

# Landscape Architectural Scenarios for Creating Safe Open Spaces in Residential Streets to Enhance Children's Active Play in a Saudi Arabian Metropolis

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*Abstract.* This study generates several landscape architectural scenarios to create safe open spaces that promote children's active play in the residential streets of Jeddah, Saudi Arabia, a rapidly growing city with inadequate provision of functional public open spaces per person. As a method, we first introduced 17 landscape architecture (LA) students to best practices of healthy and livable residential streets. We then instructed LA students to individually develop safe open space scenarios to enhance children's active play in a typical residential street in Jeddah, which resulted in 17 scenarios. Next, we assessed students' scenarios through six indicators to identify their strengths and weaknesses. We found that most of the 17 scenarios achieved the highest strengths in providing solutions for calming traffic, accommodating different play activities, and adopting effective design treatments to physically separate the proposed open spaces from traffic. We also found that the 17 scenarios are classified under four main design strategies: Building Over the Street, Traffic Island Integration, Expanded Sidewalk Verges, and Temporary Street Function Change. With their 17 interpreted landscape architectural scenarios, the four main design strategies can inform other cities with similar urban aspects and provide the health benefits of such an open space. The strategies highlight several new management issues, such as new open space locations, approvals of nearby neighbors, access to private garages, the current on-street parking strategy, and capital and operational financing. Further research is required to investigate the effectiveness of the developed scenarios in making children physically active.

*Keywords:* Landscape architecture scenarios, Residential streets, Children's active play, Safe open spaces, Public open spaces, Saudi Arabia.

## 1. Introduction

Due to rapid urbanization and unhealthy planning, residential streets have progressively lost their function as play spaces. Residential streets have become focused significantly on serving traffic. As a result, several international standards and guidelines have been developed to make residential streets livable, healthy <sup>[1,2]</sup>, and designed for children <sup>[3]</sup>. However, few studies have discussed how design solutions, strategies, and directions can be implemented to create safe open spaces for children's active play in residential streets <sup>[4]</sup>. Redesigning residential streets to be safe play spaces for

children is vital to general health (e.g., prevent childhood obesity, build healthy bones and muscles, and improve mental health) <sup>[5]</sup>, and the encouragement of physical activities and accessibility to community resources <sup>[6]</sup>. It is a fundamental step towards improving children's quality of life.

Saudi Arabia has begun its Quality-of-Life Program (QLP) <sup>[7]</sup>, part of its 2030 Vision, to improve the livability of its cities. The QLP works towards qualifying three major Saudi cities to be among the top 100 of the world's most livable cities by 2030. To attain this goal, QLP applies two ambitious concepts-lifestyle

and livability-directly linked to the Saudi's built environments. Lifestyle highlights the importance of increasing citizens' physical activities through minimizing social isolation and enhancing access to sports infrastructure. Livability emphasizes providing the minimum standard of public open space (POS) per person, as the World Health Organization recommended, to enhance residents' walking habits and reduce the prevalence of traffic deaths and diabetes [7].

The City of Jeddah is among the three major Saudi Cities qualified to be within the top 100 world's most livable cities by 2030. It is the second largest city in Saudi Arabia, with an estimated population of 4.5 million. Currently, Jeddah suffers from a deficient provision of POS, allocating only 2 m<sup>2</sup> per capita [8, 9]. This provision has become less than 1 m<sup>2</sup> of POS per capita when calculated at the residential level [4]. The lack of POS provision was due to the imperfect urban planning practice, which only concerns obtaining the 33% requirements from the overall land area of any new residential subdivisions for POS and public services without concerning the quality and effectiveness of the open spaces, and the inadequate financing for their developments [4]. These issues lead to inadequate provision for safe open spaces for children's active play in Jeddah residential areas. The lack of functional and practical POS provision for physical activities is magnified by the physical inaccessibility of a significant segment of Jeddah's shoreline open space to the public [10]. Moreover, Saudi Arabia has a high level of obesity among children [11,12] and high traffic accident rates [13]. Overcoming the low POS provision for safe open spaces for children's active play in residential areas, the high prevalence of obesity among Saudi children, and the high traffic accident rates motivate this study.

This paper generates several landscape architectural scenarios at the residential street level to explore the potential of developing safe open spaces that enhance children's active play. Therefore, in this study, *active play* is defined

as the involvement usually in unplanned physical activities that are self-directed and fun. *Active play* provides opportunities to try new things, enjoy being active, and test abilities [14]. The significance of this study relies on extending the development of residential streets' livability by creating safe open spaces that encourage physical activities and social interactions among children and improve their quality of life.

## 2. Literature Review

### 2.1 Link Between Residential Street Design and Children's Physical Activity

The Committee on Environmental Health [15] emphasized that the built environment can offer opportunities for an active lifestyle and physical activity. In this respect, Kaczynski et al. [16] highlighted that youths who live on the side of dead-end, cul-de-sac, or one-way streets reported greater neighborhood-based physical activity. Farley *et al.* [17] indicated that providing inner-city children with safe play spaces increases physical activity. However, residential streets characterized by high street connectivity and increased traffic due to high population densities decreased youth outdoor physical activity and participation near homes because of the risk of road traffic accidents [18]. Residential streets that create safe open spaces for children to play near their homes are effective in increasing their physical activity (moderate to vigorous) level and decreasing sedentary time [5,19] and sense of community [5]. Additionally, play streets in residential communities offer more benefits than physical activities, such as establishing perceptions of trust and safety, developing relationships with others, and sharing resources [20]. In summary, successfully designed residential streets to provide safe play spaces for children can increase their physical activity level and enhance their quality of life.

### 2.2 Standards and Guidelines for Redesigning Residential Streets for Children

Residential streets are the front yards of neighborhoods. The *Street for Kids* [3] provides valuable directions to create safe open spaces

(Play Streets) for children's active play in residential streets using different urban design and landscape architectural strategies (Table 1). Additionally, the Ten Healthy Street Indicators [1] highlight the importance of providing access to all community members to cities' streets, considering creating safe open spaces along residential streets to allow different activities to be practiced and enjoyed. Moreover, GDCI [21] highlights several *Traffic Calming Strategies* (TCS) to be considered to improve the livability of residential streets and make them walkable and safe to include other activities such as playing, seating, socializing, and cycling. These include lane narrowing, reducing the number of traffic lanes (road diet), lane shifts, chicane, pavement materials and appearance, and speed pumps and humps. TCS can also include the gateway treatments, which work on informing drivers that they are approaching a slower zone by providing signages, curb extensions, raised crossings, and speed tables. Additionally, applying a tree-lined street strategy with other TCS can effectively reduce traffic speed [22]. Furthermore, the use of an on-street parking strategy as a safety buffer to physically separate sidewalks from nearby traffic is another strategy that not only helps protect pedestrians from traffic but can also reduce traffic speed in local narrow streets [23]. However, what is essential to be considered in residential street design to encourage children's physical activities is that the design of streets must lower traffic speeds and volumes rather than calming traffic [24].

### **2.3 Redesigning Residential Streets to Provide Children with Active Play Spaces**

Harnik [25] suggested that residential street networks can be redesigned according to the Dutch concept, which implies being more "park-like" and prioritized for children, pedestrians, and cyclists. The width of residential streets can also be reduced to discourage cars and encourage physical activities, contributing to a healthier neighborhood [26]. Gehl [27] also argues that small nearby outdoor spaces are crucial for children's physical activities. They provide

immediate play spaces where children live rather than distant POS, such as neighborhood parks. Importantly, they are safer for young children as their families can monitor them. Moreover, providing built structures, such as playgrounds, in residential POS will offer more opportunities for children's physical activity [15]. Appropriate programming of play streets is also another important factor for success in attracting children and youth [28].

One of the famous examples of redesigning a residential street for children is Potgieterstraat Street in Amsterdam, Netherlands. The design process involved transforming a 60-meter Potgieterstraat street length by expanding the sidewalks to the traffic median to create a new safe play space with restricted traffic access. Another example is the Superblock Poblenou, Barcelona, Spain. The design strategy involved removing on-street parking spaces and some travel lanes to extend sidewalks and create central open spaces with play structures and seating areas at the area's intersections [3]. The highlighted design and management strategies and case studies provided fundamental steps to develop successful safe play spaces for children in residential streets.

### **2.4 Previous Studies on Providing Children with Active Play Spaces in Residential Streets**

Biddulph [24] highlighted that residential streets that apply the home zone concept are proven effective in encouraging children's physical activities. A home zone is a shared surface street in that its physical form and entire width encourage the equal right of access to all users, including children, adults, and vehicles. An effective residential shared street can include design treatments such as gate posts at its beginning to highlight the start of the design treatments, different paving materials, trees planting at its entrances, raised planters to set on within its area, bollards to separate users' activities from vehicles and a discontinues alignment of the street surface and abutting building lines. Generally, this study highlights different landscape architectural and urban

design strategies and treatments rather than using TCS alone to create safe open spaces in

residential streets that encourage children's active play.

**Table 1. *Street for Kids* guidelines demonstrating urban design and landscape architectural design strategies for creating safe open spaces for children's active play in residential streets.**

<i>Street for Kids</i> <sup>[3]</sup> guidelines	
<b>Urban Design Strategies</b>	<ul style="list-style-type: none"> <li>• Convert parts of residential streets for pedestrian priority or shared zones to provide opportunities for creating new spaces for children's active play</li> <li>• Limit traffic speed to 20 km/h</li> <li>• Convert some travel lanes and use their area to create permanent play spaces for children</li> <li>• Narrow travel lane width to 3 m and use the subtracted width in the increase of play space area width</li> <li>• Consider including on-street parking spaces and traffic median area (if available) in the enlargement of the new play spaces</li> <li>• Temporarily close residential streets to traffic during specific hours</li> <li>• Apply the traffic calming strategies (TCS)</li> </ul>
<b>Landscape Architectural Strategies</b>	<ul style="list-style-type: none"> <li>• Create structured and unstructured play spaces</li> <li>• Consider creating open spaces that support different play activities</li> <li>• Make open spaces attractive and inviting</li> <li>• Consider including appropriate physical separation between play spaces and traffic lanes</li> <li>• Provide seating to allow caregivers to watch children and enhance social interactions with others</li> <li>• Plant trees</li> <li>• Install play objects</li> <li>• Use appropriate surface materials to support safe active play</li> </ul>

Alhajaj <sup>[4]</sup> developed several urban design strategies that increase the functional POS provision in residential areas in the City of Jeddah. One of these strategies involved applying the concept of closing zones in some segments of local streets of high-density residential districts (apartment buildings) to create temporary, safe open spaces for children's active play since they were appropriating streets for playing football. What is helpful about this study is that the development of this strategy was primarily based on the actual use by the local culture, backing the idea by literature and practice. The study also highlighted the ideal spots where the closing zones strategy can be applied along residential streets for effective and safe use.

Krishnamurthy <sup>[29]</sup> highlighted six urban design strategies to be considered in order to encourage children's active play in residential areas. Four of these strategies focused on the development of residential streets. The first is to add street furniture, such as benches to allow

parents or caregivers to monitor their children while playing. The second is to provide safe climbing objects, as climbing is one of children's most attractive physical activities. The third is to activate sidewalks to include various play themes. The last is to make street crossings enjoyable by installing art to enhance their aesthetic appeal and improve residential street ambiance. What is significant about this study is that it listed simple urban design strategies that encourage children's active play and create lively residential streets that extend using time.

Gemmell *et al.* <sup>[30]</sup> highlighted five aspects that support children's active play in outdoor spaces of residential areas. These include the availability of nearby formal or informal open spaces for play, the availability of pedestrian infrastructure, the presence of green or natural environments, protection from traffic, and the opportunity for social connection.

In conclusion, these studies presented helpful design strategies and directions to enhance children's active play in residential streets without illustrating how to be implemented on existing streets. Thus, this study attempts to explore opportunities for creating safe open spaces for children's active play in residential streets by generating several landscape architectural scenarios that adopt and activate such strategies and directions in an existing urban context.

### 3. Methods

#### 3.1 Research Approach

The leading research question in this study is:

RQ1: How can we redesign Jeddah's wide residential streets to create safe open spaces for children's active play?

Deming and Swaffield <sup>[31]</sup>, in *Landscape Architecture Research*, argued that design operations (projective design) can be one form of research method that can produce new knowledge if it is defined by propositional components such as tactics, strategy, literature review, hypotheses, or data. Such a research approach was used in a design studio to encourage the urban landscape resilience of the City of Los Angeles through refining ecological design methods <sup>[31]</sup>. Other studies used the same approach to generate a variety of possibilities for planning a new community in the City of Perth, Western Australia <sup>[32]</sup>, develop several urban design scenarios to increase the functional POS provision in the City of Jeddah <sup>[4]</sup>, and develop urban design strategies to solve the lack issue of physical public access to a blocked urban shoreline in a mega residential district in Saudi Arabia <sup>[10]</sup>.

Informed by the projective design approach, this study is tailored to be design-driven research that establishes different street alternatives based on students' understanding of contemporary conceptual thinking and theoretical precedents. Thus, this study generated a variety of landscape architectural scenarios for redesigning a typical residential

street to create safe open spaces for children's active play upon ideas and imagination.

#### 3.2 Research Procedures

We first selected 17 landscape architecture (LA) students who enrolled in the course *Contemporary Trends in Landscape Architecture* of the LA undergraduate program taught at King Abdulaziz University, Saudi Arabia, to participate in this study. We then introduced LA students to landscape architectural and urban design strategies and trends for redesigning underutilized and lost spaces in different urban contexts including residential streets. We used PowerPoint presentations, short YouTube clips, theoretical precedents, contemporary trends, and actual case studies to enhance students' thinking on how existing streets' physical parts can be redesigned to create safe open spaces for children's active play. Besides the teaching strategies applied to support students' thinking, we used seminars to encourage active discussion and ideas sharing between students on how such design ideas, themes, and precedents can be adopted in Saudi's urban context.

Next, we introduced the 17 LA students to the contemporary urban issue of how we can create safe open spaces for children's active play in wide residential streets to help minimize the impact of the very low provision for POS per person in Jeddah's residential areas. We selected a typical residential street in Jeddah (25 meters wide) as a case study, which includes four lanes for traffic (two each way) with a raised traffic island in between and one lane on each side for parallel on-street parking (Fig. 1). Moreover, we instructed each student to develop a landscape architectural scenario that involved creating a safe open space for children's active play and explaining the point of view in a four-hour session. The proposed open space was to be created on 50 meters of the street length. The development of each open space scenario has to identify the type of activities that can be provided to enhance active

play, ensure the continuity of traffic, separate the proposed open space from traffic, employ TCS to enhance the safety of the open space and consider access to private garages of surrounding residential buildings. After LA students completed the task, we assessed their 17 landscape architectural scenarios through six indicators, developed from reviewing literature and strategies related to redesigning streets for children to highlight the strengths and weaknesses of each scenario. The six indicators included the proposed play activities, availability of safe physical access to the play space, easiness of monitoring the play space, adoption of TCS to control traffic speed in the

area of children's play space, implementation of design treatments to physically separate the play space from traffic, and availability of safe access to private garages (Table 2); the assessment of each indicator is explained in Table 3. Students' sketches and design drawings were carefully converted to formal graphics to unify the overall drawing language and make it easy to understand. Students' consent was obtained as they were informed that their design outcomes in this task would be used for research activities without identifying their identities.



**Fig. 1. (A) The plan of the typical street, illustrating the 50-meter segment selected for this study, including all traffic lanes, traffic island, and access to building garages; (B) the view of the street from the middle traffic island.**

**Table 2. Description of the six indicators used to assess the landscape architectural scenarios.**

Indicator	Description
1. Proposed play activities	This indicator investigated if the proposed scenario was developed to offer single or multiple play activities. This is because providing play spaces with different activities can be more attractive and encouraging for children's active play than the one created for a single use.
2. Availability of safe physical access to the play space	This indicator investigated if the proposed scenario requires children to cross the street to reach play spaces. In case of designing the play space on the traffic island, safe physical access like raised crossings with different surface materials must be provided to inform drivers about the possibility of having children cross the street. Other treatments that only apply shared zone with changing the pavement materials may be considered insufficiently safe without speed humps or pumps.
3. Easiness of monitoring the play space	This indicator investigated if the proposed play spaces can be easily viewed from the surrounding residential buildings' first floor as there is no possibility to view the space from the ground floor due to the properties' high solid walls. Therefore, proposing suitable planting types, heights, locations, and arrangements can play an important role in easing the viewing of the play space from the surroundings. Additionally, the location of the play space can be another factor. For example, placing the play space and its activities on the sidewalk may not be easily seen from the adjacent buildings due to high solid walls blocking the view.
4. Adoption of TCS to control traffic speed in the area of children's play space	This indicator investigated if the proposed scenario applies multiple traffic calming strategies (TCS) to reduce and control traffic speed in the play space area (e.g., apply gateway treatments, reduce the number of lanes, narrow lane width, use sidewalk extensions, provide speed tables or humps, use different pavement materials and appearance, apply chicanes and lane shifts,

		and apply tree-lined street strategy on both sides of the street).
5.	Implementation of design treatments to physically separate the play space from traffic	This indicator investigated if the proposed scenario applies multiple design solutions to enhance the physical separation of children's play spaces from traffic lanes (e.g., apply on-street parking strategy, provide green shrub hedges, change level, lift space, use fence, and use of dense trees planting or other physical buffers).
6.	Availability of safe access to private garages	This indicator investigated if the proposed scenario considers providing safe access to the private garages near the children's play spaces. Accesses to private garages must be separated from children's play spaces by an appropriate buffer (e.g., planting hedges or change in level) to make the space safe for children.

**Table 3. Levels of the six indicators developed for this study.**

Indicator	Poor 0	Low 1	Intermediate 2	High 3
1. Proposed play activities	Not defined	One	Two	Multiple
2. Availability of safe physical access to the play space	Not available	From one side of the street	From both sides of the street through limited spots	From both sides of the street through several spots
3. Easiness of monitoring the play space	Difficult	Partially can be viewed	Mostly can be viewed	Almost all of the play space can be viewed
4. Adoption of TCS to control traffic speed in the area of children's play space	Not applied	One strategy	Two strategies	Multiple
5. Implementation of design treatments to physically separate the play space from traffic	Not applied	One strategy	Two strategies	Multiple
6. Availability of safe access to private garage	Not available	Few provided	Most provided	All provided

## 4. Results

### 4.1. The 17 Landscape Architectural Scenario Forms and Ratings

We found that the 17 landscape architectural scenarios, which were developed to create safe open spaces for children's active play in this study, are classified under four main design strategies: *Building Over the Street*, *Traffic Island Integration*, *Expanded Sidewalk Verges*, and *Temporary Street Function Change* (Fig. 2).

Table 4 summarizes the ratings of the six indicators for the 17 landscape architectural scenarios developed in this study. Table 5 provides statistical data about the ratings of the six indicators, while Table 6 highlights the

proposed play activities in each scenario. Table 7 identifies the TCS used in each scenario to control speed, while Table 8 lists the design treatments applied to physically separate the proposed open spaces from traffic in each scenario. Table 9 highlights the advantages and disadvantages of the four main design strategies.

The six indicators' ratings revealed that the landscape architectural scenarios (1.1 and 1.3) obtained the highest ratings (2.8 out of 3), while the scenario (4.1) received the lowest rating (1 out of 3). Generally, 13 landscape architectural scenarios achieved  $\geq 2$  out of 3.

### 4.2. Analysis

Indicator 4 (adoption of TCS to control traffic speed in the area of children's play space) was rated the highest among other indicators (Mean= 2.6). This indicated that most of the landscape architectural scenarios apply different combinations of TCS to make the proposed open spaces safe by controlling the speed of through traffic. Indicator 1 (proposed play activities) obtained the second highest rating (Mean= 2.5) as most of the developed scenarios succeeded in providing varieties of play activities that can be accommodated within the proposed open spaces. Indicator 5 (implementation of design treatments to physically separate the play space from traffic) also obtained a high rating (Mean= 2.4). This was due to the different design treatments applied to physically separate the proposed children's play spaces from traffic in all of the landscape architectural scenarios classified

under the design strategy of *Building Over the Street* and several scenarios under the strategy of the *Expanded Sidewalk Verges*. However, it was difficult to achieve such an appropriate physical separation by applying the fourth design strategy of *Temporary Street Function Change*, which implies the unuse of permanent structures in the street.

Conversely, Indicator 3 (easiness of monitoring the play space) was rated the lowest (Mean= 1.6). It appeared that it was difficult to satisfy this indicator when using trees as a form of TCS or physical separation between traffic lanes and play open spaces, as noticed in all the landscape architectural scenarios that were classified under the design strategy of the *Traffic Island Integration* and some scenarios under the strategy of the *Expanded Sidewalk Verges*.



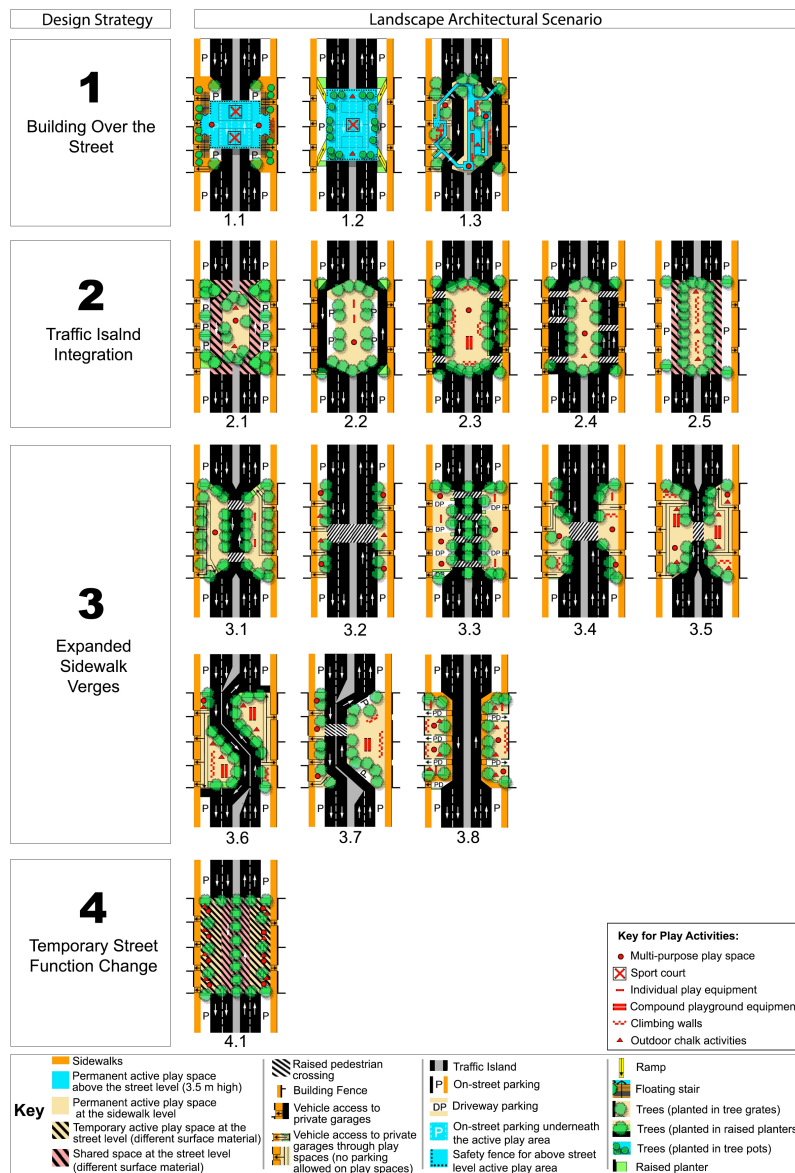


Fig. 2. The four design strategies and the 17 landscape architectural scenarios developed to enhance children's active play.

Table 4. The ratings of the six indicators for the 17 landscape architectural scenarios.

Landscape architectural scenario	Assessed indicators						Mean (out of 3)
	1	2	3	4	5	6	
Proposed play activities*	Availability of safe physical access to the play space	Easiness of monitoring the play space	Adoption of TCS to control traffic speed in the area of children's play space**	Implementation of design treatments to physically separate the play space from traffic***	Availability of safe access to private garages		
1.1	3	3	3	2	3	3	2.8
1.2	2	3	3	1	3	3	2.5
1.3	3	2	3	3	3	3	2.8

2.1	2	0	1	3	1	3	1.7
2.2	2	0	1	3	2	3	1.8
2.3	3	3	1	3	3	3	2.7
2.4	2	3	1	2	2	3	2.2
2.5	2	0	0	3	2	3	1.7
3.1	2	3	1	3	3	0	2
3.2	2	2	1	2	2	3	2
3.3	2	3	2	3	2	0	2
3.4	3	2	1	3	3	0	2
3.5	3	2	2	3	2	0	2
3.6	3	1	2	3	3	0	2
3.7	3	2	2	3	3	2	2.5
3.8	3	1	2	3	3	3	2.5
4.1	2	0	2	2	0	0	1

\* Ratings based on the proposed activities highlighted in Table 6. \*\* Ratings based on the used TCS as highlighted in Table 7. \*\*\* Ratings based on the implementation of design treatments to physically separate the play space from traffic as highlighted in Table 8.

**Table 5. Statistical data of the six indicators used to rate the 17 landscape architectural scenarios.**

Indicator	Indicator rating			Number of scenarios obtained the rating			
	Max.	Min.	Mean	0	1	2	3
1 Proposed play activities	3	2	2.5	0	0	9	8
2 Availability of safe physical access to the play space	3	0	1.8	4	2	5	6
3 Easiness of monitoring the play space	3	0	1.6	1	7	6	3
4 Adoption of TCS to control traffic speed in the area of children's play space	3	1	2.6	0	1	4	12
5 Implementation of design treatments to physically separate the play space from traffic	3	0	2.4	1	1	6	9
6 Availability of safe access to private garages	3	0	2	5	0	2	10

**Table 6. The proposed play activities in the 17 landscape architectural scenarios (based on design drawing notes and explanations).**

Landscape architectural scenario	Activities					
	Multi-purpose play space (not specified for a specific activity)	Sport court	Individual play equipment*	Compound playground equipment	Climbing walls	Outdoor chalk activities**
1.1	P	P			P	
1.2		P				P
1.3	P		P		P	P
2.1	P					P

2.2	P	P						
2.3	P				P		P	
2.4	P							P
2.5							P	P
3.1	P	P						
3.2	P							P
3.3	P	P						
3.4	P	P					P	
3.5	P				P		P	P
3.6	P				P		P	P
3.7	P				P		P	
3.8	P	P					P	P
4.1	P							P

\* Include slide, swing, jumping Jacks (springers), or rope play equipment. \*\* Such as hopscotch, walk the line, Pictionary, Tic-Tac-Toe.

**Table 7. The used Traffic Calming Strategies (TCS) in the 17 landscape architectural scenarios.**

Landscape architectural scenario	TCS							
	Use of gateway treatments	Reduce the number of lanes	Narrow lane width	Use sidewalk extensions	Use different pavement materials and appearance	Use chicanes	Apply lane shifts	Apply a tree-lined street strategy on both sides of the street
1.1	P	P						
1.2	P							
1.3	P	P					P	
2.1	P	P			P	P		
2.2	P	P				P		
2.3	P	P	P			P		P
2.4	P					P		
2.5	P	P			P			
3.1	P	P	P			P		P
3.2	P							P
3.3	P	P	P					P
3.4	P	P						P
3.5	P	P	P	P				P
3.6	P	P					P	P
3.7	P	P				P	P	P
3.8	P	P						P
4.1	P				P			

**Table 8. The proposed design treatments to physically separate the play space from traffic in the 17 landscape architectural scenarios.**

Design treatments
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Landscape architectural scenario	Apply on-street parking strategy	Provide green shrub hedges	Change level	Lift space	Use fence	Use sidewalks as a physical barrier	Use dense tree planting as a physical buffer
1.1	P		P	P	P		
1.2	P		P	P	P		
1.3			P	P	P		
2.1			P				
2.2	P		P				
2.3		P	P				P
2.4			P				P
2.5			P				P
3.1		P	P				P
3.2			P				P
3.3		P	P				
3.4		P	P				P
3.5			P				P
3.6		P	P				P
3.7	P		P				P
3.8		P	P			P	
4.1							

**Table 9. The advantages and disadvantages of the four main design strategies.**

Design strategy	Advantages	Disadvantages
Building Over the Street	<ul style="list-style-type: none"> <li>▪ Does not affect residential buildings' access</li> <li>▪ Can create a larger open space for active play that can fit different sports and activities</li> <li>▪ Create safer open spaces by completely separating it from the street traffic lanes</li> <li>▪ Easy to monitor from nearby homes</li> </ul>	<ul style="list-style-type: none"> <li>▪ May be considered costly to implement</li> <li>▪ May be considered difficult to access for elderlies and people with physical disabilities</li> <li>▪ May reduce the privacy of nearby homes</li> <li>▪ Requires a high level of maintenance</li> <li>▪ Must consider high vehicles using residential streets, such as firefighter vehicles and rubbish removal trucks</li> </ul>
Traffic Island Integration	<ul style="list-style-type: none"> <li>▪ Easy to implement and can create cost-effective play space</li> <li>▪ Does not affect residential buildings' access</li> <li>▪ Can integrate TCS principles to reduce the traffic speed in the area of the proposed open space</li> </ul>	<ul style="list-style-type: none"> <li>▪ May be considered risky to access the space from nearby sidewalks</li> <li>▪ Island width may not provide sufficient space for active play involved in sports such as football or basketball</li> </ul>
Expanded Sidewalk Verges	<ul style="list-style-type: none"> <li>▪ Easy to implement and cost-effective to create play space</li> <li>▪ Considered an effective strategy for traffic speed reduction</li> <li>▪ Can provide larger and safer open spaces for active play</li> <li>▪ Break the formality of the street grid system</li> <li>▪ Reduce the number of traffic lanes to control speed in the area of the newly created open spaces for children's active play</li> </ul>	<ul style="list-style-type: none"> <li>▪ May be considered a source of noise for adjoining residential buildings</li> <li>▪ Need special design treatments to ensure appropriate physical access to private garages</li> <li>▪ May affect the availability of on-street parking</li> </ul>

Temporary Street Function Change	<ul style="list-style-type: none"> <li>▪ Very easy to implement and cost-effective play space</li> <li>▪ Does not require complicated design treatments</li> <li>▪ Does not require identifying particular areas for crossing the street</li> <li>▪ Does not prevent residential building owners from accessing their private garages</li> <li>▪ Can allow nearby residents to park on the street</li> </ul>	<ul style="list-style-type: none"> <li>▪ Requires a high level of management to ensure availability during the allocated time for use by children</li> <li>▪ Requires high level of safety procedures to protect children from traffic</li> <li>▪ Width may not be sufficient for sports activities such as football</li> <li>▪ Needs movable furniture such as planting pots or temporary large plastic bollards to physically define the boundary of the play space while being used</li> </ul>
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## 5. Discussion

The study develops 17 landscape architectural scenarios that are classified under four design strategies. The four design strategies offer insights into redesigning residential streets to create essential safe open spaces for children's active play that contribute to improving their quality of life. Despite some of the disadvantages of these design strategies (Table 9), they can provide children of Jeddah with nearby safe open spaces for active play along with important benefits such as controlling local traffic speed, reducing neighborhoods' black surfaces, and improving residential areas' ambiance. Generally, the four design strategies are practical and adjustable to suit any city experiencing the lack of functional POS provision for children's active play in residential areas.

This study extends current literature [4,24,29,30] on redesigning residential streets for children. For example, this study shows how such urban design and landscape architectural strategies can be applied to a real case considering existing attributes such as access to private garages and solid walls, which may affect viewing the proposed play open spaces from nearby buildings. Moreover, developing the first design strategy of *Building Over the Street* can be another important contribution to literature. Previous studies and guidelines on redesigning streets for children [3] did not discuss such a solution, which can be a helpful strategy in case creating a safe open space for children at a street level is considered impossible. For example, this study selected a typical residential street in Jeddah with a 25-

meter width, though the city has other streets with less width. In this case, the design strategy of *Building Over the Street* can be an option to provide a safe open space in a street with a smaller width if the other three design strategies fail to achieve it.

Additionally, this study extends the application of TCS being discussed in GDCI [21] to reduce speed and create healthy streets. For example, several landscape architectural scenarios (2.1, 2.2, 2.4, 2.5, 3.5, and 3.7) adopted a combination of TCS such as gateway treatments, lane reduction (road diet), lane narrowing, lane shifts, chicanes, raised crossing, and the tree-lined street concept on both sides of the street to enhance the safety of children and create a livable street. Other scenarios also used additional protection measures to the TCS mentioned above to enhance the physical separation, such as providing a liner planting hedge under trees (scenarios 2.3, 3.1, 3.3, 3.4, 3.6, and 3.8) or lifting the play open spaces over the street (scenarios 1.1 and 1.3). Here, using TCS in association with other design treatments to create physically separated open spaces supports children's positive sense of their residential areas. This is because without providing appropriate infrastructure that supports physical activities and enhances the safety from traffic, children will be overwhelmed by the negative senses of danger, dislike, and limited ability to identify qualities of their residential areas that are positive, special, and memorable as confirmed by Appleyard [33]. Additionally, the developed scenarios show attempts to improve

the quality of residential streets by incorporating TCS to enhance residents' safety and reduce traffic injuries, which are currently very high <sup>[13]</sup>. It is an essential step towards supporting the Saudi Vision 2030, which implies creating a vibrant society <sup>[34]</sup>.

Redesigning parts of residential streets to provide safe open spaces for children's active play can break the streets' monotonous feel experienced while walking, especially if the four design strategies are used interchangeably or applied differently (as noticed in the different landscape architectural scenarios that were classified under the design strategies of *Building Over the Street*, *Traffic Island Integration* and *Expanded Sidewalk Verges*). Here, redesigning residential streets for children can make these urban corridors not only attractive for walking but also livable and encourage other age groups to be outdoors to enjoy other passive recreation activities. Such landscape architectural scenarios will be necessary to convert residential streets into healthy corridors and improve the quality of life in residential areas, as highlighted by Healthy Street <sup>[1]</sup>.

Regardless of the design strategies selected to provide safe open spaces for children's active play, there will be new concerns to be addressed. Queries about the specific new open space locations, approvals of nearby neighbors, access to private garages, current on-street parking strategy, and capital and operational financing to create and maintain these new spaces will be among the new issues raised. However, these are outside the scope of this study.

Lastly, this study method contributes to the literature that concerns the education of LA and urban design. Here, the study method introduces a hybrid teaching and assessment strategy, which is different from the conventional methods used to teach a design theory course and assess its learning outcomes (e.g., lectures and exams) in some LA programs. The new hybrid strategy involves three steps: first, learning from the presented

materials (e.g., PowerPoint presentations, short YouTube clips, theoretical precedents, contemporary trends, and actual case studies); second, learning from group discussions on how to apply such theories and practice in our community; third, learning by individually applying acquired knowledge to tackle actual urban issues in the community that we live in. The use of such a hybrid strategy can embed new knowledge that is found in the courses of design theories and best practices, which are considered essential components in LA education <sup>[35]</sup>.

## 6. Conclusions

This study develops four design strategies that are interpreted through 17 landscape architectural scenarios. The four design strategies are practical and adjustable to suit any city that lacks POS provision for children's active play in residential areas. The study contributes to practice and literature in three ways. First, it extends current practice on redesigning residential streets with underutilized or lost spaces to create functional safe open spaces that enhance children's active play. Second, it extends the literature on the improvement of neighborhood livability. Third, it extends current literature and practice on redesigning residential streets of Saudi cities to make them healthier and liveable. The study has three limitations that must be highlighted. The first is that the developed scenarios were performed on the scale of a conceptual site plan due to the short time allocated to this task. Thus, it did not show additional design details about the play spaces (e.g., types and specifications of used planting, pavement types, or street furniture). The second limitation involves that the landscape architectural scenarios' efficiency was not tested on Jeddah's children to know if they are suitable enough to encourage active play. The last is that the developed scenarios did not highlight the number of children that these play open spaces can serve. Further research is required to investigate the effectiveness of the developed scenarios in making children physically active.

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### Institutional Review Board Statement

Not applicable.

### Informed Consent Statement

The outcomes of this design task will be used for research activities without identifying participants' identities.

### Data Availability Statement

Not applicable.

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### Conflicts of Interest

The author declares no conflict of interest.

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# سيناريوهات عمارة بيئة لتشكيل فراغات آمنة مفتوحة في الشوارع السكنية لتعزيز اللعب النشط للأطفال في مدينة سعودية رئيسية

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المستخلص. طورت هذه الدراسة عدداً من سيناريوهات عمارة البيئة لتشكيل فراغات آمنة مفتوحة تعزز من اللعب النشط للأطفال في الشوارع السكنية في مدينة جدة، الواقعة بالمملكة العربية السعودية، والتي تتصف بأنها منطقة عمرانية سريعة النمو ذات نقص كبير في معدل الفراغات العامة المفتوحة الوظيفية بالنسبة للفرد. كمنهجية عمل، تم أولاً تقديم 17 طالباً من تخصص عمارة البيئة لأفضل الممارسات العالمية في تصميم الشوارع السكنية لأن تكون صحية وحيوية. تم بعد ذلك توجيه الطلاب إلى أن يطوروا بشكل فردي سيناريوهات آمنة تتعلق بتشكيل فراغات مفتوحة آمنة تعزز من عملية اللعب النشط للأطفال في شارع سكني مماثل للعديد من الشوارع السكنية الأخرى بجدة، وقد نتج عن هذه الخطوة تطوير 17 سيناريو. تم لاحقاً تقييم سيناريوهات عمارة البيئة المطورة من خلال ستة مؤشرات لتحديد نقاط القوة والضعف لكل سيناريو. استنتجت الدراسة أن معظم السيناريوهات المطورة حققت أعلى نقاط القوة في تطبيق حلول تصميمية فعالة لتقليل حركة السيارات، اشتمال نشاطات ترفيهية مختلفة، وتطبيق حلول تصميمية فعالة لفصل الفراغات المقترحة للأطفال عن مسارات السيارات. كما استنتج أن السيناريوهات المطورة يمكن تصنيفها ضمن أربع استراتيجيات تصميم رئيسية: البناء فوق الشارع، اشتمال الجزيرة الوسطية للشارع، توسعة حواف الأرصفة الجانبية، والتغيير المؤقت لوظيفة الشارع. يمكن للمدن الأخرى التي تعاني من نفس مشكلة مدينة جدة الاستفادة من استراتيجيات التصميم الأربعة الرئيسية لتشكيل مثل هذه الفراغات المفتوحة الضرورية لإنشاء مجتمع صحي وحيوي. تسلط الاستراتيجيات الضوء على العديد من القضايا الإدارية والفنية الجديدة المتعلقة بتطوير السيناريوهات، مثل كيفية اختيار المواقع الجديدة للفراغات المقترحة، الحصول على موافقات السكان المجاورين لأماكن الفراغات المقترحة، ضمان الوصولية إلى المرائب الخاصة، مراجعة النظام الحالي لوقوف السيارات في الشارع وأخيراً إيجاد طريقة لتمويل بناء تلك الفراغات وصيانتها وأخيراً، توصي الدراسة إلى مزيد من البحث للتحقق من مدى فعالية السيناريوهات المطورة في جعل الأطفال نشيطين بدنياً.