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SAFETY ASSESSMENT IN KÁROLYI KERT, BUDAPEST

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Abstract. *Given the dynamics of life in large cities and the associated pressures, urban parks can be classified as recreational resources that play an essential role in maintaining the population's well-being. For this reason, providing information based on safety analysis can help improve park users' perceptions and behaviours. This study aimed to identify recurring environmental and visitor-safety hazards at Károlyi Kert, Budapest, examine seasonal variation in assessment scores, and identify potential priorities for maintenance and risk reduction. Particular attention was given to distinguishing persistent concerns from temporary hazards documented under changing weather and site conditions. A total of 67 on-site assessments were recorded between 24 September 2025 and 26 September 2026. A ten-question checklist addressed environmental nuisances, ground and path conditions, heat, night-time visibility, security, safety communication, and sanitation. Yes/No responses were converted into binary risk indicators, with positive-condition questions reverse-coded. Each visit received an overall risk score calculated as the product of severity and likelihood ratings and classified into one of nine risk levels. The findings support reviewing lighting, path maintenance, sanitation, and weather-related warnings as potential management priorities. Although most assessments were classified as moderate, higher-scoring episodes highlight the value of seasonally responsive monitoring. The assessment provides a practical screening framework, but its observational design and judgement-based ratings do not establish causation or quantify the probability of visitor injury.*

Keywords*: urban parks, environmental risk assessment, visitor safety, seasonal variation, risk matrix, park maintenance, Budapest*

INTRODUCTION

Budapest's green spaces reflect historical land uses and successive periods of urban transformation (GOTHÁR, 2017; KOVÁCS et al., 2007; CSEMEZ and JOMBACH, 2011; SZILÁGYI et al., 2015) and play an important role in urban sustainable development (BAKAY et al. 2016; FAUREST, 2010; KONDOR and HORVÁTH, 2008; SALLAY et al., 2019; SZILÁGYI et al., 2021; WOJNOWSKA-HECIAK, 2016). Access to green space varies with geographical location, income, and green-space type (CSOMÓS et al., 2024), while comparative research emphasises the quantity, quality, and accessibility of green infrastructure within an environmental-justice framework (DELGADO DA SILVA et al., 2022). Research on green spaces in Budapest covers a wide range of aspects, from carbon sequestration (ABSATU et al., 2025) to the improvement of the well-being of the city's inhabitants, supporting real estate investment and development projects to initiatives aimed at creating nature protection zones (NAGY, 2002; NAGY and MALATINSZKY, 2019). Studies of green-space renewal and community gardens in Budapest highlight the importance of resident participation, institutional support, and continued engagement (KONDOR and HORVÁTH, 2008; MSEDDI and SIMON, 2022). Communication about park projects can also support public understanding of ecological functions (SZABÓ and SÁROSPATAKI, 2024). Field observations provide a complementary perspective on site conditions, as illustrated by an assessment of urban trees along the Danube (BÁTHORYNÉ NAGY and TAKÁCS, 2016).

The present study aimed to identify recurring environmental and visitor-safety hazards at Károlyi Kert, Budapest (Fig. 1), examine seasonal variation in assessment scores, and identify

potential priorities for maintenance and risk reduction.



Figure 1 – Location of Károlyi Kert

Obs.: a – satellite image of Hungary (circle indicates location of Budapest); b – satellite image of Budapest (city limits are indicated by the dotted line; the arrow indicates the location of Károlyi Kert); c – satellite image of Károlyi Kert (map by Zs. Török, processed with QGIS 2.18.17).

Repeated checklist-based observations and visit-level risk scores were used to distinguish persistent concerns from temporary hazards documented under changing weather and site conditions. The assessment served as a practical screening approach, rather than a measure of visitor perceptions or the probability of injury.

MATERIAL AND METHODS

Study design - The study used a descriptive, single-site observational design based on repeated assessments of Károlyi Kert, Budapest. Data collection began as a semester project at John Wesley Theological College, Budapest. A total of 67 on-site assessments were recorded between 24 September 2025 and 26 September 2026. The investigations did not constitute continuous monitoring or a fixed, weekly schedule for sample collection and interviews. The unit of analysis was predetermined and examined separately for each individual investigation.

A focused bibliographic investigation based on five overlapping themes: urban development and green-space provision; accessibility and environmental justice; park use and safety perceptions; participation, management, and communication; and field-based evaluation provided the contextual basis for the field study. An initial screening of the specialised literature, using Google Scholar and ResearchGate platforms as a search engine, led to the selection of 97 articles. Subsequently, the analysis was refined using keywords (such as “urban parks,” “environmental risk assessment,” and “Budapest”), and the authors focused on the key aspects addressed in this paper.

Field observations - Field assessments used visual and sensory observations recorded through a ten-question Yes/No checklist. The questions covered odour; noise and vibration; a combined category for dust, mud, litter, and pests; ground stability; slippery ground during rain or snow; heat-related concerns; adequate night-time visibility; security; communication of safety risks through signs, maps, or notices; and clean and functional toilets and sanitation facilities.

The combined dust, mud, litter, and pests item was treated as one category, regardless of how many of its components were noted. Its workbook label, "emissions," did not represent an instrument-based measurement of atmospheric pollutants.

Qualitative weather and site notes accompanied the checklist and provided context for interpreting individual assessments. For analysis, each investigation was assigned to one weather category based on these notes: dry and mild; wet (rain or mud); hot (30°C or above); after a storm; snow, ice, or thaw; and heatwave. Seasons were defined as autumn (September–November), winter (December–February), spring (March–May), and summer (June–August).

Data analysis - The risk matrix methodology is a widely used model that allows for the rapid visualisation of risk levels. This model facilitates decision-making and the implementation of further actions (KOVAČEVIĆ et al., 2019; KOULINAS et al., 2021; LEMMENS et al., 2022).

In this paper, the authors have created a matrix (Table 1) to enable risk assessment in an urban park. The study-specific categories were used for relative prioritisation and were not treated as calibrated estimates of injury probability.

Severity and likelihood were each rated on four levels (Table 1). Severity ranged from 1 (minor: discomfort or nuisance, no injury) through 2 (significant: minor injury, first aid at most) and 3 (critical: injury requiring medical attention) to 4 (catastrophic: serious injury requiring hospital treatment or worse). Likelihood ranged from 1 (rarely: hazard barely present, harm not expected) through 2 (occasional: hazard present, harm not expected with normal care) and 3 (likely: hazard widespread, some visitors could be harmed) to 4 (frequent: harm expected for some visitors).

Table 1

The Risk Assessment Code Matrix (RAC)

Severity ↓ / Likelihood →	1-Rarely	2-Occasional	3-Likely	4-Frequent
1 - Minor	1	2	3	4
2 - Significant	2	4	6	8
3 - Critical	3	6	9	12
4 - Catastrophic	4	8	12	16

Note: Higher ratings indicate greater severity or likelihood. Values in the matrix are possible scores, not observed frequencies.

Data from the 67 recorded assessments were organised and analysed in Microsoft Excel. The Yes/No checklist responses were converted into binary risk indicators, with a value of 1 representing a flagged condition and a value of 0 representing no flagged condition. For questions concerning odour, noise and vibration, the combined dust/mud/litter/pests category, slippery ground, and heat-related concerns, "Yes" was coded as 1 and "No" as 0. Positively framed questions concerning ground stability, adequate night-time visibility, security, safety communication, and clean and functional sanitation facilities were reverse-coded: "No" was coded as 1 and "Yes" as 0.

The ten binary indicators were summed for each investigation to obtain an issue count ranging from 0 to 10. This count represented the number of checklist categories flagged and was kept separate from the overall risk score. Each checklist category contributed equally to the count, regardless of the potential severity of the concern.

An overall severity rating and an overall likelihood rating were assigned to each investigation using judgement of the recorded conditions. One pair of ratings was used for the overall investigation assessment, rather than a separate pair for each checklist item.

The risk score was calculated as:

$$\mathbf{R = S \times L}$$

Here, R denotes the investigation-level risk score, S denotes severity, and L denotes likelihood.

Each investigation was classified according to its point on the nine-point risk scale, from no risk (score 1) to life-threatening (score 16) (Table 2).

Table 2

The nine-point risk scale

Level	Risk score (S×L)	Risk level
1	1	No risk
2	2	Negligible
3	3	Negligible to minor
4	4	Minor
5	6	Moderate
6	8	Serious
7	9	High
8	12	Very high
9	16	Life-threatening

Descriptive analysis included the mean and observed range of risk scores and the number and percentage of investigation in each risk category. Overall percentages were calculated using all 67 assessments as the denominator. Monthly summaries included the number of investigation, mean issue count, mean and maximum risk scores, and risk-category counts. The overall mean was calculated across individual investigation, rather than as an unweighted average of monthly means.

Chronological and monthly comparisons were considered alongside qualitative weather and site notes to describe seasonal variation and distinguish recurring concerns from temporary conditions. Interpretation took account of unequal investigation numbers and the partial coverage of September at the beginning and end of the study. The analysis remained descriptive: no significance tests, causal models, or estimates of visitor (park users) injury incidence were applied.

RESULTS AND DISCUSSION

The establishment and maintenance of a public park raise a number of issues, ranging from costs and benefits (IVÁNCSICS et al., 2019) to ensuring a sense of safety for the users of these green spaces (KOTHENCZ and BLASCHKE, 2017).

Checklist findings - The literature review informed the background to the study but did not supply a validated version of the checklist or its numerical thresholds. The recorded variables concerned observed or judged conditions relevant to potential harm, rather than verified injury events or measured visitor exposure.

Across the 67 assessments, the issue count ranged from 1 to 5 flagged categories per investigation (mean 3.18). The combined dust, mud, litter, and pests category was flagged on 66 investigations (98.5%), and inadequate night-time visibility on 58 visits (86.6%), making these the two persistent concerns at Károlyi Kert (Table 3). Slippery ground (38.8%), heat-related concerns (29.9%), unclean or non-functional toilets (23.9%), and noise or vibration (20.9%) were recorded intermittently, while unstable ground (11.9%) and odour (7.5%) were occasional. Security and the communication of safety risks were judged adequate on every investigation. This observation refers to site conditions only: in Budapest's inner-city parks, visitors' feelings of safety have been shown to vary between social groups and do not necessarily reflect actual security measures (CSOMÓS et al., 2023), and visitor perceptions may differ from objectively recorded site indicators (KOTHENCZ and BLASCHKE, 2017).

Table 3

Frequency of flagged checklist categories (n = 67 visits)

Checklist problem	Visits	% of visits
Dust, mud, litter or pests	66	98.5%
Night-time visibility not adequate	58	86.6%
Slippery ground	26	38.8%
Heat-related concerns	20	29.9%
Toilets not clean or working	16	23.9%
Noise or vibration	14	20.9%
Ground not stable	8	11.9%
Odour	5	7.5%
Security not adequate	0	0.0%
Safety risks not communicated	0	0.0%

Risk scores and the nine-point risk scale – Observed risk scores ranged from 2 to 9 (mean 5.69; median 6). Most assessments were classified as moderate (score 6; 34 visits, 50.7%), followed by minor (score 4; 21 visits, 31.3%), high (score 9; 9 visits, 13.4%), negligible (score 2; 2 visits, 3.0%), and serious (score 8; 1 visit, 1.5%) (Table 4).

Table 4

Distribution of visits on the nine-point risk scale

Risk level	Risk score	Visits	% of visits
No risk	1	0	0.0%
Negligible	2	2	3.0%
Negligible to minor	3	0	0.0%
Minor	4	21	31.3%
Moderate	6	34	50.7%
Serious	8	1	1.5%
High	9	9	13.4%
Very high	12	0	0.0%
Life-threatening	16	0	0.0%
	TOTAL	**67**	**100.0%**

No visit was classified as no risk, negligible to minor, very high, or life-threatening. Overall, 23 visits (34.3%) fell in the four lowest points of the scale (scores 1–4), 35 (52.2%) in the moderate–serious range (scores 6–8), and 9 (13.4%) at high (score 9); no visit reached the two highest points of the scale.

The issue count and the risk score were related but not equivalent. Mean risk scores rose from 4.42 on visits with two flagged categories to 7.70 on visits with five, yet high-risk visits had a somewhat higher mean issue count than moderate visits (4.56 vs 3.50): their scores reflected the potential consequences of specific conditions, such as ice or extreme heat, rather than the number of problems recorded.

Seasonal variation – Risk scores varied with season and weather (Fig. 2).

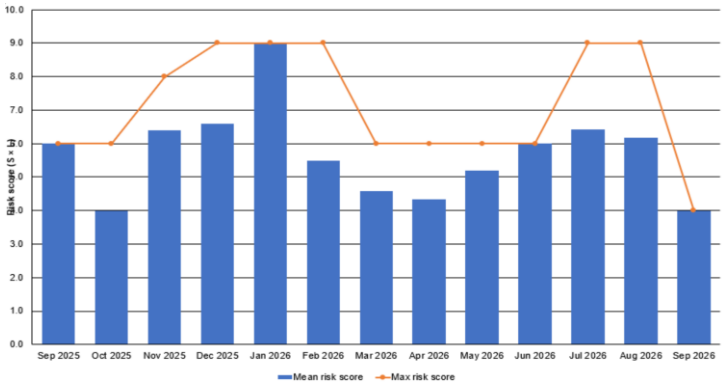


Figure 2 – Mean and maximum risk score by month

The highest monthly mean occurred in January 2026 (9.0), when all five investigations were classified as high because of snow, ice, and thaw on the paths. Seven of the nine high-risk investigation were recorded under snow or ice conditions between 31 December 2025 and 3 February 2026, and two during heatwave conditions on 26 July and 2 August 2026. The only investigation classified as serious (score 8) was recorded on 22 November 2025, after a storm, when the potential for injury from storm damage was combined with slippery paths, inadequate lighting, and unclean or non-functional toilets. Mean scores were lowest in October 2025 and September 2026 (both 4.0) and in spring (March 4.57; April 4.33); dry, mild conditions predominated in spring and September 2026. By weather type, mean scores were 4.72 on dry, mild days; 6.0 on wet days; and hot days; 7.0 after storms, and 9.0 under snow or ice and heatwave conditions.

These results indicate that lighting and path cleanliness are persistent concerns requiring routine maintenance, while slippery ground, ice, and heat are temporary, weather-driven hazards that raise risk for short periods.

Weather conditions – Weather was most closely associated with high scores (Fig. 3). All period under snow, ice, or thaw and both heat wave were scored 9 (high), whereas dry, mild days had the lowest mean score (4.72), and none of them exceeded moderate. All wet days and hot days of 30°C or more were classified as moderate, and the ones after storms averaged 7.0. Factors such as: unclean or non-functional toilets were noted on the wet days and snow or ice days but never on dry, mild days; unstable ground was recorded on all snow / ice or during winter observed period; and odour only on hot or heatwave days.

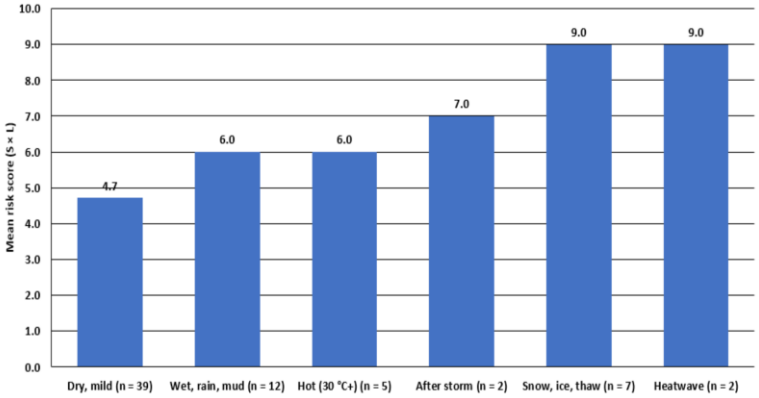


Figure 3 – Mean risk score by weather condition (n = number of visits)

Persistent and temporary hazards – Combining the overall frequencies (Table 3) with their distribution across seasons allows the checklist categories to be grouped by their pattern of occurrence. Two concerns were persistent: dust, mud, litter, or pests were recorded on at least 94% of investigations in every season, and there was inadequate nighttime visibility on every investigation in autumn, winter, and spring, falling to 50% in summer, possibly because of longer daylight hours. Slippery ground (67% of autumn and 81% of winter investigations) and unstable ground (50% of winter investigation) were cold-season hazards, while heat-related concerns (94%) and odour (22%) were concentrated in summer. Sanitation problems were linked to wet and icy weather rather than to one season, and noise or vibration occurred intermittently, mostly in summer and autumn. No security or safety communication problems were recorded. The need to revise certain routine maintenance standards has been identified, and temporary hazards have been noted that require additional, time-limited measures.

Implications for park management – Urban parks are exposed to multiple and cumulative environmental loads that require regular maintenance (SZILÁGYI et al., 2015), and the findings suggest two types of response. Persistent concerns, namely path cleanliness and inadequate nighttime lighting, call for routine measures, such as more frequent cleaning after rain and a review of lighting along the main paths. Temporary, weather-driven hazards call for seasonal measures that can be scheduled in advance: gritting and ice warnings in winter and heat-related guidance and access to drinking water in summer. Sanitation should be checked particularly after rain and during icy periods, when unclean or non-functional toilets were most often recorded. Because maintenance resources are limited, the costs and benefits of such measures need to be weighed (IVÁNCSICS et al., 2019), and the risk matrix offers a transparent way to weigh probability and impact when deciding on interventions (LEMMENS et al., 2022).

Limitations – All ratings were based on the judgement of the assessors, and a single severity–likelihood pair was assigned to each investigation rather than to each hazard. The number of investigations varied from one month to another, and the month of September was covered only partially—at the beginning and at the end of the study. Finally, the assessment recorded site conditions rather than visitor numbers or experiences; this matters because visitor perceptions may differ from objectively recorded indicators (KOTHENCZ and BLASCHKE, 2017; CSOMÓS et al., 2023).

The risk matrix itself is a simplification that combines two ordinal ratings into a single score; more advanced approaches combine it with multi-criteria and probabilistic methods (KOULINAS et al., 2021), which could be explored in future applications to urban parks.

CONCLUSIONS

Observations made over the course of a year highlighted the fact that there is no lack of communication regarding security and safety. Károlyi Kert is fully fenced and locked at night, and each entrance displays the opening hours and park rules. Staff are also present at closing time.

During the investigation period the safety in parc was classified at or below the moderate–serious range. No recordings reached the very high or life-threatening points.

Path cleanliness (dust, mud, and litter) and inadequate nighttime lighting were frequent flagged and represent persistent maintenance priorities. The high-risk hazards were linked to temporary conditions, mainly snow and ice in winter and heatwaves in summer.

The checklist and risk matrix provide a simple, repeatable screening tool for park managers, although the single-site design and judgement-based ratings mean the results indicate relative priorities rather than measured injury risk.

Future work could combine the checklist with short visitor surveys and extend the approach to other Budapest parks.

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