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Influences of the Accessibility and Availability of Green Spaces on the Liveability of Residential Complexes in Erbil City

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Abstract Liveability refers to the quality of the urban environment in consideration of dwellers' needs and expectations to increase the attractiveness of the urban environment and promote the overall quality of life. In the last couple of decades, the concept of liveability has been debated in urban studies. The Kurdistan-Iraq Region has witnessed the rise of new issues in terms of rapid urbanization and development. This study aims to assess the influences of the accessibility and availability of green spaces on a neighborhood's liveability by combining a spatial analysis checklist and a questionnaire survey amongst residents to create an interrelated tool for comprehensively and reliably measuring liveability level. Consequently, ANOVA is used to explore the differences amongst respondents' satisfaction with the characteristics of public open spaces that affect the liveability of the neighborhood. Moreover, a paired sample t-test is conducted to test the correspondence of measurement tools. Spatial analysis results indicate that inequalities exist between the cases in terms of the studied variables as they are present on the ground. This study also shows significant differences amongst respondents' satisfaction with the two characteristics that affect the liveability of the neighborhood in the selected cases. Lastly, insignificant differences are found between objective and subjective evaluations, indicating a correspondence between the spatial analysis results of the accessibility and availability of green spaces and the satisfaction of residents.

Keywords: *Liveability, Accessibility, green spaces, residents' satisfaction*

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1. Introduction

Liveability is currently a major issue worldwide. It is considered a key characteristic of cities that enable them to attract globally mobile resources. The concept of liveability generally involves three aspects: environmental quality, neighbourhood amenity and individual well-being. Moreover, this concept combines many disciplines and professional specialisations; it involves different aspects of urban life, such as how well cities work and fulfil residents' needs and expectations and how enjoyable and comfortable cities are [1]. The term liveability has progressively widened to include a range of different issues that are underpinned by a common set of guiding principles, including accessibility, equity, safety, comfort, available services, walkability, transit and participation, which provide substance to the concept of liveability [2]. Due to the increasing concentration in urban centres liveability is considered a measurable component of urban quality of life concepts in urban space [3].

The key concept of liveability is to offer an acceptable quality of life to the residents of a particular place; this concept is related to the state of the living environment [4]. Various interpretations of liveability can be adopted in accordance with different times and places; however, all definitions appear to share terms, such as 'quality of life', 'well-being' and 'life satisfaction' [5]. Moreover, the liveability and quality of a place are interrelated concepts that reflect people's perspective on their living environment; thus, the domains of human liveability and environmental quality of life comprise a set of human-environment characteristics to achieve person-environment fit [6].

1.1. Definition of Terms

Different ideas and terms related to quality of life and/or human well-being have been used to define liveability; however, formulating a precise and comprehensive definition for this notion remains difficult. 'Liveable' is the favored spelling for UK English, whilst 'Livable' is used in US English. The latter is gaining popularity worldwide. In the US, liveability represents 'quality of life' and 'well-being'. In the UK, a more precise meaning is provided to liveability, one that is connected to safety, cleanliness and the presence of plants

in local surroundings. In fact, these definitions share terms, such as quality of life, well-being, life satisfaction and happiness; thus, liveability not only describes a place and its living conditions, but also imitates and represents the perception of people about this place and whether it is suitable for living [2]. Reference [7] connected liveability to overall "quality of life and well-being'. They defined it as a 'place-based concept that generally refers to those elements of a home, neighborhood or city that contribute to quality of life and well-being'. City Plus Index enlarges the scope of definition to the urban scale by defining liveability as an urban system with delightful and desirable urban spaces that contributes to mental, physical and social well-being and personal development [8]. With the current growth and development of cities causing the deterioration of quality of life, liveability has been defined as an attempt to create a safe and healthy environment for human societies [9]. From the aforementioned definitions of liveability, many academics seem to perceive liveability as a subjective concept related to the combination between environmental and personal characteristics that reflects the overall quality of a place where people live. Thus, the term has broadened to include a range of different issues, such as safety, availability of services, accessibility, comfort, transit, walkability and participation, which give value to the concept of liveability.

1.2. Concept of Liveability

Studies on liveability have emerged from diverse fields and have been conducted in accordance with various perspectives from different time contexts as the pursuit to organize life and attain the best standard in life has preoccupied man for ages and civilizations. In the First Babylonian Empire nearly 4000 years ago (1792-1750 BC), the Babylonian king, Hammurabi, issued one of the first sets of laws considered amongst the oldest translatable writing; it was known as 'Hammurabi's Code'. Hammurabi's overwhelming vision of justice and prosperity entailed a measure of economic and social justice [10]. In the 4th century BCE, Aristotle described the state of welfare and prosperity in the city states of his time. From Aristotle's point of view, a good life is a 'virtuous life' and only by living virtuously can we achieve 'eudaimonia', which can be roughly translated into 'happiness', 'human flourishing' or an 'excellent life' [11]. Between the 3rd century BCE and the 2nd century CE, the attention of Stoicism's philosophical school focused on the good life from the point of view of individuals. The British urban planner Sir Ebenezer Howard presented his idea on how to make cities 'healthier' with easy access to nature in his book entitled 'Garden Cities of To-morrow' (1898), Howard explained his vision of designing and planning cities that offer peaceful and liveable environments replete with nature and open spaces [12]. After the Second World War, the quality of life deteriorated; therefore, initiatives, such as the Vancouver Liveability Plan and Habitat I, were taken to make cities more liveable for the population [13]. Between 1960 and 1990, architects, urban planners and authors used 'liveability' in an implicit form as they advocated for the adoption of its principles. In 1961, American-Canadian journalist Jane Jacobs expressed concern about people who are moving between buildings and their interaction in her book entitled 'The Death and Life of Great American Cities' [14]. In 1971, Danish urban planner Jahn Gehl published his book 'Life between Buildings', where he focused on public life in public spaces by developing theories about the influences of architecture and city planning on public life based on observations of life in public space, leading to the assessment and measurement of usage patterns and quality of life [15]. British humanist and urban planner Donald Appleyard published his text 'Liveable Streets' in 1981, wherein he called for the creation of liveable neighborhoods and cities through light traffic situations to enhance social interactions. He also linked the concept of liveability to the physical characteristics of a city for the human purpose as a fulfilling and joyful place to live in [16]. In the 1990s, urban governments and housing corporations increasingly used the term 'liveability' to attract and influence the social composition of urban neighborhoods [17]. Finally, in concurrence with the new millennium, the notion of liveability gained popularity because of the growing prevalence of annual surveys that rank the world's most liveable cities, such as the Mercer Worldwide Quality of Living Survey and the World's Most Liveable Cities [18]. The development of the liveability concept across different historical periods shows various aspects included in this idea, such as physical, functional, environmental, sociocultural, economic and political aspects.

1.3. Liveability Dimensions

The literature on 'liveability' indicates different dimensions to be considered to capture the concept according to different background discipline [19]. In general, the dimensions of liveability vary or are related to different aspects of life; moreover, location, situation and culture will determine these dimensions [20,21]. The reference [22] stated that liveability, in a broad sense, embraces cognitive notions, such as quality of life, character of a place and health of a community. Accordingly, three key dimensions of liveability are adopted, namely, the economic, social well-being and environmental dimensions. These dimensions constitute the so-called 'golden triad' and have shared goals, including economic efficiency, social justice and environmental protection. They are viewed as equally important and capable of being balanced, as shown in Figure 1.

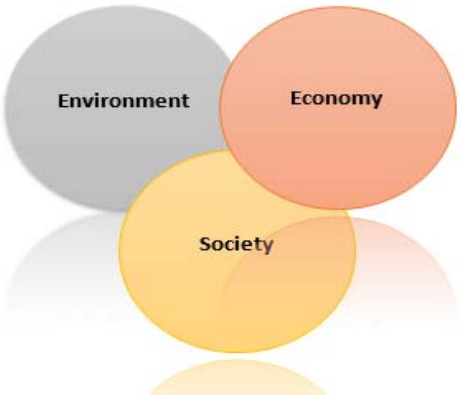

Figure 1. Golden triad of liveability [22]

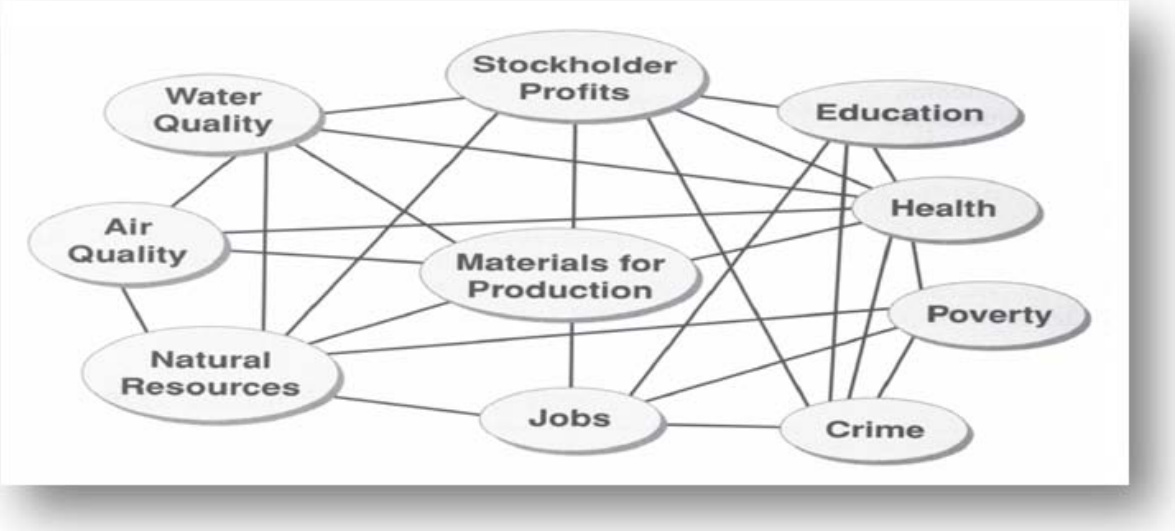

Figure 2. Web-like nature of relations amongst the dimensions of liveability [22]

The three dimensions are considered the most common approach to liveability. Each dimension has its own indicators that emphasise the interconnectedness of people and place as shown in Figure 2. The environmental dimension is related to natural resources and air and water quality. The economic dimension is related to materials, jobs and stockholder profits. Lastly, the social dimension is indicated by education, health, poverty and crime.

A range of liveability dimensions has been set by researchers based on their own views and experiences derived from the location and conditions of a study. Table 1 summarizes various liveability dimensions.

Table 1. Liveability dimensions based on different references

References	
[23]	The four pillars of liveability are identified as follows: direct investment in talent, access to work, safe environment and good governance.
[24]	Kevin Lynch emphasised the five elements of liveability, namely, vitality, sense, fit, access and control.
[19]	Liveability has four dimensions: (1) dwelling/building quality; (2) physical environment quality, including the level of services and facilities; (3) social environment quality and resident characteristics and (4) neighbourhood safety.
[25]	Liveable urban environment dimensions are classified into two groups: tangible features (related to the availability of public infrastructure) and intangible features (e.g. sense of place, local identity and social networks).

1.4. Urban Liveability

As stated by Reference [26], urban liveability focuses on several issues related to aesthetics and the physical characteristics of buildings, streets and development blocks. These features constitute a widely used approach in architectural and urban design settings.

1.4.1. Liveable City

A liveable city can be defined as a city with common and public spaces that form a centre of social life, and therefore, can be built up as a continuous network connecting the centre to more distant settlements; moreover, each pedestrian and bicycle path has its own route in all sites of community life [27]. Moreover, Reference [28] introduced a unique definition for a liveable city i.e. ‘a city means many things to many people’. Indexes have been created in accordance with various liveability indicators to measure and interpret the liveability of a place at a global scale. For example, the Happy Planet Index depends primarily on ecological footprints, whilst the Human Development Index uses health, education, living standards and general demographic and economic features as indicators. The Anholt City Brand Index uses the six ‘Ps’ (presence, place, potential, pulse, people and prerequisites). The Global Liveability Rankings, also known as the Economist Intelligence Units (EIU), consist of five weighted categories: stability, healthcare, culture and environment, education and infrastructure [29,30]. In summary, liveability is a characteristic of cities that enables them to attract various amounts of globally mobile resources that positively contribute to the overall quality of life.

1.4.2. Liveable Community/Neighborhood

A liveable community is safe and secure, it has appropriate and affordable housing, offers many potions of transportation, with encouraging community design and services where residents are want to stay in place [31]. Moreover, the American Institute of Architects [32] designed and introduced Liveability 101 as a reference to help public officials by offering 10 fundamental planning and design principles that must be considered as communities evolve over time. In the Australian context, the Victorian Liveability Research Program of the University of Melbourne provided a report to policy advisors, decision makers and urban planning organizations to apply policy-relevant spatial measures of urban liveability (at the city or neighborhood scale) across Victoria State to examine the association between urban liveability and people’s well-being [33]. Figure 3 summarizes the major domains of a liveable community/neighborhood in accordance with AARP, AIA and the Victorian Liveability Research Program.

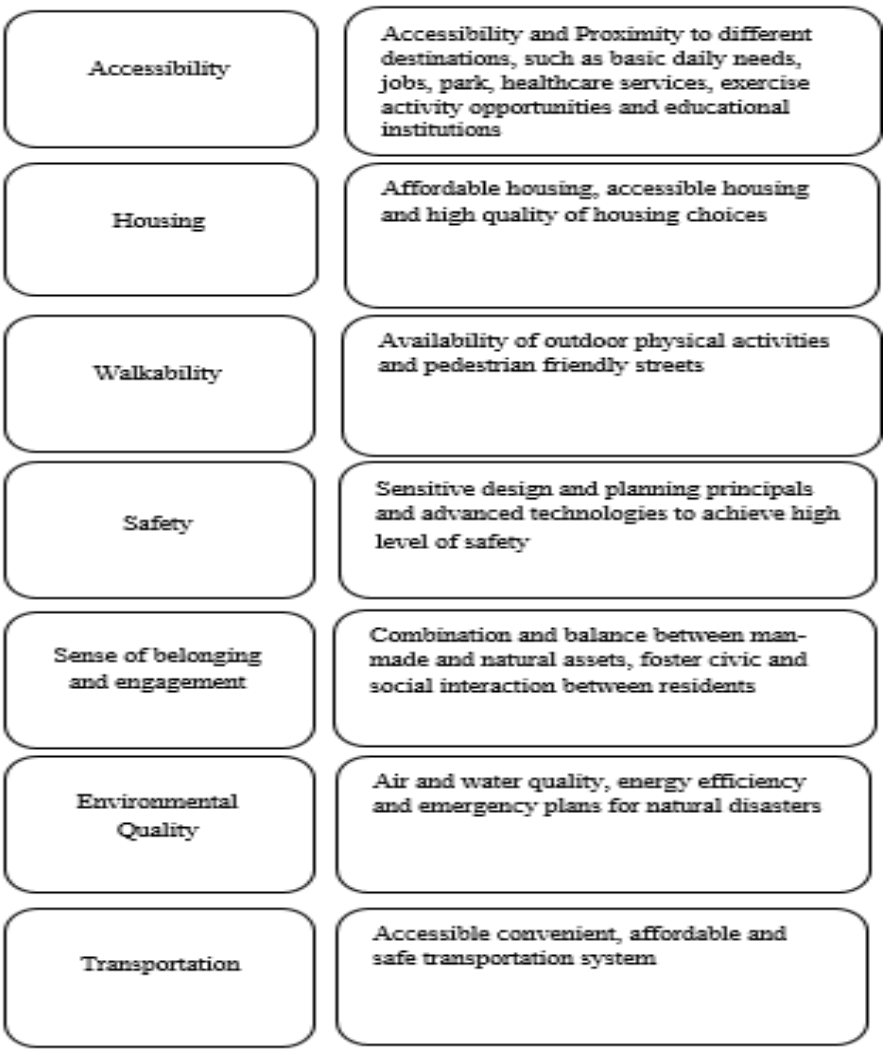

Figure 3. Summary of the major domains of a liveable community/neighbourhood adopted from [31,32,33]

1.4.3. Liveable Public Space

To date, no general overview or global index or standard specifies liveability dimensions in public spaces, although many approaches and theories are available in the existing literature; thus, a general overview is missing [34]. Sociologist William H. Reference [35] referred to design effectiveness and the use of public plazas, playgrounds and parks. A number of indicators were adopted for a successful public space, such as physical and social comfortableness, availability of natural elements and lastly, visual accessibility. The American Planning Association specified four key attributes for creating successful public spaces (Figure 4). The first indicator is related to the availability of safe and clean green spaces. The second indicator represents the physical accessibility of a place to city dwellers. The third indicator involves uses and activities and relates to the availability of basic building blocks, such as markets, shops and stores. The last indicator is sociability, and it is an important determinant of a liveable urban environment. When a public space fosters different types of social activities, such as meeting and greeting friends and neighbors, a strong sense of place or attachment between urban dwellers and the community will be perceived (Project for Public Spaces [36].

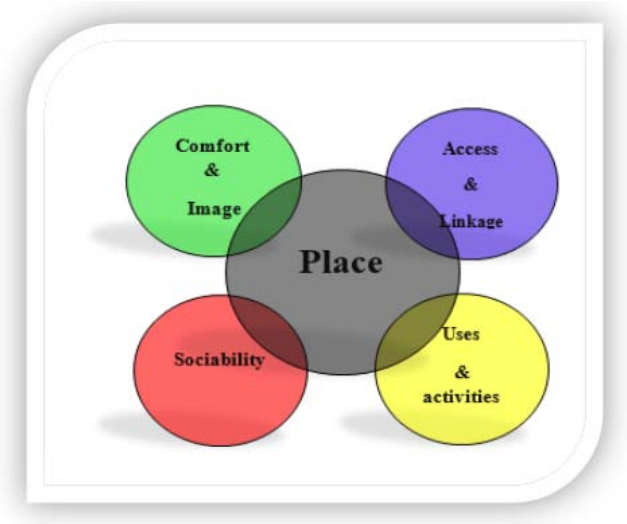

Figure 4. Place diagram adopted from [36]

2. Literature Review

Many studies have been conducted on urbanized areas in an attempt to address the notion of liveability and examine the extent to which it promotes overall quality of

life by providing sustainable and healthy living patterns. Such patterns are made available by increasing the environmental ability to protect people in the long term. Each study used a different research approach and method to assess urban areas based on their liveability. These studies can be reviewed and discussed in accordance with their adopted visions, approaches and methods. Our literature review is divided into three parts. The first part looks at studies about liveability at the city scale. The second part considers liveability at the neighborhood scale. The third part reviews studies on liveability at the public space scale. Amongst these studies, Reference [37] aimed to create a model for a liveable city index (LCI) as a reliable tool for liveability research in semi-urban cities because existing indexes are only based on economic factors. The study concluded that other important factors such as environment and safety, can be used to determine the liveability of a city. Within the same spatial context, [29] aimed to identify specific context categories of liveability in Malmo City in Sweden through 10 semi-structured interviews with local experts in the field of urban development and planning. The authors of this study expanded the content of accessibility into a macro spatial scale by identifying the external relationship category as one of the influential aspects of liveability because it reflects regional integration and transport connectivity with neighboring countries. In contrast with the previous spatial context to the neighborhood scale, reference [28] argued that the provision of green and open spaces is a key urban challenge in facing widespread development pressure. They suggested that the presence of aesthetically pleasing and well-maintained public spaces and the provision of high-quality green open spaces are important predictors of high levels of neighborhood satisfaction. Reference [38] found that the most significant dimension that measures liveability level supports the safety dimension. Moreover, neighborhood's facilities (e.g. children's educational centers, healthcare, shopping and open/green spaces) are essential in measuring a place's liveability. At the same spatial level, sustainable liveable housing attributes were investigated by [39]. Found that ease of mobility (for vehicular and non-vehicular categories) exerts a significant and serious impact on achieving a liveable sustainable housing because it enables residents to meet their daily needs within the shortest possible distance. Reference [40] concluded that distance to the central business district is one of the powerful predictors of a neighborhood's turnover, along with other indicators, such as road proximity based on the presence of a major arterial road within a 150 m buffer from the edge of a neighborhood. Reference [41] indicated that the construction and development of new urban neighborhoods in developing countries must adopt policies, such as providing neighborhoods with good infrastructure and community facilities, and must consider residents' assessment of their condition. By contrast, Reference [42] showed that desirable amenities for native-born residents included recreational and appealing aspects, such as proximity to water bodies, open spaces and community recreational facilities. By contrast, foreign-born residents preferred functional aspects, such as proximity to highways, business centers and multi-family housing units. These findings reflected the effects of sociocultural and demographic factors on perceived desirable neighborhood's amenities. Reference [43] found that safety is the most important dimension, and proper street maintenance is the most significant indicator of physical dimensions. For the functional dimension, the provision of quality healthcare and educational institutions is an essential component of a community's infrastructure. For the public space level of liveability in an urbanized area, [44] determined that vegetation density considerably influences the activity in Puputan Square as proven by users' perception. In the same spatial context, reference [45] found that operational accessibility is the most significant factor that affects the liveability of public spaces. Table 2 shows the liveability dimension and its indicators in accordance with each spatial scale (as found in the literature).

Table 2. Liveability dimension and its indicators in accordance with each spatial scale

Liveability Dimensions	Indicators	Scale
Environmental Quality & Well-being Factors	-Visual Character and aesthetic value	City neighborhood, public space
Physical and Functional	-Human Scale -Cleanliness - Air Quality - Water pollution -Sound pollution -Climate calmness (safety against natural disasters climate conditions	City neighborhood, public space
Social Dimension	-Safety from crime -Social Justice -Education -Health -Religious and cultural Facilities -Community integration, Trusted and tolerance -Sense of Belonging -Self expression -gender -vitality and Social interaction	City neighborhood, public space
Economical Dimension	-Monthly Income and/or financial situation -Daily Transport Cost -Job Creation and Opportunity	City, neighborhood
Housing Dimension	-Sufficient and Various Housing Choices -Affordable Housing -Physical, functional and Environmental Quality of Housing Units -Accessibility to Residential areas -Sense of privacy in the dwelling unit	City, neighborhood
Political Dimension	-Leadership and government system -Political Stability and Governance -Policy making and Implementation	City
External Relationship Dimension	-Airport Function and International Flights -International Conferences	City

2.1. Research Problem

On the basis of the previously mentioned literature, liveability was studied at three spatial levels: the city, neighborhood and public space levels. Previous studies approached separate aspects of livability separately, with each focusing on a specific level: the city, neighborhood, or open space. No study dealt with the topic while including indicators related to the three levels together. The majority of studies have been conducted abroad. Reference [46] stated that 'more research is required to see how liveability issues are experienced and assessed in urban neighborhoods in developing countries'. Therefore, the liveability issue in Erbil City, in general, is questionable. Accordingly, there is the lack of investigations in our locality on the impact of accessibility and availability of green spaces, on liveability. So the research problem is: there is no evidence if the local's satisfaction about the livability of their residential complexes matches the livability as measured objectively when the assessment includes many levels indicators.

2.2. Research Objectives

1. To objectively measure the studied liveability indicators through the spatial analysis of the selected residential complexes
2. To compare the satisfaction degrees of residents with the studied liveability indicators using a questionnaire survey in the studied residential complexes
3. To determine if a match exists between the objective spatial analysis results and the subjective questionnaire survey measurement of liveability

2.3. Research Questions

1. Do differences exist in the actual presence of the studied liveability indicators as measured using the checklist in the local studied residential complexes?

2. Do differences exist in the degree of satisfaction of the residents with the studied liveability indicators amongst the selected residential complexes?

3. Do the spatial analysis (checklist) results match with the results of the questionnaire survey about measuring liveability indicators?

2.4. Research Hypothesis

1. In general, differences exist in the actual presence of the studied liveability indicators as measured using the checklist in the studied residential complexes.

1.1 The accessibility indicators of the studied residential complexes vary.

1.2 The public green space indicators of the studied residential complexes vary.

2. Residents' satisfaction with the liveability indicators of the studied residential complexes varies.

2.1 Residents' satisfaction with the accessibility indicators of the studied residential complexes varies.

2.2 Residents' satisfaction with the public green space indicators of the studied residential complexes varies.

3. A correspondence exists between the results of the objective checklist (spatial analysis) and the subjective tool (questionnaire survey).

3. Research Methodology

To enhance the precision of the results, a mixed methodology approach that combines objective and subjective evaluations was used. The first one relates to an objective assessment as a preferred research strategy for testing and evaluating spatial justice concerned with the question of 'who gets what, where and how'. Most geographical inquiries on liveability have been based on objective measures of environmental quality [47]. For the current study, the objective evaluation presents a methodology of using a spatial analysis checklist and the scoring value ranges from 1 to 5, denoting ranges from 'highly inefficient' (1), 'inefficient' (2), 'neutral' (3), 'efficient' (4) and 'highly efficient' (5). With the support of AutoCAD software and ArcGIS and direct visual scanning and field survey for the studied areas, the required data were calculated and the final scoring values of the studied indicators (accessibility and availability of green spaces) were determined as follows.

For accessibility, the following indicators were used to calculate the final scoring value. A1: Accessibility to primary school (within 500 m walking distance). A2: Accessibility to local market (within 500 m walking distance). A3: Accessibility to health facilities (within 800 m walking distance). A4: Sidewalk condition and quality. A5: Accessibility to the main arterial road (within 150 m). For the first four indicators, Reference [48] is based on the identified catchment zones within easy walking distance. The final scoring value was based on dividing the catchment zone's area by the total plot area of a residential complex multiplied by five. With regard to the fifth indicator (accessibility to the main arterial road), the distance was adopted from a previously mentioned reference [40]. When the aforementioned distance is doubled, the rating will decrease by 1°.

For availability of green spaces, the following indicators were used to calculate the final scoring value. **B6**: Equitable access for all the residents. **B7**: Percentage of coverage. **B8**: Quality and facilities.

The percentage of coverage of the green spaces was adopted from the recommendations of the United Nations Human Settlements Program [49]. The second evaluation approach was based on using a questionnaire survey. The studied indicators were rated using a Likert scale ranging from 1 to 5, denoting ranges from 'highly dissatisfied' (1), 'dissatisfied' (2), 'neutral' (3), 'satisfied' (4) and 'highly satisfied' (5). Subjective evaluation was derived from the survey of residents' perception, satisfaction and evaluation with urban living because this tool provides more valuable feedback and higher validity than objective indicators. The questionnaire form was prepared by the researchers and revised following consultations with experts in the urban planning field. A total of 50 forms were distributed in each selected area, and 250 households were interviewed.

4. Sample Selection

Investment housing projects were selected in this study because they represent the largest percentage of newly implemented residential projects. Amongst the 175

housing projects implemented in all the provinces of the Kurdistan Region, 86 are distributed in different locations of Erbil City. The 5 selected residential complexes located in different zones in the city are as follows. As shown in Figure 5.

1. Dream City is located in the city centre: An investment complex for single family housing situated on a 100 m street in the northwest of Erbil. It is 2.8 km away from the city centre, and it has 1200 dwelling units, commercial facilities, restaurants, a primary school and health facilities.

2. Italian 2 City located on Masif/Salahaddin Road: A residential complex project for single family housing units located 6.5 km from the city centre. The average number of dwelling units is 1561 units. The project includes an administrative centre, parking area, local market, primary school, health centre and mosque.

3. New Azadi Project located on Bahrka Road: One of the investment single family housing projects located on Bahrka Road in the north of Erbil City with a 6.2 km distance from city centre. Ithas 612 dwelling units. The project includes facilities, such as a local market and an administrative centre.

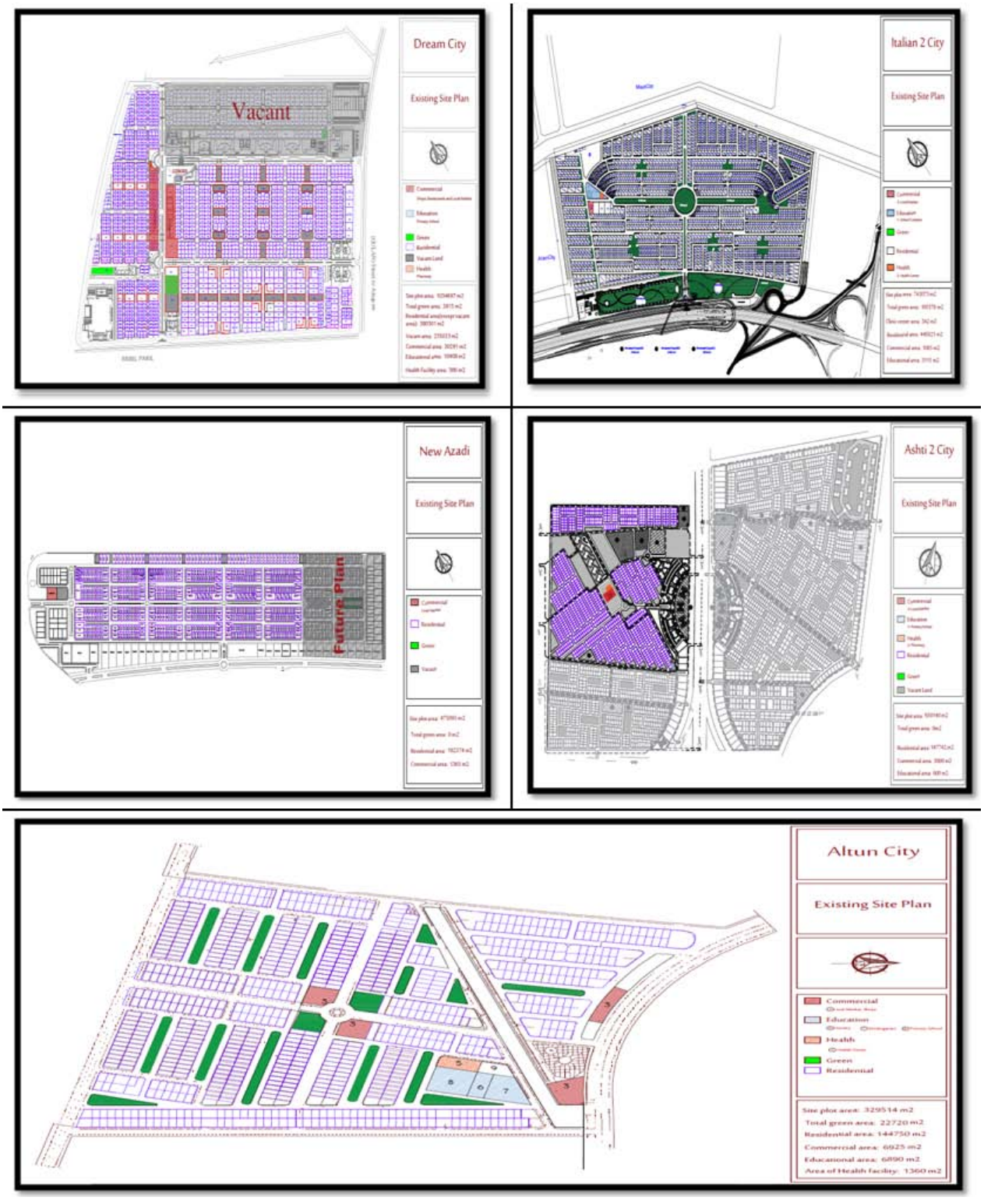

Figure 5. The Selected Residential Complexes

4. Ashti 2 City located on Koya Road: An investment complex of single family dwelling units located far from the city centre, i.e. 11.32 km. It measures approximately 65.01 hectares, with 1100 dwelling units. The project includes a commercial area, primary school and health facility.

5. Altun City located on Kirkuk and Bansllawa Roads: A residential complex project with 750 single family housing units. It is located in the southeast of Erbil City with a distance of 8.5 km distance from the city centre. It includes a commercial area, school, mosque, police station, kindergarten, nursery, service zone, green areas and health facilities.

5. Results and Discussion

5.1. Results and Discussion of the Objective Evaluation

The scoring values of the tested indicators (accessibility and availability of green spaces) are provided in Table 3.

5.1.1. Analysis and Discussion of Accessibility Indicators

To analyse the accessibility of each neighbourhood, the researchers identified the average mean score for the related sub-indicators (A1 to A5) to indicate the final scoring value that represents this indicator for each neighbourhood, as shown in Figure 6.

A neighbourhood with a higher scoring mean value is more accessible and supposed to be a more walkable neighbourhood. Moreover, the nearest to the main arterial road is the nearest to city centre, average scoring values of all the selected neighbourhoods were as follows: Altun City, 3.4; Dream City, 3.2; Italian 2 City 2, 3.6; Ashti 2, 3.2 and New Azadi.

The result confirmed that the highest average scoring value was recorded for Italian 2 City, although the project's basic facilities are not completely covered by the recommended walking distance. The sidewalk conditions and its accessibility to the main arterial road raised its scoring value, and this outcome indicates that the city is more comfortable for walking and easily connected to the city centre. As expected, New Azadi exhibits the minimum scoring value for accessibility because it does not have the majority of basic facilities (primary school and health facilities) and the existing local market covers 25.7% of the total plot with the recommended walking distance.

5.1.2. Analysis and Discussion on Availability of Green Spaces Indicators

The coverage percentage of green spaces for each neighbourhood was identified using the official maps converted to AutoCAD. Then, their accessibility, quality and facilities were evaluated through a field survey and visual scanning. The average scoring values for these indicators were calculated for each sample, as shown in Figure 7.

Table 3. Checklist's Results of the Studied Areas

Factors / Neighbourhoods	Accessibility									Availability of Green Spaces						
	A1	A2	A3	A4			Average value	A5	Total average	B6	B7	B8			Average value	Total average
				A4.1	A4.2	A4.3						B8.1	B8.2	B8.3		
Altun City	4	5	5	3	2	2	2	1	3. 4	4	2	2	1	2	2	2.6
Dream City	3	2	4	3	1	1	2	5	3.2	1	1	1	1	1	1	1
Italian 2 City	3	2	4	5	3	4	4	5	3.6	3	4	4	4	4	4	3.6
Ashty 2	2	5	5	4	2	3	3	1	3.2	1	1	1	1	1	1	1
New Azadi	1	1	1	4	1	4	3	4	2	1	1	1	1	1	1	1
Total average scoring value of each indicator in all five studied cases	Accessibility								3.080	Availability of Green Spaces						1.84

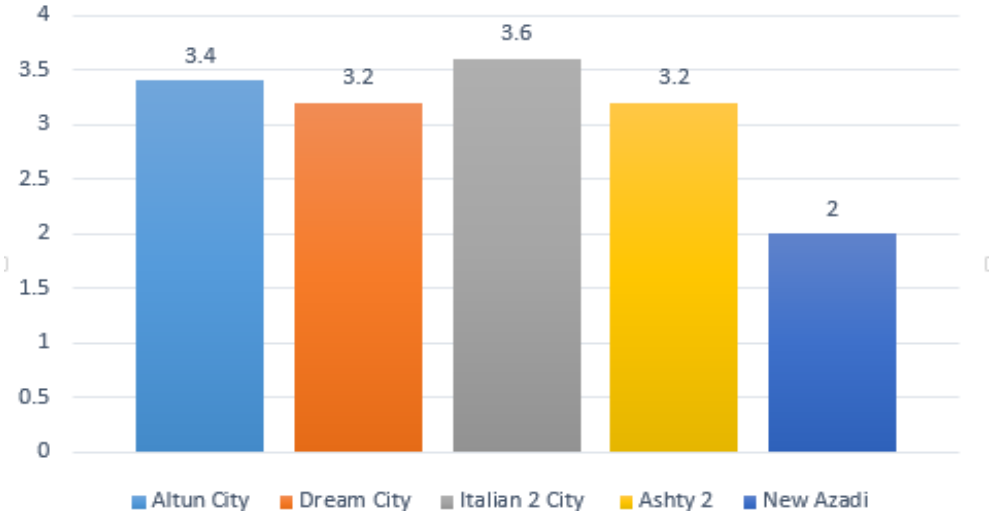

Figure 6. Average scoring values of accessibility indicators for each studied area

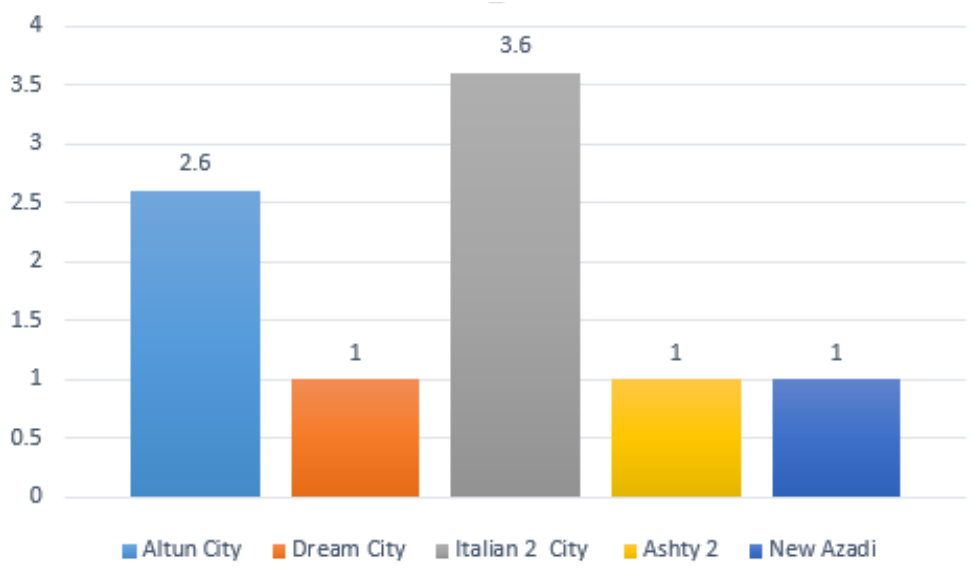

Figure 7. Average scoring values of the availability of green space indicators for each studied area

The maximum scoring value was recorded for Italian 2 city with a scoring value of 3.6, indicating that it encourages social life and physical activities and promotes health by providing a liveable and attractive environment. The percentage of coverage is 14% of the total plot area of the site, and the green area is equipped with facilities for playing, exercising and sitting. Altun City recorded a 2.6 value, the coverage percentage was 7% and public green spaces were allocated equally in all parts of this project. However, the lack of facilities and vegetation turned them into neglected spaces and failed to attract the residents to visit them or practice any social or sports activity. Three of the selected study areas (Dream City, Ashti 2 and New Azadi) recorded the minimum scoring value of 1 (highly inefficient). In accordance with Dream City's proposed plan, public green spaces were specified and equally distributed in all the parts of the project (covering 2% of the total plot area of the site). However, they were acquired by the residents and converted to private gardens or parking space. In Ashti 2, the percentage of planned green spaces (in the proposed plan) was 5.4%, but the survey of the actual plan situation showed that all public green spaces were neglected due to the lack of required facilities and equipment. For the New Azadi project, the percentage of the proposed plan does not exceed 0.3% but is not actually implemented. Therefore, these projects are inefficient in terms of social life, health promotion and providing a pleasant and attractive environment.

A fluctuation of the scoring value was noted for this indicator among the selected study areas. The maximum scoring value does not exceed 3.6, as scored for Italian 2 City on Massif Road, followed by Altun City on Kirkuk and Bansllawa Roads, which scored 2.6. The remaining selected study areas (Dream City, Ashti 2 and New Azadi), i.e. the majority of the areas reflect a severe shortage of public green spaces in terms of coverage percentage, facilities and quality, negatively affecting the quality of life, health and social ties of the residents.

Accordingly, the first research question about the differences in the actual presence of the studied liveability indicators in the selected residential complexes is answered. In terms of accessibility, Italian 2 City recorded the maximum scoring value of 3.6, whereas New Azadi recorded the minimum scoring value of 2. With regard to the availability of green space indicators, Italian 2 City achieved the maximum scoring value of 3.6, and the minimum scoring value of 1 was recorded for three projects: Dream City, Ashti 2 and the New Azadi complexes.

5.2. Results and Discussion on the Subjective Evaluation

5.2.1. Analysis and Discussion of the Degree of residents' satisfaction with the accessibility indicator

The results of the questionnaire survey indicated a similarity between the planning of Altun City and Italy 2 City in terms of the accessibility parameter. Both cities have the highest level of accessibility according to the availability and central location of basic daily needs with a slight difference in the satisfaction of respondents with the sidewalk condition. A lower degree of satisfaction with accessibility was recorded for New Azadi because of the lower degree of respondents' satisfaction with providing basic daily needs and facilities within walking distance. The ANOVA result was ($F = 47.58$, $p<0.05$). Accordingly, a statistically significant difference exists amongst respondents' satisfaction from the studied areas with the accessibility indicator. Refer to Table 4 for additional details.

5.2.2. Analysis and Discussion of the Degree of Residents' Satisfaction with Green Area Availability

The highest degree of residents' satisfaction with green spaces in the studied areas was recorded in Italian 2 City. The lowest degree of satisfaction of residents was observed in New Azadi as residents were strongly dissatisfied with the overall indicator because of the severe lack of green spaces. The ANOVA test result was ($F = 135.99$, $p<0.05$). Accordingly, statistically significant differences exist between respondents' satisfaction amongst the selected case studies with regard to the availability of green space indicator. Refer to Table 5 for additional details.

Table 4. Descriptive Analysis and One-Way ANOVA of Accessibility Indicator

Indicator	Case Study	N	Mean	Standard Deviation	Standard Error	*F*-test	p-value
Accessibility	Altun City	50	3.37	0.42	0.06	47.58	0.000*
	Dream City	50	3.03	0.47	0.07		
	Italian 2 City	50	3.16	0.55	0.08		
	Ashti 2 City	50	2.77	0.32	0.05		
	New Azadi	50	2.11	0.67	0.09		
	Total	250	2.89	0.66	0.04		
* Significant at level 0.05 (p< or =0.05), n=250							

Table 5. Descriptive analysis and one-way ANOVA test of the availability of green space indicator

Indicator	Case Study	N	Mean	Standard Deviation	Standard Error	*F*-test	p-value
Availability of green spaces	Altun City	50	2.33	0.96	0.14	135.99	0.000*
	Dream City	50	1.92	0.47	0.07		
	Italian 2 City	50	3.66	0.44	0.06		
	Ashti 2 City	50	1.96	0.38	0.05		
	New Azadi	50	1.13	0.32	0.05		
	Total	250	2.20	1.00	0.06		
* Significant at the level 0.05 (p< or=0.05), n=250							

From the aforementioned results of the degree of residents' satisfaction with the accessibility and green space indicators, the second research question about the difference in the degree of residents' satisfaction with the studied liveability indicators amongst the selected residential complexes was answered. Figure 8 presents the outcomes of the objective and subjective evaluations amongst the studied areas.

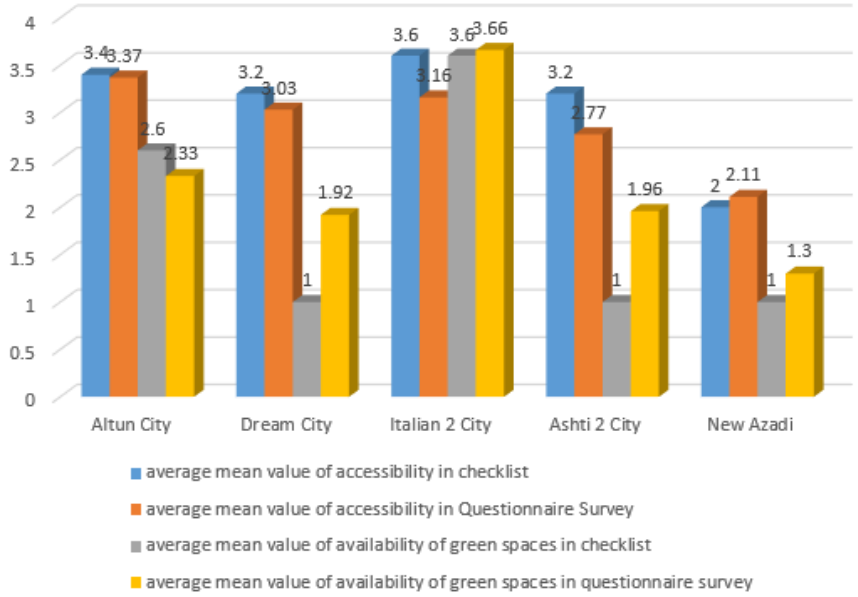

Figure 8. Objective and subjective evaluation results amongst the studied areas

Table 6. Comparison of the questionnaire and checklist results

Comparison of the Questionnaire (Q) and Checklist (CH) results		Mean	Standard Deviation	*t*-value	Significance
Pair 1	Accessibility Q	2.888	0.486	−1.767	0.152
	Accessibility CH	3.080	0.626		
Pair 2	Availability of green spaces Q	2.200	0.926	1.462	0.218
	Availability of green spaces CH	1.840	1.203		
* Significant at level (p<0.05), n=250					

5.3. Comparison of the Results of the Objective Evaluation (Checklist) and the Subjective Evaluation (Questionnaire Survey)

A paired sample *t*-test was performed to examine the third research question regarding the correspondence between the results of the checklist and the questionnaire survey. As shown in Table 6 and based on a significance level of $p<0.05$, insignificant differences occurred between the results of the checklist and the questionnaire survey in relation to the two selected liveability indicators. The *t* values for both tested pairs (Pairs 1 and 2) were more than 0.05. This result supports the accuracy and reliability of both tools and proves the validity of the third research hypothesis.

6. Conclusion

The spatial analysis results show that Italian 2 City has the maximum mean value in terms of accessibility and the presence of green spaces, whilst the minimum mean value is recorded in the New Azadi Complex for both studied indicators. This result reflects the inequalities between the five selected zones in terms of the allocation of basic daily needs within easy walking distance, connectivity with the entire city and the presence of green spaces. Accordingly, the first and second research hypotheses are proven to be valid. The ANOVA test results indicate significant differences between residents' satisfaction with the selected liveability indicators. Altun City scored the maximum degree of satisfaction for the accessibility indicator because basic daily needs are within walking distance. The New Azadi Project recorded the minimum degree of satisfaction given that the majority of basic daily needs are not covered within walking distance. Italian 2 City recorded the maximum degree of satisfaction for the presence of green spaces. Conversely, the minimum degree of satisfaction was recorded by three complexes (Dream City, Ashti 2 and the New Azadi), reflecting a severe shortage in open green spaces in the majority of the studied complexes. Meanwhile, results of the paired sample *t*-tests showed a correspondence between the objective and subjective evaluation approaches for measuring the liveability indicators. Thus, the validity of both results and the third hypothesis, which posits a correspondence between the results of the objective checklist (spatial analysis) and the subjective questionnaire survey, are supported.

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