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Refugee Children's Access to Play in Meso-Environments: A Novel Approach Using Space Syntax and GIS

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Abstract: Being able to explore and play in quality open spaces in the neighbourhood is crucial for refugee children since refugee facilities often have inadequate playspaces indoors and outdoors. Access to meso-environment playspaces (around refugee accommodations) would provide refugee children with the opportunity for optimal physical, cognitive, emotional and social development and support their social inclusion. This study explores refugee children's access to play areas in meso environments with six study sites in Berlin. Active space for refugee children's play is assessed using: (1) open-source data collection, (2) method notions of perceived distance and spaces, (3) staff survey with site investigation and (4) space syntax theories of potential accessibility. Results indicated the fact of unequal playspace distributions for refugee children in Berlin with children-oriented assessment. The utilisation of space syntax in the context of refugee children is relatively unexplored. This study is thereby contributing to the space syntax literature by exploring the broader application potential of its methods. Further studies should broaden study sites with more precise environmental measures.

Keywords: migrants; accessibility; space syntax; urban design; meso environment; perceived distance; parental neighbourhood; safety; active playing; informal space

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1. Introduction

Neighbourhood playspaces (such as parks, playgrounds and other spaces available for children's playing, more details in Section 2.2) provide children with the opportunity to practice and hone social, cognitive, emotional and physical skills [1]. From architectural and urban planning perspectives, offering children enough public areas for play is an important starting point to meet children's needs for play and development [2]. Research has already reported that neighbourhood spaces provide refugee children with opportunities to build social ties with peers, transcend national boundaries, develop supportive social bonds and bridges and attain social inclusion [3–5]. Accessible neighbourhood playing spaces can be highly beneficial for children with refugee backgrounds since they live in unfamiliar and uncertain situations with limited indoor and outdoor playspaces within their refugee accommodations [6–8]. Despite the strong evidence supporting the health benefits of neighbourhood playing, studies rarely investigated the neighbourhood for refugee children's play [9]. Since lack of play behaviour can produce a long-term impact on children's future health and further development [10], and given the increasing number of fugitive families, especially the numbers of children's asylum applications [11], it is critical to collect evidence in design fields that can explore neighbourhood playing among refugee children.

Accessibility to playgrounds has traditionally been quantified using metric proximity, such as the shortest physical distance from the home to the playground [12]. However, traditional metrics often fail to reflect people's actual experience accessing the playspaces [13].

How humans perceive space is not purely metric; perceived distance is understood as even more important for the spatial experience than physical distance [14,15]. Recently, a few studies proposed novel spatial modelling frameworks for estimating cognitive distance in urban spaces [16–18]; a researcher also developed a space syntax assessment of the urban integration of built playgrounds and playground accessibility from children's perspectives [2]. Despite that, measurements for non-refugee children may not apply to refugee children since they live in very different settings (micro and meso environments) [7]. Refugee children and their parents have specific concerns and perceptions of the neighbourhood (e.g., safety) [7,19,20]. Hence, refugee children's access to neighbourhood playing should be investigated separately to produce insight and empirical material academically.

Within this frame of reference, this paper approaches an assessment of refugee children concerning meso-environment's playspace accessibility, with the objective to present and evaluate the facts of existing neighbourhood environments for refugee children's play.

2. Theoretical Framework

2.1. Perceived Neighbourhood Distance for Refugee Children and Their Parents

Refugee children and their parents carefully explore the neighbourhood due to their specific concerns about neighbourhood safety [19,20]. Refugee children's unsupervised play may only happen inside or at vicinities of refugee accommodations [19]. Playing mostly happens with their parents' company. From children's perspective, they may perceive the area accessible within 10–15 min of walking as their neighbourhood [21,22] and if the playground is easy for them to access [2]. As mentioned before, the study by KTH Royal Institute of Technology developed a configurative measurement for children's perceived distances to playgrounds [2]; still, no such research treating specifically refugee children's perceptions is known to the authors. This article tried to approach perceived distance for refugee children with several technical methods as redefining angular measure, road segment weight, destination choices and available playing spaces in short path finding models.

2.2. Formal and Informal Playspaces for Refugee Children

As defined earlier by the authors' review, two categories of neighbourhood spaces are related to refugee children's potential for play as formal and informal [7]. Formal playspaces are facilities or spaces explicitly built for the purpose of playing—examples such as playgrounds, parks, and sports fields. Informal playspaces refer to any urban spaces that are readily and freely available to refugee children. Refugee children may have limited resources of official or specific facilities for playing or are not motivated to go to these spaces in meso environments. They may live in neighbourhoods with limited playing-related facilities (e.g., parks) initially [20,23], or the existing parks were seen as not being a good place for children to play by parents and children [20]. The neighbourhood may be deemed unsafe or unfriendly for children to access these playspaces, since facilities may already be occupied by children from this neighbourhood [24]. Financial problems may be another primary reason, since families can hardly afford existing programs in commercial play facilities [25–28]. Moreover, the existing commercial formal facilities may have lower accessibility for refugee families if they fail to respond to their cultural sensibilities [8,19].

The abovementioned and the authors' previous review indicated the potential of informal playspaces for refugee children's play [7]. Refugee children enjoy playing in informal places since playing could be raised from temporary rules instead of formal regulations by social norms [19,29]. Research shows informal spaces play an essential role in refugee children's play but also highlights limitations and problems in realising informal playspaces' full potential [20,27,29–31]. Still, there is a lack of an academic assessment and definition of informal spaces related to refugee children's play. In this article, the authors approached potential informal spaces by measuring 'grasslands' from available databases, which helped to contribute to the understanding of informal settlements for refugee children's play; a more detailed assessment should be developed in the future.

2.3. Space Syntax and Playspace Accessibility for Refugee Children

Research has noticed that refugee children tend to be active in informal settlements for play [29]. The authors' previous research also subdivided these formal and informal playspaces in refugee accommodations' neighbourhoods and established an understanding between spatial characteristics and refugee children's play [8]. Space syntax was applied in this article as a spatial measurement tool related to refugee children's perceived distance concerning neighbourhood playing, which helps to build an in-depth cognition based on spatial configurations. The potential of employing space syntax seems multi-fold. Researchers argue that the configuration of the city has a direct impact on the social life that takes place in it and that urban form and configuration both separate and bind us together. The fundamental ideas of space syntax are how human spatial behaviour relates to the city's physical design [32,33]. In a detailed explanation, individual spaces such as playspaces and the connections between them in the built environments create specific opportunities for playing. In architectural terms, these features are best seen in the layout of the neighbourhood, and space syntax is the theory that analyses the layout of space in buildings and cities [34]. It can respond to the need to collect data on residents and intrinsically express how a configurational approach could influence their social and physical behaviour.

Although there is great potential to complement and build upon existing methods for quantifying refugee children's access to play in neighbourhoods, not many studies have applied this method in the context of children; in a brief opinion essay, Cutumisu and Spence [35] outlined some of the advantages of using space syntax in measurements relating to children's playing. First, aspects of the environment, such as safety and sense of place, may influence children's play, and space syntax has the capability to explain children's movement relying solely on spatial configuration. Second, topology-geometric descriptors of space syntax can better represent the built environment concerning children's perceptions since they resonate with how children develop and navigate spatial knowledge. Finally, space syntax provides a measurement-based way of assessing meso-environment accessibility based only on simple data such as road segment data.

Nevertheless, the authors are aware of the fact that only a few studies focus on this topic; as mentioned before, one study applied space syntax in the context of children's play associated with playground accessibility [2]. The utilisation of space syntax in refugee children's playspaces accessibility is a necessary but still relatively unexplored field. This study is thereby continuing to contribute to the space syntax literature by exploring the broader application potential of its theories.

3. Methodology

3.1. Data Sources and Processing

The sampling strategy of refugee accommodation selections is based on purposeful criteria [36]: available GIS data, the number of children residents (6 to 12 years old) and locations (Table 1). As a pilot study, six refugee accommodation sites completed the data collection of staff surveys and field investigations from July 2018 to February 2019. The study sites were anonymised, named I to VI based on interview/observation times and accommodation types. Figure 1 illustrates six study sites and their locations. Sites I, III and IV were located in residential areas, while sites II and V were in industrial, grassland or undefined areas (definition by OpenStreetMap). Site VI was located inside the neighbourhood park. Until data summarising time, 4/6 accommodations were closed, and Site I was transferring to different operators.

Table 1. Comparison of refugee accommodation features, children's demographic information and neighbourhood features across six study sites.

Study Site	Accommodation Types	Expected Stay Period in This Accommodation	Existing Period	Interview/ Observation Date	Children Population: Aged 6–12 [1]	Children's Countries of Origin [1]	Neighbourhood Feature [3]
I	initial reception		12.2015-current [2]	30.07.2018	30	Muslim and Asia	residential area
II	initial reception	3–6 months	09.2014–08.2019	16.10.2018	33	Asia and Africa	residential area
III	initial reception		02.2012-current	23.10.2018	27	Multi-ethnic	industrial/grassland
IV	Tempohomes	uncertain period	12.2016–07.2019	14.02.2019	20–30	Muslim	residential area
V	community accommodation		07.2015–10.2020	30.11.2018	18	Multi-ethnic	undefined areas
VI	community accommodation	12 months	04.2015–09.2020	23.01.2019	30	Muslim	inside a park

[1] By each individual interview time; current: November 2022; [2] The accommodation is still open but runs by different operator compared to interview time. [3] Defined by OpenStreetMap of each individual interview and observation date.
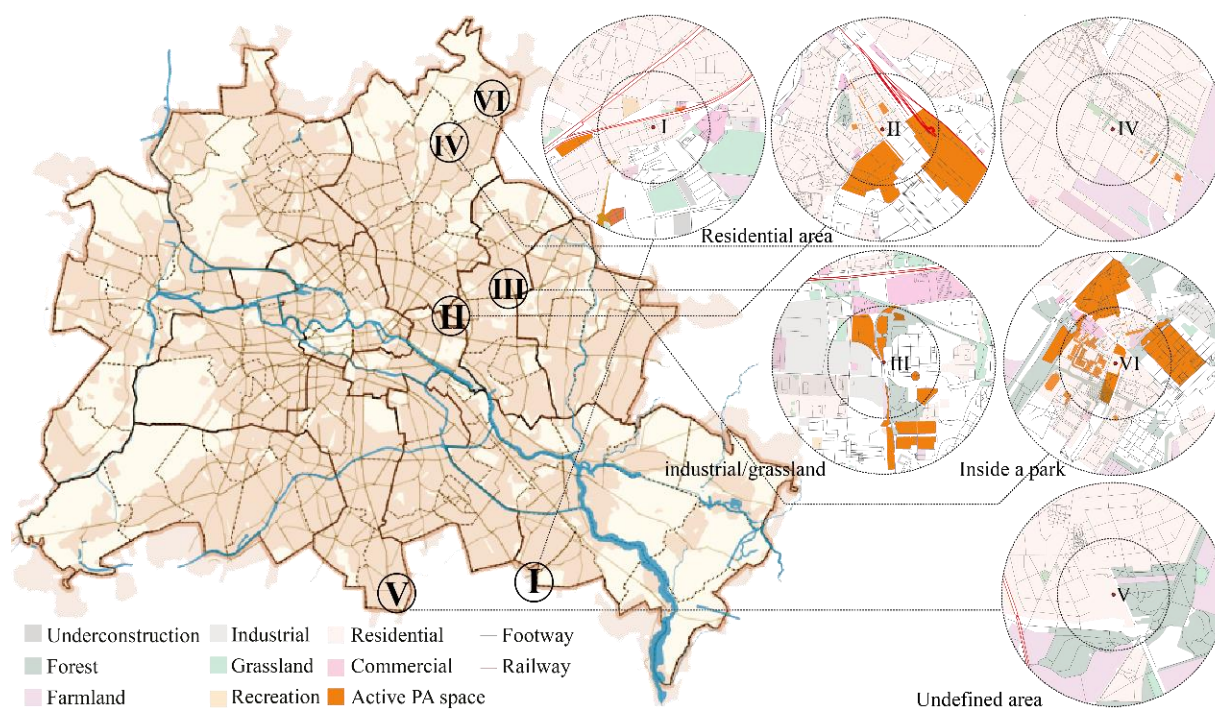
Figure 1. Location (left) and neighbourhood featured in six study sites in Berlin (right).

It is worth mentioning that instead of the official land use of Berlin (German Flächen-nutzungsplan Berlin, FNP) [37], the authors applied unofficial OpenStreetMap since we aimed to document neighbourhood environments for refugee children while staying in these temporary refugee facilities [8,38]. OpenStreetMap (real-time changes, map features automatically available) is more responsive to reflect these situations than FNP (5–6 year changes, map features manually available).

As shown in Figure 2: *Step 1:* road segment data (pathways for pedestrians) were obtained by the OpenStreetMap [39] as geographic information system (GIS) software. Elk 2 ([40], an open-source data-based tool for map and topographical generating) was applied to optimise the data in Rhino 6 environments. Model inputs were generated road segments, land use and facility functions; the specific coding of each spatial characteristic category is shown in Supplementary Materials Table S1. *Step 2:* Children staff surveys and neighbourhood target playspace investigations were applied on this basis. In *Step 3*, these elements were used for calculating the respective requirements of playspaces

from children/parental perceived distance (500 m and 500–1000 m), and *Step 4* provides comparative analysis to represent playspace distributions.
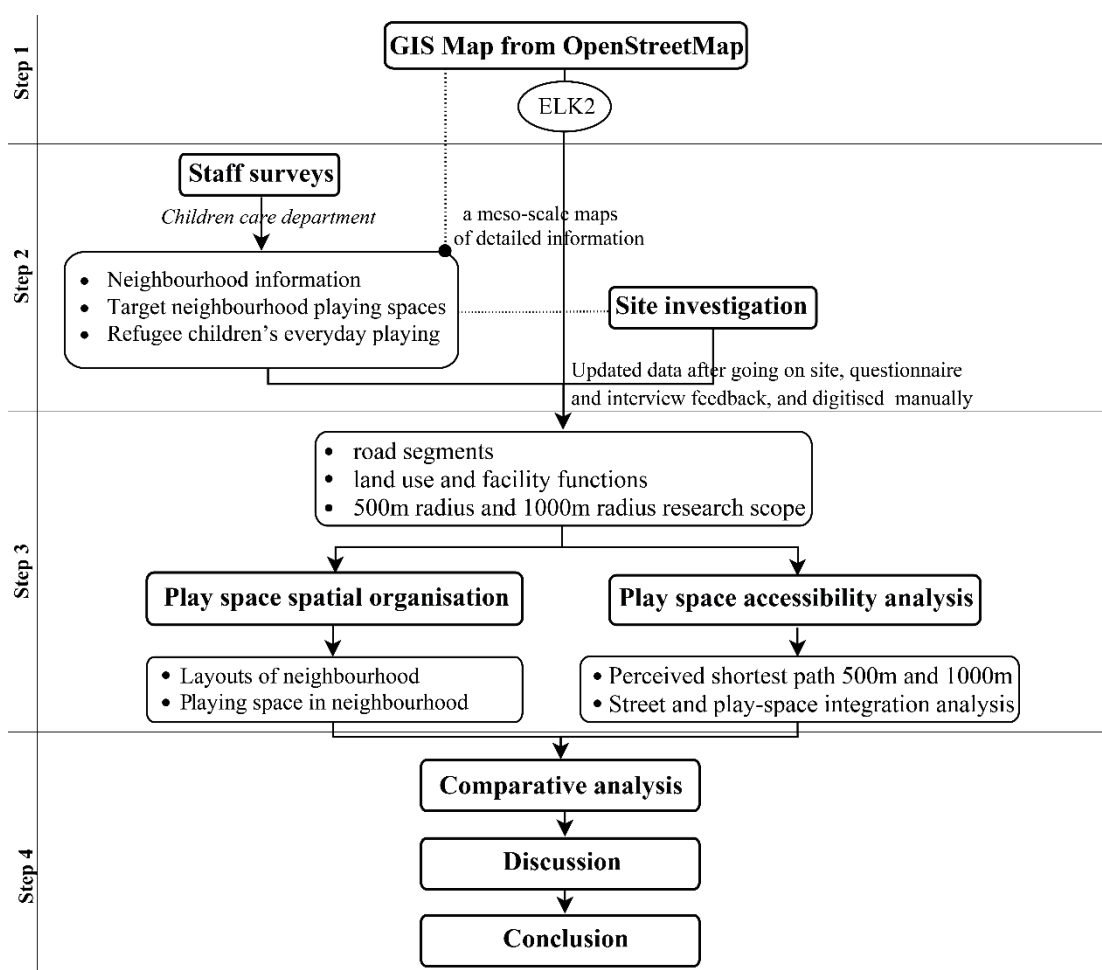

Figure 2. Overview of meso-environments approach including data sources, steps, technical methods and outputs.

Staff Survey and Site Investigation

Surveys for children's departments include basic situations, existing meso environments and refugee children's daily playing lives. They also helped the researchers to identify neighbourhood playspaces for refugee children with provided maps. The existing meso environments for children's play were rated with five-degree questions from 1 (worse) to 5 (excellent). All interviewees were fully informed about the research process (e.g., by email) and provided signed consent. Site investigations were applied after the staff survey as the researcher SC took photos and observed staff-reported neighbourhood playspaces in real sites.

3.2. Technical Approach for Playspace Definitions and Accessibility

3.2.1. Potential Playspaces: Formal and Informal

As mentioned before, the formal and informal playspaces were defined by existing map features [41] in Table 2; detailed references could be found in Supplementary Materials Table S2.

3.2.2. Perceived Neighbourhood Distance and Accessible Playspaces

Dijkstra's algorithm [42] was applied to obtain the shortest paths from a refugee accommodation to all potential playspaces. Figure 3 gives examples of two points to

find the shortest path; it is hard for pedestrians to follow the exact mathematical shortest path with complicated turns (e.g., only turns 90 degrees in road selections) in unknown or undeveloped built environments (a); users feel comfortable walking and orienting on straight lines [43,44] as (b) and (c). The angular measure is introduced here for this purpose: it reflects the straight percentage of the paths (how large, in terms of angles, changing of directions was along the path) and controls the influence with the geodesic measure coefficient [45]. This study chose the angular measure value in Figure 3b to perceive children's walking choices.

Table 2. Map feature and coding of potential formal and informal playspaces.

Category	Coding of Map Feature
Formal playspace	
Sport facility	sport centres; sport facilities
Park	all kinds of parks; garden; resort
Playground	all kinds of public ball playground; public playground
Informal playspace	
Grassland	open grassland; green space

The words presented here may differ from actual search strings; more details in Supplementary Materials Table S2.

Figure 3. Shortest path findings with the influence of (**a**) the shortest block-distance path from two points; (**b**) choice in between; (**c**) the fewest number of turns path from two points.

It is evidenced from previous research that parents are worried about neighbourhood physical safety concerning traffic [19,20]. The authors reflected this issue by assigning equal weight index values to each investigated road segment. This calculation will ensure all shortest paths happen only on existing road segments (Figure 4a), and no shortcutting is allowed (Figure 4b).

Figure 5a shows the destination method to potential playspaces: the nearest shape point of space was chosen in this research with the existing segments as road destinations (defined as playspace-located road segment) to include more potential playspaces.

Figure 5b,c show other possibilities: split and perpendicular road segments to find space centre points as destinations.
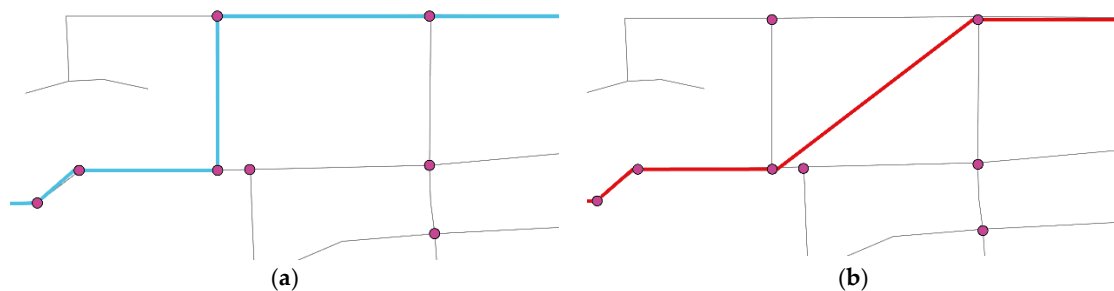

Figure 4. Shortest path findings with (**a**) existing segments; (**b**) new shortcut.
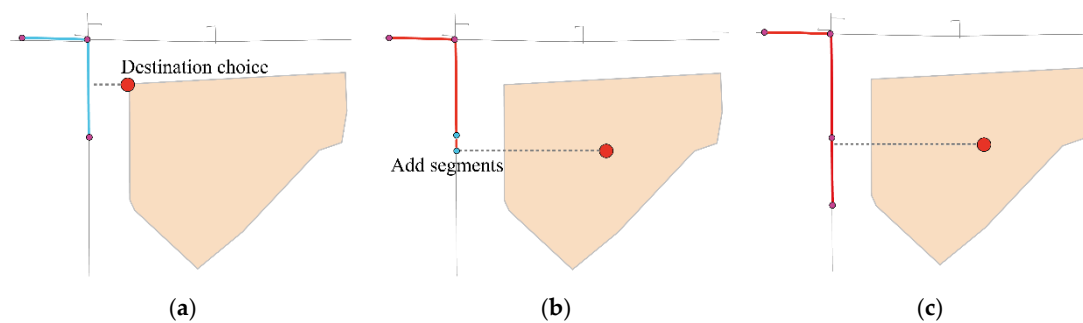

Figure 5. Shortest path findings with (**a**) existing road segment to the closest shape point; (**b**) add a segment to the centre point; (**c**) existing road segment to the centre point.

As abovementioned method choices, two types of perceived distances to playspace were set: (1) shortest paths under 500 m represent *children's perceived distance* (for neighbourhood) by approximated 10–15 min' walking [21,22]; (2) shortest paths from 500 m to 1000 m represents an additional view from a *parental distance* for the neighbourhood [46,47]. Staff also reported that refugee children's play was always supervised by parents; parents' perspectives partly decide where children can play [8,19]. All inputs were mathematically simplified, optimised and manually checked before calculation since some error inputs may lead to matrix recomputation.

3.2.3. Active Playspaces

Global integration reflects how one space is related to other spaces and their intimate physical space, moreover reflecting the centrality of space compared to all other spaces in the network. It indicates other spaces' potential as active destinations. Precisely, the spaces located in road segments with the top 10% ranking from the foreground network refer to space with the best (high) accessibility [48]. The spaces located in road segments with the top 10–20% ranking constituted the main skeleton of the urban frameworks and were defined as medium accessibility in this study. The bottom 80% ranking reflects road segments where residents travel less efficiently [18], defined as low accessibility in this research. All results were produced with Depthmap X software [49].

In summary, a multi-step playspace assessment will be given here:

Potential playspaces refer to all formal and informal playspaces from the GIS map within the research scope;

Accessible playspaces mean potential playspaces located less than perceived neighbourhood distances (500 m and 500–1000 m away from target facilities);

Active playspaces are accessible playspaces located on road segments that have the top 20% global integration with a subdivision as high accessibility (top 10%) or medium accessibility (top 10–20%).

4. Results and Comparison

4.1. Spatial Characteristics and Potential Playspaces

Site I was surrounded by residential buildings (Figure 6). The railroads and highways split this area and reduced its accessibility. There are three sport facilities, nine inside park playgrounds and small playgrounds around residential blocks as formal playspaces. There were also nine park areas in the research scope. Moreover, there were 27 green spaces.
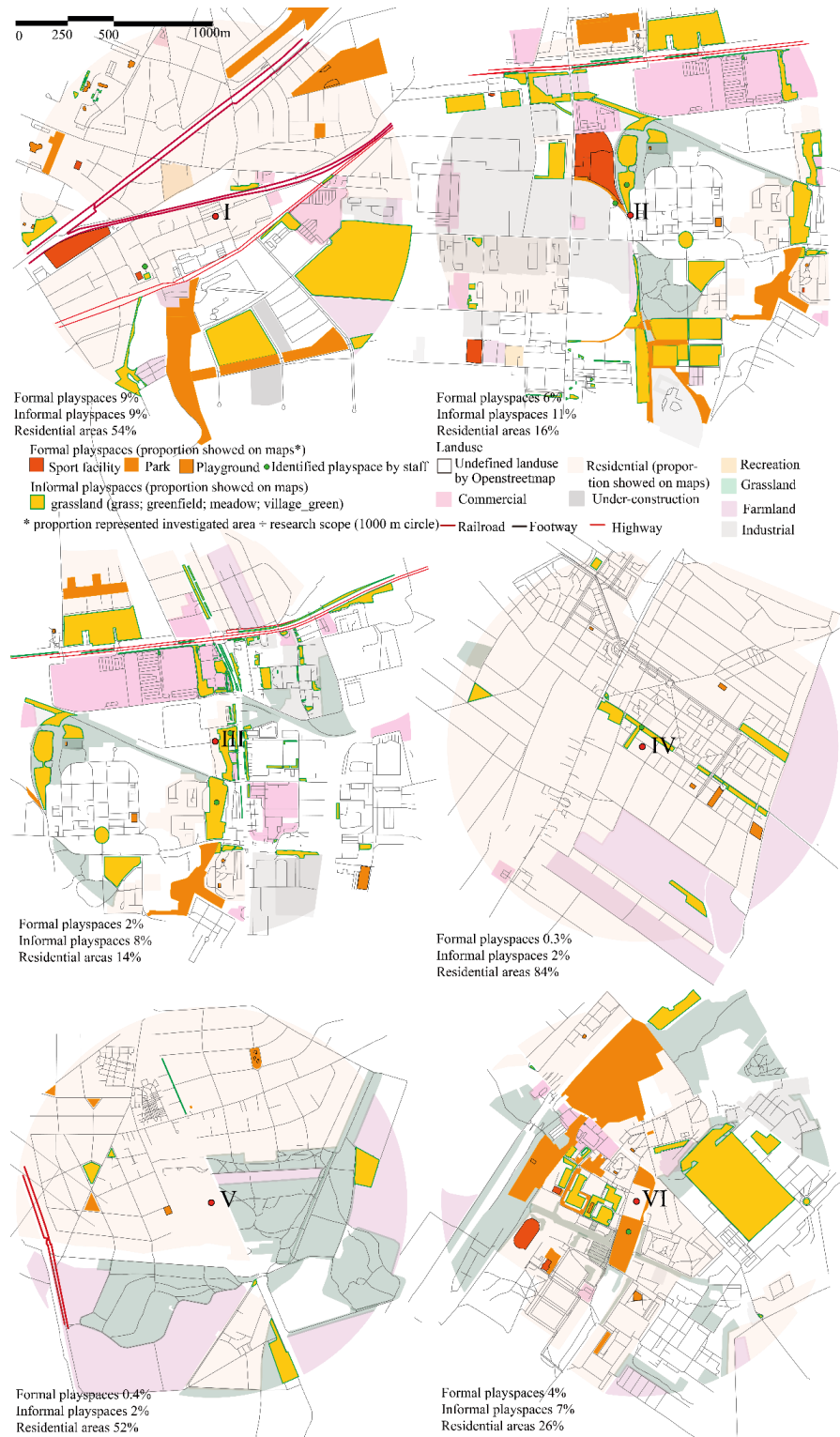

Figure 6. Potential playspaces and land use of six study sites.

Site II was in an industrial area that connects greenspace and park-sport facilities; both were identified by the staff as children's playspaces (Table 3). Most potential playspaces were pretty sizable, and the majority of parks are connected with grasslands. Six sport facilities, 12 park areas and five playgrounds are found in this neighbourhood as formal playspaces. There are 51 grasslands as potential informal spaces. The primary roads on top divided this area.

Site III stayed inside a residential area, surrounded by mix-use undefined areas, and the primary roads cut this neighbour into parts. Three playgrounds and six parks were potential formal playspaces. There were 59 informal playspaces in this neighbourhood.

Site IV owned an integrated residential neighbourhood without heavy traffic. Potential playspaces were evident in this neighbourhood: five playgrounds (formal) and 13 grasslands (informal) between residential blocks or streets.

Table 3. Staff-identified neighbourhood playspace investigation.

Study Site	Photo and Location	Space Size/m²	Map Feature	Observation Feature	Observation Date
I		796	grassland	ball field	30 July 2018
II		4576	park		16 October 2018
		24,335	grassland		

Table 3. *Cont.*

Study Site	Photo and Location	Space Size/m²	Map Feature	Observation Feature	Observation Date
III		15,145	grassland		23 October 2018
		25,848	grassland		
IV	Photographs were not allowed immediately around this site due to accommodation protection regulations				
V	No identified space				
VI		38,541	park		23 January 2019

Site V was settled in a residential area next to a sizeable forest, which lacked resources for playing. A total of five parks were identified as potential formal and eight grasslands as informal playspaces. The staff reported no playspace for refugee children in the neighbourhood; they mentioned that families always stayed inside the accommodation.

Site VI stayed in an integrated residential neighbourhood without heavy traffic—the park where site VI was located was identified by staff as the playspace for refugee children. There were another three sport facilities, 15 parks and six playgrounds as potential formal playspaces. Fifteen grasslands were potential as informal playspaces.

4.2. Accessible Playspaces

As shown in Figure 7, no playspace is accessible under children-perceived distance for Site I. Two formal (sport facilities) and three informal spaces are accessible under parental distance; the left one is also mentioned by staff as a playspace for children.

Figure 7. Accessible playspaces of six study sites.

In Site II, the park and sport-facilities combination are accessible by children-perceived distance. The integrated eight parks and a playground are accessible at parental distances. Five and nine informal playspaces are accessible at children-perceived and parental distance.

Only three formal playspaces (one park and two playgrounds) are accessible under parental distance for Site III. However, the staff mentioned that children went to neighbourhood open spaces to play very often; investigation also showed that there are many informal playspace choices for children: 12 and 30 informal spaces are accessible at children-perceived and parental distance.

In Site IV, 1/5 playgrounds mentioned above is accessible by children-perceived distance, and three are accessible under parental distance. There are both five informal spaces under children- and parent-perceived distance. Staff identified one as a playspace for children.

Site V has only one informal playspace under parental distances.

Site VI has three accessible playgrounds and five parks by children-perceived distance; in the parental distance, 14 formal spaces are accessible, including the three sports facilities, one playground and ten parks. As for informal spaces, six and three are accessible by children-perceived and parental distance.

4.3. Active Playspaces and Accessibility Comparison

4.3.1. Active Playspace Comparison

Accessible playspaces located in the top 20% of all investigated road segments in the depth map views is shown in Figure 8a. Active formal and informal playspaces by children-perceived distances are compared in Figure 8b. Site VI has the most active formal playspaces of seven (three playgrounds and four parks). The park where Site VI is located was also the staff reported playspace for children. Site II has the second most active formal playspaces as sport facilities combination with a park. Among them, sport-facility 1 was identified by staff as the playspace. There is only one active playground for Site IV. Sites II, III, IV and VI have active informal playspaces: III has the most of 10. The other three have equal numbers of five. Sites I and V have no active playspace by children-perceived distances.

Site VI has the most active formal playspaces in the parental distance (Figure 8c), including three sport facilities, two playgrounds and five parks. Site II owns one sport facility. Site IV is surrounded by two playgrounds. No formal playspace is active for Sites III and V from this distance. Site III has the most active informal playspaces of 12, followed by Sites I of 3, II of 2 and VI has one, respectively.

Staff reported 'children's neighbourhood playspace' were raised from the results: only staff from Sites II and V identified formal playspaces as parks for refugee children's play visits. Staff from other sites (including site II) identified 'open public space', 'grassland' or 'green space' as playspaces. From staff perceptions, there was no evident difference between these two types of spaces for refugee children's playing purpose.

4.3.2. Comparison at Overall Levels

The numeric data of all findings are represented through a graphic comparison in Figure 9. Site VI had the most variety of active playspaces (formal and informal) and investigated road segments from all perceived distances, except informal spaces from parental distances, which also reflected its integration. Site III had the second most active playspace; the limitation was that all spaces were identified as informal. Site II had formal and informal playspaces from all. Site IV had active playspaces of seven, and most of them were informal spaces at children-perceived distance. Site I had fewer active playspaces of five, the least road segments, and active informal and formal playspaces were within parental distance. Children in Site V had the least resources for playing as there was no active space and the second least investigated road segments.
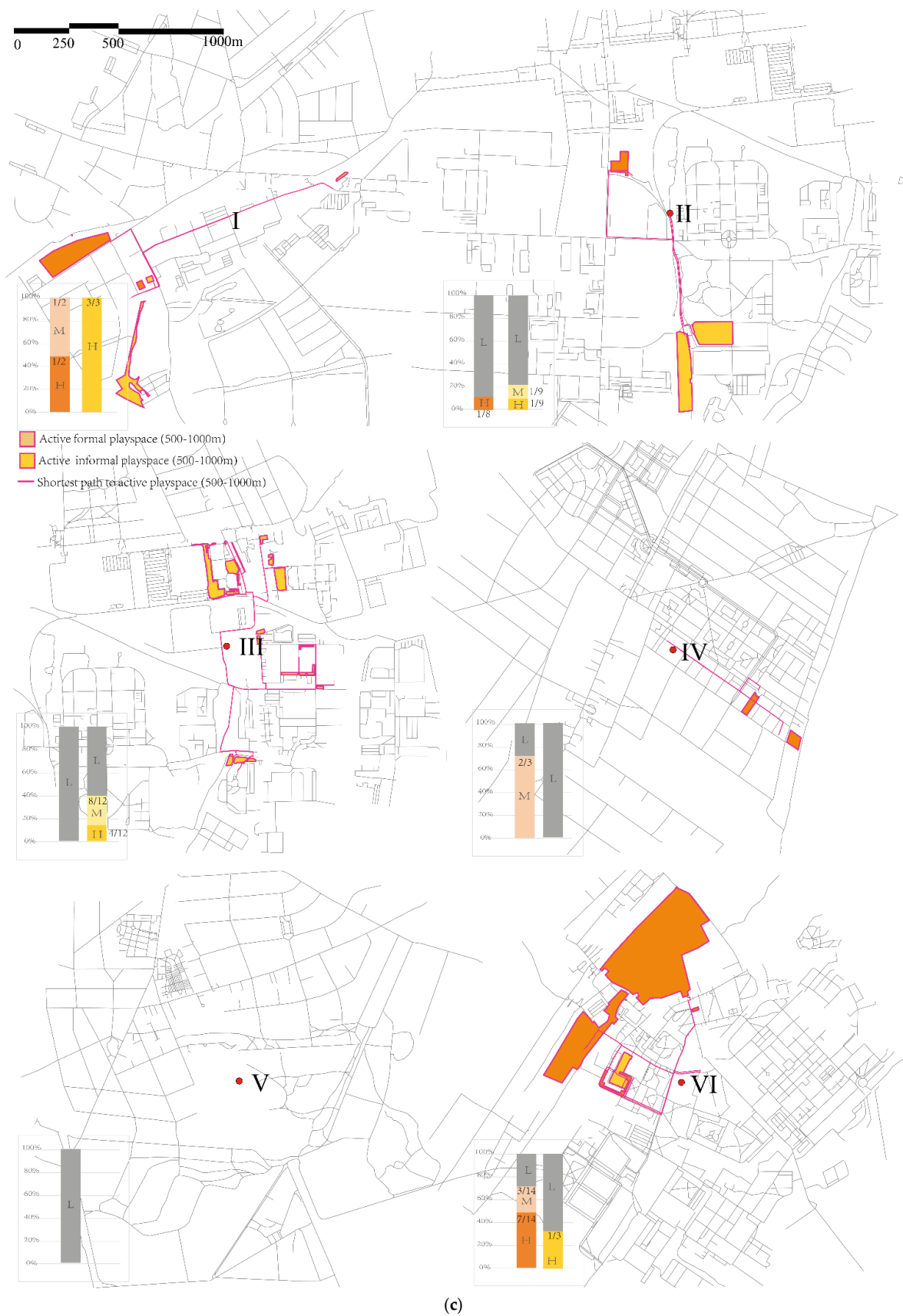
Road segment global integration

Low/deep ■ High/shallow ■ Active formal playspace ■ Acive informal playspace ■

(**a**)

Figure 8. *Cont.*

Legend:
- Inormal active playspace (<500m)
- Formal active playspace (<500m)
- Shortest path to playspace (<500m)
- Identified PA-space by staff survey

Sport facilities: 1-2
Park: 1

Playground: a-c
Parks: 1-5

(**b**)

Figure 8. *Cont.*

Figure 8. (**a**) Accessible playspace located in the top 20% of all investigated road segments in the depth map views; Global integration and active playspaces of six study sites: (**b**) under 500 m; (**c**) 500–1000 m.
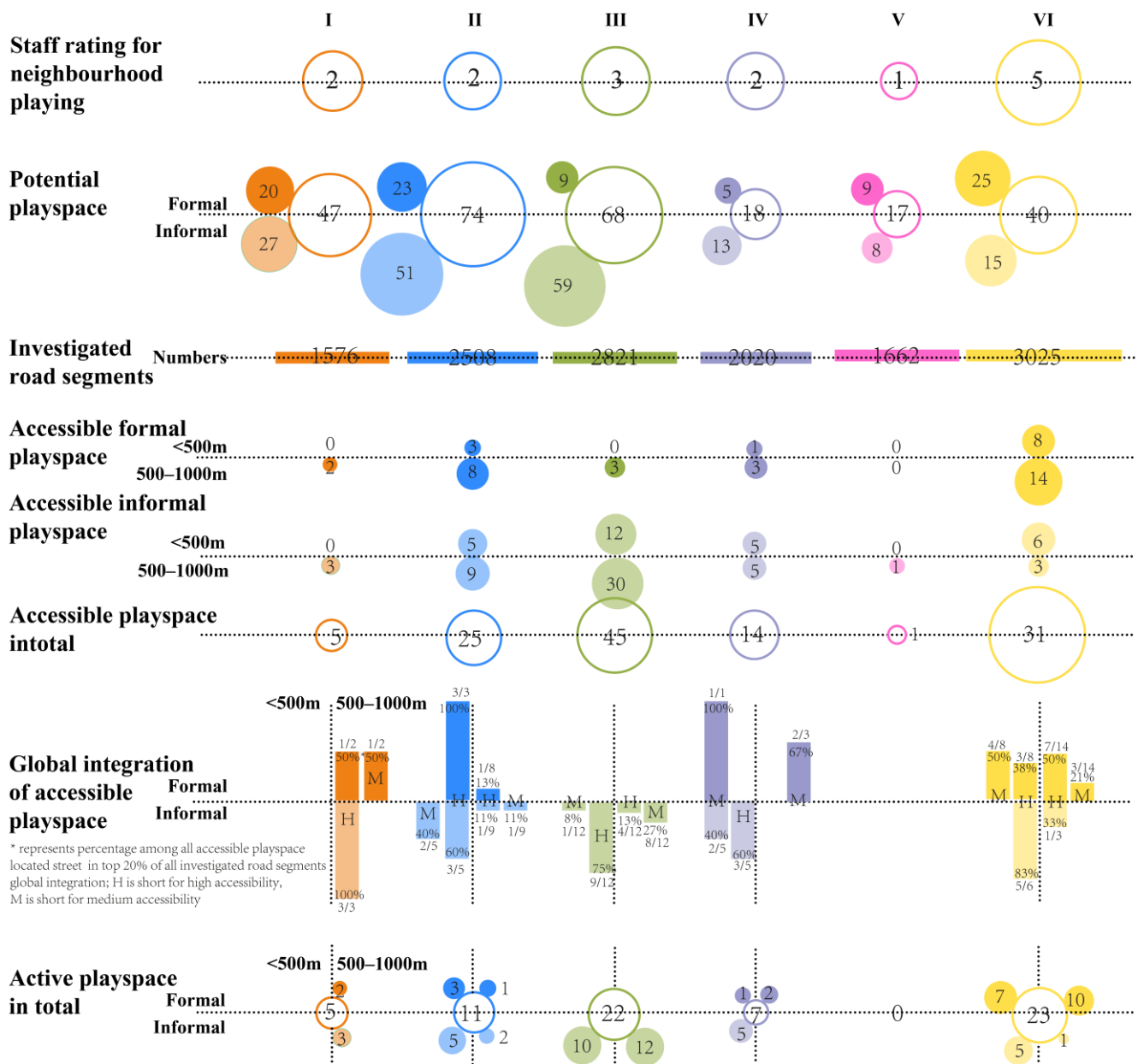
Figure 9. Overall comparison of six study sites.

5. Discussion

5.1. Accessibility of Meso-Environments Playspaces for Refugee Children

As mentioned earlier, since formal playspaces in host countries were formed differently from their countries of origin (e.g., spatial organisation), children and their parents perceived more space accessibility for their children's play purposes, either formal or informal [8,19]. This theme could also be found in existing research; for instance, natural spaces may be more familiar playspaces to refugee children as newcomers due to the global similarity of nature [28]. Alternatively, children will capture perceived accessibility to the limited nature that they own, noting details in describing their playing, such as tracking a mouse in snow or putting off the neighbour's trash in their playspace [26]. This research has investigated the accessibility of formal and informal spaces for refugee children's play purposes from a methodological perspective. Further studies should recognise these informal playspaces and identify their spatial features.

The playing resources and their accessibility for refugee children were rarely investigated, and the research agenda has been established narratively [7]. This research investigated these space characteristics quantitatively and qualitatively. Staff surveys indicated that neighbourhood playspaces for refugee children were both formal (playground, parks) and informal (grassland, open spaces) qualitatively; the quantitative analysis from GIS data also indicated the potential for informal spaces to support children's play purpose. However, the limited access to presented playspaces and the expected effects resulted from this situation on refugee children should be developed as a form of argument in the future. Some deeper interpretation in the context of other studies is needed, more than narratively [7], concerning refugee children's play perspectives (e.g., leisure needs and/or typical playing behaviours of refugee children).

5.2. Strengths and Limitations of the Research

There were several limitations due to the explorative nature of this study: only six study sites were included, which is a small sample size that decreased statistical analysis power. However, the authors tried to approach this as a pilot study, and this research aimed to investigate the accessibility of meso-environment playspaces for refugee children with a novel methodological perspective. A small sample size can be regarded as a limitation. From another aspect, this pilot study shows its potential to be used on a larger sample in Berlin and in other cities to collect more and deeper results and create wider a basis for further comparisons. Moreover, the meso-environment playspaces were identified by children staff (children supervisors) instead of refugee children since the authors failed to approach refugee children in each refugee accommodation for existing legal and ethical issues. Children staff were persons who supervised refugee children's daily playing; they could be highly responsive to these investigations. This article, therefore, tries to combine the results from more comprehensive levels. However, the staff surveys of identifying refugee children's playspaces outcomes may present low reliability due to the lack of a commonly accepted definition of playing environment quality for refugee children. There is a lack of questionnaire templates that can be used for its rapid quantitative/qualitative approach; more precisive analysis should be implemented in future studies. In summary, the presented study is a new approach related to the assessment of selected aspects in the context of refugee children's access to play in meso environments.

5.2.1. Strengths and Limitations for Accessibility Measures

The road segments do not include 'Qualitative' design measures related to walkability (e.g., sidewalk width/deep, ground floor usage plan and transparency of facades or trees). Even though this research tried to approach an assessment by perceived distance, it still lacks design measure perspectives and commonly accepted definitions.

5.2.2. Strengths and Limitations for Environmental Measures

As mentioned earlier, the authors applied OpenStreetMap instead of FNP. It is challenging to integrate the zoning categories and assess accessibility since each zoning category has different requirements for providing formal playspaces. If the researcher does not know which zoning category it falls in (i.e., undefined area in OpenStreetMap), it is impossible to assess if it provides enough playgrounds. Alternatively, it needs to be performed manually. However, OpenStreetMap is an unofficial tool for land use investigation; the results may have low reliability compared to FNP. Another limitation was including only grassland as informal playspaces since other space features (e.g., open space) could not be added by the GIS system's existing map features. Rupprecht and Byrne [50] developed a measurement of informal green spaces with potential for global application; however, it was still unclear if these green spaces could be applied to refugee children's play purposes. More potential informal spaces should be included and investigated (e.g., direct observation) in the future. Even though the presented study developed a method to investigate informal playspaces

for refugee children's play, a commonly accepted definition of informal playspaces and a method for its rapid quantitative assessment should be developed.

6. Conclusions and Future Research

This research embeds space syntax with many other methods for the assessment of refugee children's access to playspaces from methodological perspectives. GIS with Elk has more comprehensive capabilities for spatial data management and geographic analysis, which helps identify potential playspace and construct its spatial characteristics. The method notions' perceived distance analysis based on Dijkstra's algorithm indicated accessible playspace, and space syntax combined with topological analysis integration was applied to this study on evaluating the information on active playspaces. A summary of findings is presented below:

This study investigated distributions of play-related resources for refugee children in meso environments from different refugee facility locations in Berlin. This evaluation has potentialities to be introduced to related decision-makers in the location choice process. Furthermore, the space syntax's integration was used to describe a playspace's spatial characteristics by its located road segments. The integration reflects the physically intimate percentages of target space located road segments among all, which refers to its (space) potential as a destination; a more integrated road is more accessible, and its destination space has higher accessibility. In this research, the global integration analysis showed that most informal playspaces are located on streets with high accessibility, indicating their potential for playing. Below are specific research topics that deserve detailed investigations:

- Studies with broader study sites to understand play-related resource distributions at a comprehensive level;
- The new approach presented in this research has the potential to be developed/repeated on a larger sample in Berlin but also in other contexts; further studies should test this;
- Further studies should focus on potentialities for informal playspaces and investigate their spatial features;
- Future studies with a more tightly controlled setting choice include objective measures of the built environment, particularly playing spaces in meso environments (distance, size, and features) and safety (crime statistics), which are warranted;
- Besides meso environments, further studies should investigate the role of macro environments for refugee children's play (e.g., the connectivity of transportation system is relevant to non-refugee children's playing);
- Investigate whether there is a lack of congruence between perceived and objective measures of the meso environment and understand if they are independently or jointly associated with refugee children's playing.

In summary, although this research is conducted at the regional level of refugee accommodations' meso environments in Berlin as a pilot study, it has the potential to be applied in other contexts: active playspaces are potentially located for those integrated neighbourhoods in residential areas with more investigated road segments. This research produced a feasible concept with low data requirement, making it easier for related urban planners and architects in location choice stages to choose, find and evaluate existing meso environments for refugee children's play purposes from their perspectives more instantly.

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