How Feasible is the 15-Minute City Concept in Istanbul: The Case of Beşiktaş District

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Abstract

This study aims to reveal the extent to which accessibility values calculated using digital platforms (15-minute city score) align with the physical, social and environmental realities on the ground—specifically in two distinct areas within Istanbul's Beşiktaş district, representing the polar extremes—the highest and lowest values—of the 15-minute city scores. Supported by field data, this study employing qualitative research methods addresses, in turn: how accessibility values are calculated, a morphological analysis of the selected areas, and an evaluation of the alignment or discrepancies between the calculated 15-minute city scores and the existing field data. Furthermore, the study will discuss the causes and mechanisms behind the observed discrepancies, the extent to which they represent reality, the reliability of remote calculations, and how these calculations should be utilised in official data. The findings contribute to enabling urban authorities to evaluate the data they use in planning and transport studies more accurately.

Keywords—15-minute cities, digital computing, field research, 15-minute city score toolkit, Beşiktaş, Istanbul

I. INTRODUCTION

In a context where traffic problems are making transportation increasingly frustrating, the quality of urban life has begun to depend on the concepts of accessibility and walkability. Among the urban planning approaches developed in this context, the "15-minute city" approach, in particular, has become the focus of academic research and policy debates in recent years. It has achieved this by offering a comprehensive model that aims to ensure the basic needs of daily life can be met quickly on foot or via micromobility. The growing influence of the 15-minute city approach has made the decisive role of physical proximity, service diversity, and accessibility in urban areas more prevalent in shaping user behavior. In this context, recent empirical studies evaluate the sustainability of cities through "minute-based" accessibility analyses of urban services and test the 15-minute city approach using spatial data [1-5].

Some studies in the literature show that accessibility is influenced not only by distance measurements but also by public transportation integration, environmental quality, the condition of infrastructure, functional density, and spatial distribution. Other studies have also developed various methodologies that utilize "x-minute" analyses to measure accessibility [6-8]. These studies reveal that access to functions such as health centers, schools, grocery stores or public transit stops within a specific time threshold directly shapes the daily life practices of city residents. The concept of accessibility has long held a central position in geography, transportation planning, and urban design studies and can be measured using various methods. While normative measures focus on idealized targets, positive measures are based on actual movements [9]. The cumulative opportunities approach [10] and the analysis of the shortest distance to a destination [11] have emerged as common methods for assessing accessibility. In addition, models that account for an individual's sociodemographic characteristics, travel behavior, or public transportation use have also been developed [12-13]. Although efforts related to digital accessibility assessments are on the rise, relatively little attention has been given to research evaluating the alignment of digitally generated accessibility outcomes with the urban conditions observed in the field.

Recent studies in the literature have highlighted certain limitations in digital accessibility assessments conducted for the “15-minute city” concept. In one such study, Mouratidis [14] notes that digital accessibility assessments often fail to fully account for different modes of transportation, public transit stops that facilitate interaction and transportation between city neighborhoods are not sufficiently taken into account in the assessment, uncertainties in identifying boundaries that create accessibility barriers, and the failure to adequately represent different groups in accessibility assessments due to the assumption that people walk at a specific standard speed. Consequently, this situation highlights the need to incorporate field data—which includes site-specific physical, topographic, and morphological conditions—into accessibility assessments calculated via digital platforms.

The aim of this study is to critically evaluate, through field observations, the extent to which the values generated by the 15-minute city score toolkit—a digital accessibility calculation toolkit—accurately reflect real-world urban conditions. The primary objective of this research is not to redevelop the computational model underlying the digital accessibility toolkit or to calibrate its scoring system based on field data. Instead, the study aims to reveal the alignment or misalignment between the units with the highest and lowest accessibility scores—as calculated via the digital platform—and the reality on the ground; it also examines which physical, topographic, and morphological characteristics account for the identified discrepancies. In this way, the strengths and weaknesses of digital accessibility analyses will be brought to light. This approach will provide a critical assessment aimed at enabling the more informed and context-sensitive use of digital calculation tools for walkability in urban planning and transportation policies. In this context, the research seeks to answer the following questions:

- What degree of alignment or discrepancy exists between the digital accessibility scores calculated using the 15-minute city score toolkit and field observations?

- What physical, morphological, and topographical characteristics account for the differences between evaluations based on digital calculations and field observations?

- What approaches do these identified differences suggest for interpreting digital accessibility evaluations and applying them in urban planning efforts?

This article is structured as follows: Following the introduction, it discusses the negative impacts of urbanization and efforts toward pedestrian-oriented planning to address them (Section A), as well as general information on the 15-minute (x-minute) city approach (Section B). Next, the methodology for calculating 15-minute city scores is discussed (Section II). Following that, the analysis of the Beşiktaş district’s demographic and physical characteristics and the study area begins (Section III). Subsequently, the cell with the highest 15-minute city score (Section A) and then the cell with the lowest 15-minute city score (Section B) are analyzed. In the final evaluation section, the digital calculations are compared with field analyses, and the reasons for any discrepancies are assessed whilst considering literature. The study concluded with recommendations regarding what should be considered in planning processes within the context of the 15-minute city concept (Section IV).

A. The problem of modern cities: transportation and accessibility

Industrialization has brought about rapid urbanization. After World War II, urban development accelerated, and cities have significantly deviated from the principle of proximity, which has long been at the heart of urban planning. One reflection of rapid developments in the fields of economics and technology in cities is the increasing prevalence of automobiles and the construction of wide highways to accommodate this vehicle density. These rapid changes in the urban landscape have become factors that directly affect accessibility. People have begun to live farther away from their workplaces and the amenities needed to meet their daily needs, and urban sprawl has become more prevalent. As urban policies have supported outward urban sprawl, dependence on cars has increased, while the use of public transportation and active mobility has declined [15]. In this regard, the quality of life for urban residents and environmental sustainability in the 21st century are being affected by problems stemming from motor vehicle use—such as the ever-increasing dependence on cars—as well as rapid urbanization and the negative consequences of urban sprawl.

Every situation experienced and taken for granted throughout the day—often without even realizing it—affects city dwellers and their surroundings, and in a sense, shapes them [16-17]. In his essay “Architecture in Everyday Life,” Dell Upton [18] redefines architecture not as a collection of monumental forms, but as a condition of everyday life experienced through the body. According to Upton, architecture is not merely something that is drawn; it is also something that is lived, experienced, and constructed through the body. In this regard, the traffic congestion, sustainability issues, and inequalities in access that we encounter in our surroundings will, at their core, be made possible by changes in “everyday life” [18]. Changes in everyday life will reshape the mobility patterns of cities. Urban planning approaches have now shifted from a car-centric planning approach to a search for a pedestrian-oriented transformation. In this regard, walking behavior is emerging as a key component of sustainable urban life, be it environmentally, socially, or individually [19]. Accordingly, walking-focused planning approaches, such as the “15-minute city” concept that has gained prominence in urban planning literature in recent years, are coming to the forefront.

B. *What is the concept of the 15-minute city (X minutes)?*

The 15-minute city is based on the idea that residents’ neighborhood-focused daily needs are met primarily by non-motorized transportation or on foot. Carlos Moreno, who first proposed this idea at a climate conference in 2016, has influenced and enriched global discussions on the quality of urban life, the reduction of the carbon footprint, and sustainable urban development through the 15-minute city concept. Moreno defines the 15-minute city concept through four fundamental principles: (a) density, (b) proximity, (c) diversity, and (d) digitalization [20-22]. The first of these, density, is considered in terms of people per square kilometer—in contrast to the ultra-high-density buildings found in traditional planning. It refers to the optimal number of people that a given area can comfortably support in terms of urban service provision and resource consumption for sustainable urban planning. The principle of proximity refers to a city dweller’s access to basic needs and services, both in terms of time and space. The principle of diversity refers to a mixed-use distribution at the neighborhood scale, where building functions—such as housing, workplaces, entertainment, and cultural spaces—meet the needs of city residents. Digitalization, meanwhile, is a principle that encompasses digital solutions designed to meet everyday needs—whether through digital tools inspired by smart city concepts or through real-time services and online interactions. This principle enhances accessibility while reducing transportation needs; in particular, it leads to lower emissions by decreasing automobile use. Consequently, it contributes to making cities more resilient in areas such as sustainability and climate change [20].

The principles identified by Moreno are spatial and functional characteristics that directly influence a pedestrian-focused approach to urban mobility. The concept of walkability, examined within the framework of the “15-minute city” concept [15]—which offers an alternative urban development strategy aimed at designing more livable, sustainable and efficient urban environments, in contrary to traditional, car-centric planning practices—is not shaped solely by these principles. Considering literature, the following elements can also be added to the characteristic features of 15-minute cities: livable public spaces, walkable and cyclable streets, inclusiveness and placemaking, and ubiquity. In this regard, the first step is to design walkable and bike-friendly streets, with the goal of establishing a comfortable, seamless, and barrier-free transportation network for all road users—including pedestrians, cyclists, and non-motorized travelers. This infrastructure is supported by public space designs that prioritize local community participation. These placemaking practices aim to strengthen people’s sense of belonging to the area and reinforce local identity at new focal points created within the city. In accordance with the principle of inclusivity, which lies at the heart of this approach, all city residents—regardless of their individual abilities, age, gender, or background—are guaranteed the ability to move safely and without barriers in public spaces and to benefit equally from urban services. Finally, the principle of ubiquity envisions the extension of all these qualities throughout the entire city, ensuring that residents can access these standards seamlessly at every point in the city, regardless of their socioeconomic or demographic status [23]. Therefore, the 15-minute city concept offers a flexible design model that must be considered in all its dimensions.

II. RESEARCH METHODOLOGY, DATA COLLECTION, AND ANALYSIS

The study titled “15-minute city score toolkit – urban walkability analytics [24]” is a design developed by Fondazione Transform Transport ETS to measure cities’ compliance with the 15-minute city concept using a quantitative method. This toolkit utilizes Python-based software that runs in the QGIS environment. The objective of this study is to develop a digital calculation method that makes the level of accessibility to services capable of meeting the basic daily needs of a specific area at both micro and macro scales repeatable and standardized. Consequently, this study builds upon walkability score measurements such as Walk Score and presents a calculation framework based on the components of the 15-minute city. The steps followed in the digital calculation method for the 15-minute city score are as follows:

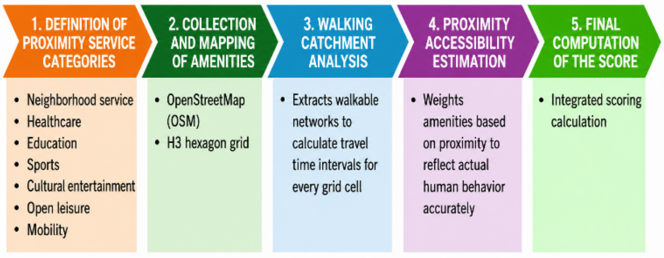

FIG. I STEPS FOLLOWED WHEN CALCULATING THE 15-MINUTE CITY SCORE ,VISUALIZED BY THE AUTHOR USING DATA FROM URBAN MOBILITY METRICS, [24].

In the initial phase of designing the digital calculation tool, service categories that meet people's daily needs were identified. These service categories were grouped under eight main headings: "i) Neighborhood services (including personal and community services—e.g., post offices, banks, civic and community centers, police services, water filling stations, local government offices, bars and cafes, tobacco shops, and newsstands), ii) Healthcare: (hospitals, pharmacies, first aid, clinics, and local health services), iii) Neighborhood shops: (grocery stores, retail stores, bookstores, local markets, restaurants, supermarkets, and local non-food shops), iv) Education: (kindergartens, schools, colleges, universities, vocational schools, and libraries); v) Sports: (gyms and sports facilities); vi) Cultural entertainment: (cinemas, theaters, art centers, and museums); vii) Open leisure: (parks, children's playgrounds, and gardens); viii) Mobility: (surface-level public transportation stops, bike parking facilities, bike-sharing and car-sharing facilities, underground metro stations, and railway stations) [24]"

In the second phase of the method, Open Street Map [25] was used as a platform to obtain data containing the spatial counterparts of the identified service categories. One of the primary reasons for choosing Open Street Map [25] is that it is a platform with an open data source. Additionally, it was selected because its ability to host data on different cities holds the potential to enable cross-city comparisons of the scores to be calculated. Furthermore, the system was designed to allow users of this toolkit to add their own spatial datasets. This approach will facilitate the integration of local government data into the system, thereby enabling more precise analyses.

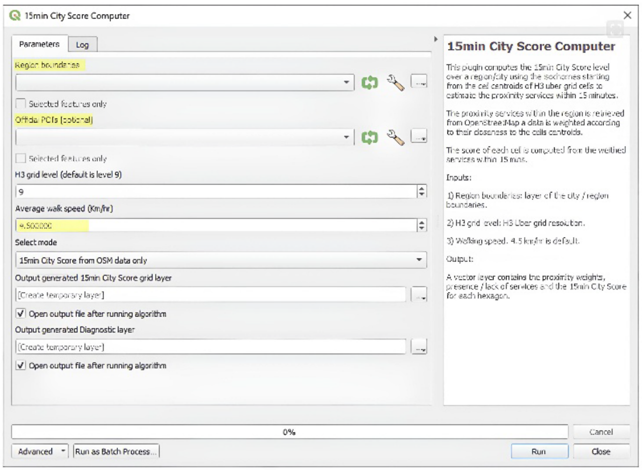

FIG. II INTERFACE OF THE 15-MINUTE CITY SCORE TOOKIT IN QGIS [24]

In the third phase of the tool design, a grid system was established to prevent scale discrepancies caused by administrative boundaries, and areas were identified where scores related to the 15-minute city approach would be measured. Spatial boundaries were delineated using the H3 Hexagon Grid System developed by Uber, rather than a traditional grid system. The hexagonal cells are designed to cover an area roughly the size of a neighborhood. The center of each hexagonal cell was configured to serve as the starting point for 15-minute accessibility calculations [24].

In the next phase, it is necessary to measure users' accessibility to the defined service functions within the H3 hexagons. For the pedestrian accessibility analysis, a pedestrian network was created using data from Open Street Map [25] regarding walkable road networks. The starting points created at the cell centers in the previous stage were connected to these networks. In these scenarios, isochrones ranging from 1 minute to 15 minutes were generated. Consequently, the accessibility scenarios for each cell within the grid system were integrated into the pedestrian route networks. The calculation process was carried out based on an average walking speed set at 4.50 km/h. During this process, spatial analyses were performed using Python's built-in libraries as well as libraries such as GeoPandas, NetworkX, OSMnx, Shapely, and PySAL. When establishing the relationship between the pedestrian route networks and service functions, the service area closest to the cell center was taken as the basis for each service category. Separate calculations were performed for each of the 8 categories: neighborhood shops and services, education, healthcare, sports, open leisure, cultural entertainment and mobility. Each category was first calculated as a value between 0 and 1; then, these values were combined across all 8 service categories to yield a value between 0 and 8. These calculated metrics were then converted into percentages. Thus, areas scoring between 90 and 100 indicate that daily needs can be met within a 15-minute timeframe.

The 15-minute city score toolkit is not an assessment tool developed specifically for certain cities and usable only in those cities. The toolkit's adaptable structure allows it to be applied in cities with various spatial, demographic, and transportation characteristics. Indeed, the toolkit has been applied in 112 different cities, primarily located in Europe; it has been used across a broad geographic area stretching from Reykjavík in the northwest, to Umea in the north, Lisbon in the west, Istanbul in the east, and Limassol in the southeast. This broad scope of application demonstrates the method's transferability to different urban contexts and its applicability in new case studies. While this does not, on its own, prove the method's validity or reliability, it does show that it offers a flexible evaluation framework capable of adapting to different urban conditions and being used in comparative spatial analyses [24].

To support the methodological robustness of the study, the principles of construct validity, internal validity, external validity, and reliability proposed by Robert K. Yin [26] for case study research were taken into account. Construct validity was supported by the combined use of multiple data sources. To support the interpretation of accessibility conditions, Open Street Map data used by the 15-minute city score toolkit, Caltopo topographic data, municipal planning data, Google Earth imagery, and field observations were analyzed together. In the process of interpreting the findings, the road hierarchy, topography, block sizes, usable green spaces, pedestrian infrastructure, and other physical environmental characteristics that could affect accessibility were taken into account. Google Earth imagery and street-level photographs were used not as an independent analysis dataset, but to document and illustrate the observed physical conditions. Internal validity was ensured by interpreting discrepancies between the calculated digital assessments and field observations in light of the study area's physical and spatial characteristics (e.g., topography, road hierarchy, block structure, pedestrian infrastructure, and available green spaces) within the context of accessibility. Since the study is based on a single case study, the findings are not statistically generalizable; however, they offer analytical insights applicable to similar urban contexts. Finally, the study's reliability is supported by a clear definition of the data sources used, the study area selection process, and the analytical approach, thereby strengthening the study's applicability in similar case studies within the same analytical framework.

III. CASE STUDY: ISTANBUL'S BEŞİKTAŞ DISTRICT

The 15-minute city score toolkit's study on Istanbul covers only the European side. Consequently, it is not possible to select a location from the Anatolian side for the study area. For this reason, a district on the European side of Istanbul has been designated as a sample area where a comparative analysis of the digital accessibility score and field data can be conducted. Furthermore, the 15-minute city score toolkit's omission of the "density" parameter—one of the fundamental principles of the "15-minute city" concept—in its digital calculation processes is based on the assumption that the areas the model currently calculates are urban areas with a specific population density. In line with this methodological assumption, a district with medium-to-high population density was selected as the sample area for the study. At the same time, the aim was to exclude areas—such as the Historic Peninsula—that have specific and strict site-specific conservation plans, and where urban interventions and morphological transformations are therefore limited. In this context, and considering the aforementioned constraints and methodological criteria, Beşiktaş—which represents a critical threshold as an intersection point of transportation networks within Istanbul's macro-form and also exhibits a dynamic urban morphology—serves as a unique case study for testing the feasibility of "15-minute city" policies.

According to Endeksa [27] data, the population density of the Beşiktaş district is significantly higher than the national average for Turkey. Furthermore, it has been determined that Beşiktaş's population density is higher than that of Istanbul, a megacity. Consequently, the Beşiktaş district meets the density principle—defined as the number of people per kilometer—which is one of the fundamental principles of the "15-minute city" concept.

Region/Area	*Total Population (People)*	*Population Density (People/ km2)*
Türkiye	85,664,944	109.80
Istanbul	15,701,602	2,869.93
Beşiktaş	167,264	9,265.56

TABLE I COMPARISON OF POPULATION AND POPULATION DENSITY IN TURKEY, ISTANBUL, AND BEŞIKTAŞ, ENDEKSA [26].

Upon closer examination of the Beşiktaş district, it can be stated that it comprises a total of 23 neighborhoods, all of which are fully urbanized [25]. According to calculations based on property ownership across Beşiktaş, residential property accounts for 83.68%, while commercial properties account for 16.32% [27]. Therefore, it can be stated that residential areas are generally predominant. This situation aligns with the residential-focused design of "15-minute cities," which aims to meet people's daily needs at the neighborhood level.

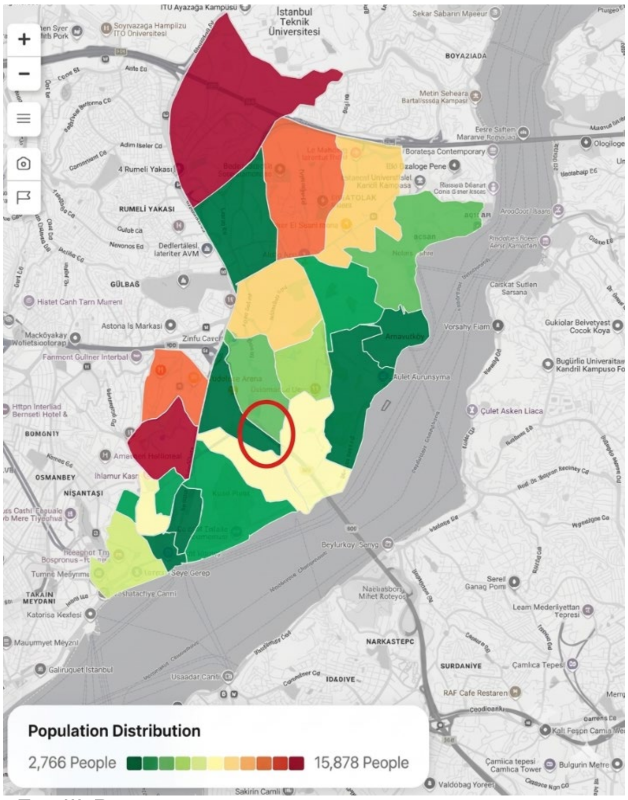

FIG. III POPULATION DISTRIBUTION BY NEIGHBORHOOD IN THE BEŞIKTAŞ DISTRICT AND THE AREA WHERE THE STUDY AREA IS MARKED, ENDEKSA [27].

Another notable demographic point is the age distribution of the population in Beşiktaş district. According to data from Endeksa [27], the population aged 65 and over in the Beşiktaş district is significantly higher than that of other age groups.

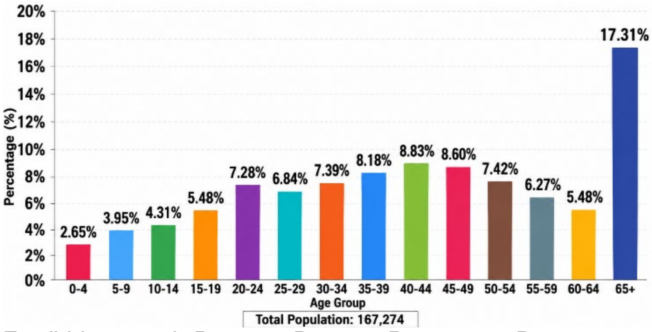

FIG. IV ISTANBUL'S BEŞIKTAŞ DISTRICT POPULATION DISTRIBUTION BY AGE, VISUALIZATION GENERATED USING AI BASED ON ENDEKSA DATA, [27].

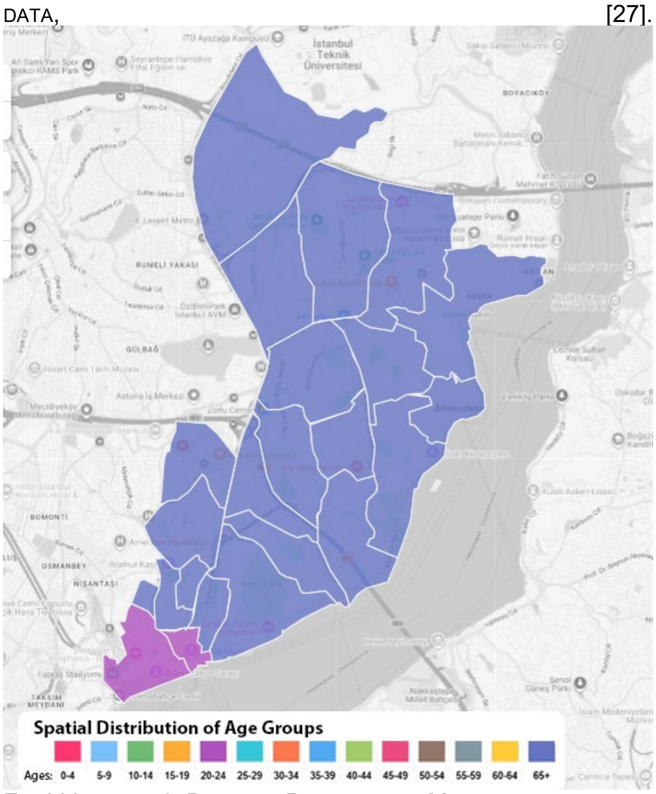

FIG. V ISTANBUL'S BEŞIKTAŞ DISTRICT, THE MAP SHOWING THE AGE DISTRIBUTION OF THE POPULATION IN THE BEŞIKTAŞ DISTRICT, ENDEKSA, [27].

The cells within the Beşiktaş district were analyzed using the 15-minute city score toolkit [24], and five adjacent cells with different scores were identified. The cell with the highest 15-minute city score is 92; the cell with the lowest score is 30; and the others have scores of 87, 63, and 76. Consequently, these five cells were numbered from one to five, and within the scope of the study, cells with scores below 50 were assigned number 5, those in the 50–70 range were assigned number 4, those in the 70–80 range were assigned number 3, those in the 80–90 range are designated as cell number 2, and those with scores over 90 are designated as cell number 1.

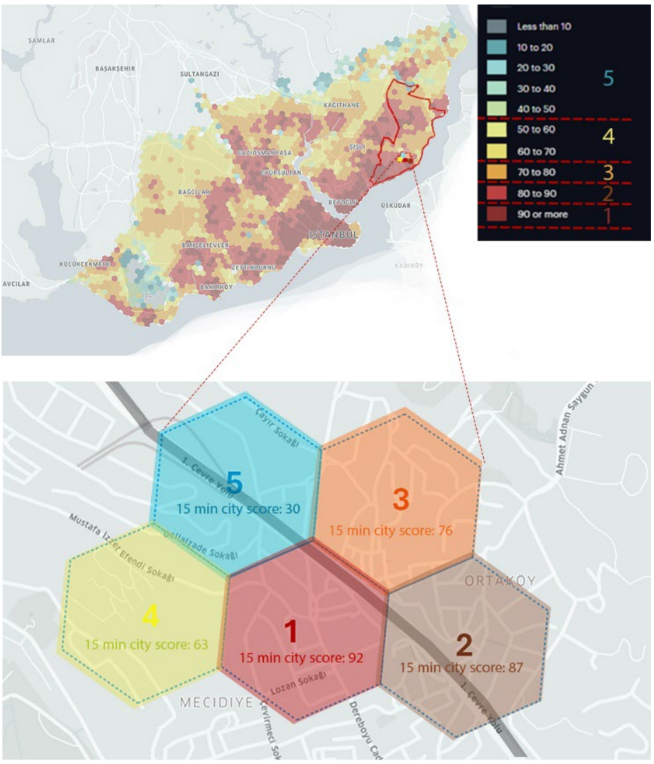

FIG. VI THE SCORES FOR ISTANBUL'S BEŞIKTAŞ DISTRICT IN THE 15-MINUTE CITY SCORE TOOLKIT [24] AND THE CELLS WITH THE HIGHEST AND LOWEST SCORES SELECTED FOR THE STUDY AREA

In this study, the H3 hexagonal cell with the highest score of 92 points and the H3 hexagonal cell with the lowest score of 30 points were examined in detail. The study examined the consistency of the cells that yielded extreme (highest and lowest) values in the digital analyses with actual field conditions; the model's capacity to reflect spatial reality and its level of accuracy were analyzed. Since it is methodologically impossible to directly compare and validate the intermediate values generated quantitatively in digital modeling with empirical (field) observations due to their nature, cells numbered two, three, and four were excluded from the scope of the study due to its limitations. The structural and scalar differences between the mathematically generated quantitative intermediate values and the qualitative field observations do not allow for a direct comparison of these two data sets.

A. Cell number 1 (15-minute city score:92) Examining the cell with the highest score

FIG. VII MAP AND IMAGES OF CELL NO. 1 IN THE BEŞIKTAŞ DISTRICT, WHICH HAS A 15-MINUTE CITY SCORE OF 92 (VISUALIZED BY THE AUTHOR USING OPEN STREET MAP [25] AND GOOGLE EARTH [30]).

Cell number 1 is located at the intersection of the Mecidiye, Ortaköy, and Levazım neighborhoods in Beşiktaş. Building heights in the area range from 2 to 10 stories. The average building height is around 6–7 stories. The 15 Temmuz Şehitler Bridge, one of the main transportation arteries of Istanbul's macro-form, is located on the edge of this cell. The ground level is at a height that allows a road to pass under the bridge. Slope levels vary in places. There is a street near the center of the cell (marked in yellow on the map) and side streets connecting to it. Various service functions, such as pharmacies, dining establishments, and grocery stores, are located along this street, which serves the area much like the marketplace of cell number 1. A mosque is located at the section where the street ends at an intersection. The street network includes several dead-end streets, reducing network connectivity and pedestrian permeability. The areas shown in green on the map are the Greek Orthodox Cemetery, an area belonging to the Armenian Catholic Monastery, and the Jewish Cemetery. There is also a children's park in an area near the perimeter of the cell.

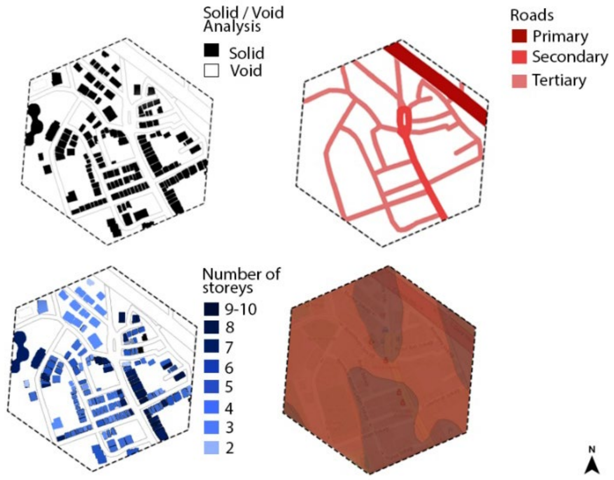

FIG. VIII ANALYSES OF A CELL IN THE BEŞIKTAŞ DISTRICT WITH A 15-MINUTE CITY SCORE OF 92, BASED ON OPEN STREET MAP [25]; BUILT-UP/VACANT AREA ANALYSIS (TOP LEFT), BUILDING HEIGHT ANALYSIS (BOTTOM LEFT); ROAD NETWORK ANALYSIS (TOP RIGHT); SLOPE ANALYSIS (BOTTOM RIGHT).

Based on the analyses conducted, an evaluation of Cell Number 1 revealed that the presence of service areas with various functions along the street near the center of this cell, as well as pedestrian access for meeting daily needs, is more consistent with the 15-minute city approach—a finding also confirmed by digital calculations. However, more in-depth examinations of the area revealed through the road network analysis that some parcels are quite large. Although the service functions are located on a street near the cell's center, pedestrians coming from the periphery to the center must walk around these large parcels to reach the street. Furthermore, the road network analysis revealed that walking continuity is disrupted because some streets end in cul-de-sacs. Another finding from the analyses is that the areas appearing as "green" on digital platform maps do not serve the "open leisure" category within the 15-minute city concept. On the map corresponding to Cell Number 1, the areas appearing in green are the Jewish cemetery and the church garden. One might assume that the church garden is an "open leisure" area serving the public. However, field observations revealed that the church is an abandoned historic structure and its garden is an overgrown, neglected area, and therefore not in use. Consequently, it can be argued that the current status of service categories—which are evaluated on digital platforms based on the presence or absence of a feature in the area—sometimes does not actually reflect the provision of the relevant service in practice.

Another issue identified during the analysis is the absence of contour line data in Open Street Map and the fact that slope is not factored into the 15-minute city score toolkit methodology. The data on contour lines used in the field analyses was retrieved from the Caltopo website [29]. In this regard, it can be argued that a digital calculation that does not account for contour lines does not accurately reflect the actual walkability time of the area.

Analyses were initially conducted using Open Street Map as the data source during the digital calculation phase. However, building floor heights were also unavailable on Open Street Map [25]. Therefore, data on building floor heights was obtained from Beşiktaş Municipality's plans for the area. While reviewing the municipality's plans, it was observed that some structures present in the municipal plans were not found on Open Street Map [25]. This finding was also confirmed using another platform, Google Earth Pro application [30]. Consequently, it was observed that the "empty" spaces in the parcels included in the density analysis were, in fact, so densely built-up that they did not allow for pedestrian passage. The conclusion drawn from all these field analyses and observations is that, despite this area having the highest score on digital platforms, the field analyses reveal the presence of conditions that negatively impact walkability and accessibility.

B. Cell number 5 (15-minute city score:30) Examining the cell with the lowest score

Cell Number 5 is located between the Balmumcu and Levazım neighborhoods of Beşiktaş. The number of stories in this cell ranges from 2 to 7. The average number of stories is 3–4. As previously mentioned, the 15 Temmuz Şehitler Bridge—one of the main transportation arteries of Istanbul's macro-form—is situated right in the center of Cell Number 5. The bridge meets ground level in the area where this cell is located. However, there is no direct connection between the main artery and this area. Furthermore, there is only a single axis within the cell that provides an underpass beneath the bridge. The increasing density of contour lines in the northwest direction of the study area indicates that the topographic slope and elevation difference increase in this direction. Streets that can be classified as secondary roads predominate within the cell. The areas shown in green on the map legend represent the surfaces where the bridge piers make contact with the ground. The area consists primarily of residential zones.

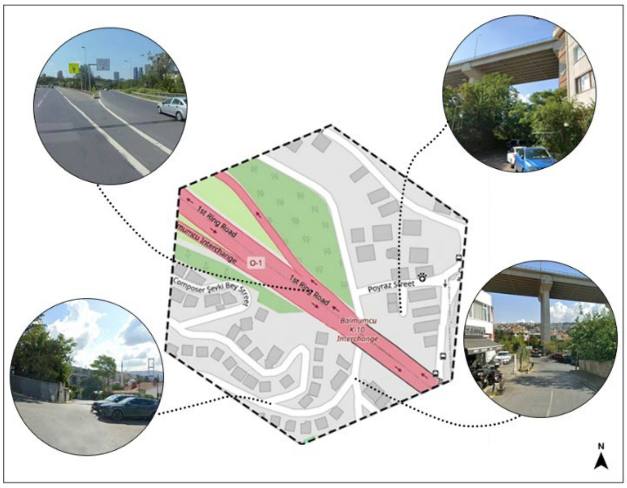

FIG. IX MAP AND IMAGES OF CELL NO. 5 IN THE BEŞIKTAŞ DISTRICT, WHICH HAS A 15-MINUTE CITY SCORE OF 30 (VISUALIZED BY THE AUTHOR USING OPEN STREET MAP [25] AND GOOGLE EARTH [30].

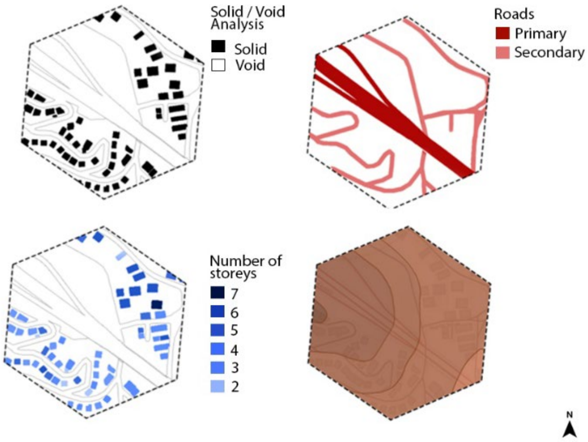

FIG. X ANALYSES OF A CELL IN THE BEŞIKTAŞ DISTRICT WITH A 15-MINUTE CITY SCORE OF 30, BASED ON OPEN STREET MAP [25]; BUILT-UP/VACANT AREA ANALYSIS (TOP LEFT), BUILDING HEIGHT ANALYSIS (BOTTOM LEFT); ROAD NETWORK ANALYSIS (TOP RIGHT); SLOPE ANALYSIS (BOTTOM RIGHT).

Based on the analyses conducted, when evaluating cell No. 5, the presence of the bridge at its center divides the cell into two distinct areas. Since access is provided via a single axis under the bridge, it is not possible to cross from any other location, either on foot or by vehicle. This situation negatively impacts connectivity between these two areas within the same cell. Another issue is that the green spaces—which function as a spatial buffer zone to mitigate the negative effects and risks of high-speed traffic at the point where the bridge meets ground level—are unusable green spaces. In other words, these areas do not serve the “open leisure” function within the 15-minute city concept. Although there is a neighborhood market in the section north of the bridge, it is set up only on certain days of the week and remains closed on other days, so it does not meet people’s daily needs. This is because there are no supermarkets or shopping areas in either of the two districts. The fact that this area—which is primarily residential—lacks the infrastructure to meet its service needs has resulted in this cell receiving a low score. Considering that slope was disregarded in the digital calculations, it is likely that Cell 5’s current score of 30 is actually even lower based on field data. Therefore, in the planning processes to be carried out to integrate this cell into the 15-minute city paradigm, the dynamics of Istanbul’s macro-form must be considered. Designing an optimized H3 hexagonal cell that prevents the bridge from acting as a spatial barrier (dividing element) or defining a holistic perimeter using an alternative grid system, would be a more rational approach that enhances methodological accuracy.

IV. DISCUSSION AND CONCLUSION

The study titled “15-minute city score toolkit – Urban Walkability Analytics [24],” conducted by Fondazione Transform Transport ETS, uses quantitative methods to assess cities’ alignment with the “15-minute city” concept and performs a digital calculation. The methodological approach used in this calculation identifies eight distinct categories related to meeting people’s daily needs: neighborhood services, healthcare, neighborhood shops, education, sports, cultural entertainment, open leisure, and mobility. However, it is important to note that all subcategories within each of these categories represent services that people need in their daily lives. For example, the “education” category includes subcategories such as daycare centers, elementary schools, middle schools, and universities. In the calculation, the presence of any of these within a given area indicates that the cell is close to educational services. However, just as the presence of a daycare center does not meet the need for an elementary school, the presence of a pharmacy does not meet the need for a health clinic. Therefore, from a methodological standpoint, organizing service categories into broad headings does not serve the purpose of meeting daily needs within the “15-minute city” concept [31]. In this case, the digital measurements to be conducted will represent a quantitative expression of the number of service categories in the area.

Although the global scale “15-minute city score toolkit,” which utilizes Open Street Map data, provides a macro-scale standard by being applied in different cities, since the topography of each city is different, taking contour lines into account in the calculations will help produce more realistic results. Indeed, in the case of Beşiktaş, the morphological barrier effect created by the suspension bridge axis—which forms the city’s main transportation backbone and connects the two shores separated by the Bosphorus Strait—poses a risk that digital calculations within the relevant H3 cell may produce misleading results if topography and elevation relationships are not taken into account. Therefore, ensuring that the grid system defined by the digital calculations has a flexible structure shaped according to the city's macroform is crucial for integrating the area into the "15-minute city" concept. Furthermore, since performing calculations using a single data source would prevent the inclusion of different paradigms—such as slope—in the calculations, it is necessary to diversify and cross-reference the data sources used and to verify the data.

The slope parameter also affects "accessibility by foot or bicycle," which is a fundamental component of the 15-minute city concept. For this reason, it is critically important that each primary and secondary road in the area have a percentage gradient suitable for vulnerable groups. On the other hand, a different approach, as stated by Mouratidis, is that people generally access local destinations—such as stores, public transit stops, parks, and elementary schools—on foot. Because walking is considered more inclusive—as it can be undertaken by a larger portion of the population compared to cycling—it is deemed more suitable as the foundation of the "15-minute city" approach [29]. On the other hand, equipping the urban fabric with the infrastructure needed to support bicycle use and, at the same time, conducting public awareness campaigns through infographics, billboards and short videos on mass media platforms (social media, television, radio, etc.) are of great importance in terms of the contribution of bicycle use to sustainability. This holistic approach will not only support individuals' established walking habits but also ensure that bicycles play a significant role in urban accessibility scenarios.

When assessing an area's suitability for the "15-minute city" concept, it is necessary to utilize demographic data on the area's residents in addition to physical environmental conditions. This approach is of critical importance for enhancing user experience and spatial equity. Indeed, an analysis of demographic data for the Beşiktaş district reveals that the proportion of the population aged 65 and older is significantly higher compared to other age groups, making it imperative to take into account the specific needs of this demographic in urban mobility calculations. However, the fact that macro-scale digital calculation models treat all segments of society through a single standardized pedestrian profile—in accordance with the principles of inclusivity and ubiquity—can lead to such local demographic vulnerabilities being overlooked. In the 15-minute city score toolkit's digital calculation, the average walking speed was determined to be 4.50 km/h. However, research on walking speed indicates that among different age groups, the lowest walking speed—3.39 km/h—is observed in women aged 80–99, and it has been established that the distance covered in 15 minutes at this speed is 850 meters [31, 32]. Therefore, when determining the urban walking speed parameter, approaches such as establishing a more inclusive speed range that reflects the mobility capabilities of different vulnerable groups—rather than relying on standard and uniform assumptions—and developing alternative scenarios that take climate and weather conditions into account will ensure more realistic and empirical results in planning studies. Thus, this situation will directly contribute to ensuring social justice and spatial equity in access to urban services.

Considering all these assessments, the cells examined in the Beşiktaş district have shown that an area that received the highest score on digital platforms as being most suitable for the "15-minute city" concept may actually perform less well in field analyses. Although field findings indicate that the actual value of this theoretically high-scoring cell is lower, parameters such as the diversity of functions provided by digital calculations and the integration of walking routes into street network analysis also highlight, from a certain perspective, that cell's potential suitability for the "15-minute city" concept. Therefore, directly classifying a cell that receives a high score from digital calculations as "perfectly suitable" does not align with field realities. However, completely disregarding this high score would also be a flawed approach. Similarly, the cell with the lowest score in digital calculation analyses should not be completely disregarded by stating that "no connection can be established with the 15-minute city concept." Instead, a much more realistic and constructive approach would be to thoroughly examine—using field data—the topographic and morphological constraints, spatial barriers, and infrastructure deficiencies that cause the low score; this would help identify the areas that need development and uncover the hidden potential of the site.

The critical framework provided by this study serves as an important methodological foundation for future research on urban accessibility and the "15-minute city" concept, prioritizing the integrated consideration of digital assessments and on-site realities. In this regard, to evaluate accessibility—specifically the ability to meet people's daily needs—more realistically and accurately at the scale of the "15-minute city" concept (within the boundaries of a neighborhood), future studies should: designing a new grid network (gridal system) shaped by the macroform dynamics of cities and examining the impact of different spatial tessellation approaches on accessibility outcomes are among the priority research topics. Furthermore, incorporating data on user experiences—which cannot be calculated via digital platforms—into the research process by uncovering them through field observations and in-depth qualitative interviews will strengthen the methodology. Additionally, integrating parameters identified through field studies—such as slope, walking speeds specific to user groups, physical infrastructure and amenities designed for groups at a disadvantage due to age or other reasons, needs arising from seasonal variations, and variables in day-and-night usage—parameters that can be determined through field studies—into digital accessibility models can offer significant methodological advancements in reducing the discrepancy between field observations and digital data, thereby enabling context-sensitive urban planning practices. Regarding the technical aspects of the computational process, ensuring that variables obtained from various digital platforms are included in the analysis without omission, and incorporating data from these diverse platforms into the research after comparing and verifying them, will enable more precise and accurate spatial analyses and, in turn, strengthen the reliability of the research findings. It is anticipated that the integration of these empirical and data-driven findings—along with the development and testing of a new computation-based algorithm—will ultimately lead to the generation of region-specific, concrete planning and design recommendations aimed at enhancing urban accessibility, thereby making cities more compatible with the "15-minute city" concept.

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