SAFOMETER - ASSESSING SAFETY IN PUBLIC SPACES: THE URBAN AREA OF PRISHTINA

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ABSTRACT:

This paper introduces SafoMeter, a framework for assessing safety in public spaces using an index-based evaluation system that combines objective safety indicators with subjective perceptions of safety. The methodology is piloted in the urban area of Prishtina, Kosovo, and involves field data collection using the mobile application Mergin to map data for objective indicators and gather user responses on perceived safety. Analysis is conducted using QGIS software to create a map that showcases safe and unsafe areas of the city, rated from 0 to 10, with 10 indicating the safest areas. The study results demonstrate that SafoMeter effectively identifies and visualizes areas in need of urgent safety interventions. The tool enables evidence-based decision-making for policymakers by utilizing geospatial data to identify specific locations that require interventions. SafoMeter provides a practical approach to assess safety in public spaces and guide place-based policies to enhance urban safety, particularly for marginalized groups.

1. INTRODUCTION

As cities expose people to increasing threats, urban planning perspectives on safety remain on the periphery of urban design and policy. The feeling of safety is a primary emotion that affects individuals' well-being and behaviour, and public spaces play a significant role in shaping these emotions (Pánek et al., 2017). Ensuring safety in public spaces is essential for creating inclusive and sustainable urban environments (United Nations, 2021). However, there is often a gap in understanding the actual safety conditions in public spaces, as it requires a multidimensional approach that considers both objective indicators and subjective perceptions of safety.

The right to a safe environment is a fundamental human right. Thus, today's cities should consider all the possible threats that inhabitants face daily and offer better surroundings. A good planning strategy addresses and emphasises a safe environment in which we live, especially in public spaces.
Negotiating the use of public spaces poses a significant challenge for marginalised groups and particularly for women, for whom sexual harassment and other forms of sexual violence in public spaces are an everyday occurrence in cities worldwide (UN Women, 2021, Kalpana and Surabhi 2007).

Safety assessment processes conducted by different actors have rarely considered the perceived sense of risk from different user groups of public spaces. Considering this, SafoMeter's approach to assessing safety builds on the idea that considering the diversity of the perceptions of the people who use public spaces is a crucial task for urban sustainability as a means to deliver solutions that improve both safety and a sense of safety for all groups. Furthermore, there is an urgent need to develop a gender-sensitive approach to creating safe public spaces, as gender plays a significant role in determining feelings of insecurity, with notable differences between men and women (UN Women, 2020). Gender-based violence continues to be a pervasive risk that disproportionately affects women, to the extent of violating fundamental human rights, including the right to free movement (Polko and Kimic, 2021).

The SafoMeter framework was designed to ensure that women's perspectives are included in the assessment of safety in public spaces. By incorporating participatory methods, SafoMeter allows women to share their experiences and perceptions of safety. This approach amplifies the voices of women, a group often marginalised in public space planning and design. By gathering data on the specific safety concerns and needs of women, SafoMeter enables policymakers and planners to develop more gender-sensitive approaches to public space design. This is crucial as women may experience safety risks that men do not, such as gender-based violence or harassment. Therefore, it is important to include women's perspectives in the evaluation of safety in public spaces to create more inclusive and equitable spaces for everyone.

Moreover, SafoMeter pays special attention to uncovering the spatial distribution of unsafe public spaces within the city. In this regard, its method utilises geospatial data for the purpose of assessing site-specific safety and analysing the distribution of unsafe hotspots within the city. Aiming to contribute to ongoing efforts in developing a comprehensive methodology for assessing safety in public spaces, SafoMeter presents an innovative approach through its index-based evaluation system. The methodology combines both objective and subjective safety indicators to provide a more holistic understanding of safety in public spaces, capturing not only the physical aspects but also the perceptions and experiences of users. This integrated approach provides a more accurate assessment of safety conditions in specific locations, which can inform evidence-based decision-making for policymakers and urban planners in identifying areas that require urgent safety interventions.

In addition to introducing SafoMeter's methodological framework for assessing safety in public spaces, this paper showcases the results of a study conducted in the Municipality

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of Prishtina where SafoMeter is piloted by generating the results of the safety index of public spaces and its spatial distribution.

2. METHODOLOGY

2.1 Conceptual framework

The framework for assessing safety in public spaces adheres to a human-centred approach that analyzes public spaces by closely examining people's everyday experiences. In contrast to conventional methods, the framework emphasizes the need to consider data from individual evaluations of perceived safety. By doing so, it enables the investigation of intersecting causes that go beyond environmental associations with feelings of safety. The subjective evaluations of users of public space are considered very important due to the low correlation between objective characteristics and subjective assessments of urban quality of life (QoL), as shown in previous research results (Von Wirth et al., 2014).

Aiming to conduct a holistic assessment of safety, this framework is built by mediating indicators that assess both objective safety and subjective perceptions of safety (Figure 1). Objective indicators will be used to measure the physical characteristics of a place and their implications on safety, while subjective indicators will measure psychological and emotional safety in public spaces.

Geospatial data is a crucial component of the SafoMeter framework, used to identify the spatial distribution of unsafe spaces in public areas and prioritize areas needing safety interventions. This incorporation allows SafoMeter to offer a comprehensive and detailed assessment of the safety levels of public spaces in a city.

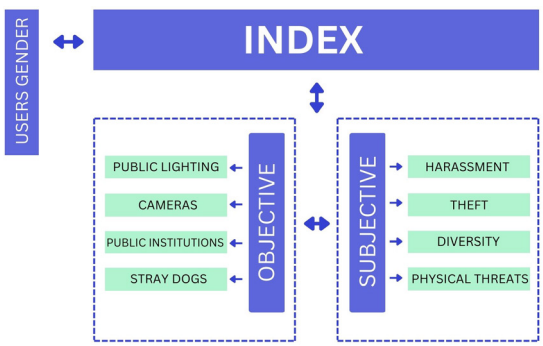

Figure 1. SafoMeter conceptual framework

2.2 Indicators

The physical characteristics of public spaces influence people's behaviour; the physical features of public spaces determine their degree of occupancy. Research on the relationship between the built environment and perceived safety highlights several physical components attributed to feelings of safety (Alwah, et al., 2020).

Spatial criteria/features from previous research consider the urban structure and accessibility as the two broad categories of spatial elements that positively or negatively affect people's sense of safety (Wojnarowska, 2016, UN Habitat, 2020). The SafoMeter framework selects a group of indicators for measuring site-specific safety, as shown in Table 1.

Indicator	Impact	Definition
Objective		
Public Lighting	positive	The presence of public lighting in public spaces
Cameras	positive	The presence of cameras directed at public spaces
Public Institutions	positive	The presence of public institution facilities in public spaces
Stray dogs	negative	The presence of stray dogs in public spaces at the time of data collection

Table 1. Objective indicators for compiling the index.

At the same time, the framework emphasizes the necessity of collecting data from individual assessments of perceived safety. By doing so, it explores intersecting causes beyond physical aspects that affect feelings of safety. Furthermore, SafoMeter's approach focuses on producing differentiated conclusions from the assessment process to reveal the experiences of the most vulnerable.

As such, SafoMeter selects a list of indicators to measure the individual perception of site-specific safety, as presented in Table 2.

Indicator	Impact	Definition
Subjective		
Harassment	negative	Perception on threats from possible harassment in public spaces.
Theft	negative	Perception of risk from being a victim of theft in public spaces.
Diversity	positive	Perception of the sense of inclusion and dominance of diverse users in public spaces.
Physical Threats	negative	Perception of threats from possible physical in public spaces.

Table 2. Subjective indicators for compiling the index.

2.3 Compiling the Safety Index

SafoMeter uses an index-based approach to assess the safety of public spaces. The safety index value ranges from 0 to 10, with different indicators contributing to the overall value of the index. The indicators used in the SafoMeter framework can have a positive or negative effect on the overall value of the index (Table 1 and 2).

When calculating the safety index score, treating both subjective and objective indicators equally mean considering both individual perceptions and factual evidence of equal importance for the assessment of safety. By adopting this approach, the framework recognizes the complementary nature of these two types of indicators and acknowledges their significance in achieving a comprehensive understanding of public space safety. In this regard, both types of indicators are given equal weight when determining the overall score of the Safety Index for the assessment of the safety of public spaces via SafoMeter. Subjective indicators, such as individual opinions or perceptions, and objective indicators, such as measurable data or factual evidence, are treated equally in a formula for calculating the Safety Index score (Wojnarowska, 2016).

2.4 Study area

The data used in the study to assess safety in public spaces focused on the urban area of Prishtina, the capital city of Kosovo. The Municipality has an official population of approximately 200,000 inhabitants, with nearly 150,000 residing in the urban area (Agjencia e Statistikave të Kosovës, 2012). The gender distribution is almost equal, with a slight dominance of females.

As the main city for political, economic, and social developments in Kosovo, Prishtina is an attractive area for living, working, tourism, and other activities. However, population data in various planning or strategic documents for Prishtina are often outdated, lacking indication of data generation timeline. Furthermore, there is a lack of spatial data on physical and technical infrastructure, green spaces, and public spaces. Additionally, spatial data on cases of violence, thefts, harassment, and other threats impacting citizens' well-being are scarce, posing challenges in analyzing social and environmental phenomena in the city.

SafoMeter tests its methodology in the urban part of Prishtina, which is a complex space with heterogeneous characteristics and requires extensive data for analysis. Once the methodology is successfully applied in this pilot area, it can be extended to other parts of the municipality and Kosovo to gain better insights into the overall safety in public spaces.

2.5 Data and analysis

The data collection process for SafoMeter followed a two-stage approach with different data collection methods. Geo-referenced data on the physical elements of public spaces were collected through field surveys, along with on-field surveys of passers-by and users of public spaces. Data collection for populating the SafoMeter platform took place over a period of three months (July, August, and September 2022), at various hours during the day and evening. The data was collected using the open license application Mergin via mobile phones. The data collection project was carried out in QGIS, version 3.22.12 LTR, and involved 8 layers, one for each indicator.

For objective indicators, data collection was carried out from 09:00 to 22:00. One the other hand, for subjective indicators, data collection was conducted 2 or 3 days during the week, when the spaces were expected to be more crowded. In areas such as public squares or parks, data collection was done more frequently and at different times. Data were collected through a fast survey with questions for each indicator, using a questionnaire designed for the SafoMeter study to collect citizens' perceptions on personal security. Respondents were required to be 18 years or older, in compliance with legal restrictions on surveying minors.

Data for each of the 8 indicators were collected and recorded as point data, which were then aggregated into a hexagonal grid with a perimeter of 100 meters for analysis and visualization of the Safety Index. The following steps were followed to transform the indicators into the index:

1. Classification of indicators as positive or negative impact on the index
2. Normalization of each indicator using the corresponding formula
3. Equal weighting of indicators
4. Clustering into the index

Normalization was carried out using the min-max method, whereby values were converted to a numerical scale of 0-10 through mathematical formulas. Formulas used for normalization are:

Indicators with a positive impact:

$$\frac{(value - smallest\ value)}{(largest\ value - smallest\ value)} x\ 10 \quad , \qquad (1)$$

Indicators with a negative impact:

$$1 - \frac{(value - smallest\ value)}{(largest\ value - smallest\ value)} x\ 10 \quad , \qquad (2)$$

The obtained results are displayed on the map according to the hexagonal grid, depending on the obtained value, classified into ten classes with a natural break to present the distribution of unsafe areas.

3. RESULTS AND DISCUSSION

3.1 The results of the objective indicators

3.1.1 The presence of public lighting: For the indicator that measures the presence of public lighting, a total of 10530 lighting poles were collected. Among them, 7951 were identified as functional lights, while 2579 or one-fourth of them as non-functional. The presence of non-functional lights in significant areas of the city creates dark spots and dark neighborhoods, as evident from the cartographic presentation (Figure 2).
For example, the area around the "Fadil Vokrri" stadium lacks functional lighting and is perceived as unsafe by surveyed citizens. Non-functional lighting is also found in other parts of the city, such as the densely populated neighborhood of 'Muhaxherret' close to the central area of Prishtina and a section of the main road inside Gërmia Park, contributing negatively to the safety index for these areas.

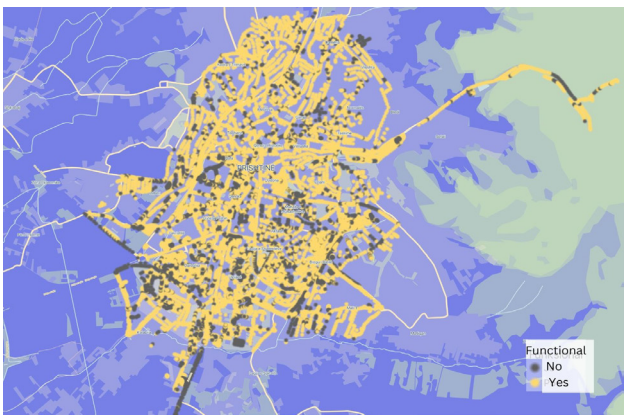

Figure 2. The presence of public lighting in the urban area of Prishtina.

3.1.2 The presence of cameras: For the indicator that measures the presence of cameras in public spaces, a total of 7154 points were collected, with each point representing one camera.
Among them, 6387 were privately owned, and 767 were publicly owned. While the presence of cameras has a positive effect on the safety index, data collected in the field revealed

that 90% of the cameras visible from the study area's public spaces are privately owned, set up for various activities, primarily business (Figure 3).
Although these privately owned cameras offer access to their recordings to relevant institutions, the fact that only 10% of the cameras are publicly owned, with fast and secure access, raises questions about the positioning of this indicator as a positive impact in the index.

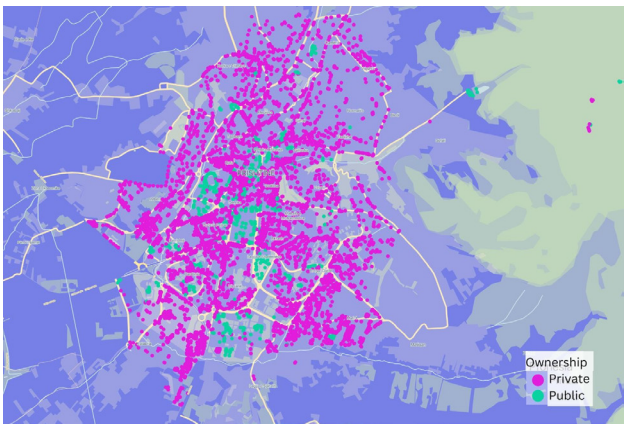

Figure 3. The presence of cameras in the urban area of Prishtina.

3.1.3 The presence of public institutions: For the indicator that measures the presence of public institutions within public spaces, a total of 25 institutions were mapped and categorized based on their functions, such as public administration, police, health, or fire brigade (Figure 4).
These institutions are predominantly located in the city center, with very few in other areas, reflecting the administrative centralization of the Municipality of Prishtina and inadequate spread of services in outer neighborhoods. The high concentration of these buildings in the city center directly impacts the safety index of these areas, increasing their level of safety.

However, data collection for public institutions should be expanded to include accurate locations of other institutions within the urban area of Prishtina to provide a more realistic assessment in the index.

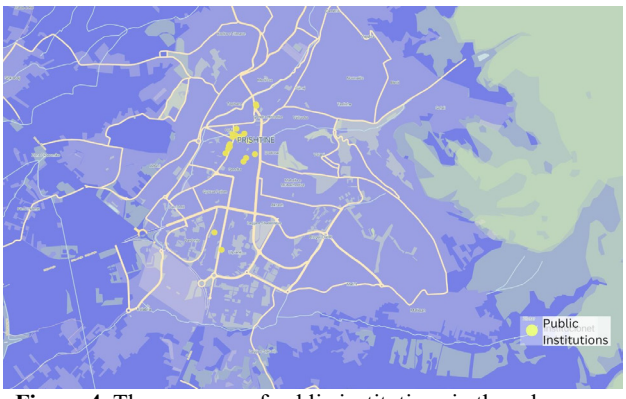

Figure 4. The presence of public institutions in the urban area of Prishtina.

3.1.4 The presence of stray dogs: For the indicator that measures the presence of stray dogs in public spaces, data was collected on the locations where stray dogs were observed during fieldwork. A total of 242 locations were identified, with 98 locations having only one dog at that time and 144 locations having multiple dogs (Figure 5). The distribution of public spaces with the recorded presence of stray dogs was almost uniform throughout the data collection area. However, collecting data for registering stray dogs requires a longer period of conduction as dogs move, potentially resulting in multiple registrations of the same dog.

Nevertheless, this provides an overview of the current state and geographical extent of this phenomenon in the city, and the impact on the calculation of the index remains accurate. The collected locations also serve as a starting point for further in-depth work to assess the presence of stray dogs in the city more accurately.

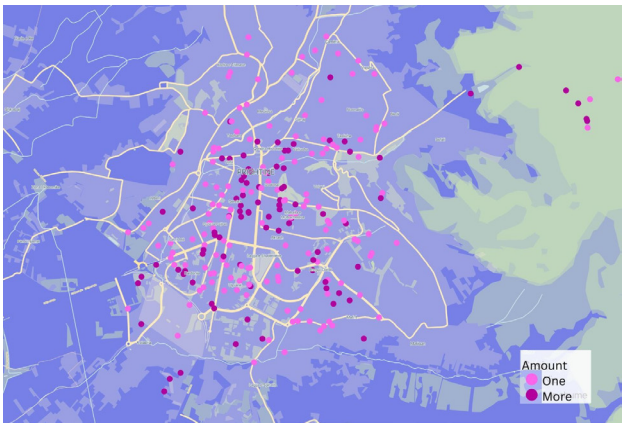

Figure 5. The presence of stray dogs in the urban area of Prishtina.

3.2 The results of the subjective indicators

3.2.1 Harassment: The field survey gathered a total of 248 data points to assess the subjective indicator for the perceived risk of being harassed, with one point per person surveyed. The data includes information on the respondents' location, gender, the gender of the individuals they feel threatened by, and the type of harassment.

Women surveyed in all spaces where data collection was conducted expressed fear of verbal and physical harassment, as indicated in the map (Figure 6), which shows that the entire urban area of Prishtina is perceived as a high-risk zone for harassment. Similar to studies conducted in other cities, women in Prishtina reported anticipating harassment from men in almost all public spaces where data was collected.

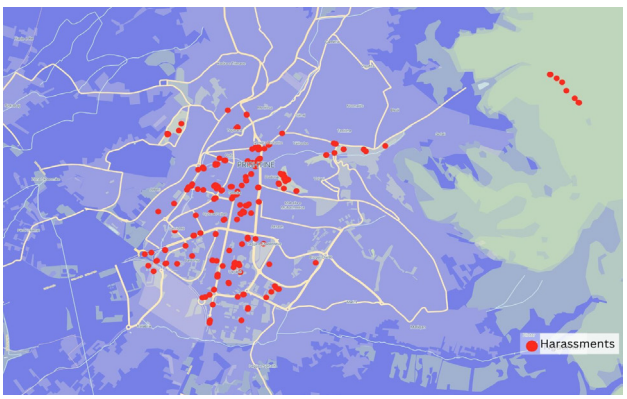

Figure 6. The perceived fear of harassments in the urban area of Prishtina.

3.2.2 Perception of being a victim of theft: A total of 227 respondents reported fear of becoming victims of theft in public spaces, and these perceptions were recorded as data points on the map (Figure 7).

The perception of thefts was observed throughout all of the urban area of Prishtina, including the central area of the city, despite the higher presence of social activity during all daily periods.

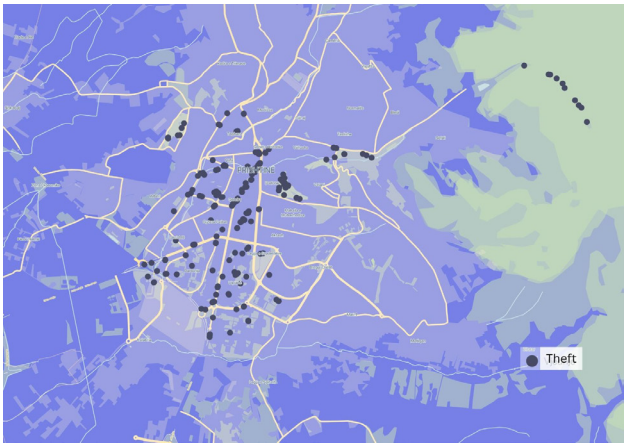

Figure 7. The perceived fear of theft in the urban area of Prishtina.

3.2.3 Perception of Diversity: During the field data collection, a total of 400 data points were recorded for the indicator measuring perceived diversity in public spaces (Figure 8). Respondents evaluated the space they were in on a scale of 1-3, with 1 indicating the space is not diverse at all, and 3 indicating the space is very diverse.

Out of the collected data, 45 respondents assessed the public space as not diverse (grade 1), 187 as moderately diverse (grade 2), and 168 as very diverse (grade 3). It's worth noting that the surveys were mainly conducted in the most populated public spaces of the study area with a higher diversity of people.

Respondents assessed spaces around the City's Central Bus Station as less diverse, while parks like Germia Park were assessed as very diverse in most of the cases.

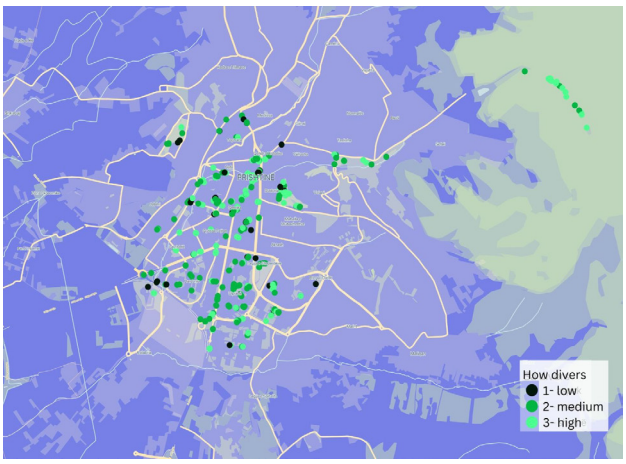

Figure 8. The perceived diversity in the urban area of Prishtina.

3.2.4 Physical Threats: A total of 236 data points were collected to estimate citizens' perceptions of physical threats in public spaces (Figure 9).

The most commonly mentioned physical threats were lack or irregularities of physical infrastructure, presence of stray dogs, threats coming from atmospheric conditions (such as snow or wind), and electric scooters. The map shows that this phenomenon is spread across all areas of Prishtina.

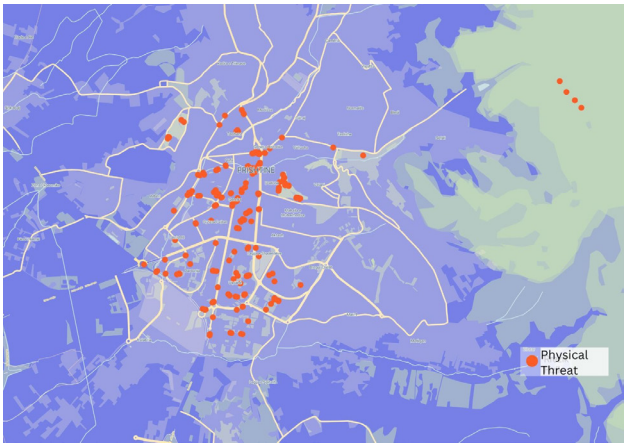

Figure 9. The perceived fear of physical threats in the urban area of Prishtina.

3.3 The results of SafoMeter safety index in Prishtina

The study results in Prishtina indicate that the safety score in the city's public spaces is generally low, with none of the evaluated spaces having a Safety Index value above 5.57 (Figure 10). A significant portion of the public spaces, approximately 17%, scored in the lowest range of 0-1, indicating a high level of unsafety.

The absence of public lighting was identified as a significant factor negatively impacting the safety index, particularly in areas where non-functional lighting was prevalent. Lighting is considered a factor in public spaces that increases safety. According to observational evidence, there is a correlation between improved ambient lighting and increased feelings of safety among individuals spending time outdoors in their community (Kaplan and Chalfin, 2021).

The study found that the city's parks, including Gërmia Park, Central City Park, and Arbëria Park, were evaluated as the least safe. Additionally, many central areas within Prishtina were also identified as unsafe hotspots. Although only about 4% of the public spaces in the study area scored higher on the Safety Index, these spaces were also small, isolated, and not well connected, posing challenges for safe movement, especially for marginalized groups. This highlights the importance of improving safety in public spaces, particularly in parks and central areas, to ensure that all individuals have equal access to safe public spaces in Prishtina.

Geographic Information System (GIS) methods were employed to create maps that illustrate the spatial distribution of public spaces according to their safety score. The use of GIS allowed for the identification of patterns in the distribution of safe and unsafe spaces, aiding in the identification of high-risk areas and informing the allocation of resources to improve safety in public spaces. The maps produced provide a useful tool for

policymakers and urban planners to prioritize interventions in areas with the greatest need.

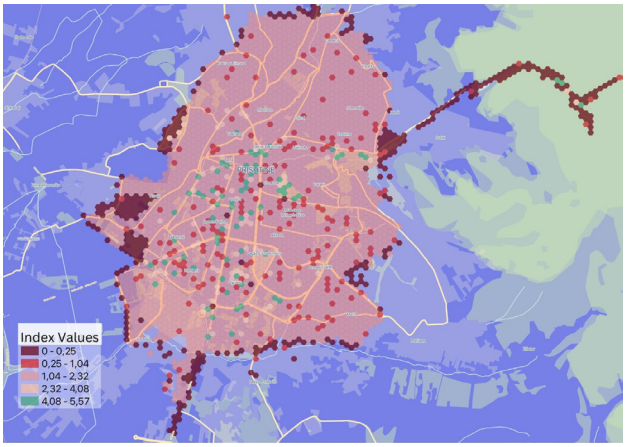

Figure 10. The Safety Index map for the urban area of Prishtina.

4. CONCLUSIONS

In conclusion, SafoMeter is a valuable initiative that aims to systematically measure safety in public spaces using a set of 8 indicators. The data collection process involves various methods, such as fieldwork for geo-referenced physical attributes of public spaces and field survey of user perception of safety in public spaces.

The results of the assessment in Prishtina, Kosovo, indicate that public spaces in the city have a low safety rating, with areas evaluated scoring below half of the safety index scale or with a maximum value of 5.57. This highlights the urgent need for intervention in terms of improving physical infrastructure and addressing safety concerns posed by the human factor. Parks and green spaces, which are already limited in Prishtina, were identified as particular hotspots with low safety scores.

The SafoMeter field survey conducted in the study area of Prishtina revealed that women respondents expressed fear of verbal and physical harassment in public spaces. The extent of public spaces perceived to pose risks of harassment by women was found to encompass the entire urban area of Prishtina. These findings are consistent with studies conducted in other cities (UN Women, 2021), further underscoring the need for effective measures to address gender-based violence and enhance safety in public spaces.

Moreover, the SafoMeter survey results indicate that a significant majority of women respondents identified men as the potential perpetrators of harassment, highlighting the gendered nature of public space safety concerns. Assessing women's perceived safety is crucial, given that gender is a determinant of feelings of insecurity, and the experiences of men and women in public spaces can vary significantly. These findings can amplify the need for gender-sensitive approaches in designing and managing public spaces to promote safety and inclusivity.

Geospatial data plays a crucial role in assessing safety in public spaces and identifying areas that require interventions. By mapping safety-related indicators, such as lighting, visibility, accessibility, and density of people and activities, geospatial data can reveal patterns and trends in safety and identify areas where safety is compromised. This information can then be used to develop targeted interventions to improve safety in specific locations. Additionally, geospatial data can facilitate the monitoring and evaluation of these interventions by providing a baseline for comparison and tracking changes over time. The use of geospatial data in safety assessment can help policymakers and urban planners create evidence-based policies and interventions that improve safety in public spaces, ultimately enhancing the quality of life for city residents.

The use of open-source software tools such as Mergin app and QGIS software enabled the collection and analysis of data in a cost-effective and efficient manner, making the process more accessible to researchers and practitioners. Furthermore, these tools allowed for greater collaboration and transparency, as data could be easily shared with stakeholders and made available as open data for researchers and the public.

Additionally, policymakers must consider the social aspect of safety in public spaces, including addressing issues such as social exclusion, discrimination, and unequal access to public spaces. This requires engaging with diverse social groups, including marginalized communities, and incorporating their perspectives and needs into the decision-making process.

4.1 Study limitations

The study has several limitations that should be considered when interpreting the findings.

Firstly, the data collection for the SafoMeter platform was conducted for a limited period, which may not capture long-term changes in safety in public spaces. Continuous data collection throughout the year would provide a more accurate representation of real-time assessments.
Secondly, the use of a hexagonal grid for data analysis may not capture the heterogeneity of real-world public spaces. While this approach is consistent with similar studies (Pánek et al., 2017), it may oversimplify the characteristics of different areas within the grid.
Thirdly, some of the indicators used in the study, such as the presence of stray dogs, may require more in-depth and accurate measurements, which could be challenging to collect within the limited time frame of the study.

Additionally, the exclusion of individuals aged 10-18 years from the field surveys due to legal restrictions limits the representation of this age group in the data. Further efforts to gather data from this sensitive age group through organized processes should be considered to make SafoMeter more comprehensive and inclusive.
These limitations highlight the need for further research and ongoing data collection to refine the SafoMeter assessment and ensure that it accurately reflects the complex and dynamic nature of safety in public spaces.

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