

EVALUATION OF ACCESSIBILITY TO HEALTH FACILITIES PROBLEMATIQUE VIA SPACE SYNTAX METHOD IN THE CONTEXT OF TURKIYE LEGISLATION

Sağlık Tesislerine Erişilebilirlik Sorunsalının Türkiye Mevzuatı Çerçevesinde Mekân
Dizim Yöntemi ile Değerlendirilmesi

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ARTICLE INFORMATION

ABSTRACT

Research Article

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The regulation on the Preparation of Spatial Plans guides health infrastructure planning at the zoning scale, including provisions for minimum per capita land requirements in Türkiye. However, at the local level, the spatial distribution and accessibility of health facilities play a critical role in ensuring equitable and efficient healthcare service delivery. This study aims to evaluate the adequacy of health facility areas at the neighborhood scale in the Central District of Kastamonu Province. First, the health facility area per capita was calculated for each neighborhood to assess compliance with the legal standards. Subsequently, spatial intelligibility was analyzed using DepthMapX-0.29 software by generating connectivity and integration maps and calculating their correlation coefficient (R^2). The findings reveal that while the Saraçlar neighborhood had the highest intelligibility value ($R^2 = 0.48$), it was found to be insufficient regarding the allocated health facility area. These findings indicate that although the area is perceptually accessible, there is a spatial deficiency in healthcare provision. Ensuring access to health services is a fundamental human right, and from this perspective, transportation and spatial planning must prioritize enhancing access to public services. The results underline the necessity of revising spatial planning regulations by incorporating perceptual accessibility considerations to address local healthcare needs better.

Keywords: Accessibility, Space Syntax Method, Connectivity, Integration, Health Facilities.

MAKALE BİLGİSİ

ÖZ

Araştırma Makalesi

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Türkiye’de sağlık altyapısının imar ölçeğinde planlanmasında “Mekânsal Planlar Yapım Yönetmeliği” uygulanmakta olup yönetmeliğe göre kişi başına düşen alan koşulu bulunmaktadır. Ancak sağlık tesis alanları yerel ölçekte sağlık arzı açısından önemli olup erişilebilir konumda yer seçmesi verimli hizmet sunumu açısından oldukça önemlidir. Bu bağlamda araştırmanın amacı Kastamonu İli Merkez İlçesinde mahalle ölçeğinde sağlık tesis alanlarının yeterliliğini analiz etmektir. Araştırmada öncelikle her mahalle için kişi başına düşen sağlık tesisi alanı hesaplanarak mevzuata bağlı yeterlilik durumu tespit edilmiştir. Ardından DepthMapX-0.29 yazılımı kullanılarak bağlantısallık ve bütünleşiklik haritalarının korelasyon katsayısı (R^2) elde edilerek okunabilirlik analizi yapılmıştır. Araştırma sonucunda Saraçlar Mahallesi’nde R^2 değeri en yüksek (0.48) iken sağlık tesislerinin alansal açıdan yeterliliği düşük bulunmuştur. Sağlık tesis alanı eksikliği olduğu

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belirlenen mahallede yüksek okunabilirlik değeri alanın algısal erişilebilirlik açısından iyi düzeyde olduğunu göstermektedir. Günümüzde de önemli olan sağlık tesislerine erişim kolaylığı tüm insanların temel haklarından birisidir. Bu bağlamda, insanların yaşam kalitelerini de etkileyen ulaşım planlamasının “kamusal mekânlara geçişin artırılması” çerçevesinde ele alınması önemli bir gerekliliktir. Sonuçlar aynı zamanda algısal erişilebilirlik boyutunda mekânsal planlara ilişkin mevzuatın geliştirilmesi gerekliliğini ortaya koymaktadır.

Anahtar Kelimeler: Erişilebilirlik, Mekân Dizim Yöntemi, Bağlantısallık, Bütünleşiklik, Sağlık Tesisleri.

1. Introduction

It is of great importance to consider accessibility in cities' spatial planning and decision-making processes. Interconnected public spaces, such as streets and avenues, are areas where various socio-cultural interactions occur. Therefore, these public spaces, which play a crucial role in shaping social relations, should be planned in coordination with each other. Since the 20th century, significant progress has been made in transportation planning, and cities' transportation plans have become an integral part of urban development strategies. The primary goal of these plans is to create an accessible and high-quality environment by developing transportation networks (Zafersoy and Batirbaygil, 2014; Mamat and Sisman, 2021).

In recent years, the issue of accessibility has become an indispensable part of social life. Accessibility refers not only to the ease of movement between spaces but also to the integration of these spaces within the broader urban context, thus representing the interconnectedness of urban areas (Horner, 2004; Karlström and Mattsson, 2009; Wang et al., 2016; Wu et al., 2025). Spatial accessibility, in particular, is defined as the evaluation of health facilities' locations in relation to the needs of those requiring health services, considering factors such as transportation, travel distance, time, and cost (Penchansky and Thomas, 1981; Wang, 2012; McGrail and Humphreys, 2014; McGrail, 2015; Wang et al., 2018). Recent studies have emphasized the importance of equitable access to healthcare in urban environments, particularly in light of growing population densities and urbanization (Brondeel et al., 2014; Alrashed, 2021; Kavanagh et al., 2022).

In cities with insufficient or poorly designed accessibility to urban spaces, density tends to accumulate around areas that meet basic human needs, such as health and education, leading to issues like skewed urbanization and traffic congestion (Elmaci, 2019; Iamtrakul et al., 2022). Improving the accessibility of public spaces in urban areas enhances the quality of life and highlights the importance of livability in cities (Doi et al., 2008; Németh and Schmidt, 2010; Vukovic et al., 2021). Urban integration refers to the ability of individuals to connect with and live harmoniously within their environment. Moreover, people meet their social needs through interactions in urban spaces, reinforcing the interconnectedness of

accessibility and urban integration. These two concepts are deeply linked, as urban integration can be evaluated through transportation networks (Zheng et al., 2022).

Access to health services is a critical concern for both researchers and policymakers. Healthcare access is increasingly discussed as a fundamental human right alongside other urban infrastructure (Brudney, 2016; Schraufnagel et al., 2017; Zafri et al., 2021). Moreover, ensuring equitable healthcare access in urban areas has gained importance in the context of urban planning and public health policy (Pearsal et al., 2021). Additionally, healthcare supply analysis is inherently multidimensional, requiring both spatial and non-spatial multivariate approaches (Kavanagh et al., 2022). As such, ensuring access to health facilities is an important responsibility for urban planners and decision-makers. Efficient access to healthcare can be achieved by optimizing the distribution of health resources across the urban landscape (Wang, 2012; Gauthier et al., 2021). Accessibility in health-related areas is crucial, particularly in emergency situations such as traffic accidents or natural disasters, where timely access to healthcare can be life-saving (Arca, 2012; Kemec et al., 2019; Gauthier et al., 2021).

Transportation challenges are frequently cited as the primary barrier to accessing healthcare services (Branch and Nemeth, 1985; Kim et al., 2007; Syed et al., 2013). In accessibility studies, which are central to physical planning, the use of Space Syntax methodology offers valuable insights into the accessibility of road networks through connectivity and integration analyses. High connectivity and integration values are key indicators of how easily a location can be accessed via the transportation network and contribute to the clarity and ease of navigation. These factors also reflect the understandability and suitability of the road network for both pedestrian and vehicle traffic (Hillier et al., 1987; Hillier et al., 1993; Karimi, 2012; Dovey and Pafka 2017; McCormack et al. 2021).

The relational structure of urban spaces is central to creating meaningful connections between them. Morphological studies are essential for understanding these relational dynamics (Hillier, 1996; Steadman et al. 2010). By analyzing the spatial relationships of urban transport networks with varying morphological characteristics, we gain significant insights into the development of social knowledge about these spaces (Karimi, 2012). In this context, an analytical method capable of defining spatial morphology from a conceptual perspective is needed. Space Syntax emerged as a methodology designed to make "unseen states visible." This approach, based on the formation characteristics of space within the integrity of urban relations, is considered an effective tool for understanding the analytical structure of urban spaces and their part-whole configurations, leading to the development of urban centers (Hillier, 1996; Gauthier et al., 2021; Geng et al., 2021).

In this study, the Space Syntax method was applied to assess the accessibility of healthcare facilities in the city center of Kastamonu. By analyzing the connectivity and

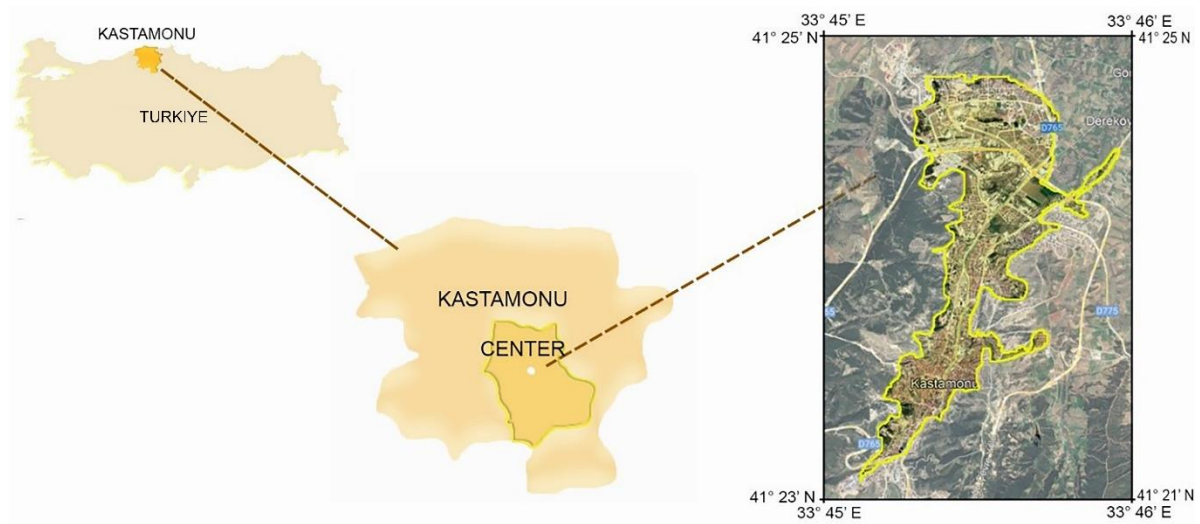
integration of the urban road network, neighborhoods with high perceptual accessibility that facilitate effective access to healthcare services were identified. This study contributes to the growing literature on spatial planning and accessibility by emphasizing the importance of incorporating spatial morphology into healthcare infrastructure planning to optimize the efficiency and effectiveness of healthcare service delivery in urban environments.

2. Materials and Method

2.1. Study Area

The area of Kastamonu, located in the Western Black Sea Region, is 13.108 km². Kastamonu, which constitutes approximately 1.7% of Türkiye's surface area, 74.6% of the surface area of the province is mountainous and forested, 21.6% is plateau and 3.8% is plains. The natural environment and human relations have an important role in the urbanization process of Kastamonu, which is very rich in terms of vegetation. The spatial organization of the city is shaped according to natural environmental elements.

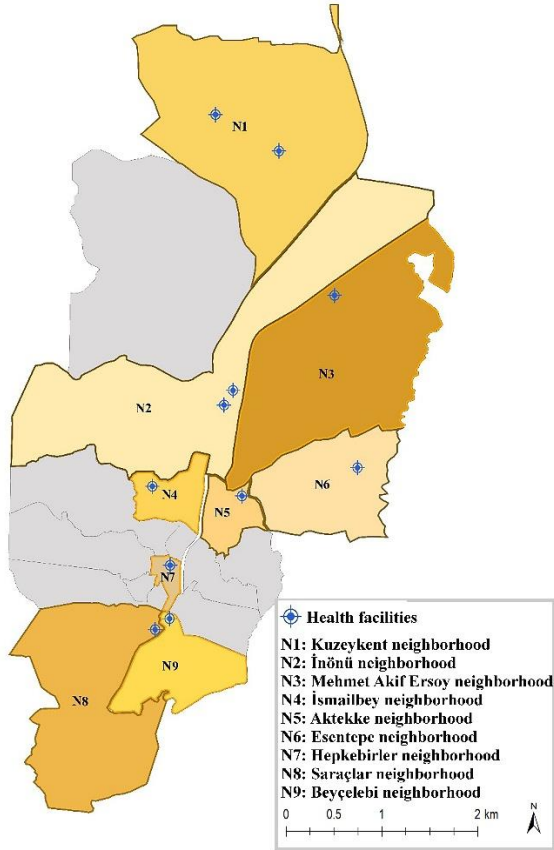
Figure 1: Study Area Location Map



The population of Kastamonu in 2023 is 388.990 and the population of the Central district is 155.011. 49.37% of the center population is male and 50.63% is female (TUIK, 2023). The study was carried out in the central district of Kastamonu province. The health facilities in the district constitute the material of the study. There are 19 neighborhoods in total in the central district. While there are no health facilities in 10 neighborhoods, there are

12 health facility areas in total in 9 neighborhoods. These health facilities cover an area of approximately 69.274 m² (Figure 2).

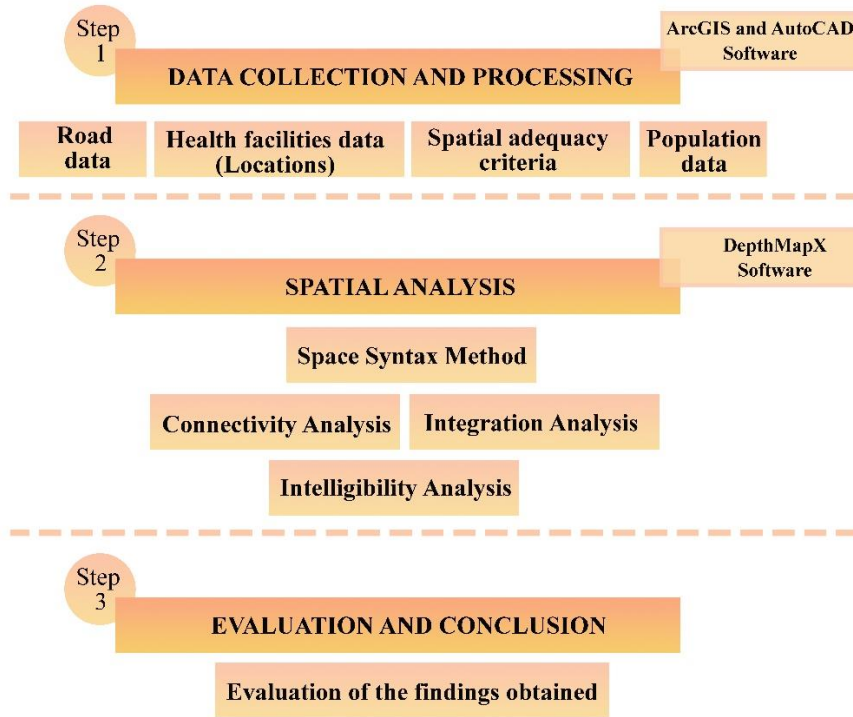
Figure 2: Health Facilities Location Map



2.2. Research Methodology

The method of the study consists of 3 stages. The flowchart of the study is given in Fig 3.

Figure 3: Workflow Designed For This Study



2.2.1. Data Collection and Processing

In the “Data Collection and Processing” stage, firstly, road, population, and areal adequacy criteria data were obtained. The road data obtained in shp format using the PyOSM method was edited in the ArcGIS 10.4.1 program and saved in dwg format to be transferred to the AutoCAD program. Then, the locations of the health facilities were determined by using the Google Earth Street View program and field work. Spatial adequacy criteria (m²/person) were determined according to Annex 2 (Minimum Standards and Minimum Area Size Table for Different Population Groups in the Field of Social and Technical Infrastructure) on Spatial Arrangement of Zoning Plans published in the Official Gazette dated 14.06.2014 and numbered 29030. Population data for 2023 was obtained from the TÜİK database.

2.2.2. Spatial Analysis: Space Syntax Terminology and The Approach

In the “Spatial Analysis” stage, the path data was transferred to the DepthMapX-0.29 software. The connectivity and integration status of Kastamonu city center road networks were determined using the “axial maps tool”. After the connectivity and integration analyses were performed, an “Intelligibility” analysis was performed to determine “perceptual accessibility”. The analyses were performed at the city center scale and then evaluated at the neighborhood scale.

Spatial accessibility is widely applied as a scientific method for assessing the distribution of public services such as health care. Accessibility perception explores more non-spatial dimensions with surveys conducted with users (Sanchez et al., 2000; Guagliardo, 2004). Spatial accessibility, on the other hand, has a multidimensional structure and is a complex research area. Gravity-based potential model (Hansen, 1959), two-step floating catchment area (M2SFCA) metrics applications (Delamater, 2013; GcGrail, 2015; Tao et. al., 2018), the huff model, and floating catchment area methods (Luo, 2014), measurements of the accessibility of health facilities through GIS (Luo and Wang, 2003) are discussed with many techniques.

The Space syntax method used in the study is a set of techniques supported by theoretical approaches used to describe spatial models of regions, cities, or built environments at different scales, and indoor organizations and to study the interactions of these areas with social structure. The primary goal of these techniques is to reveal the potential of spaces to bring people together and guide people by objectively examining the relationship of the spatial organization with human movement and fields of view. In the space syntax method, the integration of people with space is examined at various scales, from buildings to small urban areas. Understanding the relationship between pedestrian movement and urban texture, organization of movement in complex functional structures, accessibility, privacy, hierarchy, etc. the method used in many fields is effectively used in the field of pathfinding and legibility of space due to the study of general pedestrian movement (Gundogdu, 2014).

Bill Hillier and Julienne Hanson developed the space syntax method in 1984. It is considered one of the most effective scientific movements in architecture and urban design, with the space syntax method they created on the accessibility of spaces (Yilmaz and Oter, 2021). Space syntax quantifies and examines the relationship between human behavior and the built environment, from a single house and more complex building types to neighborhoods, settlements, and metropolitan areas (Hillier, 1996; Major, 2018). Space syntax argues for a fundamental relationship between space and society, as realized in the standard features of the built environment based on two main concepts: the objectivity of space as a material and our intuitive relationship with it. First, space is not a background of human activity but is shaped by shaping and human use of space. Second, the spatial configuration consists of the characteristics of individual spaces and the interrelationships between all spaces that make up the entire urban network of the city. This feature emphasizes the social logic of the space (Tannous et al., 2021).

Axial maps are the most crucial spatial syntax method used to analyze the integration and accessibility of street/road networks (Yilmaz and Oter, 2021). The axis map, which is formed with the help of axial lines, forms the basis of spatial analysis (Hillier and Hanson,

1984). Axial line integration analysis reveals the spatial integration of public spaces. According to the natural motion theory, integrated areas have a more central role in cities (Hillier et al., 1993). Unlike geographic metrics, space syntax metrics are based on network configuration. Therefore, places will be located in more legible locations and allow people to access them comfortably (Yilmaz and Oter, 2021). "Integration" in axial line analysis indicates how easily a person can reach a place and a measure of syntactic accessibility.

On the other hand, connectivity is a local syntactic measure that includes the computational relationship between a space and its neighboring areas. Parts with higher connectivity will be more accessible, and these routes are expected to be used more frequently. The high correlation between connectivity and integration makes the space understandable and predictable for pedestrian/vehicle movement. The degree of intelligibility is read by looking at the shape of the distribution in the graphics created by the "Depthmap Program." Graphs are made by placing connectivity and integration values on the X and Y axes. The points formed by the intersection of these values take on colors ranging from red to blue, as in axial maps. If the dots (representing spaces) form a 45-degree curve from the bottom left to the top right, it always shows that the area is a little more connected and more integrated (Hillier, 1996; Belir, 2021). This correlation (R^2) between connectivity and integration values is accepted as the "intelligibility/readability value." The higher the R^2 value the higher the intelligibility of a layout (Long and Baran, 2012). This value is also an important indicator that perceptual accessibility is high (Baran et al., 2008; Marcus, 2010; Karimi, 2012; Dovey and Pafka 2017; McCormack et al. 2021; Yilmaz and Oter, 2021; Siregar et. al. 2021).

Although there is no official fixed, standardized scale for R^2 (coefficient of determination) used in intelligibility analysis in the Space Syntax literature, there is a common classification used for ease of interpretation in various studies. According to these values, usability values with an R^2 value above 0.40 are generally interpreted as medium to high perceptual accessibility, while values below 0.20 indicate poor readability (Hillier and Hanson, 1984; Peponis et al., 1990; Hillier et al., 1993; Karimi, 2012):

- $R^2 < 0.20$ = Very low intelligibility (Perceptual accessibility is very poor)
- $0.20 \leq R^2 < 0.40$ = Low intelligibility (Perceptual accessibility is low)
- $0.40 \leq R^2 < 0.60$ = Moderate intelligibility (Perceptual accessibility is moderate)
- $0.60 \leq R^2 < 0.80$ = High intelligibility (Perceptual accessibility is high)
- $R^2 \geq 0.80$ = Very high intelligibility (Perceptual accessibility is very high)

The Space Syntax method was chosen in this study due to its robust analytical capacity to assess spatial configurations and their interaction with human movement, especially in urban environments. Unlike other spatial accessibility models, such as gravity-based or floating catchment approaches that focus primarily on service proximity and distribution, Space Syntax provides a structural analysis of the built environment, enabling the examination of spatial integration, connectivity, and intelligibility. These qualities are particularly relevant for understanding pedestrian accessibility and movement patterns within complex urban textures. Rooted in architectural theory and urban morphology, Space Syntax offers a multidimensional understanding of how spatial organization influences accessibility at multiple scales, from buildings to neighborhoods. Its emphasis on the social logic of space and the predictive power it offers through metrics like integration and connectivity makes it a valuable methodological choice for exploring how urban form impacts navigability, visibility, and potential usage of spaces. Given the study's aim to analyze spatial accessibility not only in physical but also in cognitive terms, Space Syntax provides a more holistic and interpretative framework compared to traditional GIS-based models.

In the final stage, the perceptual accessibility status of the health facilities in terms of readability was determined, and their adequacy in terms of area was compared.

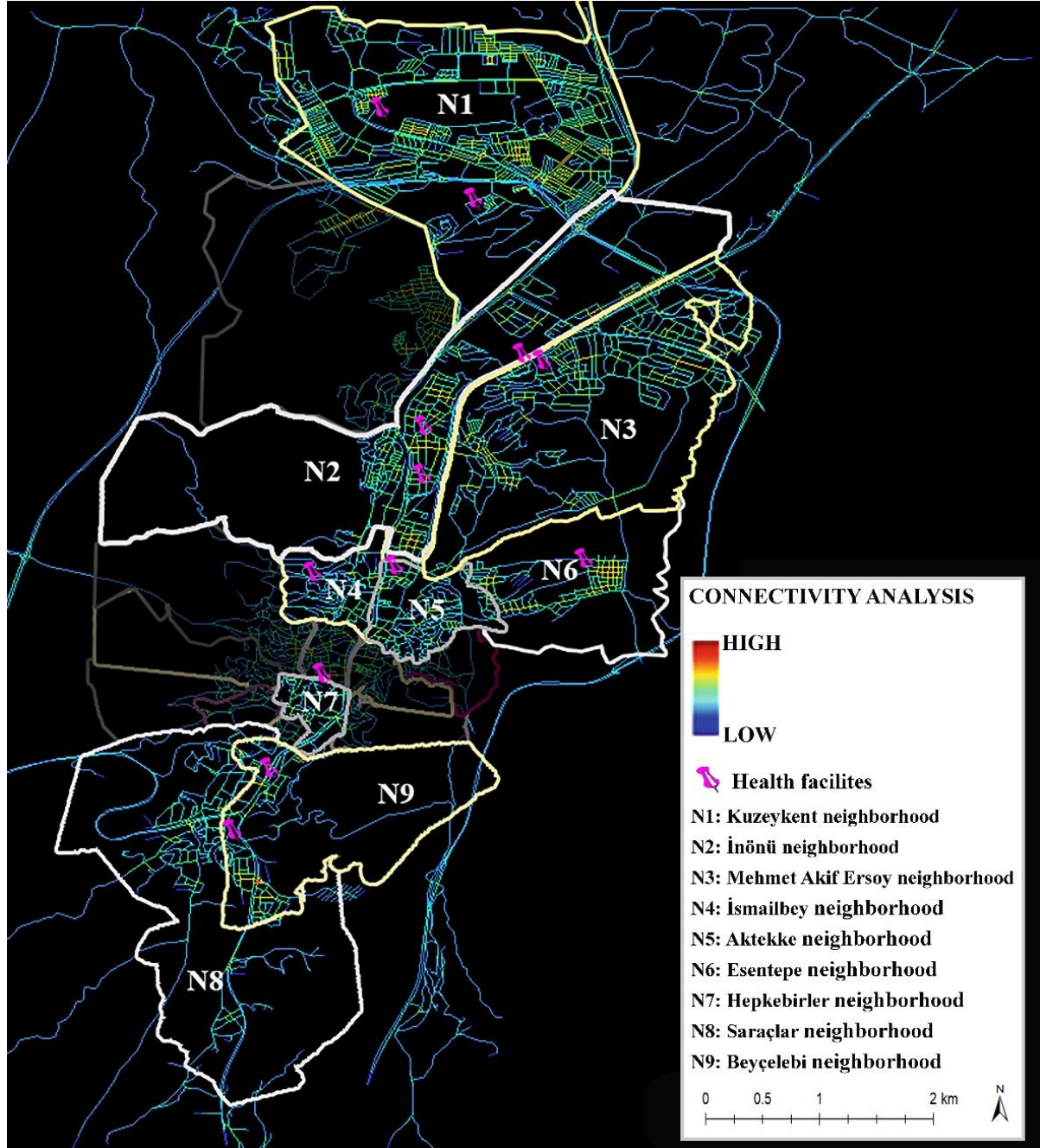
3. Results

3.1. Connectivity Analysis

When the connectivity analysis is evaluated at the neighborhood scale; It is seen that the health facilities in N1, where yellow and red colors are concentrated, that is, the connectivity status is good, are interconnected. In N2 and N3, it is seen that yellow and green colors dominate the streets where the health facilities are located; that is, the health facilities are interconnected, while it is seen that the blue color dominates the neighborhoods. It is seen that road networks are planned in connection with each other in the streets where health facilities are located in these neighborhoods where the level of connectivity of road networks is low in general. The predominance of blue in N4 and N9 indicates that the level of connectivity of healthcare facilities is low. The predominance of green and yellow colors in N5 and N8 indicates that the road networks are interconnected; that is, access to the health facility is at a good level. It is seen that the color blue is dominant in N6, but yellow color is prevalent in the street where the health facility is located. This situation shows that the road networks are interconnected in accessibility to the health facility. On N7, on the other hand, it is seen that the yellow color dominates the streets where the health facilities are located; that is, the road networks are interconnected, while the green color is dominant throughout the neighborhood. If the connectivity analysis is evaluated in general, it is seen that the

connectivity of the road networks in the Central district is generally at a moderate level (Figure 4).

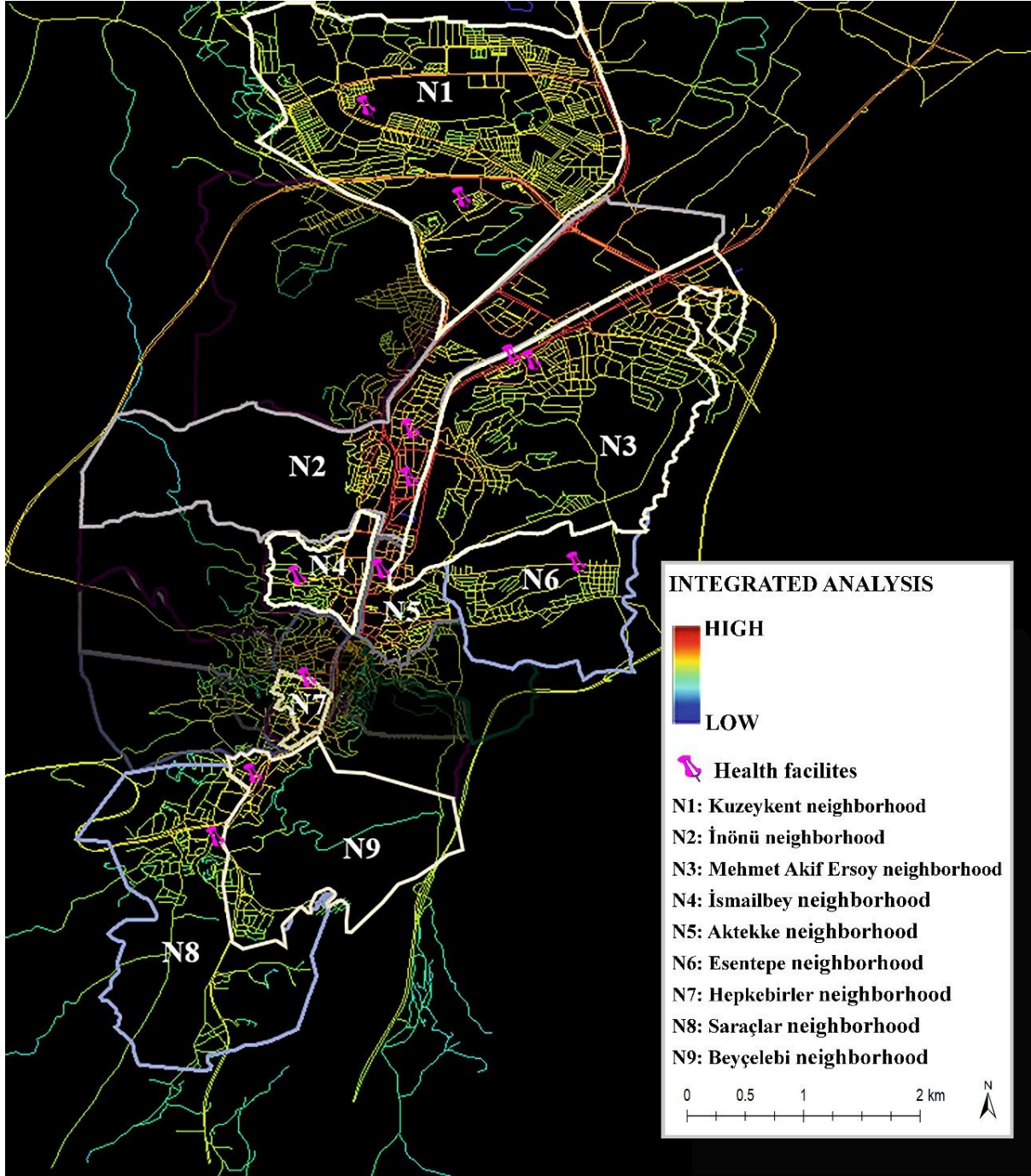
Figure 4: Connectivity Analysis



3.2. Integration Analysis

When the integration analysis is evaluated at the neighborhood scale; The presence of orange and red colors on the main roads in N1 and N2 indicates the high integration value on these roads; that is, these roads have a central role in the neighborhood. The presence of yellow and orange in the road networks throughout the neighborhood indicates easy accessibility to health facilities. The yellow color of road networks in N3 and N4 indicates that the level of integration is moderate. The fact that there is a health facility in N5 and the roads on the street are orange and red shows that accessibility is easy. The fact that the road networks are predominantly green in N6, N7, and N9 indicates a low level of integration. It is seen that access to health facilities in these neighborhoods is not easy. N8 is a neighborhood with high integration value. The orange and red colors seen in the road networks, especially on the street where the health facility is located, are an essential indicator of the high level of integration. This shows how easy it is to access the health facilities in the neighborhood. Suppose the integration analysis is evaluated in general. In that case, the dominance of orange and red colors throughout the map indicates that access to health facilities is easy throughout the district. In contrast, blue and green colors indicate neighborhoods where accessibility is not easy (Figure 5).

Figure 5: Integrated Analysis



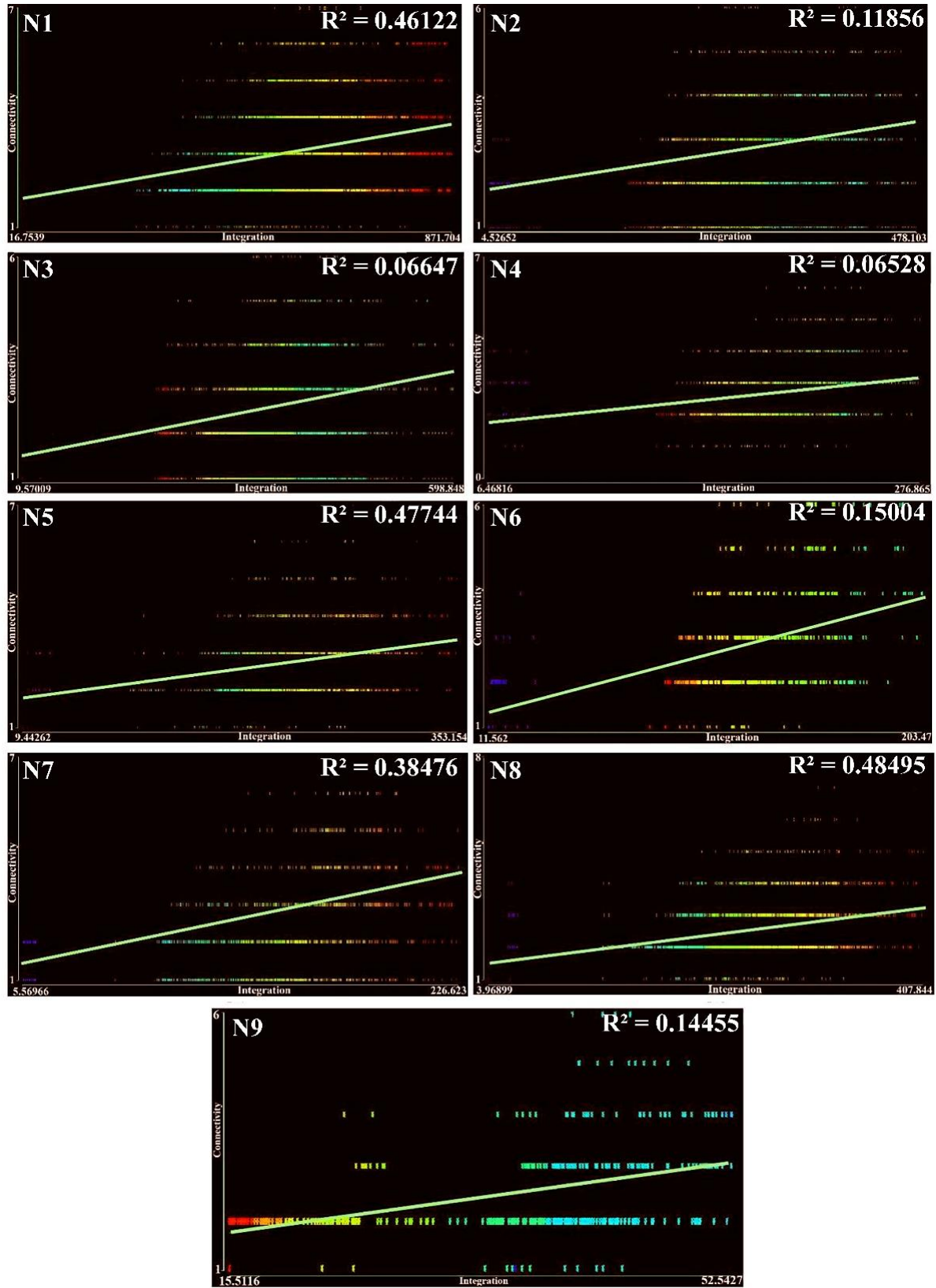
3.2. Intelligibility Analysis (Perceptual Accessibility)

In the correlation graphs made with the connectivity and integration values, the readability status of the neighborhoods in terms of accessibility to health facilities was determined. The highest readability value ($R^2=0.48$) is observed in the Saraçlar

Neighborhood, the lowest readability value ($R^2=0.06$) is observed in the Mehmet Akif Ersoy and Ismailbey Neighborhoods.

The intelligibility analysis, represented through the correlation between connectivity and integration values, provides insight into the perceptual accessibility of the urban fabric. In this context, higher R^2 values indicate that local spatial cues are more reflective of the overall spatial configuration, suggesting a stronger cognitive understanding of the area. Accordingly, the Saraçlar Neighborhood, with the highest intelligibility value ($R^2 = 0.48$), appears to offer a more perceptually accessible and legible environment, potentially facilitating easier orientation and wayfinding. In contrast, the low R^2 values observed in Mehmet Akif Ersoy and Ismailbey Neighborhoods ($R^2 = 0.06$) reflect weaker spatial legibility, which may hinder users' ability to navigate and comprehend the spatial structure intuitively (Figure 6).

Figure 6: Intelligibility graphs of the road networks of the neighborhoods



3.4. Spatial Adequacy and Perceptual Accessibility

The analysis of neighborhoods is discussed in comparison with the legislation of the country. In the Spatial Plans Construction Regulation, the value indicating that the health facilities of Kastamonu province are spatially sufficient is 1.50.

The spatial qualifications of the health facilities built in this context are given in Table 1. According to these data, in 9 neighborhoods where there are health facilities, 3 neighborhoods had a minimum level of adequacy of health facilities compared to the population, while 6 neighborhoods were found to be insufficient. In terms of proficiency, the highest rate (4.26) is seen in Hepkebirler District, while the lowest rate (0.02) is seen in İnönü Mahallesi. Considering the connectivity values, the highest rate (8) is seen in Saraçlar Mahallesi, and the lowest rate (0) is seen in İsmailbey Mahallesi. In integrated values, the highest rate (871.70) is observed in the Kuzeykent Neighborhood, and the lowest rate (3.96) is observed in the Saraçlar Neighborhood. The road networks of Saraçlar Mahallesi have more connections and less integration. It is seen that the highest readability rate is in Saraçlar District, while the lowest rate is in Mehmet Akif Ersoy District.

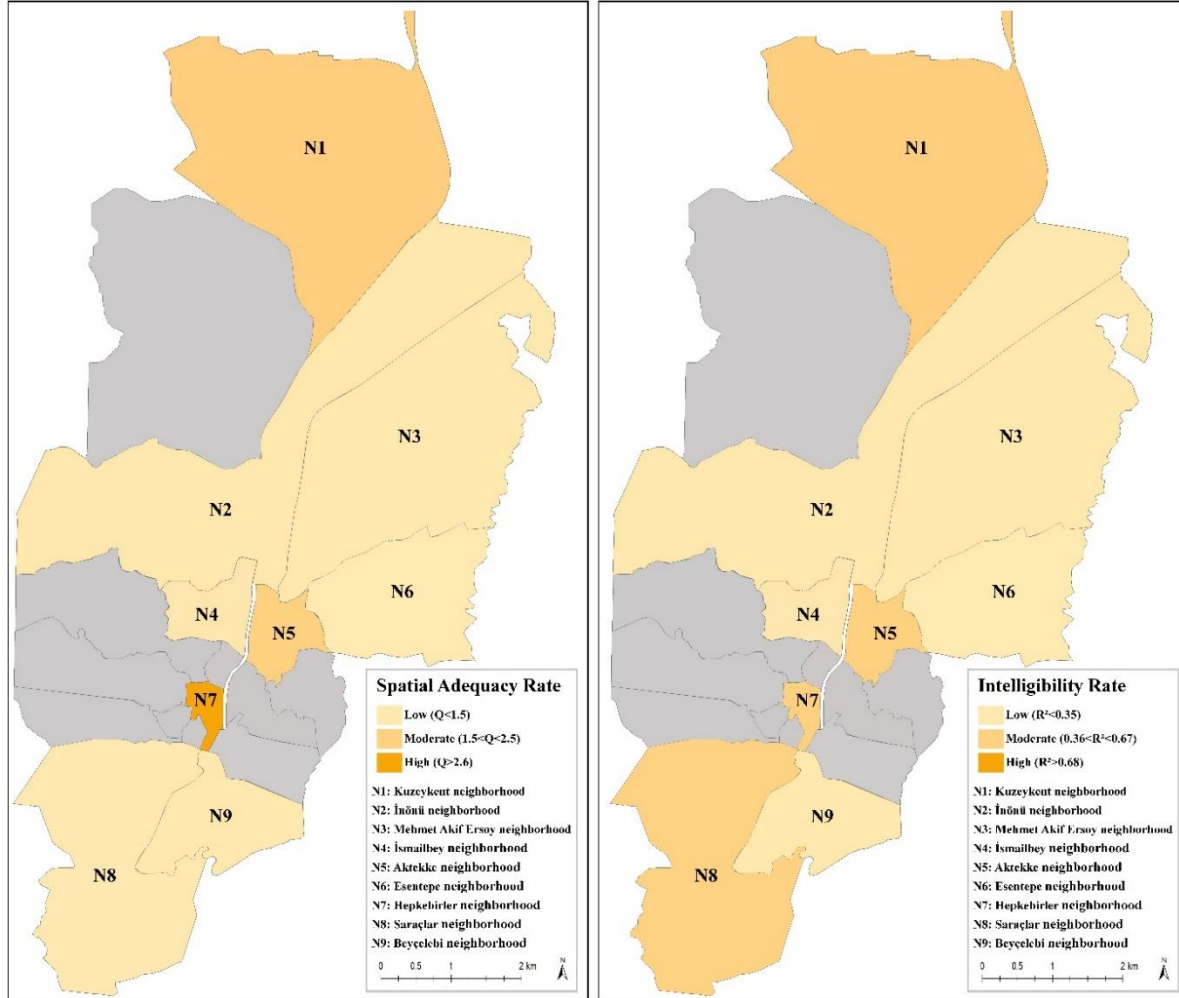
Table 1: Spatial Adequacy and Accessibility of Health Facilities

Neighborhoods	Health Facility Area (m ²)	Population	Spatial Competence (m ² /person)	Connectivity		Integrity		Legibility (R ²)
				Lowest	Highest	Lowest	Highest	
N1	46.176	27.814	1.66	1	7	16.75	871.70	0.46
N2	468	21.847	0.02	1	6	4.52	478.10	0.11
N3	3093	23.814	0.11	1	6	9.57	598.848	0.06
N4	275	3.687	0.07	0	7	6.46	276.86	0.06
N5	7580	4505	1.68	1	7	9.44	353.15	0.47
N6	322	3528	0.09	1	6	11.56	203.47	0.15
N7	7852	1842	4.26	1	7	5.56	226.62	0.38
N8	2020	13.618	0.14	1	8	3.96	407.84	0.48
N9	1488	2899	0.51	1	6	15.51	52.54	0.14

As a result of the data obtained, maps were created by classifying the calculated values to compare the spatial adequacy and perceptual accessibility of the health facilities in the neighborhoods. The qualification rate is low; There are six neighborhoods (N2, N3, N4, N6, N8, N9), two neighborhoods (N1, N5) with a medium level, and one neighborhood (N7) with a high level. While there are five neighborhoods (N2, N3, N4, N6, N9) where the readability rate is low, four neighborhoods (N1, N5, N7, N8) are at a medium level, and there is no neighborhood where it is high. In N8, the spatial adequacy of health facilities is low, while the

legibility of road networks is moderate. In N7, on the other hand, while the spatial adequacy is high, the intelligibility of the road networks is moderate (Figure 7).

Figure 7: Spatial Adequacy and Intelligibility of Neighborhoods With Health Facilities



4. Discussion

It is important to what extent people move in cities, spend time finding their way, or read their surroundings. A space syntax method is an effective tool for understanding how people move in the urban environment and perceive the environment. It is not correct to evaluate urban spaces only with their physical characteristics. At the same time, it is a crucial requirement to determine the readability of urban spaces. The study aimed to examine the locations of health facilities in the Kastamonu Central district in terms of urban planning and revealed the suitability of the space syntax method in exploring this subject. According to the study results, it is thought that the space syntax method plays a vital role in determining the areas with high accessibility.

Road networks with moderate connectivity and high integration values are strong spatial axes that can be intensively used for accessing health facilities. In Space Syntax theory, such routes often correspond to intelligible and well-integrated paths that support natural movement and enhance spatial comprehension (Hillier & Hanson, 1984; Hillier et al., 1993). High intelligibility reflected in the correlation between local and global spatial variables indicates that individuals are more likely to intuitively understand the structure of the environment, which contributes to higher levels of perceived accessibility and ease of navigation (Peponis et al., 1990; Karimi & Parham, 2022). Recent studies confirm that spatial configuration significantly affects how people perceive and use urban spaces, particularly in relation to health access and walkability (Zhang & Cheng, 2020; Koohsari et al., 2021). Moreover, accessibility is not solely shaped by spatial structure but also by various managerial, social, and infrastructural factors (Tao, Cheng, Zeng, & Li, 2018). In the study, the spatial adequacy level of health facilities was determined according to the Spatial Plans Construction Regulation, which is the relevant legislation in Türkiye. It has been concluded that 6 of the nine neighborhoods with health facility areas are insufficient, and 3 of them are sufficient. The readability rates are also low in N2, N3, N4, N6, and N9, where health facility areas are spatially deficient; N1, N5, and N7, which have high spatial proficiency, have been found to have moderate readability rates. Since readability is related to the degree to which a system can be fully comprehended, values greater than 0.45 indicate that it is easy to navigate in road networks and that the visual dominance is high. In this context, the readability ratios in N5 and N8 must be more significant than 0.45. Although there are deficiencies in terms of health facility area, it has been determined that the highest readability value is in N8. The fact that the health facility area in the neighborhood, which is a new development area in the southern part of the city, is not at a sufficient level in terms of area, but the connectivity and integration values are high, is an indication that the neighborhood is at a good level in terms of accessibility to health facilities. These results are an important indicator that the neighborhood is in a suitable location for the health facility area to be built for the population's needs.

The results of the study are consistent with similar studies in the literature. At the same time, the results obtained are parallel to the literature and reiterate the importance of the relationship between spatial structure and perceptual accessibility; in this context, it is thought that the findings can be a guide in spatial planning decisions, especially those aimed at increasing access to health services.

5. Conclusion

The analytical evaluation process presented in this study offers an objective and scientifically grounded approach that can inform spatial planning and site selection decisions. In neighborhoods where health facilities vital components of urban welfare are insufficient, identifying appropriate locations and enhancing spatial connectivity and integration through targeted planning interventions may substantially improve accessibility. In particular, increasing the intelligibility of street networks, as indicated by stronger correlations between connectivity and integration values, can enhance both physical and perceived accessibility to health services and other public spaces. Given the rising traffic-related challenges associated with urbanization, improvements in the spatial legibility of urban road networks are expected to contribute positively to urban mobility and quality of life. The study findings suggest that rather than solely expanding transportation infrastructure, planning strategies should prioritize strengthening connections to public spaces and improving the perceptual clarity of movement networks. Such approaches are likely to yield more sustainable and inclusive accessibility outcomes, particularly in underserved urban areas.

Avenues for Future Research

Space Syntax provides a powerful tool for better understanding the current structure and functioning of urban spatial networks. It helps identify the most appropriate interventions to improve spatial accessibility for the benefit of all citizens. Therefore, the findings of this research may support similar studies applicable to other urban contexts. At the local level, this approach can contribute to a more analytical and evidence-based planning process by identifying neighborhood-scale accessibility disparities. Future research can benefit from integrating syntactic analysis with socio-demographic, land-use, or transportation datasets to generate a more holistic understanding of spatial equity. Moreover, comparing syntactic measures with user-based data such as travel behavior or perception surveys could reveal how perceived and actual accessibility align or diverge. Longitudinal studies may also help monitor changes in accessibility over time, particularly in areas undergoing rapid urban transformation. Additionally, exploring how vulnerable or underrepresented groups experience spatial accessibility could provide valuable insights for inclusive urban planning.

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