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Perceptual Disparities in Transportation Accessibility, Neighborhood Quality, and Satisfaction across Metro, Urban, and Rural Areas

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In this study, we examined the spatial inequalities in transportation accessibility, neighborhood environments, and overall satisfaction across metropolitan, urban, and rural areas in South Korea, and explored the relationships among these factors. Utilizing the 2020 Korea Housing Survey, we applied inequality indices and multinomial logistic and ordinal regression models. Our analysis highlights several key findings. The Gini index for overall neighborhood satisfaction is 0.075, indicating moderate inequality, whereas transportation accessibility shows a more pronounced disparity with an index of approximately 0.120. Multinomial logistic regression results underscore that transportation accessibility—particularly to hospitals, markets, and public transportation—significantly impacts resident satisfaction, particularly in metropolitan and urban settings. Rural residents generally report more favorable conditions in terms of lower pollution, better parking, and stronger social ties. However, metropolitan residents benefit from superior pedestrian environments, educational facilities, and safety, leading to a higher satisfaction with housing quality but a greater tendency to relocate. Additionally, in rural areas, housing quality and access to essential services such as hospitals, public transportation, and markets are crucial for neighborhood satisfaction. This study enhances the literature by providing an additional understanding and offering practical insights for policymakers and urban planners aiming to create more equitable and sustainable communities.

1. Introduction

Urbanization has driven significant spatial transformations across societies,[1–3] manifesting in the emergence of distinct core-periphery dynamics that shape socio-economic and spatial inequalities.[4,5] At the heart of this process lies a key factor, that is, uneven development,[6,7] where competition across locations is inherently oligopolistic, and economic activities are

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distributed unevenly.[8] That is, urbanization not only intensifies economic competition but also reinforces spatial inequalities, resulting in differentiated accessibility to resources, opportunities, and services across core, semi-core, and periphery regions.[9] These inequalities extend into everyday life, particularly in the availability and quality of transportation infrastructure, neighborhood environments, and the associated quality of life.[10]

In South Korea, rapid urbanization has accentuated disparities among metropolitan, urban, and rural areas, generating distinct spatial experiences for residents.[11,12] Core areas, typically metropolitan regions, concentrate economic activities, advanced infrastructure, and high-quality public services.[13] Conversely, semi-core and periphery regions encounter challenges such as limited transportation options, less developed neighborhood environments, constrained access to essential services, and limited opportunities and capabilities for innovation.[14] Understanding these disparities is crucial because they directly affect how residents perceive transportation accessibility, neighborhood conditions, and overall satisfaction.

Despite extensive research highlighting the role of transportation accessibility and neighborhood environments in shaping the quality of life, existing studies often overlook the perceptual differences across metro, urban, and rural contexts. The spatial heterogeneity in experiences of residents—particularly in terms of transportation and neighborhood conditions—remains underexplored, which is a significant gap given the complex socio-economic dynamics of rapidly urbanizing societies such as South Korea.

This study seeks to fill that gap by addressing the following research questions: First, are there notable inequalities in perceptions of transportation accessibility, neighborhood environments, and overall satisfaction across metro, urban, and rural areas? Second, how do perceived quality and satisfaction levels differ among residents in these spatial contexts? Third, do distinct patterns emerge in the associations between transportation accessibility, neighborhood environments, and satisfaction across these areas? To answer these questions, we analyzed representative national survey data from the 2020 Korea Housing Survey (KHS) using a combination of inequality indices (Gini and Theil indices) and multinomial logistic and ordinal regression models.

By examining spatial heterogeneity in perceptions across metro, urban, and rural areas, this study provides crucial insights into how urbanization processes shape spatial inequalities in South Korea. Specifically, it highlights how differential access to transportation and neighborhood amenities—driven by urbanization—leads to variations in perceived quality and satisfaction across different spatial contexts. The findings from this research hold significant implications for evidence-based urban planning and policy formulation. By offering a deeper understanding of spatial heterogeneity in experiences of residents, this study equips policymakers and urban planners with the knowledge needed to design tailored interventions that address the diverse needs of residents in an increasingly urbanized world.

2. Background

Friedmann and Wolff[15] classified core regions as traditional industrialized and potentially post-industrial regions housing the majority of corporate headquarters and serving as major

markets for global production. These core regions also harbor world cities, acting as pivotal hubs for banking, finance, administration, and ideological influence.[16,17] Semi-core regions, meanwhile, denote rapidly industrializing areas whose economies remain reliant on core region capital and technical expertise. Serving as conduits between core and peripheral markets, they occupy an intermediate position, potentially experiencing a transition toward greater industrialization and economic autonomy. Conversely, periphery regions represent areas trapped in an ongoing process known as the development of underdevelopment, leading to pervasive challenges such as economic marginalization, technological backwardness, and political vulnerability.

This theoretical framework elucidates persistent disparities across economic as well as societal dimensions among core, semi-core, and periphery regions.[18,19] For instance, transportation accessibility and neighborhood environments emerge as critical determinants of the quality of life,[20–24] reflecting the broader socio-economic disparities inherent in core-periphery dynamics.

The core-periphery framework is central to this study as it provides a structured lens to examine persistent disparities in both economic and societal dimensions across regions. The framework underscores the spatial and socio-economic hierarchies that shape access to resources, opportunities, and services. Such hierarchies extend beyond economic indicators to permeate everyday life, affecting the critical determinants of the quality of life such as transportation accessibility and neighborhood environments. Within this context, core areas generally enjoy superior transportation options, well-developed neighborhood environments, and greater access to essential services, whereas semi-core and periphery areas face varying degrees of accessibility limitations and infrastructural inadequacies.

By employing the core-periphery framework, we aim to uncover how these spatial hierarchies manifest in residents' perceptions and experiences across three distinct contexts—metropolitan (metro), urban, and rural areas. The framework helps us analyze how differences in regional development affect perceptions of transportation accessibility, neighborhood environments, and overall neighborhood satisfaction. The emphasis on the hierarchical nature of these regions aligns directly with the broader focus of this study on spatial inequalities, offering a robust conceptual foundation for our analysis.

Extensive research has underscored the pivotal role of transportation accessibility and neighborhood environments in shaping the quality of life of residents.[25,26] Access to reliable and efficient transportation options is essential for facilitating access to employment, education, healthcare, and other essential services, particularly in densely populated urban areas.[27,28] Notably, existing literature highlights stark spatial disparities in transportation accessibility and neighborhood environments particularly between urban and rural areas.[29,30] For instance, there is a significant gap in the level of accessibility to social infrastructures, such as healthcare services and public transportation.[31,32]

Despite the significant body of literature, there are several research gaps that this study aims to fill. First, while existing studies have highlighted the importance of these factors, they often overlook the perceptual differences in how transportation and neighborhood conditions are experienced across different spatial contexts, particularly in metro, urban, and rural areas.

Second, there is a lack of comprehensive studies applying a core-periphery framework to understand how these perceptions vary across spatial hierarchies in rapidly urbanizing societies such as South Korea. Specifically, most research studies focus on objective measures of accessibility and infrastructure, with limited attention paid to subjective experiences and satisfaction levels. Finally, the interconnectedness of transportation accessibility, neighborhood environments, and overall satisfaction has been examined in isolated contexts, but comparative analyses across spatial contexts—such as metropolitan, urban, and rural areas—remain scarce.

3. Materials and Methods

3.1 Research questions

To fill the identified research gap, we aim to address the following research questions: First, are there notable inequalities in residents' perceptions of transportation accessibility, neighborhood environments, and overall satisfaction across metro, urban, and rural areas? Second, how do perceived quality and satisfaction levels differ among residents in these spatial contexts? Third, do distinct patterns emerge in the associations between transportation accessibility, neighborhood environments, and satisfaction across these areas? To answer these questions, we analyzed representative national survey data from the 2020 KHS using a combination of inequality indices (Gini and Theil indices) and multinomial logistic and ordinal regression models.

3.2 Study area

South Korea, located on the Korean Peninsula in East Asia, served as the study area for this research. Characterized by its dynamic economy, rapid urbanization, and diverse geographical landscapes, South Korea offers a rich context for exploring spatial heterogeneity in perceptions regarding transportation accessibility and neighborhood environments. In this research, we divided the country into distinct spatial contexts, including metro, urban, and rural areas. The categorization was aligned with the administrative classification system in South Korea.

Metro areas in South Korea comprise bustling urban conglomerations including Seoul, Busan, Incheon, Daejeon, Daegu, Kwangju, and Ulsan. These regions are characterized by high population densities (see Table 1) as well as extensive transportation networks including subway systems and expressways, and a wide array of commercial, cultural, and recreational amenities. Urban areas encompass smaller cities and towns outside of the metropolitan centers. While they

Table 1
Characteristics of the three regional classifications framed in this study.

Regional Classification	South Korea	Metro (Core)	Urban (Semi-core)	Rural (Periphery)
Population Density	365764	525313	313367	295863
Employment Density	151708	217772	129372	121914
Household Density	15299	214540	130694	127223
Housing Density	141712	178205	136288	121083

may not boast the same level of population density or economic activity as metros, urban areas still offer a range of services and amenities, including educational institutions, healthcare facilities, and retail establishments. Lastly, rural areas in South Korea typically exhibit lower population densities and are characterized by traditional agrarian livelihoods.

3.3 Data

We used the 2020 KHS, a data source obtained from the Korea Research Institute for Human Settlements. This dataset was compiled in accordance with the Housing Basic Act and its Enforcement Decree, following rigorous protocols outlined in Article 20. KHS serves as a vital tool in understanding the intricate nexus between housing and transportation dynamics, aligning with the strategic objectives of the national land use planning framework. Targeting a diverse array of households across contemporary South Korea, the survey employed structured questionnaires and face-to-face interviews conducted by trained enumerators. Spanning from July 13 to December 23, 2020, the survey engaged a robust sample size of 51421 households, allowing for comprehensive insights into housing patterns and associated behaviors. Table 2 presents the socio-demographic characteristics of the survey respondents.

Data validation procedures included stringent checks for logical errors and outliers, coupled with statistical analyses to ensure data integrity. Any identified discrepancies underwent meticulous verification processes, leveraging survey forms, response content reviews, and supplementary telephone validations where necessary. The weighting of survey outcomes incorporated sophisticated design weights considering sampling probabilities, complemented by post-adjustments grounded in nonresponse correction and population demographics, thus ensuring the representativeness and reliability of the final dataset.

Table 2
Socio-demographic characteristics of samples in the dataset used in this study.

Features		Sample Size (%)
Residential Location	Seoul Metropolitan Area	48.8
	Metropolitan Areas	20.2
	Others	31.0
Household Income	Below 2500000 won	41.3
	2510000–4990000 won	37.7
	Above 5000000 won	21.0
Housing Type	Single-family Housing	31.0
	Apartment	51.1
	Others	17.9
Age of Household Head	Below 40	24.9
	40–49	21.3
	50–59	23.0
	Above 60	30.7
Household Size	1	30.2
	2	27.9
	3	20.7
	Above 4	21.2

3.4 Methods

We employed three analytical methods to comprehensively analyze data from the 2020 KHS: (1) inequality indices, including the Gini and Theil indices, and (2) multinomial logistic and (3) ordinal regression models. The selection of these methods is grounded in their suitability to address the research questions in Sect. 3.1.

First, the Gini and Theil indices were chosen to gauge inequalities in perceptions regarding the quality of transportation accessibility, neighborhood environments, and neighborhood satisfaction across and within metro, urban, and rural areas. The Gini index, a widely utilized measure of income inequality,[33] was adopted to assess disparities in perceived quality across spatial contexts. Higher Gini index values indicate greater inequality, suggesting that certain areas may experience more pronounced disparities in perceptions than others. Similarly, the Theil index, commonly utilized in economics to quantify inequality,[34] was applied to assess variations in perceptions within each spatial category. These indices provide a robust measure of inequality, essential for understanding the distributional aspects of perceived neighborhood quality and identifying areas with significant disparities. We calculated the Gini and Theil indices for neighborhood satisfaction, the perceived quality of transportation accessibility, neighborhood environments, and housing across metro, urban, and rural areas, then compared the indices to assess spatial heterogeneity. Table 3 provides a detailed overview of the variables.

Second, multinomial logistic regression was utilized to analyze categorical dependent variables with more than two outcome categories.[35,36] In this study, multinomial logistic regression was employed to examine the association between residents' perceptions of transportation accessibility, neighborhood environments, and overall neighborhood satisfaction and their residential location (i.e., metro, urban, and rural), controlling for relevant covariates (see Table 3). This statistical method is particularly suitable for this analysis as it enables the estimation of the probability of each outcome category relative to a reference category, providing insights into the differential effects of predictors across different levels of perception and residential areas. The ability of the MNL model to handle categorical outcomes with multiple levels makes it ideal for exploring the complex relationships between neighborhood perceptions and location types. The MNL model estimates the probability of each location category relative to a reference category (i.e., rural areas), providing insights into how different predictors affect residents' location preferences.

Third, we utilized ordinal regression to examine the relationship between ordinal dependent variables and one or more independent variables.[37,38] In this study, ordinal regression was employed to analyze residents' perceptions of transportation accessibility, neighborhood environments, and overall neighborhood satisfaction, which are measured on Likert scales (see Table 3). This statistical approach allows for the assessment of the likelihood of different levels of perception (e.g., low, medium, and high) based on various predictors, such as residential location (metro, urban, and rural), socio-economic factors, and housing characteristics. The ordered nature of the dependent variable justifies the use of ordinal regression, which models the cumulative probability of responses falling into different categories.

By employing these methods, we ensure a comprehensive and detailed analysis of the data, allowing us to address the research questions effectively and provide empirical evidence on the determinants of residents' perceptions and satisfaction with their neighborhoods.

Table 3
Variable description.

Name	Description	Unit	Method		
			I	M	O
Overall Neighborhood Satisfaction					
Neighborhood	Perceived quality of neighborhood	4-point Likert scale: 1. Very dissatisfied; 4. Very satisfied	O		O
Spatial Classification					
Region	Spatial location of housing, categorized as metro, urban, and rural areas	Metro/Urban/Rural	O	O	
Perceived Quality of Transportation Accessibility					
Market	Perceived quality of accessibility to markets of the neighborhood	4-point Likert scale: 1. Very dissatisfied; 4. Very satisfied	O	O	O
Hospital	Perceived quality of accessibility to hospitals of the neighborhood	4-point Likert scale: 1. Very dissatisfied; 4. Very satisfied	O	O	O
Public Institution	Perceived quality of accessibility to public institutions of the neighborhood	4-point Likert scale: 1. Very dissatisfied; 4. Very satisfied	O	O	O
Culture	Perceived quality of accessibility to cultural areas of the neighborhood	4-point Likert scale: 1. Very dissatisfied; 4. Very satisfied	O	O	O
Welfare	Perceived quality of accessibility to welfare services of the neighborhood	4-point Likert scale: 1. Very dissatisfied; 4. Very satisfied	O	O	O
Public Trans	Perceived quality of accessibility to public transportation of the neighborhood	4-point Likert scale: 1. Very dissatisfied; 4. Very satisfied	O	O	O
Perceived Quality of Neighborhood Environments					
Parking	Perceived quality of parking of the neighborhood	4-point Likert scale: 1. Very dissatisfied; 4. Very satisfied	O	O	O
Pedestrian	Perceived quality of pedestrian environments of the neighborhood	4-point Likert scale: 1. Very dissatisfied; 4. Very satisfied	O	O	O
Education	Perceived quality of education of the neighborhood	4-point Likert scale: 1. Very dissatisfied; 4. Very satisfied	O	O	O
Safety	Perceived quality of safety of the neighborhood	4-point Likert scale: 1. Very dissatisfied; 4. Very satisfied	O	O	O
Noise	Perceived quality of noise of the neighborhood	4-point Likert scale: 1. Very dissatisfied; 4. Very satisfied	O	O	O
Cleanliness	Perceived quality of cleanliness of the neighborhood	4-point Likert scale: 1. Very dissatisfied; 4. Very satisfied	O	O	O
Pollution	Perceived quality of pollution of the neighborhood	4-point Likert scale: 1. Very dissatisfied; 4. Very satisfied	O	O	O
Relationship	Perceived quality of relationship with neighbors	4-point Likert scale: 1. Very dissatisfied; 4. Very satisfied	O	O	O
Perceived Quality of Housing					
Housing	Perceived quality of housing	4-point Likert scale: 1. Very dissatisfied; 4. Very satisfied	O	O	O
Move	1 if the household has an intention to move out, 0 otherwise	Yes/No		O	O
Housing Characteristics					
Housing Area	Area of housing in square meters	Numeric		O	O
Underground	1 if the housing is situated underground, 0 otherwise	Yes/No		O	O
Household Characteristics					
HH Asset	Aggregate value of assets of household in units of 10000 South Korean won	Numeric		O	O
HH Debt	Aggregate value of debts of household in units of 10000 South Korean won	Numeric		O	O
HH Size	Household size	Numeric		O	O

Data source: Korea Research Institute for Human Settlements
Method: Inequality indices, including Gini and Theil indices (I), Multinomial Logistic Regression (M), and Ordinal Regression (O)

3.5 Variables

In our study, key variables are neighborhood satisfaction, regional classification, the perceived quality of transportation accessibility, and neighborhood environment (see Table 3). Overall neighborhood satisfaction (Neighborhood) served as the dependent variable for the ordinal regression model, reflecting residents' satisfaction with their neighborhoods. Spatial classification (Region), a nominal variable representing residents' spatial location categorized as metro, urban, and rural areas, was used as the dependent variable for the multinomial regression model. The same set of independent variables listed in Table 3 was utilized in both models. Key independent variables included the perceived quality of transportation accessibility, neighborhood environment, and housing. These variables were measured on a Likert scale ranging from least satisfied (1) to most satisfied (4), indicating residents' perceptions of ease of access to markets, hospitals, public institutions (e.g., city hall), cultural venues, welfare services, and public transportation. The perceived neighborhood environment encompassed diverse aspects of residents' lives, including parking, pedestrian environments, education, safety, noise, cleanliness, pollution, and neighborly relationships. We also examined the perceived quality of housing in two aspects: the quality of housing in which the household resides and intention to move out. Additionally, innate housing characteristics such as area and location, and household characteristics including assets, debts, and size, were included as control variables. The survey weights derived from KHS were applied to adjust for the complex sampling design and ensure the representativeness of the findings.

4. Results

4.1 Perceptual inequalities between and within metro, urban, and rural areas

Table 4 shows the results of Gini and Theil indices, illustrating disparities and variations in perceptions across metro, urban, and rural areas. The Gini and Theil indices results provide valuable insights into inequalities across various variables, indicating significant differences in residents' perceptions in South Korea. Specifically, Gini values of 0.075 suggest a moderate level of inequality in overall neighborhood satisfaction, highlighting disparities in how residents perceive and experience satisfaction with their neighborhoods. Moreover, a Gini value of approximately 0.120 indicates inequalities in the perceived quality of transportation accessibility among residents in metro, urban, and rural areas. Additionally, the results suggest likely inequalities in perceptions of neighborhood environments, encompassing safety, cleanliness, noise levels, and education, within South Korea.

Furthermore, certain index scores are notably higher in rural areas than in metro and urban areas, indicating heightened levels of inequality or disparities in specific variables in rural settings. For instance, rural residents encounter challenges in accessing essential services such as healthcare, education, and transportation, underscoring significant perception inequalities within rural areas. Notably, disparities within rural areas are particularly pronounced concerning transportation accessibility to markets (0.175), hospitals (0.187), cultural places (0.207), and public transportation (0.162), as well as educational infrastructures (0.158).

Table 4
Gini and Theil indices.

Variables	South Korea	Metro	Urban	Rural
	Gini (Theil Index)	Gini (Theil Index)	Gini (Theil Index)	Gini (Theil Index)
Observations	50202	22637	16960	10605
Overall Neighborhood Satisfaction				
Neighborhood	0.075 (0.016)	0.069 (0.014)	0.072 (0.015)	0.090 (0.021)
Perceived Quality of Transportation Accessibility				
Market	0.124 (0.032)	0.103 (0.023)	0.103 (0.024)	0.175 (0.057)
Hospital	0.130 (0.036)	0.102 (0.023)	0.112 (0.027)	0.187 (0.064)
Public Institution	0.114 (0.029)	0.091 (0.019)	0.100 (0.023)	0.167 (0.054)
Culture	0.160 (0.049)	0.138 (0.038)	0.142 (0.039)	0.207 (0.076)
Welfare	0.117 (0.029)	0.113 (0.027)	0.109 (0.025)	0.137 (0.039)
Public Trans	0.120 (0.031)	0.104 (0.023)	0.105 (0.025)	0.162 (0.050)
Perceived Quality of Neighborhood Environments				
Parking	0.136 (0.038)	0.139 (0.039)	0.142 (0.041)	0.117 (0.029)
Pedestrian	0.087 (0.018)	0.079 (0.016)	0.085 (0.018)	0.105 (0.024)
Education	0.106 (0.026)	0.083 (0.017)	0.093 (0.020)	0.158 (0.050)
Safety	0.078 (0.016)	0.072 (0.014)	0.077 (0.015)	0.092 (0.020)
Noise	0.111 (0.027)	0.107 (0.025)	0.114 (0.028)	0.111 (0.026)
Cleanliness	0.083 (0.017)	0.081 (0.017)	0.084 (0.017)	0.084 (0.017)
Pollution	0.088 (0.018)	0.082 (0.017)	0.087 (0.019)	0.091 (0.018)
Relationship	0.071 (0.014)	0.065 (0.012)	0.071 (0.015)	0.079 (0.014)
Perceived Quality of Housing				
Housing	0.079 (0.017)	0.075 (0.015)	0.077 (0.016)	0.089 (0.020)

4.2 Perception differences between metro, urban, and rural areas

Table 5 depicts the outcomes of univariate (mean) and bivariate (ANOVA) analyses for various variables, facilitating a comparative examination of factors affecting neighborhood satisfaction and the quality of life across metro, urban, and rural areas. Metro areas exhibit the highest mean level of overall neighborhood satisfaction, with a score of 3.00, followed by urban areas with a mean score of 2.99, and rural areas registering the lowest mean score of 2.85. Notably, perceptions of transportation accessibility display considerable variation across different neighborhood types, as evidenced by the mean scores provided. Residents in rural areas tend to perceive a lower transportation accessibility quality than their counterparts in metro and urban areas. For instance, mean scores for variables such as Market, Hospital, Public Institution, and Public Trans are notably lower in rural areas (2.45, 2.37, 2.54, and 2.61, respectively) than in metro and urban locales. Moreover, rural areas exhibit the lowest mean score for perceived education quality at 2.64, suggesting that residents in rural settings harbor the most negative perceptions of educational standards among the three types of area. However, it is noteworthy that residents in rural areas express higher satisfaction levels with certain aspects of neighborhood environments, including parking availability, noise levels, cleanliness, pollution, and relationships with neighbors.

Table 6 presents the multinomial logistic regression model, incorporating the independent variables outlined in Table 3. While the McFadden R-squared value of 0.113 indicates a fairly

Table 5
Univariate and bivariate analysis results.

Variables	South Korea	Metro	Urban	Rural	ANOVA (*P*-value)
Overall Neighborhood Satisfaction					
Neighborhood	3.00	2.99	2.99	2.85	<0.001
Perceived Quality of Transportation Accessibility					
Market	2.90	3.00	3.00	2.45	<0.001
Hospital	2.90	3.00	2.97	2.37	<0.001
Public Institution	2.90	3.03	3.00	2.54	<0.001
Culture	2.60	2.74	2.74	2.18	<0.001
Welfare	3.00	3.02	3.05	2.88	<0.001
Public Trans	2.90	3.05	3.02	2.61	<0.001
Perceived Quality of Neighborhood Environments					
Parking	2.90	2.78	2.84	3.02	<0.001
Pedestrian	3.00	3.03	3.06	3.05	<0.001
Education	2.90	3.00	3.01	2.64	<0.001
Safety	3.10	3.05	3.09	3.03	<0.001
Noise	2.90	2.89	2.91	3.06	<0.001
Cleanliness	3.10	3.03	3.11	3.13	<0.001
Pollution	3.10	2.99	3.07	3.26	<0.001
Relationship	3.10	3.04	3.07	3.23	<0.001
Perceived Quality of Housing					
Housing	3.00	2.98	3.01	2.95	<0.001

low goodness-of-fit for the final model, the direction and significance of parameter estimates yield notable insights. The analysis of the model coefficients reveals the significant impact of perceived transportation accessibility on categorizing residents into metro, urban, and rural areas. Particularly noteworthy are the significant and positive parameter estimates associated with transportation accessibility to various places of interest (POIs), including markets (0.204), hospitals (0.523), public institutions (0.208), cultural sites (0.366), welfare services (0.094), and public transportation (0.250). Also, the considerable magnitude of the parameter estimates for access to hospitals (0.523 for metro and 0.435 for urban) underscores residents' heightened satisfaction with medical transportation services in metro and urban locales.

Turning to perceptions of neighborhood environments, variables such as parking (−0.553), noise levels (−0.199), cleanliness (−0.175), pollution (−0.621), and social relationships with neighbors (−0.503) exhibit significant and negative associations. These findings suggest that residents in rural areas generally experience more favorable neighborhood conditions than their counterparts in metro areas. Conversely, residents in metro areas tend to report better pedestrian environments, educational facilities, and safety measures than those in rural locales. Moreover, residents in metro and urban areas express a higher level of satisfaction with housing quality but also demonstrate a greater inclination to relocate from their current residences. Notably, housing and household characteristics play a significant role, with residents in metro areas typically residing in smaller dwellings yet possessing greater household assets and debts than their rural counterparts.

Table 6
Multinomial logistic regression results.

Variables	Metro (reference. Rural)		Urban (reference. Rural)	
	Parameter estimates	Standard errors	Parameter estimates	Standard errors
Intercept	1.795***	0.157	0.621***	0.162
Perceived Quality of Transportation Accessibility				
Market	0.204***	0.030	0.311***	0.031
Hospital	0.523***	0.029	0.435*	0.030
Public Institution	0.208***	0.028	0.064***	0.029
Culture	0.366***	0.022	0.367*	0.022
Welfare	0.094***	0.022	0.124***	0.023
Public Trans	0.250***	0.024	0.160***	0.024
Perceived Quality of Neighborhood Environments				
Parking	−0.553***	0.023	−0.510***	0.023
Pedestrian	0.087**	0.032	0.064*	0.032
Education	0.383***	0.027	0.332***	0.027
Safety	0.108**	0.034	0.149***	0.035
Noise	−0.199***	0.026	−0.283***	0.027
Cleanliness	−0.175***	0.033	-0.061*	0.034
Pollution	−0.621***	0.031	−0.446***	0.032
Relationship	−0.503***	0.032	−0.521***	0.033
Perceived Quality of Housing				
Housing	0.061*	0.030	0.066*	0.031
Move-out	0.559***	0.063	0.581***	0.064
Innate Housing Characteristics				
Housing Area	−0.572***	0.035	−0.335***	0.036
Underground	2.722***	0.361	2.133***	0.366
Household Characteristics				
HH Asset	0.076***	0.006	0.010	0.006
HH Debt	0.027***	0.003	0.054***	0.003
HH Size	0.159***	0.012	0.175***	0.013
Model Statistics				
Observations	50202			
McFadden R^2	0.113			
Log-Likelihood	−46,903			

Note: Base alternative = Rural
*Significant at $p < 0.10$; **Significant at $p < 0.05$; ***Significant at $p < 0.01$

4.3 Associations between transportation accessibility and neighborhood qualities

We subsequently constructed an ordinal regression model employing the Likert-scale responses of satisfaction with their neighborhoods as the dependent variable. The final four models yielded Nagelkerke R-squared values of 0.591 for South Korea overall, 0.575 for metro areas, 0.616 for urban areas, and 0.563 for rural areas (see Table 7). Several noteworthy findings emerged from the analysis. Higher levels of satisfaction with transportation accessibility within their neighborhoods significantly increased the odds of experiencing greater overall satisfaction with their neighborhood. Notably, the magnitude of satisfaction with hospital accessibility

Table 7
Ordinal regression results.

Variables	South Korea	Metro	Urban	Rural
	Coefficient (Odds Ratio)	Coefficient (Odds Ratio)	Coefficient (Odds Ratio)	Coefficient (Odds Ratio)
Intercept (1|2)	10.160***	9.989***	10.999***	8.689***
Intercept (2|3)	14.579***	14.835***	15.413***	12.666***
Intercept (3|4)	21.117***	21.616***	22.063***	18.581***
Spatial Classification				
Metro	0.099*** (1.105)	—	—	—
Urban	0.113*** (1.12)	—	—	—
Perceived Quality of Transportation Accessibility				
Market	0.450*** (1.569)	0.326*** (1.386)	0.631*** (1.880)	0.388*** (1.473)
Hospital	0.581*** (1.788)	0.755*** (2.128)	0.443*** (1.557)	0.563*** (1.756)
Public Institution	0.190*** (1.210)	0.255*** (1.290)	0.249*** (1.283)	0.047*** (1.048)
Culture	0.330*** (1.390)	0.366*** (1.442)	0.313*** (1.367)	0.263*** (1.301)
Welfare	0.249*** (1.283)	0.198*** (1.219)	0.335*** (1.398)	0.202*** (1.224)
Public Trans	0.436*** (1.547)	0.309*** (1.362)	0.510*** (1.665)	0.524*** (1.689)
Perceived Quality of Neighborhood Environments				
Parking	0.318*** (1.374)	0.299*** (1.349)	0.325*** (1.385)	0.289*** (1.335)
Pedestrian	0.133*** (1.142)	0.059*** (1.060)	0.131*** (1.140)	0.157*** (1.170)
Education	0.365*** (1.440)	0.430*** (1.538)	0.479*** (1.614)	0.217*** (1.242)
Safety	0.293*** (1.341)	0.225*** (1.253)	0.344*** (1.410)	0.334*** (1.396)
Noise	0.423*** (1.526)	0.486*** (1.627)	0.336*** (1.399)	0.485*** (1.624)
Cleanliness	0.175*** (1.191)	0.203*** (1.225)	0.190*** (1.210)	0.028*** (1.029)
Pollution	0.158*** (1.172)	0.003 (1.003)	0.218*** (1.244)	0.258*** (1.295)
Relationship	0.437*** (1.547)	0.393*** (1.481)	0.414*** (1.513)	0.422*** (1.525)
Perceived Quality of Housing				
Housing	1.294*** (3.647)	1.626*** (5.085)	1.185*** (3.271)	0.972*** (2.644)
Move	−0.122*** (0.885)	−0.077*** (0.926)	−0.179*** (0.836)	−0.109*** (0.897)
Innate Housing Characteristics				
Housing Area	0.098*** (1.103)	0.099*** (1.104)	0.049*** (1.050)	0.115*** (1.122)
Under Ground	−0.189*** (0.828)	−0.094*** (0.911)	−0.285*** (0.752)	−1.520*** (0.219)

Table 7
(Continued) Ordinal regression results.

Household Characteristics				
HH Asset	0.013*** (1.013)	0.012*** (1.012)	0.025*** (1.026)	−0.001 (0.999)
HH Debt	−0.010*** (0.990)	−0.003*** (0.997)	−0.015*** (0.985)	−0.013*** (0.988)
HH Size	−0.028*** (0.972)	−0.011*** (0.989)	−0.006*** (0.994)	−0.079*** (0.924)
Model Statistics				
Observations	50202	22637	16960	10605
Nagelkerke R^2	0.591	0.575	0.616	0.563

*Significant at $p < 0.10$; **Significant at $p < 0.05$; ***Significant at $p < 0.01$

(0.581) exhibited a substantially higher impact than the other transportation accessibility factors, followed by public transportation accessibility (0.436). Similarly, satisfaction with various aspects of neighborhood environments, including parking availability (0.318), pedestrian environments (0.133), education (0.365), safety (0.293), noise levels (0.423), cleanliness (0.175), pollution (0.158), and relationships with neighbors (0.437), significantly affected neighborhood satisfaction levels.

Furthermore, satisfaction with housing quality demonstrated a significant and positive correlation with neighborhood satisfaction, whereas the intention to move out exhibited a negative association with it. Interestingly, these associations remained consistent across metro, urban, and rural areas, indicating the universal importance of transportation accessibility, neighborhood environments, and housing as determinants of neighborhood satisfaction levels regardless of residents' locations. Additionally, regarding the magnitude of coefficients, residents in rural areas placed particular emphasis on housing quality, with odds ratios of 2.644. Furthermore, accessibility to essential services such as hospitals (odds ratio of 1.756), public transportation (1.689), and markets (1.473), and noise levels (0.1624) are deemed significant contributors to neighborhood satisfaction within rural areas. These findings underscore the critical role of housing quality and accessibility to essential services in shaping residents' perceptions and satisfaction with their neighborhoods, particularly in rural settings.

5. Discussion

5.1 Major findings

In this study, we aimed to investigate the spatial heterogeneity in residents' perceptions of transportation accessibility, neighborhood environments, and overall neighborhood satisfaction across metropolitan, urban, and rural areas in South Korea. The major findings are as follows. First, the Gini and Theil indices revealed significant disparities in perceptions across metro, urban, and rural areas. The Gini value of 0.075 for overall neighborhood satisfaction reflects moderate inequality, whereas that of 0.120 for transportation accessibility points to more pronounced disparities.

Second, the multinomial logistic regression results highlighted the significant role of transportation accessibility and neighborhood environments in shaping the satisfaction of residents across different spatial contexts. Specifically, positive and significant parameter estimates were associated with access to key POIs such as hospitals (0.523), markets (0.204), and public transportation (0.250), with hospital access having the most substantial impact on satisfaction, especially in metro and urban areas. Also, residents in rural areas generally experience more favorable neighborhood conditions, such as lower levels of pollution, better parking availability, and stronger social relationships with neighbors, than those in metro areas. However, metro area residents report better pedestrian environments, educational facilities, and safety measures, alongside a higher level of satisfaction with housing quality, despite expressing a greater inclination to relocate.

Third, the ordinal regression analysis showed that a higher level of satisfaction with transportation accessibility, especially access to hospitals (0.581) and public transportation (0.436), significantly increases overall neighborhood satisfaction. Similarly, aspects of neighborhood environments such as parking availability, pedestrian environments, education, safety, and relationships with neighbors are important contributors to satisfaction across all spatial contexts. In rural areas, housing quality (odds ratio of 2.644) and access to essential services such as hospitals (1.756), public transportation (1.689), and markets (1.473) play a particularly strong role in shaping neighborhood satisfaction. These findings emphasize the importance of housing quality and service accessibility in affecting satisfaction levels, especially in rural settings.

5.2 Implications

The findings from this study offer several important policy insights that can guide efforts to address spatial inequalities and improve quality of life. First, the pronounced disparities in transportation accessibility, especially in rural areas, highlight the need for infrastructure investments. Policies should focus on expanding access to essential services, particularly healthcare and public transportation, in these underserved regions.

Second, the differing priorities of residents in metro, urban, and rural areas necessitate context-specific policy approaches. For instance, rural communities value housing quality and social relationships more than other factors, suggesting that interventions focused on housing improvements and community-building initiatives would be particularly effective. In contrast, urban areas may benefit from policies that target environmental enhancements and reduce stressors such as pollution and noise.

Third, the disparities identified in this study underscore the importance of inclusive regional development strategies that address the unique needs of each spatial context. Coordinated efforts that integrate spatial planning, economic development, and social policy are essential for reducing regional inequalities and promoting more sustainable and livable communities across South Korea.

5.3 Limitations and future research directions

It is crucial to acknowledge several limitations. First, the cross-sectional design prohibits the establishment of causal relationships between variables. Second, reliance on self-reported data may introduce response bias and inaccuracies, particularly in gauging perceptions of transportation accessibility and neighborhood environments. Third, the survey's exclusive focus on general households within South Korea may introduce sampling bias. Additionally, while the study addresses key variables, other factors such as social capital and governance structures remain unexplored. Furthermore, the simplistic categorization of spatial contexts may overlook intricate urban-rural gradients and intra-urban nuances. Finally, caution is warranted when extrapolating the findings to regions with divergent socio-cultural and economic contexts. Addressing these issues in future research will offer deeper insights and more robust evidence, ultimately guiding policymakers and planners in fostering more inclusive, equitable, and sustainable communities across diverse spatial contexts.

Future research could address these limitations by adopting longitudinal designs to better capture causal relationships and temporal shifts in perceptions. Expanding the study to incorporate diverse populations, including marginalized groups and non-permanent residents, would enhance representativeness and deepen our understanding of spatial heterogeneity. Additionally, integrating variables such as social capital, governance structures, and cultural factors could provide a more holistic view of the determinants of neighborhood satisfaction. Finally, comparative studies across different countries or regions would offer valuable perspectives on how socio-cultural and economic differences shape neighborhood experiences.

6. Conclusions

In this study, we delved into the intricate dynamics among transportation accessibility, neighborhood environments, and overall neighborhood satisfaction across diverse spatial contexts, encompassing metro, urban, and rural areas, within South Korea. We believe that this research enriches the discourse in transportation and urban planning by furnishing empirical evidence on the determinants of residents' perceptions and satisfaction with their neighborhoods. Furthermore, our study offers invaluable insights into the spatial variability of perceptions regarding transportation accessibility and neighborhood environments across metro, urban, and rural areas in South Korea, thereby informing strategies for fostering sustainable and livable communities.

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Data Availability Statement

This study used publically available data sources found at https://mdis.kostat.go.kr/index.do (assessed on February 5, 2024)

Conflicts of Interest

The authors declare no conflicts of interest.

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