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The Impact of Morphological Shifts in the Historical Fabric on Attachment to Place in Post-Conflict Cities: A Case Study of Old Mosul

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ABSTRACT

This research aims to analyze the impact of morphological transformations on the historical urban fabric of Old Mosul following the armed conflict and explore how these transformations affect residents' levels of place-related connection. Place-related connection is considered a crucial psycho-social indicator for understanding patterns of return, resettlement, and the reconstruction of urban identity. The study is based on the fundamental premise that reconstruction is not limited to rebuilding buildings, but also encompasses rebuilding the relationship between people and place, including collective memory, identity, and social bonds. The study employed a mixed-methods approach, including spatial analysis using geographic information systems (GIS) to compare changes in the urban fabric between 2014 and 2023. It also utilized a field survey of 120 participants to measure dimensions of place-related connection according to the Scannell and Gifford (2010) model and semi-structured interviews with a representative sample of residents and specialists. Data were analyzed using descriptive statistics, Pearson's correlation coefficient, and linear regression analysis. The results showed a high level of spatial identity and social cohesion, contrasted with a low level of spatial dependency. This reflects the population's attachment to the historical memory and symbolism of the place, despite the deterioration of its functional and service infrastructure. The results also revealed a significant negative correlation between the extent of urban damage and levels of spatial attachment ($r = -0.61$, $p < 0.01$), while urban transformation explained 37% of the variance in spatial attachment according to the regression model ($R^2 = 0.37$, $p < 0.001$). These findings confirm that the connection to place remains strong, both emotionally and socially. However, its sustainability requires the reactivation of urban spaces, the revival of traditional functions, and the improvement of infrastructure services. The originality of this study lies in its provision of an analytical framework that combines spatial and psychosocial methodologies to understand the dynamics of reconstruction in post-conflict cities. It also contributes to enriching Arabic literature in the field of urban planning and heritage by providing an applied model that can be used in other cities with similar conditions and by directing urban policies towards a human-spatial approach based on identity, memory, and social relations, and not just on physical reconstruction.

1. INTRODUCTION

Historic urban areas affected by armed conflict are among the most complex urban contexts globally, given the interplay of physical, social, political, and psychological dimensions that shape their future [1]. In these environments, the impact of conflict extends beyond the physical destruction of urban structures and spaces. It erodes the social fabric, disrupts daily life, alters value systems and collective identity, and diminishes the capacity of places to retain their function, symbolism, and role in shaping the collective memory of individuals and the community. A prime example is the Old City of Mosul in Iraq, which suffered extensive destruction of its heritage buildings, traditional pathways, and public spaces during the recent conflict, particularly in the Citadel and Al-Maydan districts [2]. This resulted in a distorted urban fabric and a fractured social environment.

These transformations have led to a global debate on the need to reconsider reconstruction methodologies in post-conflict cities, moving beyond simply rebuilding buildings and infrastructure to encompass the reconstruction of human connections, collective memory, and symbolic relationships with place, a concept aligned with "human-centered reconstruction [3]." Contemporary literature in environmental psychology and urban planning emphasizes that revitalizing historic cities requires more than just physical reconstruction; it necessitates reviving social bonds and repairing their relationship to the built environment [4]. In this context, the

concept of place-relatedness emerges as a pivotal theoretical framework for understanding the relationship between people and their built environment [5]. It is a key indicator of the sustainability of return, stability, and the revitalization of social life in affected cities [6].

Scannell and Gifford [7] presented a three-dimensional explanatory model of place-relatedness, based on the personal, psycho-emotional, and spatial-environmental dimensions, asserting that the interaction between these levels forms the foundation of the human urban experience. Lynch [8] presented a visual framework that identifies the elements of the city image as fundamental to constructing urban perception and belonging, while Pallasmaa [9] focused on the role of the senses, memory, and psychological impressions in shaping the relationship between people and place, indicating that spatial experience transcends visual perception to encompass emotional, sensory, and physical dimensions [10]. Despite the richness of these theoretical foundations globally, their application in post-conflict historic Arab cities remains limited, both in academic research and planning practice [11].

A review of the literature reveals a clear research gap related to the absence of systematic studies linking morphological transformations in damaged historic cities to the sense of place among their inhabitants. There is also a marked scarcity of studies that combine spatial analysis using geographic information systems (GIS) with socio-psychological tools in analyzing post-conflict cities. This leads to the central question of this research: the nature of the relationship between the urban changes witnessed in Old Mosul after the conflict and the levels of place connection among its residents, and how this relationship can be empirically measured by integrating the spatial and human dimensions. Accordingly, this research aims to analyze the impact of morphological transformations in Old Mosul on residents' sense of place. This is achieved through a methodology that integrates spatial map analysis using GIS, measuring place-related connection via standardized questionnaires based on the Scannell and Gifford model, and conducting qualitative interviews to explore the dimensions of spatial experience, memory, and identity among the population. This objective leads to a set of key questions, including: How has the urban fabric of Old Mosul changed since the conflict? What is the level of residents' sense of place across its three dimensions (identity, dependency, and social cohesion)? How do urban transformations affect residents' relationship to their place and their desire to return and settle? And what factors support or hinder the revitalization of this historical fabric?

This study is based on the fundamental premises that increased levels of urban damage are linked to decreased levels of connection to place, that partial preservation of elements of the traditional urban fabric contributes to strengthening identity and belonging, and that the quality of transportation networks and public spaces plays a crucial role in supporting return and social continuity. Furthermore, social bonds act as a mediating factor that reinforces the strength of connection even in conditions of physical deterioration. The significance of this research lies in its attempt to construct an integrated cognitive and methodological model for understanding the relationship between urban transformations and connection to place in damaged historical cities. This is achieved through an applied framework that combines spatial analysis tools with socio-psychological interpretations of urban space, thereby guiding reconstruction policies toward an approach more sensitive to identity and cultural context. Ultimately, this approach enhances Mosul's ability to reclaim its urban, cultural, and social role, not only as a physical space but also as a living entity bearing memory, belonging, and history.

2. STUDY AREA AND DATA COLLECTION

2.1 Study area

2.1.1 Overview of the study area

To understand the nature of the study, it is first important to consider the historical and urban specificities of Mosul [12]. It is one of the oldest urban centers on the banks of the Tigris River and a prominent cultural center that has witnessed a diverse combination of architectural styles and social and economic functions over the ages. With its old neighborhoods, markets, mosques, and churches, Mosul has been a rich field of urban transformation, blending historical heritage with the dynamics of modern urban growth [13].

Against this background, Figure 1 shows the location of the study area in the heart of Old Mosul, between the Old Bridge and the Fifth Bridge on the western bank of the Tigris River. Here, the Al-Qala'at and Al-Midan districts stand out as two of the most historically and urbanistically significant neighborhoods, having formed the core of the city's historical foundations since Assyrian times [14]. This area is characterized by a diverse urban fabric that combines residential, commercial, and religious functions, while it is bordered to the east by a direct riverfront, providing a visual and environmental extension that has a significant impact on the identity of the urban landscape [15].

The area contains prominent heritage landmarks such as the Umayyad Mosque (Al-Mustafa), the Prophet George Mosque, and the Church of Al-Tahera and the Church of Joseph, all of which sustained severe damage during the recent war [16]. The urban fabric is characterized by an organic composition, narrow alleys, and buildings of diverse architectural styles, ranging from traditional houses with internal courtyards to relatively modern buildings. The topographic gradient, which ranges from 15 to 24 meters above river level, produces a terraced horizon that adds visual and functional complexity to the urban landscape [17]. Thus, this area does not merely represent a traditional urban cluster, but rather constitutes an integrated heritage environment that reflects the interplay of historical, topographical, and social factors, making it a fertile field for analysis and study [18].

Figure 1. Aerial image of Mosul highlighting the study area and key landmarks

Figure 2. Map of the study area indicating heritage sites
Source: Researcher's compilation

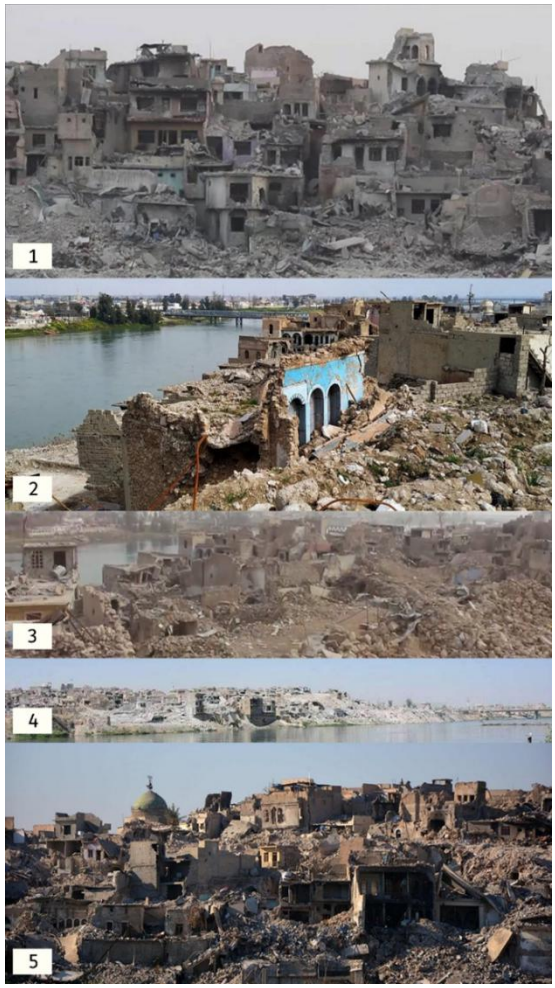

Figure 3. Post-liberation urban landscape of the Qalaat riverfront observed from the opposite bank (February 2020, field research)

Based on the general characteristics of the site and its historical and urban significance, Figure 2 shows a detailed plan of the Al-Qala'at and Al-Midan districts, demonstrating the distribution of the major heritage and religious landmarks that form the heart of the urban fabric of Old Mosul [19]. The plan highlights prominent mosques such as Sheikh Al-Shatt Mosque, Al-Musfa Mosque, and the Umayyad Mosque Minaret, along with historic churches such as Al-Tahera Church and the Church of Joseph (St. Joseph) [20]. The figure also demonstrates the connection of these landmarks to major urban axes such as Nabi Jirjis Street, Nineveh Street, and Ghazi Street, in addition to their interconnection with open spaces that provide the area with a variety of uses and direct connection to the Tigris River [21].

This distribution demonstrates how the urban fabric of the area is not merely an accumulated spatial structure, but rather an integrated system that combines religion, daily functions, markets, and public spaces, reinforcing its status as a heritage urban environment with a unique character that warrants study and analysis.

As Figure 3 illustrates, the scenes of extensive destruction of the urban and heritage fabric across the Al-Qlayaat and Al-Midan areas demonstrate that the challenge is no longer limited to rebuilding damaged buildings alone, but extends to include restoring the identity of the place and reviving its historical, cultural, and social value [22]. The loss of mosques, churches, and traditional markets not only created an urban gap, but also deepened the crisis of disconnection in the local community's memory and its sense of belonging to its heritage spaces. Hence, the importance of this research in approaching the area not as a physical ruin in need of reconstruction, but rather as an urban heritage space requiring a collaborative scientific intervention that balances preserving authenticity with meeting the requirements of contemporary urban development [23].

The study area enjoys a prime location on the banks of the Tigris River and boasts a rich urban and social history, reflected in the diversity of land uses and the formation of its urban fabric. Table 1 illustrates the area's key characteristics, including its location, historical significance, population density, and urban development.

Table 1. Main characteristics of the study area

Indicator	Description
Location	Situated between the Old Bridge and the Fifth Bridge, adjacent to the Tigris River on the eastern side.
Historical Significance	Hosts prominent heritage landmarks including ancient mosques and churches reflecting religious and cultural diversity.
Land Use	A mix of residential, commercial, and religious functions within an integrated urban fabric.
Population Density	Previously characterized by high density, significantly reduced after the war.
Urban Form	Organic fabric with narrow alleys, topographic variation (15-24 m), and diverse architectural styles.

Based on these spatial, historical, and urban characteristics that distinguish Al Qlayat and Midan areas [19], it becomes necessary to address a number of current urban problems resulting from the repercussions of the war and the accompanying widespread destruction and loss of infrastructure and heritage spaces [24]. While the urban fabric reflects significant potential for revitalization, current indicators reveal complex challenges that require in-depth analysis and a comprehensive vision to find balanced solutions between preserving heritage identity and the requirements of contemporary development [25].

2.1.2 Data collection methods

The study adopted a mixed data methodology based on primary sources such as field observations, interviews,

participatory mapping, and questionnaires, in addition to secondary sources such as historical maps, official documents, and satellite images. This diversity allowed for the construction of a comprehensive picture that combined the morphological, social, and emotional dimensions of urban transformations.

2.1.3 Challenges in data collection

The study encountered field challenges, most notably the destruction of infrastructure, the accumulation of rubble, population displacement, and security restrictions. To overcome these challenges, remote sensing and drone technologies were employed, along with coordination with local authorities and community organizations to facilitate access and ensure the safety of researchers.

2.1.4 Integrating spatial analysis tools

GIS was used to compare historical maps with satellite images, 3D modeling to monitor morphological changes, and digital simulations to test reconstruction scenarios. This integration contributed to enhancing the accuracy of tracking urban transformations and supporting evidence-based decision-making.

2.1.5 Socio-economic context

Before the war, the Qlayaat and Midan areas represented a vital economic and social center with a high population density and extensive urban diversity. After the war, however, they witnessed the collapse of infrastructure and the local economy and the mass displacement of residents. These transformations demonstrate that successful reconstruction requires integrating the social and economic dimensions with physical interventions.

2.1.6 The role of community participation in data collection

The local community was engaged through participatory mapping and dialogue workshops to document places of symbolic value and understand the emotional dimension of belonging. This contributed to enhancing the credibility of the results and revealing the gap between official policies and the needs of the population, underscoring the importance of integrating community participation into reconstruction strategies.

2.2 Research design and analytical tools

The research adopted a quasi-experimental design that compared the pre- and post-war periods, relying on a combination of quantitative (questionnaire analysis using SPSS), qualitative (interview coding according to thematic analysis), and digital spatial (GIS, 3D modeling, and Depthmap analysis) methods. This combination enabled the monitoring of urban morphological transformations and an understanding of their relationship to spatial attachment, providing an analytical framework that can be employed in studies of the reconstruction of heritage areas affected by conflict.

2.3 Study limitations and limits of generalization

The study was limited to the Al-Qala'at and Al-Midan neighborhoods in Old Mosul, making its findings specific to a specific spatial context and not representative of the entire city. Data were collected during the period 2019-2022, i.e., in the immediate post-liberation phase, a transitional timeframe whose data may subsequently change as reconstruction progresses. Furthermore, the reliance on qualitative data and a quasi-experimental design, along with the limited number of participants due to displacement, limits the possibility of quantitative generalization. Therefore, the findings are not suitable for direct application to other cities, but they provide an analytical and methodological framework that can be employed in similar studies to address the issues of rebuilding heritage areas affected by conflict.

3. METHODOLOGY

3.1 Research design and framework

This study adopted a multi-instrumental analytical methodology within a case study framework aimed at analyzing the relationship between morphological transformations in the historical urban fabric and the levels of place-related attachment among residents of Old Mosul after the conflict, particularly in the Citadel and Al-Midan districts. This design is based on integrating spatial analysis using GIS with sociometric tools derived from environmental psychology, in addition to a qualitative interpretation of residents' experiences and collective memory. This integration aims to provide a comprehensive reading that links urban, symbolic, and behavioral changes, thus achieving the principle of triangulation to ensure the accuracy and interpretive validity of the results.

3.2 Study population and sample

The study population consists of residents of Old Mosul, especially those who lived in the area before the conflict and returned after liberation or who remain socially and emotionally attached to it. A purposive, directed sample was selected due to the nature of the topic and its connection to spatial experience.

The quantitative sample size consisted of 120 participants whose data were collected through a field survey, while 15 semi-structured interviews were conducted with a qualitative sample comprising local residents, engineers, planners, and administrative officials involved in reconstruction and the management of heritage sites. Participants were selected to ensure age and gender balance and to represent pre- and post-conflict residence groups, while adhering fully to the ethics of scientific research, including obtaining informed consent and maintaining participant privacy.

3.3 Data collection tools

The study employed three main data collection tools, aiming to develop an integrated methodology that combines spatial analysis, social data, and urban planning. These tools were selected to align with the nature of the topic, which encompasses both the urban and psychosocial dimensions of connection to place in a post-conflict context.

First: Spatial Analysis Using GIS

GIS was utilized as a primary tool to monitor changes in the historical urban fabric of Old Mosul. This was achieved by comparing satellite imagery covering the period from 2014 to 2023. The analysis included identifying the locations of damaged buildings, monitoring the loss of heritage buildings,

examining the decline in urban density, and analyzing the network of movement and permeability, as well as the distribution and functions of public spaces. This process contributed to the production of analytical maps that illustrate the main morphological changes and provide a spatial base for comparison with social indicators, thus linking urban data with the behavior of the population.

Second: Quantitative Questionnaire to Measure Place Attachment

The study employed a questionnaire based on a five-point Likert scale to measure the dimensions of place attachment according to the Scannell and Gifford model, which comprises three main axes: spatial identity, spatial dependency, and social cohesion. The questionnaire included 12 items equally distributed across the three dimensions, allowing for an accurate assessment of the various components of place attachment among participants. The instrument's reliability was tested using Cronbach's alpha coefficient to ensure the consistency of the items and the reliability of the resulting findings.

Third: Qualitative Interviews (Semi-Structured Interviews)

In addition to the quantitative data, semi-structured interviews were conducted with a select group of local residents and urban planning and heritage professionals. These interviews aimed to interpret the quantitative results, deepen the understanding of urban experiences and the collective memory of the residents, and explore the socio-spatial meanings associated with identity and belonging. Qualitative data underwent thematic analysis using thematic coding, which allowed for the identification of recurring patterns and significance, enhancing the reliability of the conclusions.

3.4 Statistical analysis methods

Quantitative data were analyzed using a range of statistical methods appropriate to the nature of the variables under study. This included descriptive statistics to calculate the arithmetic means and standard deviations of the spatial correlation indices, and the use of Cronbach's alpha coefficient to verify the reliability of the internal scale. Pearson's correlation coefficient was also applied to measure the strength and direction of the relationship between urban transformations and spatial correlation levels. Additionally, linear regression analysis was used to interpret the proportion of variance in correlation levels attributable to urban changes.

3.5 Study limitations

The spatial scope of the study is limited to the Citadel and Al-Midan areas in Old Mosul, given that they are among the most damaged areas and possess the highest heritage and social value. The timeframe encompasses the post-liberation period from 2019 to 2023, during which the region witnessed initial reconstruction efforts and the gradual return of residents. The study's thematic scope focuses on analyzing the relationship between urban transformations and spatial identity, without delving into a detailed assessment of security and service aspects. Methodologically, given the study's reliance on data based on residents' perceptions and personal experiences, it was balanced with objective spatial analysis and qualitative interviews to mitigate potential emotional bias.

4. RESULTS AND ANALYSIS

4.1 Questionnaire analysis and descriptive statistics

The results of the questionnaire data analysis indicate clear correlations between demographic characteristics and levels of spatial attachment in post-war Mosul across three dimensions: spatial identity, place dependence, and social attachment. A descriptive statistical approach was adopted using indicators such as the arithmetic mean and standard deviation, in addition to frequency distributions and percentages for response categories.

The results showed that the elderly group demonstrated higher levels of spatial identity compared to younger groups, reflecting the cumulative relationship between collective memory and the historical urban environment. In contrast, younger groups demonstrated a greater ability to adapt to the city's morphological transformations, indicating a change in spatial interaction patterns across generations.

Participants' responses were analyzed according to dimensions of place-relatedness to determine levels of identity, belonging, and social dependency within the study area. Table 2 summarizes the statistical results of the survey, showing the mean, standard deviation, and most frequent response categories for each dimension.

Table 2. Summary of questionnaire results

Dimension of Place Attachment	Mean Score	Standard Deviation	Most Frequent Response Category
Place Identity	3.8	0.76	Strongly Agree (45%)
Place Dependence	3.5	0.82	Agree (40%)
Social Bonding	3.9	0.74	Strongly Agree (48%)

4.2 General introduction

This chapter presents the research findings derived from field, spatial, and statistical analysis aimed at interpreting the relationship between morphological transformations in Old Mosul and levels of attachment to place after the conflict. The study relied on primary data collected through a questionnaire administered to 120 residents of the Citadel and Al-Midan districts, in addition to the analysis of urban maps, satellite imagery, and direct field observations. The results seek to answer the central research question: How do urban, service, and social changes affect levels of belonging, return, and stability among residents of historical areas after the conflict?

4.3 Demographic sample characteristics

Before analyzing spatial correlation, levels, and measuring the impact of morphological transformations in Old Mosul, it was essential to characterize the demographic characteristics of the study sample. This was necessary to determine its representativeness of the local population and to understand the age and social backgrounds of the participants. This characterization contributes to enhancing the credibility of the results and their interpretability within the urban and social context of the studied area. Table 3 illustrates the most important demographic indicators associated with the study participants.

Demographic data indicate that the majority of the sample are male, which is expected in studies related to reconstruction and community participation in heritage cities, where men are often more present in activities related to urban space and public affairs. The data also shows that the young and middle-aged age groups (20-40 years) represent the largest segment at approximately 66%, reflecting the vital role of these groups in reconstruction processes and future decisions related to housing and stability.

Regarding the length of time spent in the area before the conflict, the data indicate that more than two-thirds of the participants (62.5%) had lived in the area for more than ten years. This is a significant indicator of the depth of the sample's spatial experience and its historical connection to the region. This finding is closely related to the study's theme, as the connection to a place is often stronger among individuals with extensive spatial memory and long living experiences.

Table 3. Demographic characteristics of the study sample

Variable	Category	N	%
Gender	Male	72	60.0%
	Female	48	40.0%
Age Group	< 20 years	10	8.0%
	20–30 years	38	32.0%
	31–40 years	41	34.0%
	41–50 years	21	18.0%
	> 50 years	10	8.0%
Years of Residence Before Conflict	< 5 years	15	12.5%
	5–10 years	30	25.0%
	> 10 years	75	62.5%
Return to the Area After Conflict	Returned	68	56.7%
	Did not return	52	43.3%

Finally, the return data shows that 56.7% of the participants returned to the area after liberation, compared to 43.3% who did not. These figures reflect, on the one hand, the desire of a large segment of the population to restore their relationship with the place despite the urban and service challenges, and on the other hand, they indicate that the deterioration in the urban environment and basic services still represents an obstacle for some to return and settle again.

4.4 Levels of place attachment

To measure the level of place-related engagement in Old Mosul after the conflict, participants' responses were analyzed using a five-point Likert scale comprising three main dimensions: spatial identity, spatial dependency, and social cohesion. These dimensions reflect the psychological, social, and functional aspects of the relationship between residents and their urban environment. Table 4 shows the means and standard deviations for each dimension, allowing for an assessment of the degree of emotional and practical interaction with place amidst the current urban transformations.

The results indicate a high level of emotional and social attachment to the place, with spatial identity registering the highest average. This reflects the strength of cultural, religious, and historical symbolism in shaping the residents' relationship with the city. Social cohesion was also high, demonstrating the persistence of stable networks of relationships among residents despite conflict and displacement.

Conversely, spatial dependency showed a lower average, indicating that the residents' ability to conduct their daily lives within the area has been significantly affected by the deterioration of infrastructure and basic services, as well as the disruption of economic activities. This disparity between emotional belonging and functional dependency on the place underscores the necessity for reconstruction efforts to be accompanied by urban and service improvements that restore the place to its vital role in daily life. Attachment to the place alone is insufficient to guarantee return and stability without providing a livable urban environment.

Table 4. Arithmetic means for the dimensions of place attachment

Dimension	Number of Items	Mean	Standard Deviation	Response Level
Place Identity	4	4.21	0.61	High
Place Dependence	4	3.08	0.84	Moderate
Social Bonding	4	3.94	0.73	High
Overall Average	12	3.74	0.72	Relatively High

4.5 Returning to housing after conflict

Return rates to the area after conflict are a key social indicator for understanding the capacity of the historic urban fabric to regain its vitality and its residential and social role. The ratio of returnees to non-returnees is a significant indicator of the urban environment's viability and functional recovery, as well as the strength of social bonds and emotional attachment to the place. Figure 4 illustrates the return rates to Old Mosul after the end of the armed conflict.

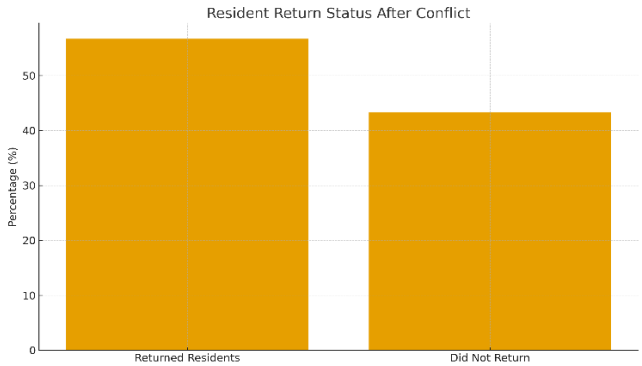

Figure 4. The situation of population return after the conflict

The data shows that approximately 56.7% of the population returned to live in the area after the conflict, compared to 43.3% who did not. This result is explained in light of other study indicators; the relatively high percentage of returnees reflects strong social ties and a deep-rooted sense of belonging, in addition to a genuine desire to resume traditional life despite the challenges.

Conversely, the percentage of those who did not return indicates the presence of urban, service, and economic obstacles that continue to impede a full return, such as inadequate basic services, damaged infrastructure, and the absence of economic activities, in addition to security and economic factors.

These data reflect the clear disparity between the strong social and emotional connection to the place, on the one hand, and the current state of services and urban infrastructure,

which has not yet reached a level that supports a comprehensive return, on the other. This supports the findings of the previous study regarding the necessity of accompanying physical reconstruction efforts with programs to revitalize social life and basic services, thus ensuring the sustainability of the return and the revitalization of urban functions.

4.6 Statistical analysis of study data

4.6.1 Reliability analysis

The internal reliability of the Place Connection Scale was tested using Cronbach's Alpha to verify the consistency of the questionnaire items. The results showed a reliability coefficient of 0.89, which is higher than the academically acceptable limit (0.70). This indicates that the measurement instrument has a high degree of internal consistency and is suitable for measuring the different dimensions of place connection among the study sample. This result confirms that the participants' responses were stable and not random, reflecting a clear understanding of the questionnaire items. This enhances the reliability of the data in interpreting the relationship between urban transformations and place connection.

4.6.2 Pearson correlation analysis

To determine the nature and strength of the relationship between morphological transformations and levels of place connection, Pearson's correlation coefficient was used. The results showed a strong negative correlation between the level of urban damage and the degree of place attachment, with a correlation coefficient of:

$$r = -0.61, p < 0.01$$

This indicates that the greater the extent of urban destruction and material losses in the urban fabric, the lower the level of residents' functional and daily attachment to the place.

Conversely, a strong positive correlation was found between the dimension of place identity and social cohesion:

$$r = 0.74, p < 0.01$$

This means that the strength of social, religious, and cultural ties contributes to strengthening the sense of continuity and belonging to the place, even in the face of urban deterioration. This result reflects the central role of collective memory and family ties in supporting residents' desire to return and revitalize the place.

4.6.3 Linear regression analysis

Simple linear regression analysis was performed to verify the ability of urban transformation variables to explain the change in levels of place attachment. The coefficient of interpretation was:

$$R^2 = 0.37, p < 0.001$$

This indicates that urban transformations explain 37% of the change in levels of attachment to place. This is a significant percentage that reflects the importance of the physical dimension in shaping the relationship of residents to their urban environment. The remaining percentage (63%) indicates the presence of other complementary factors of a social, psychological, and service-related nature (such as the availability of basic services, security, cultural heritage, and social relations), which are equally important aspects of post-conflict urban planning.

These results show that rebuilding attachment to place is not merely a physical reconstruction process, but requires integrating the spatial dimension with social, cultural, and economic considerations.

4.6.4 Comprehensive interpretation of statistical results

In general, the statistical results indicate that Old Mosul possesses a strong and deeply rooted emotional and social attachment, while suffering from functional weaknesses related to the lack of services and the deterioration of the urban environment. These findings reflect that successful reconstruction requires a parallel approach to both the urban landscape and the social structure of the place, so that public spaces, transportation networks, and services are reformulated in a way that enables residents to restore their daily relationship with the place and not just their symbolic connection to it.

5. DISCUSSION

This discussion explains the findings of the spatial, social, and qualitative analysis in light of theoretical literature on place-related relationships and post-conflict planning. The data show that rebuilding the connections between people and place in affected historic areas is not only about removing the traces of destruction or developing infrastructure, but also fundamentally depends on reviving urban symbolism, strengthening collective memory, and restoring the social dynamics that constituted the identity of the place before the conflict. This interpretation aligns with international trends that recognize that reconstruction in historic cities requires human-heritage approaches that balance urban preservation with social healing and the sustainability of urban life.

5.1 Continuity of the historic fabric and its role in strengthening place-related relations

The study showed that areas that preserved parts of their traditional urban fabric, including organic alleyways and visual connections to heritage and religious landmarks, recorded higher levels of place-related relationships. This highlights the importance of the built environment as a repository of collective memory and identity, demonstrating that architectural heritage not only fulfills its material function but also plays a profound psycho-symbolic role that reinforces a sense of belonging.

These findings align with Scannell and Gifford's model, which frames the connection to place within the "person-place-process" triad, and with Lynch's [8] conception of the city as a mental mechanism for perceiving and recalling place. These data underscore the importance of basing reconstruction in Mosul on restoring urban memory and repairing the damaged infrastructure, rather than replacing it with alien or identity-neutral architectural models.

5.2 Functional decline and weakened daily reliance

Despite the increased emotional and value-based attachment to place, the results showed a decline in the functional reliance of urban spaces due to the deterioration of

basic services, damage to transportation networks, and the decline of traditional social activities. This reveals a gap between "emotional attachment" and "the ability to live daily," indicating that attachment to a place alone is insufficient to guarantee a sustainable return of residents unless the physical environment, infrastructure, and services are strengthened. Thus, "symbolic return" requires "urban and social preparation" to transform it into a stable, actual return.

5.3 Collective memory and the social dimension as a foundation for revitalizing place

Qualitative interviews show that residents' attachment to place extends beyond the images of buildings to a broader system encompassing social ties, cultural and religious practices, and inherited memories. This finding aligns with the literature emphasizing that reconstruction is as much a social act as it is an urban one, and that historic cities are not restored by building materials alone but by re-weaving the social bonds that give a place its life. This reinforces the importance of participatory planning and involving the community in shaping its vision of the place.

5.4 Reconstruction: Between physical construction and healing place

The results reveal a gap between physical reconstruction and the restoration of urban meaning; approaches that focus on constructing structures without integrating heritage and symbolic values produce environments that "appear built" but lack social life and a civic spirit. Therefore, successful reconstruction requires preserving the fabric and visual landscape, revitalizing public spaces as social theaters, and employing urban design that supports human return before the completion of infrastructure.

5.5 Comparison with international literature

The findings of this study align with Kaplan's research on environmental interconnectedness and Jan Gehl's arguments regarding the centrality of public space in revitalizing social life. They also correspond with research on post-conflict cities such as Sarajevo, Beirut, and Grozny, which has emphasized the importance of collective memory in urban regeneration. However, the study makes a unique contribution related to the Arab-Iraqi context, where the spiritual dimension intertwines with urban development, traditional social practices persist despite physical disruption, and heritage is viewed as a way of life, not merely a visual element.

The findings of this study confirm that place in Old Mosul is not merely a physical framework, but a system of identity, memory, and social relations, and that effective reconstruction must go beyond repairing the stones to rebuilding the human being and their collective memory. It also demonstrates that any urban intervention that ignores the emotional and social dimension of place risks producing a “soulless city,” and that genuine urban recovery is as much a symbolic and communal process as it is an urban and material one.

6. CONCLUSIONS

The findings of this study reveal the complex relationship between morphological transformations in the historical urban fabric and the levels of spatial connection among residents in a post-conflict context. This is achieved by analyzing Old Mosul after its liberation, specifically in the Citadel and Al-Midan neighborhoods, which constitute the historical and symbolic heart of the city's identity and culture.

Spatial analysis using GIS demonstrated profound changes in the area's urban structure. These changes included the widespread deterioration of heritage buildings of historical and symbolic value, along with the loss of large areas of traditional public spaces and the fragmentation of connections between them. A clear disruption in the network of historical pathways and walkways was also evident, resulting in the emergence of functionally and visually incomplete urban spaces. This negatively impacted the readability of the area and the continuity of its social functions and heritage value.

On a social level, the field study results showed that spatial identity remained relatively strong, driven by the history and religious and cultural symbolism of the site. It also became clear that social bonds remained strong despite the spatial fragmentation caused by the war, reflecting the strength of collective memory and the local community's attachment to its spatial roots. Conversely, spatial dependency witnessed a significant decline due to the loss of many daily jobs, difficulty in movement, and the weakening of service infrastructure. This indicates that the greatest impact of urban transformation was on the practical use of space, rather than on the emotional and symbolic dimension of the community's connection to it.

Furthermore, the results of the statistical analysis of the relationship between urban transformations and spatial attachment confirmed that severe morphological damage is associated with a significant decrease in levels of spatial attachment, while the relative preservation of urban landmarks contributes to maintaining a sense of belonging and a readiness to return and settle. The data showed that disruption of the transportation network and the deterioration of public spaces directly affect patterns of social use of space, reinforcing the hypothesis that the physical fabric of the city constitutes a pivotal element in sustaining the psychological and social bonds of its inhabitants.

These findings collectively indicate that reconstruction in historically damaged contexts cannot be viewed merely as a physical or technical process, but rather as a socio-psychological-spatial process requiring a comprehensive, integrated approach. The success of reconstruction in Mosul depends not only on rebuilding buildings and roads, but also on reviving the memory of the place, restoring its architectural identity, and supporting the return and resettlement of its residents. The Mosul context clearly demonstrates that residents cling to the historical symbolism of the place and re-employ it in shaping their relationship with it, despite the scale of the destruction. Therefore, preserving heritage architectural features and reconnecting the components of the urban fabric become fundamental priorities in recovery projects.

In conclusion, this study offers a significant scientific contribution by developing an applied framework that integrates spatial analysis using GIS and spatial theories, thus helping to measure and understand the impact of urban transformations in the post-conflict context. It also contributes to developing a model that can be replicated in other cities that have experienced similar conditions, and supports expanding the discussion on the psycho-spatial dimension in reconstruction processes, stressing that sustainable urban recovery requires directing building policies towards an identity- and place-sensitive approach, rather than being

limited to a material response to urban damage.

7. RECOMMENDATIONS

Based on the study's findings regarding the impact of morphological transformations in Old Mosul on the connection to place and urban social behavior, a set of recommendations emerges that can contribute to strengthening reconstruction efforts and urban sustainability in historic areas affected by conflict.

First and foremost, a planning approach based on identity-sensitive reconstruction should be adopted. Reconstruction should not be viewed merely as a physical process, but as a social and cultural one that reshapes the relationship of residents to their place and supports the restoration of a sense of belonging and collective memory. This requires preserving the remaining historic architectural elements and addressing the spaces resulting from the destruction in a way that visually and functionally reintegrates them within the urban context, while respecting authenticity and local architectural character.

The study also recommends strengthening the interconnectedness of circulation networks within the historic fabric and reactivating traditional pathways that once connected vital centers within Old Mosul. Improving accessibility and mobility not only facilitates daily activities but also fosters social interaction and revitalizes public spaces, representing a crucial step towards restoring the social and economic vitality of the area.

On the other hand, the study emphasizes the importance of strengthening community participation in planning and reconstruction projects, given its crucial role in building trust and engaging residents in shaping their city's future. This can be achieved through participatory workshops, local community councils, and awareness initiatives that enhance residents' understanding of the value of heritage and the importance of its preservation. This approach contributes to aligning urban interventions with community needs and aspirations, thereby increasing their chances of success and sustainability.

The study also recommends integrating spatial analysis and spatial correlation measurement tools into planning decision support systems in heritage cities. This would allow GIS technology and behavioral and social analysis to guide urban recovery policies. Developing pre- and post-conflict urban databases would help planners and researchers understand the trajectory of urban and social changes and continuously and objectively assess the impact of interventions.

In light of the challenges posed by the post-conflict context, the study suggests strengthening reconstruction programs with vocational training in traditional restoration, heritage crafts, and the use of digital technologies for documentation and modeling. This contributes to empowering the local community and building specialized technical capacities, and encourages the sustainability of efforts and the revitalization of economic and cultural activities rooted in the historic city.

Finally, the study emphasizes the need to encourage future research that explores the relationship between spatial identity and collective memory, on the one hand, and post-conflict urban and planning transformations, on the other, while making comparisons across similar urban contexts both regionally and globally. This approach would broaden the scientific understanding of the interaction between the built environment and community behavior, and contribute to building an integrated knowledge framework for the rehabilitation of damaged historic cities, ensuring their sustainability and the continuation of their urban and cultural role.

8. FUTURE RESEARCH DIRECTIONS

8.1 Study limitations

Despite the scientific value of this study in analyzing the relationship between morphological transformations and spatial attachment in the post-conflict context, several limitations must be considered when interpreting the results. These include:

8.1.1 Limited spatial scope

The study was confined to a specific sector within the historic center of Mosul (the Citadel and Al-Midan neighborhoods), which may not fully reflect all spatial patterns and conditions in the rest of the city or other cities with similar circumstances.

8.1.2 Changing social conditions

The dynamics of displacement and the partial return of the population affected the sample composition. Levels of spatial attachment may differ between residents who have gradually returned and those who have not yet been able to return.

8.1.3 Limited pre-conflict data

The study faced difficulty in obtaining comprehensive and detailed records of the urban and social structures before the conflict, necessitating reliance on satellite imagery analysis and secondary sources.

8.1.4 Impact of security and logistical factors

Some sites may be completely inaccessible for field visits due to reconstruction and security conditions, limiting the comprehensiveness of direct field monitoring.

8.1.5 Nature of mental measurement tools

While the Scannell and Gifford scale is reliable in measuring place-related attachment, it remains dependent on participants' subjective assessments, which may be influenced by personal experiences and selective memory.

Therefore, the results should be viewed as an analytical indicator to support understanding urban and social dynamics, not as a definitive and comprehensive judgment.

8.2 Applicability

The study's findings provide a framework applicable to:

Reconstruction plans sensitive to heritage identity.

Designing participatory strategies to engage residents in shaping the future of the place.

Supporting local decision-makers in evidence-based urban planning.

8.3 Future research prospects

This study opens up several avenues for future research, most notably:

Longitudinal studies: Tracking the evolution of spatial engagement across different reconstruction phases to observe

gradual shifts in spatial identity and social integration.

Integrating virtual reality (VR) and digital modeling: Using virtual simulations of pre- and post-conflict heritage urban environments to test the impact of proposed designs on user experiences and spatial engagement.

Post-conflict city comparisons: Conducting comparative studies with Arab and regional cities (such as Aleppo, Beirut, and Sarajevo) to identify commonalities and differences in the dynamics of urban and emotional recovery.

Developing psycho-urban measurement models: Creating advanced measurement tools that combine spatial analysis, psychosocial indicators, and urban mobility data to enhance understanding of the relationship between spatial identity and post-conflict planning.

Studies on the role of local communities in reconstruction: Analyzing the Impact of Community Participation and Participatory Governance on Promoting Return, Stability, and Identity Reconstruction.

These future paths highlight the importance of a multidisciplinary approach that integrates planning science, urban anthropology, environmental psychology, and digital technologies to develop effective models for revitalizing damaged historic cities.

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