1406 (46.7%)	2976 (49.7%)	4383 (48.7%)
Female	1605 (53.3%)	3009 (50.3%)	4613 (51.3%)
Population group			
Black African	2797 (92.9%)	5088 (85.0%)	7885 (87.6%)
Coloured	106 (3.5%)	186 (3.1%)	292 (3.2%)
Indian/Asian	40 (1.3%)	156 (2.6%)	196 (2.2%)
White	68 (2.3%)	555 (9.3%)	623 (6.9%)

total. It is common practice in the literature to present sample distributions using column percentages (total in Table 2) without identifying the categories of the dependent variable. In this study, the researchers included the sample distribution by the categories of dependent variables to provide a platform for easier understanding of the multivariable regression results, which report interactions between the primary predictor and control variables. The focus, however, is on reporting the sample distribution on the total column.

As shown in Table 2, most of the sample was from low-income households (75%) and resided in formal dwellings (84%), while 65% lived in dwellings owned by their households. The majority of the sample were from low-income neighbourhoods (75%), most were not satisfied with government security (75%) and streetlights (61%). Regarding the crime situation, 45% reported that it worsened, while 25% and 21% indicated that it remained the same and improved, respectively. About 80% of the sample had not been a victim of crime in the 12 months preceding the

data collection date. Regarding water, 84% of the sample reported being satisfied with the quality they received from their municipalities, although almost 70% experienced water interruptions to varying degrees. Regarding demographic characteristics, the sample comprised 25% from the 1940–1969 birth cohort, with a slightly higher proportion of 27% being from the 1980–1989 cohort, while the youngest cohort, 2000–2003, accounted for just six per cent of the sample. About 51% of the sample was female, and 88% was Black African, with the White population group accounting for seven percent.

Spatial variability in neighbourhood satisfaction. The map shown in Fig. 3 presents the spatial distribution of the levels of neighbourhood satisfaction at the ward level across the Gauteng province. Out of 529 wards, only three had less than 25% of respondents who reported dissatisfaction with their neighbourhood. In 50 out of the 529 wards, the proportion of respondents reporting satisfaction with their neighbourhoods was between 25 and 49%, and these are highlighted in yellow on the map. Most of Gauteng Province's wards had 50–74%, or 75–100%, of respondents' satisfaction with their neighbourhoods.

Levels of neighbourhood satisfaction: Objective indicators.

This study used objective and subjective predictor variables. Following this classification, the bivariate results are presented with objective indicators (these include household income, dwelling type, dwelling ownership, neighbourhood income, population group, sex, birth cohort, victim of crime and water interruptions in Fig. 4). The results for the primary predictor variable, household income, show that a significantly higher proportion of respondents from middle-income households were satisfied with their neighbourhoods. This higher satisfaction among middle-income households could be attributable to more resources to afford housing in better neighbourhoods that provide more convenient access to amenities such as parks and schools (Lovejoy et al., 2020; Scheba et al., 2021; Lynge et al., 2022). The results presented in Fig. 4 show the point estimate (red diamond) of the proportion of respondents who indicated that they were satisfied with their neighbourhood and the associated 95% confidence intervals (CI) represented by blue- top-down lines. Where the 95% CIs of the low and middle-income categories do not intersect, it indicates a significant difference. The objective indicators show significant differences in levels of neighbourhood satisfaction by dwelling type, neighbourhood income level, the experience of crime (crime victim), water interruptions, population group and the birth cohort, which is also confirmed in studies elsewhere (İnal-Çekiç; 2023; Ogu (2002)). One of the notable patterns in Fig. 3 is the decline in the proportions reporting neighbourhood satisfaction by birth cohort, which is shown in the notable decreases associated with younger cohorts. Wang and Wang (2016) posit that it may be because those who are elderly have less desire than the younger groups.

Levels of neighbourhood satisfaction: Subjective indicators.

Regarding subjective measures, there were notably higher levels of neighbourhood satisfaction among those who reported being satisfied with government security services, roads and streetlights in their area (these include satisfaction with government security, roads, streetlights, crime situation and the environment- Fig. 5). The results also showed more significant proportions reporting neighbourhood satisfaction among respondents who stated that the crime situation in their area improved compared to those who stated that it worsened. Among those who experienced environmental harm, the proportion that was satisfied with their neighbourhood was significantly lower than that of those who reported

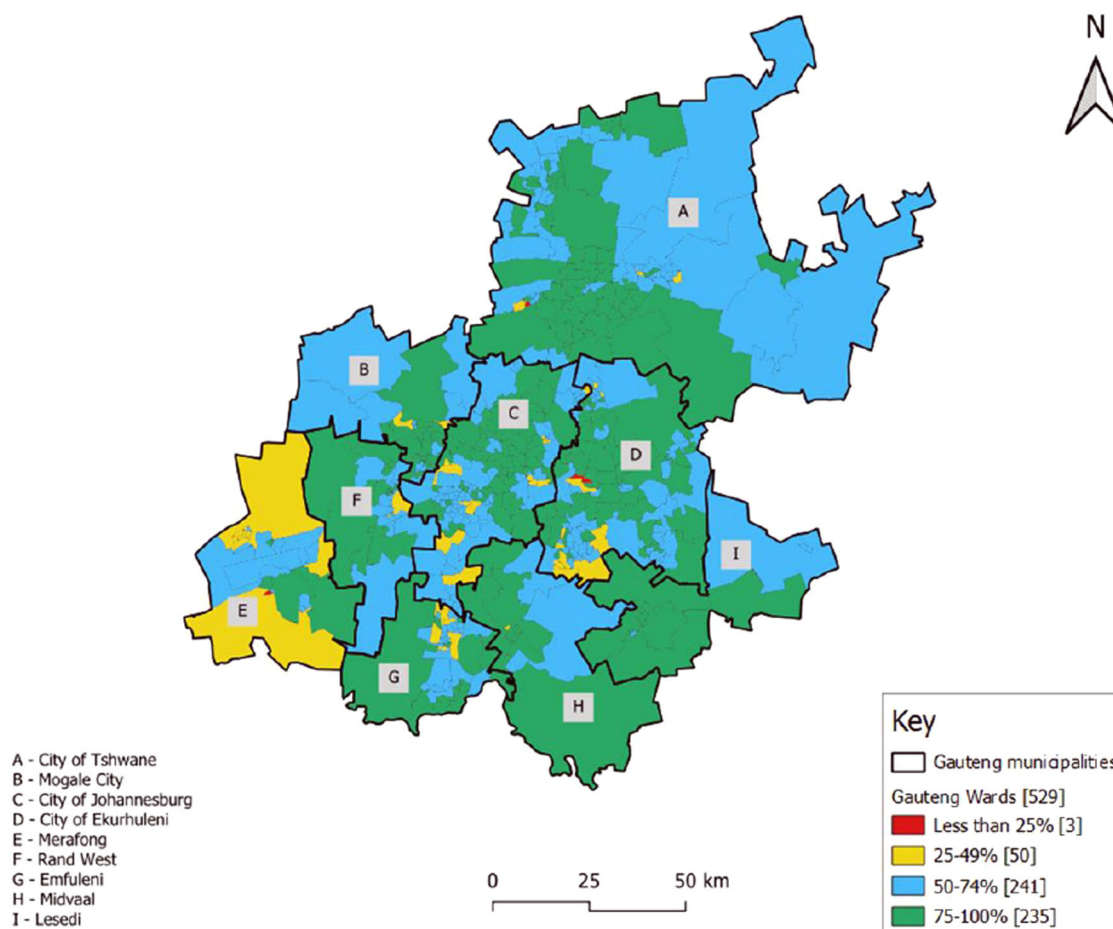


Fig. 3 The spatial distribution of the levels of neighbourhood satisfaction at the ward level across the Gauteng Province.

that they did not experience environmental harm. Exploring these subjective measures provides a more nuanced understanding of other intangible aspects of satisfaction that are overshadowed when only objective measures of satisfaction are used for analysis (Ogu (2002)).

Predictors of Neighbourhood Satisfaction: Interactions between household income and objective variables. The bivariate results presented in the previous section showed that, for the most part, the household income and the control factors (objective factors and subjective variables) are notable factors in distinguishing neighbourhood satisfaction. To determine the net impacts of these variables, we explored a multivariable logit model with post-estimation of predicted average probabilities of neighbourhood satisfaction. The results from the multivariable analysis are presented in Figs. 6 and 7. While the results are presented in separate graphs for each variable, it is noteworthy to highlight that they were obtained from one regression model. There are two pieces of results shown in each graph. The first is the difference between the average predicted probabilities of neighbourhood satisfaction between low and medium household income classifications, denoted by blue and red lines. The second is the difference between the categories of each control variable, which is obtained by comparing them within the categories of household income classification.

These two pieces of results enable the study to determine beyond doubt whether household income matters in understanding neighbourhood satisfaction. In this section, we first look

at the results for the objective indicators as they interacted with the primary predictor variable - household income, focusing on glaring patterns. By looking at the objective variables, the general pattern is that the predicted average probabilities of neighbourhood satisfaction are higher in association with living in a medium-income household than a low-income household. However, the gaps are mostly insignificant. The only statistically significant result between low and medium household income was observed in staying in medium-income neighbourhoods.

Figure 6 shows that the average predicted probability of neighbourhood satisfaction associated with living in a medium-income household in medium-income neighbourhoods was significantly greater than that associated with living in a low-income household in medium-income neighbourhoods. The housing deficit theory can also be used to explain these findings as it argues that the type of neighbourhood remains a significant independent predictor of neighbourhood satisfaction. For example, the presence or absence of some norms, e.g. the primary land uses available in an area, can result in either satisfaction or dissatisfaction (Mohit et al., 2014). Medium-income neighbourhoods in the GCR generally provide better amenities than low-income neighbourhoods. Moreover, they have higher property taxes and rates for municipal services, which, on the one hand, may be satisfactory for medium-income earners yet dissatisfactory for low-income earners, as also confirmed by Lovejoy et al. (2020). The neighbourhood and household income results also show a significant positive net effect of household income when comparing low and medium-income households. The average predicted probability of neighbourhood satisfaction was significantly higher

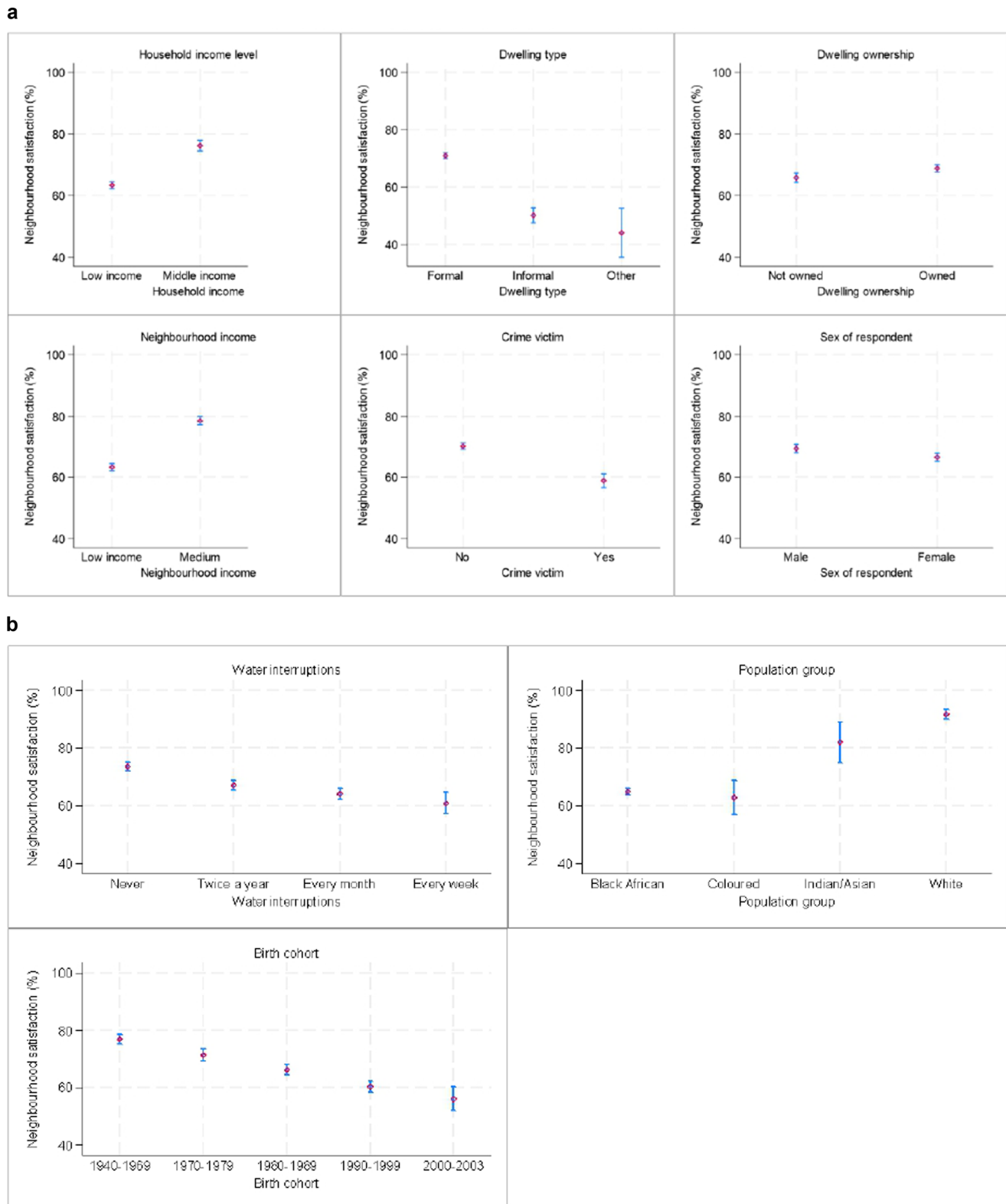


Fig. 4 Level of satisfaction using objective indicators. a Objective indicators: household income level, dwelling type, dwelling ownership, neighbourhood income, crime victim, and sex of respondent. **b** Objective indicators: water interruptions, population group, and birth cohort.

for individuals living in medium-income households situated in medium-income neighbourhoods than those with medium-income households residing in low-income neighbourhoods. The psychological construct theory also explains these findings as the perceived meaning or ideal situation that individuals place on a

neighbourhood environment affects one's satisfaction or lack thereof (Mohit et al., 2014). Thus, low satisfaction among medium-income earners residing in low-income neighbourhoods in South Africa might result from lower or poorer services associated with these neighbourhoods (Lynge et al., 2022).

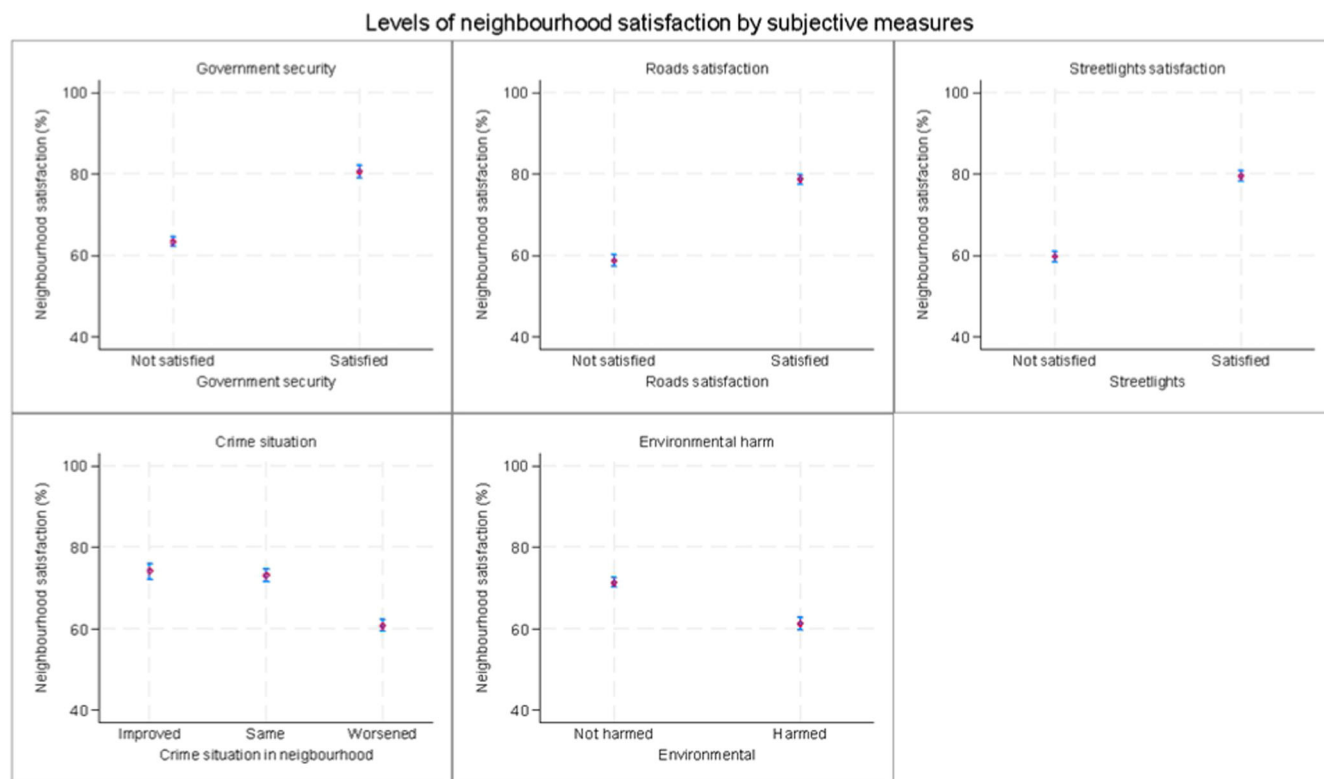


Fig. 5 Neighbourhood satisfaction using subjective indicators.

Regarding dwelling ownership, there was a more defined benefit in the category of medium-income households. The results showing interactions between household income and dwelling ownership show that the average predicted probability of neighbourhood satisfaction increased for individuals living in medium-income households as one moved from 'not owned' to 'owned' dwelling. This finding contrasts Ogu (2002) outcome that house owners are prepared to ignore inadequacies in the dwelling unit. Additionally, home ownership provides a sense of stability and security where homeowners may contribute to the improvement of their dwelling unit and their neighbourhood which can contribute to higher levels of satisfaction. Nevertheless, similar findings did not apply to low-income household owners as no significant differences in satisfaction were obtained among low-income households who moved from not owned to owned. This could be attributed to other factors that may affect satisfaction beyond home ownership, such as the design of the house (Buys and Miller, 2012), access to amenities (Ibem et al., 2015) or social interactions (Kutor et al., 2022). The effect of crime experience was more significant for individuals from medium-income households than their counterparts from low-income households. In those who did not experience crime (crime victims), the average predicted probability of neighbourhood satisfaction was higher for those from medium-income households than low-income households. However, when looking at crime victims, the average predicted probability of neighbourhood satisfaction was lower for those from medium-income households. In the disaggregation of South African neighbourhood typologies, medium-income households are generally found in medium-income neighbourhoods. These areas are generally safer than low-income households as these households can privately provide better security measures (DHS (2019); Dlamini and Tesfamichael, 2021). This means that individuals from medium-income households are generally shielded from violent crime that occurs in low-income neighbourhoods with more frequency. The

experience of crime is thus likely to be more traumatic to individuals from medium-income households.

The average predicted probabilities of neighbourhood satisfaction for the individuals from the 1980–1989 and 1990–1999 birth cohorts were significantly lower than those from the 1940–1969 birth cohort. Wang and Wang (2016) posit that those who are elderly generally tend to be more satisfied with their lives than the younger groups. Across all the birth cohorts, the average predicted probabilities of neighbourhood satisfaction were higher for individuals from medium-income households than those from low-income households. Regarding population group, the results show the added benefits of household income on neighbourhood satisfaction for all groups except Black Africans. The lack of positive benefits of household income on neighbourhood satisfaction for Black Africans can be understood in terms of the legacies of past spatial planning and place attachment. During the development of cities in South Africa, Black Africans were restricted mainly to high-density townships, and many continue to reside in these townships despite higher incomes. Townships generally lag behind suburban areas in indicators such as safety, social amenities and quality of infrastructure like roads. Consequently, a lack of satisfactory community-level variables diminishes the potential benefits of improved household income on neighbourhood satisfaction. Nonetheless, while the overall results for the interactions between household income and population group were not statistically significant at a 95% confidence level, it is evident that household income plays a role in individual neighbourhood satisfaction.

There were no differences in predicted probabilities of neighbourhood satisfaction associated with household income status when respondents never experienced water interruptions. Observable differences emerged when water interruptions were reported—twice a year, every month and every week. The importance of household income emanates from the fact that during water interruptions, households either buy water from private sellers or wait in long

Predicted average probabilities of neighbourhood satisfaction by household income and objective confounders

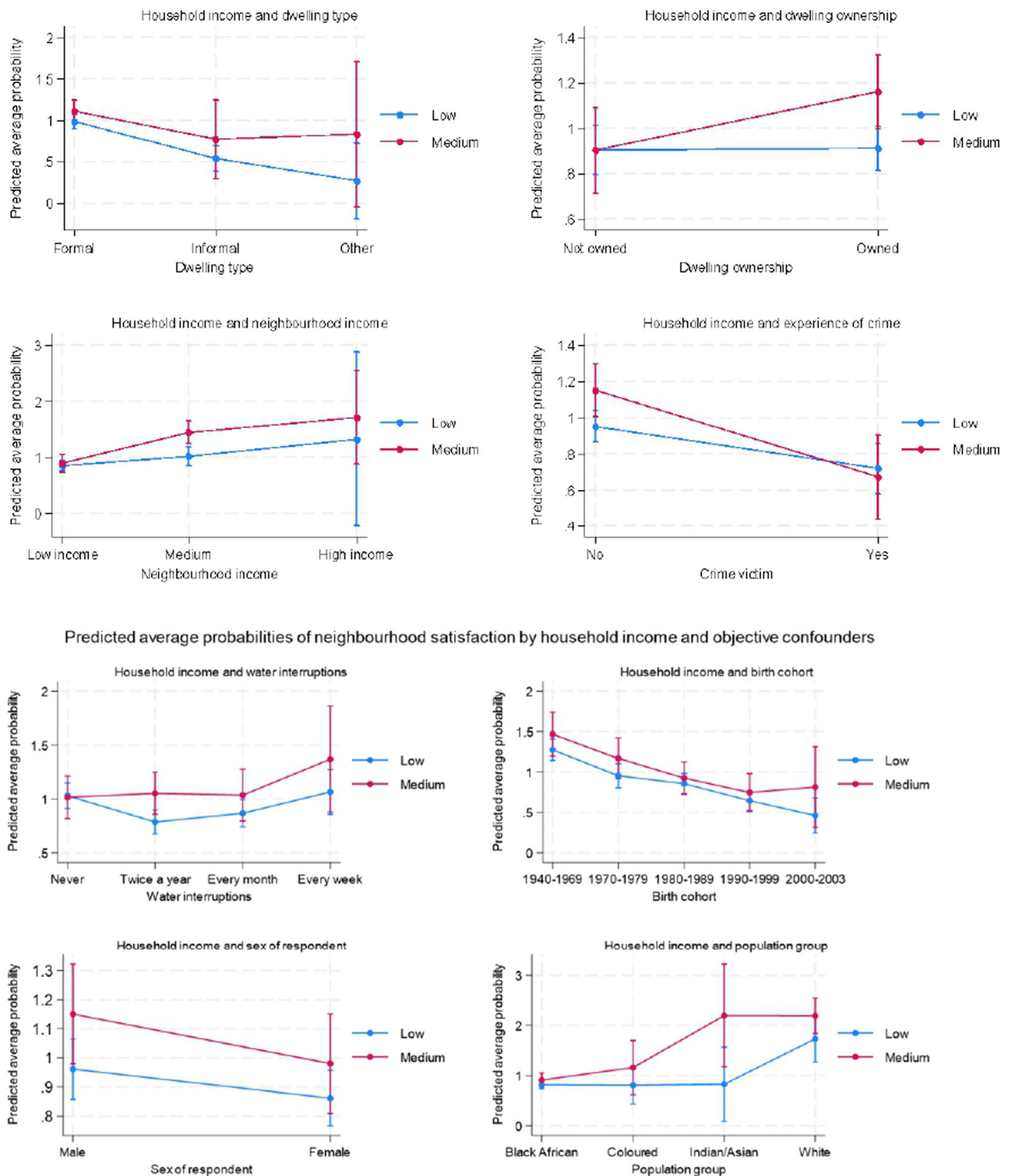


Fig. 6 Interactions between household income and objective variables.

queues for water from municipal trucks. In other instances, households with investment capacity have access to boreholes or storage facilities (like Jojo tanks), enabling them to access water during interruptions. The convenience of buying water from private sellers or having storage facilities is often the preserve of medium

and high-income households. It is one of the reasons why, in cases where water interruptions were reported, the predicted average probabilities of neighbourhood satisfaction were higher for individuals living in medium-income households than their counterparts from low-income households. The interaction between household

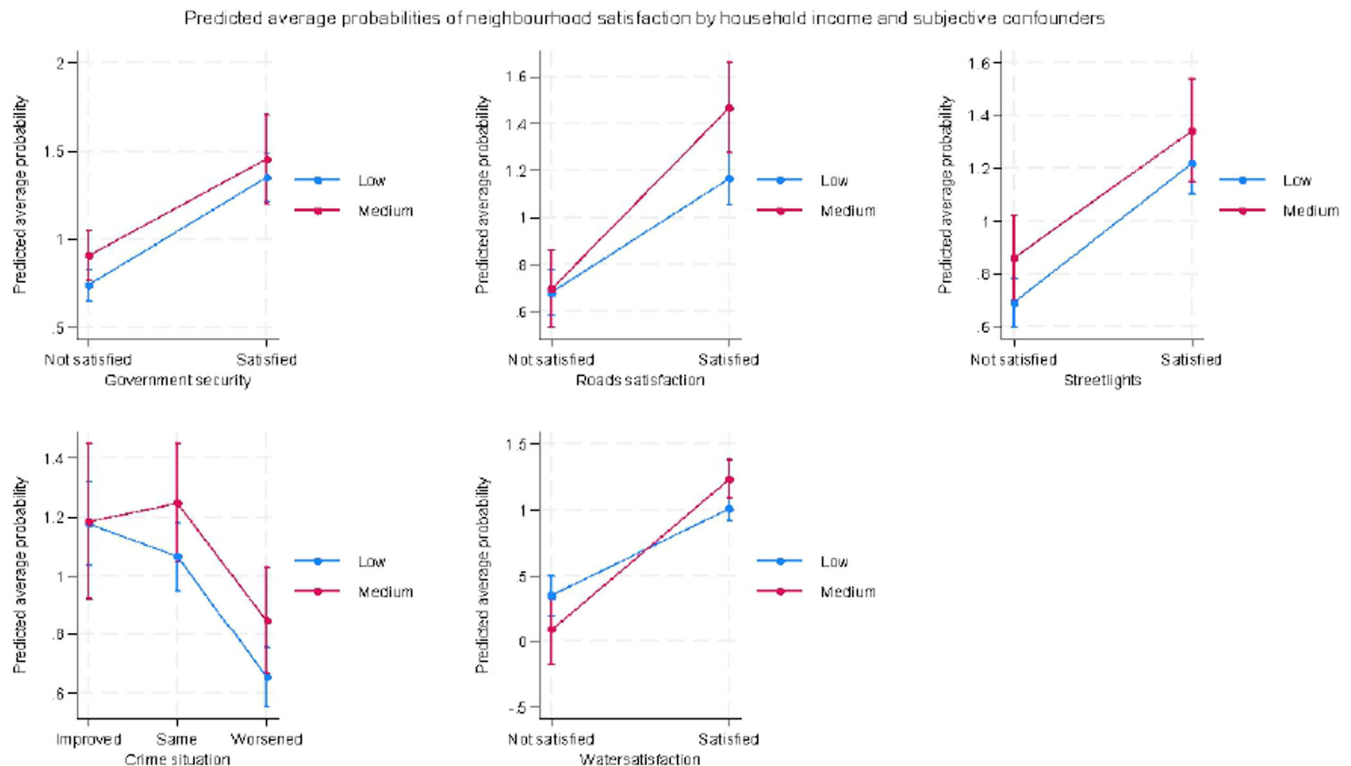


Fig. 7 Interactions between household income and subjective variables.

income and water interruption showed that living in a medium-income household did not differentiate the predicted probabilities of neighbourhood satisfaction when water interruptions were considered.

Predictors of neighbourhood satisfaction: interactions between household income and subjective variables. Compared to objective control factors, there were more defined differences in predicted average probabilities of neighbourhood satisfaction between the control factor categories. As shown in Fig. 7, satisfaction with government security services, roads, streetlights and water was associated with significantly greater predicted average probabilities of neighbourhood satisfaction within both low—and medium-income categories. In all these control variables, the predicted average probabilities of neighbourhood satisfaction were higher for individuals from medium-income households than those from low-income households, although they had no statistical significance.

From Fig. 7, the results for roads and water satisfaction showed unique patterns. Regarding road satisfaction, there was no observable difference in the predicted average probabilities between individuals from low- and medium-income households. However, an observable gap emerged when moving to the satisfied category, where living in a medium-income household was associated with a notably higher predicted average probability of neighbourhood satisfaction than living in a low-income household. Looking at water quality satisfaction, the predicted average probability of neighbourhood satisfaction was lower for individuals from medium-income households than those from low-income households if they were not satisfied with the water quality they received from the municipality. The opposite was observed when respondents reported that they were satisfied with the water quality they received from their local municipality, whereby the predicted average probability associated with living in a medium-income household was higher.

The results for the crime situation showed that the predicted average probability of neighbourhood satisfaction was significantly lower for individuals who reported that it worsened compared to the other two categories when looking at respondents from low-income households only. The results were not statistically significant but showed a similar pattern when looking at respondents from medium-income households. There is an observable benefit on neighbourhood satisfaction derived from living in a medium-income household, as shown by the higher predicted average probabilities where the crime situation was reported to have remained the same or worsened.

Conclusion

This study provides critical insights into how income and other non-monetary factors interact to shape neighbourhood satisfaction in the Gauteng Province. The study contributes to global South scholarship on neighbourhood satisfaction, particularly in heterogeneous and emerging societies such as Gauteng province in South Africa. The study addressed the gap in localised studies that analyse neighbourhood satisfaction levels across different income groups. This quantitative study sufficiently tested the hypothesis of the study that higher income means greater satisfaction with one's neighbourhood. However, it does not sufficiently cover the rich, in-depth perspectives of participants that would be covered in comparison to a qualitative study. Moreover, some unexpected findings could not be fully explored through quantitative means.

By examining the interactions and overlaps between these characteristics, the research provides insight into the distinct experiences of residents in Gauteng Province with varying income backgrounds under different circumstances. The study confirms the strong association between household income and individuals' neighbourhood satisfaction; however, other non-monetary factors play a crucial role in determining the level of satisfaction regardless of income. It was established from the study that other

determinants, such as road satisfaction, crime situation, dwelling ownership, place of residence and water quality satisfaction, are strongly associated with neighbourhood satisfaction in medium-income households in comparison to low-income households in Gauteng Province. Medium-income households often possess greater means to tackle non-financial aspects, such as securing improved housing, gaining access to safer communities and affording better water and sanitation services. Hence, their expectations are higher, and they are more sensitive to non-monetary factors. However, this does not mean that low-income earners do not aspire to live in neighbourhoods with these services. However, in most cases, Low-income households often prioritise basic needs such as food, shelter and healthcare, which may overshadow the importance of non-monetary factors. Literature also suggests that low-income households demonstrate greater resilience and adaptability to unfavourable non-monetary conditions, owing to their experiences with economic challenges, which may lead to lower demand for satisfaction from non-monetary aspects. Moreover, they possess robust social support networks within their communities, which can alleviate the effects of negative non-monetary factors on their overall satisfaction.

Understanding these nuances is critical for developing policies that promote equitable urban development and improve the quality of life in rapidly urbanising areas. The study makes two key policy recommendations that both require multiple stakeholder engagement throughout the planning cycle. The first one includes prioritising investments in infrastructure and basic services such as improving water quality and road conditions and enhancing safety by implementing crime prevention strategies in low- and medium-income areas. The second recommendation is to invest in community development programs to improve low-income neighbourhoods' social reputation, social interaction and place attachment. Such programs require buy-in from the community and political leaders. Such programs include improving public spaces to appeal to the liveability of low-income neighbourhoods, promoting art and cultural events, neighbourhood watch programs and community policing initiatives that create opportunities for economic empowerment among low-income households. By addressing these specific factors contributing to the disparities between the various income categories in Gauteng, neighbourhood satisfaction is improved and these are positive efforts towards achieving sustainable human settlements at a regional scale.

Data availability

Data supporting this study are openly available from DataFirst at <https://doi.org/10.25828/wemz-vf31>.

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Author contributions

The authors contributed equally to writing this article.

Competing interests

The authors declare no competing interests.

Ethical approval

The University of Witwatersrand's Human Research Ethics Committee (Non-Medical) approved the Quality of Life survey questionnaire and methodology used for this study under Protocol Number H19/11/09. The research was conducted in line with the relevant guidelines of the University of Witwatersrand's Human Research Ethics Committee (Non-Medical) when human participants are involved. The ethics clearance was approved on 06 March 2023.

Informed consent

The participants were asked for their consent to take part in and publish the results of the Quality of Life survey questionnaire. They were fully informed about the purpose of the research, assured of their anonymity and informed about how their data would be used. They were also made aware that there were no foreseeable risks associated with participating.

Additional information

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