



## RESEARCH ARTICLE

### ASSESSMENT OF PUBLIC PLAYGROUND SAFETY IN AYDIN, TURKEY

Prof. Dr. Baris KARA<sup>1,\*</sup>, Prof. Dr. Bulent DENIZ<sup>2</sup>, Prof. Dr. Cigdem KILICASLAN<sup>2</sup> and  
Prof. Dr. Zohre POLAT<sup>2</sup>

Aydin Adnan Menderes University, Faculty of Agriculture, Department of Landscape Architecture 09970 South Campus Cakmar-Aydin, Turkey

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#### ABSTRACT

**Background:** In this study, the safety of 54 public playgrounds in 12 neighborhoods in Aydin (Turkey) city was assessed in terms of 9 important risk factors that may cause injury, and a risk map was created. The simple random sampling method was used to determine the neighborhoods and public playgrounds included in the study. The Playground Safety Survey was prepared to assess safety of playgrounds. ArcMap 10.3 software was used to create the risk map of playgrounds and Statistical Package for Social Sciences (SPSS) 19 software was used for statistical analysis of research data. Among the important risk factors, playgrounds were evaluated as "Very safe" in terms of the fall/equipment height (4.90), dangerous equipment (4.77), protective surfaces (4.26) playground equipment surface material (4.25) factors, "safe" in terms of the head entrapment hazards (3.89), swings (3.67) and clothing entanglement hazards (3.57) factors, and "unsafe" in terms of the dangerous plant material (2.60) and fall (use) zones (1.88) factors. In terms of the safety score, 75.93% of the playgrounds in Aydin (41 playgrounds) were found to be "Safe" (3.75). While rubber tiles or unitary synthetic surface were used under 80.72% (134 playground equipment) of the investigated 166 playground equipment, concrete was used under 4.22% (7 playground equipment). The playgrounds in Ilicabasi and Osman Yozgatli neighborhoods with low socioeconomic status were found to be more unsafe than the playgrounds in Girne and Mimar Sinan neighborhoods with high socioeconomic status.

#### INTRODUCTION

Childhood is the most important period of the human development in which the foundations of mental and personality development are laid. During this period, plays and playgrounds have significant effects on the physical, mental, emotional, and social development of children (Duerr Evaluation Resources 2011; Milteer *et al.* 2012). Unless playground safety is ensured, the development of children is not healthy enough. Children's playing in unsafe playgrounds can lead to the constant risk of accidents, injuries, or even deaths (Botsoglou *et al.* 2011; Cheng *et al.* 2016). Playground injuries are common injuries that make up a significant part of childhood injuries in most developed countries (Chalmers & Langley 1990; Mott *et al.* 1994). In the U.S., there are over 200,000 emergency service applications every year because of injuries occurring in playgrounds (O'Brien 2009; Vollman *et al.* 2009). Fifteen-twenty of these emergency service applications result in death (Drago *et al.* 1997; Mack *et al.* 1998; NPPS 2005). Because of playground injuries, every year, 15,000 emergency service applications are made in the

Netherlands (Beugels 1993), and 7500 applications in New Zealand (Chalmers *et al.* 1996). Injuries and even deaths in playgrounds occur because of important risk factors (Macarthur *et al.* 2000; Laforest *et al.* 2001) such as protective surfaces, fall (use) zones, fall/equipment height, head entrapment hazards and clothing entanglement hazards (Chalmers & Langley 1990; Rivara 1995). Children's possibility of injury during play shows the risk and safety level of the playground. Very few studies have been conducted to assess playground safety. In the Netherlands, 7150 pieces of playground equipment in 663 playgrounds were investigated in terms of inappropriate surfacing material, broken or missing parts, rotten or worn-out parts, and entanglement. Because of the study, inappropriate surfacing material was determined in 6% of playground equipment, broken or missing parts in 10%, rotten or worn-out parts in 15%, and entanglement in 2.3% of playground equipment (Beugels 1993). In the study carried in Cardiff, the protective surface safety of playgrounds was examined. According to the results of the study, it was showed that the safest protective surface for playgrounds was synthetic material and hardwood chips, and these materials could be used in all cities (Mott *et al.* 1997). Only one study was carried out on playground safety in Turkey. Twenty-four playgrounds in Elazı city center were examined for their compatibility with safety standards.

\*Corresponding author: Prof. Dr. Baris KARA,

Aydin Adnan Menderes University, Faculty of Agriculture, Department of Landscape Architecture 09970 South Campus Cakmar-Aydin, Turkey.

It was found out that 87.5% of playgrounds did not have a protective surface with appropriate thickness and features, 95.8% of playground equipment was not safe, and 83.3% had sharp edges and pinch points. Almost all playgrounds were not compatible with safety standards and to need to be developed (Acik *et al.* 2004). This study hypothesizes that “the safety level of playgrounds in neighborhoods with low socioeconomic status will also be low.” The study aims to evaluate the safety of public playgrounds in parks in Aydin (Turkey) city in terms of important risk factors that may cause injuries and to create a risk map.

## MATERIALS AND METHODS

Aydin city neighborhood map, public playgrounds map, public playgrounds list, Playground Safety Survey, data of socioeconomic status of neighborhoods, literature and software make up the materials of the study.

**Sample:** The simple random sampling method was used to determine the neighborhoods and public playgrounds included in the study. Twenty-four neighborhoods in Aydin city were divided into three groups as “Low-Middle-High” according to their socioeconomic differences, and 12 neighborhoods were selected among them. 30% of the playgrounds in each neighborhood were selected. In the study sample, 54 public playgrounds in Aydin were determined. All playgrounds in the neighborhoods where the number of playgrounds is three and less than three are included in the scope of the sample. One hundred sixty-six pieces of playground equipment found in playgrounds were examined (Table 1).

**Playground safety survey development and assessment:** The Playground Safety Survey was prepared by taking the CFA/PIRG Playground Safety Survey - Spring 2002 assessment form (CFA, 2019) as a basis. The Playground Safety Survey includes 49 questions on nine important risk factors that can cause injury in playgrounds. The most common risk factors that threaten safety in playgrounds were included in the study. Important risk factors include protective surfaces, fall (use) zones, playground equipment surface material, fall/equipment height, swings, head entrapment hazards, clothing entanglement hazards, dangerous equipment and dangerous plant material (Allen *et al.* 2013). The safety of public playgrounds in Aydin was assessed in terms of important risk factors. For risk analysis, each important risk factor was scored between 1-5. One was determined to be the most negative score, and five was determined to be the most favorable score. Because of the scoring, important risk factor scores of each playground equipment, playgrounds in each neighborhood and the city were found. Important risk factor scores were summed up, and by calculating the arithmetic mean of the total scores, safety scores were found. Important risk factor scores and safety scores were graded according to a 5-point Likert-scale, and the safety levels of playgrounds were determined (Bond & Peck 1993). The important risk factor scores and safety scores were between 1-1.80 were defined to be “Very Unsafe,” scores between 1.81–2.60 “Unsafe,” scores between 2.61-3.40 “Moderately Safe,” scores between 3.41-4.20 “Safe,” and scores between 4.21–5 “Very Safe”. With safety score calculations, the playground's safety scores and the safety scores of the neighborhoods and the city according to the playgrounds they have were determined. Playgrounds with the highest safety score in each neighborhood and city were detected.

A risk map, in which the safety scores of playgrounds and neighborhoods in Aydin city were showed, was created.

**Data collection:** Playgrounds were visited, and observations and measurements were made to determine important risk factors. Observation and measurement results were entered the Playground Safety Survey.

**Data analysis:** ArcMap 10.3 software was used to create the risk map of playgrounds in Aydin. Statistical analysis of the research data was performed using Statistical Package for the Social Sciences (SPSS) 19 software. Correlation and regression analyses were performed to determine the relationship between the safety of playgrounds and socioeconomic status of neighborhoods.

## RESULTS AND DISCUSSION

The important risk factor scores of neighborhoods were determined according to the playgrounds they have (Table 2). According to this, while Adnan Menderes, Fatih, Girne, Mimar Sinan and Yedi Eylul neighborhoods had the highest (5 points) protective surfaces score, Ilica basi neighborhood had the lowest (1.00 points) protective surfaces score. The neighborhoods with the highest fall (use) zones score were Girne, Mimar Sinan and Osman Yozgatli with 2.11 points, because the neighborhood with the lowest score was Ilicabasi with 1.00 points. While the fall/equipment height score was identified to be the highest (5.00 points) in Adnan Menderes, Ata, Fatih, Girne, Ilicabasi, Kemer, Mimar Sinan, Orta, Veysi Pasa and Yedi Eylul neighborhoods, it was found to be the lowest in Osman Yozgatli neighborhood (3.67 points). The clothing entanglement hazards score was the highest (5.00 points) in Ilicabasi neighborhood and the lowest (1.89 points) in Fatih neighborhood. The neighborhood with the highest dangerous plant material score was Veysi Pasa neighborhood with 4.33 points and the neighborhood with the lowest score was Mesudiye neighborhood with 1.00 points.

**Table 1. The sample size of the study**

Socioeconomic status	Neighborhoods	Number of playgrounds	Number of playground equipments
Middle	Adnan Menderes	5	17
Middle	Ata	5	13
Middle	Fatih	3	9
High	Girne	11	37
Low	Ilicabasi	1	1
Middle	Kemer	5	17
Middle	Mesudiye	2	6
High	Mimar Sinan	9	30
Middle	Orta	4	11
Low	Osman Yozgatli	3	8
Middle	VeysiPasa	2	5
Middle	YediEylul	4	12
City of Aydin	12	54	166

The important risk factor with the highest score in playgrounds in Aydin was fall/equipment height with 4.90 points, whereas the important risk factor with the lowest score was fall (use) zones with 1.88 points. Yedi Eylul neighborhood had the highest safety score (4.05 points), Osman Yozgatli neighborhood had the lowest safety score (2.86 points). A safety score of the city of Aydin was 3.75 (Table 2). The variety of protective surfaces used under playground equipment was identified. With a ratio of 27.61% (37 playground equipments), Girne neighborhood was observed to be the neighborhood where rubber tiles or unitary synthetic surface were used at the highest ratio as the protective surface under the playground equipment.

**Table 2. Important risk factors and safety scores of the neighborhoods and the city according to playgrounds**

Neighborhoods	Important Risk Factors																				Safety Scores																																																																																																																																																											
	Protective surfaces		Fall (use) zones		Playground equipment surface material		Fall/Equipment height		Swings		Head entrapment hazards		Clothing entanglement hazards		Dangerous equipment		Dangerous plant material		Mean	SD																																																																																																																																																												
	Adnan Menderes	5.00	1.53	4.57	5.00	3.80	4.07	4.07	2.07	3.87	0.24	Ata	4.40	2.07	4.87	5.00	3.53	4.73	2.60	4.73	2.60	3.84	0.35	Fatih	5.00	1.22	3.89	5.00	4.33	3.67	1.89	5.00	2.78	3.64	0.09	Girne	5.00	2.11	3.95	5.00	3.80	3.85	3.91	4.64	2.58	3.87	0.25	Ilicabasi	1.00	1.00	5.00	5.00	-	1.00	5.00	5.00	3.67	3.33	-	Kemer	3.90	1.70	4.30	5.00	3.25	4.80	3.67	4.73	2.33	3.77	0.45	Mesudiye	2.00	1.67	4.00	4.33	3.50	3.67	3.67	5.00	1.00	3.20	0.76	Mimar Sinan Orta	5.00	2.11	4.54	5.00	3.78	3.93	3.96	4.70	2.48	3.94	0.25	Osman Yozgatli	1.33	2.11	2.33	3.67	3.00	2.33	3.00	4.78	3.22	2.86	0.69	Veysi Pasa	3.50	1.50	4.67	5.00	3.50	3.33	3.67	4.67	4.33	3.80	0.29	Yedi Eylul	5.00	1.89	4.67	5.00	3.75	4.00	4.00	4.83	3.33	4.05	0.37	Important Risk Factors Score	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD	3.75*	0.41		4.26	1.39	1.88	0.94	4.25	0.82	4.90	0.57	3.67	0.59	3.89	1.09	3.57	1.12	4.77	0.32	2.60	1.14			
Important Risk Factors Score	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD	3.75*	0.41																																																																																																																																																										
	4.26	1.39	1.88	0.94	4.25	0.82	4.90	0.57	3.67	0.59	3.89	1.09	3.57	1.12	4.77	0.32	2.60	1.14																																																																																																																																																														

Important Risk Factors Score/Mean Safety Score: (1-1.80) Very Unsafe; (1.81-2.60) Unsafe; (2.61-3.40) Moderately Safe; (3.41-4.20) Safe; (4.21-5.00) Very Safe  
 \*Safety Score; SD: Standard Deviation for City of Aydin.

**Table 3. Compliance rates of important risk factors of playground equipment with safety standards**

Types of playground equipments	Important Risk Factors				
	Fall (use) zones	Playground equipment surface material	Fall/Equipment height	Head entrapment hazards	Clothing entanglement hazards
Slides (n=50)	16.00	94.00	100.00	36.00	30.00
Swings (n=49)	30.61	85.71	95.92	95.92	69.39
Seesaws (n=42)	30.95	64.29	-	80.95	78.57
Merry-Go-Round (n=2)	0	100.00	-	100.00	100.00
Climbers (n=23)	21.74	73.91	100.00	91.30	100.00

**Table 4. Variations in important risk factors of playgrounds according to the socioeconomic status of neighborhoods**

		SE	p level
Protective surfaces	0.697	0.127	<0.01**
Fall (use) zones	0.123	0.107	0.256
Playground equipment surface material	0.114	0.093	0.225
Fall/Equipment height	0.145	0.062	<0.05*
Swings	0.129	0.070	0.072
Head entrapment hazards	0.193	0.122	0.120
Clothing entanglement hazards	0.197	0.126	0.125
Dangerous equipment	-0.058	0.036	0.112
Dangerous plant material	-0.113	0.130	0.390
Safety score	0.158	0.042	<0.01**

\*p<0.05 (bolded); \*\*p<0.01 (bolded) , model regression coefficient estimates; SE, standard error.

Table 5. The distribution of safety levels of playgrounds according to safety scores

Neighborhoods	Very Unsafe	Unsafe	Moderately Safe	Safe	Very Safe
Adnan Menderes				5	
Ata			1	3	1
Fatih				3	
Girne			1	9	1
Ilıcabasi			1		
Kemer			1	3	1
Mesudiye			1	1	
Mimar Sinan				8	1
Orta				4	
Osman Yozgatli		1	1	1	
Veysi Pasa				2	
Yedi Eylul				2	2
Aydin City		1	6	41	6

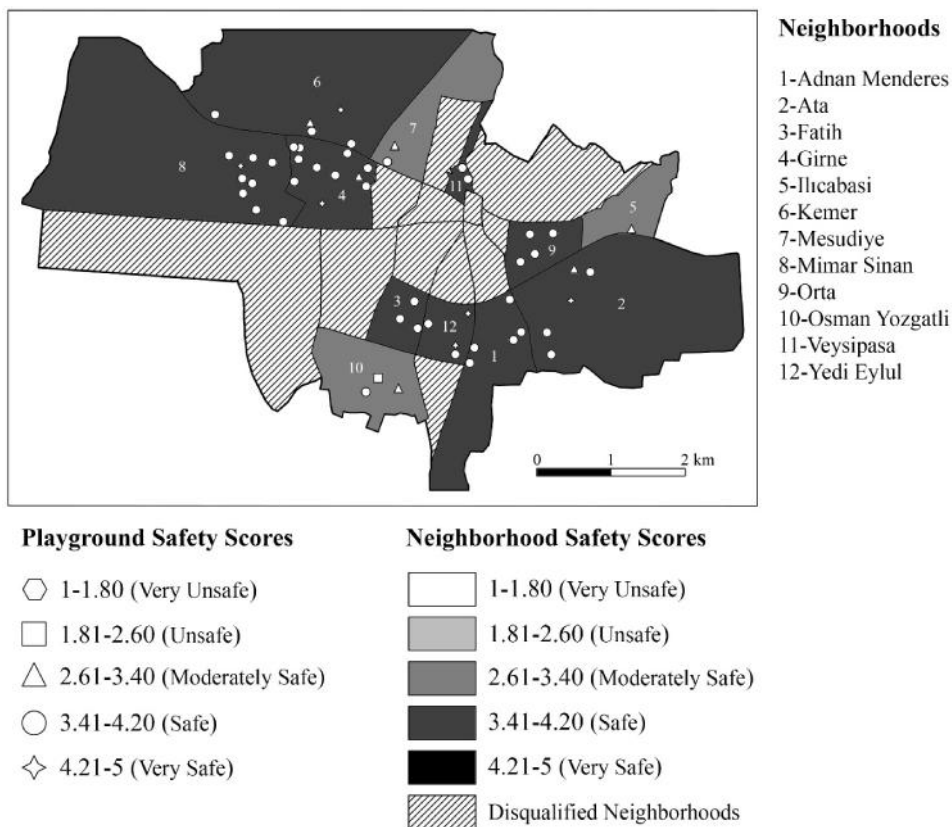


Figure 1. The risk map displays the safety levels of playgrounds and neighborhoods in Aydin



Figure 2. The safest (a) and the unsafest (b) playgrounds in Aydin

The neighborhood, where rubber tiles or unitary synthetic surface were used at the lowest ratio, was Veysi Pasa neighborhood with a ratio of 2.24% (3 playground equipments). In Aydin, rubber tiles or unitary synthetic surfaces are used as the protective surface under playground equipment at the highest ratio with 80.72% (134 playground equipments). The ratio of using concrete as a protective surface is 4.22% (7 playground equipments). All the playground equipments, that are used concrete as protective surfaces under them, are in Ilicabasi (1 playground equipment) and Osman Yozgatli (6 playground equipments) neighborhoods. When the compatibility of playground equipment with important risk factors standards was examined, the highest compatibility was observed between seesaws and the fall (use) zones standard at a ratio of 30.95%, between slides and climbers and the fall/equipment height standard at a ratio of 100%, and between climbers and the clothing entanglement hazards standard at a ratio of 100% (Table 3). A linear and statistically significant relationship was observed between protective surfaces and fall/equipment height and socioeconomic status of neighborhoods. A linear and statistically significant relationship was also observed between the playgrounds' safety score and socioeconomic status of neighborhoods in the city (Table 4). When playgrounds with the highest safety score were compared, Metin Oktay park playground in Mimar Sinan neighborhood ranked first with 4.41 points, and Besalet Surur Yavuz Park playground in Ilicabasi neighborhood ranked twelfth with 3.33 points. Of the 54 playgrounds examined in the city of Aydin, 41 were "Safe," and one was "Unsafe." In terms of the safety score, "Very Safe" playgrounds are in Ata, Girne, Kemer, Mimar Sinan and Yedi Eylul neighborhoods, whereas "Unsafe" playgrounds are in Osman Yozgatli neighborhood (Table 5, Figure 1). The safety levels of the neighborhoods were determined based on the important risk factor scores of the playgrounds they have (Table 2). While Adnan Menderes, Fatih, Girne, Mimar Sinan and Yedi Eylul neighborhoods were found to be "Very Safe" in terms of the protective surfaces score, Ilicabasi neighborhood was identified to be "Very Unsafe."

In terms of the fall (use) zones score, Girne, Mimar Sinan and Osman Yozgatli neighborhoods were found to be "Unsafe," and Ilicabasi neighborhood was found to be "Very Unsafe." In terms of the fall/equipment height score, Adnan Menderes, Ata, Fatih, Girne, Ilicabasi, Kemer, Mimar Sinan, Orta, Veysi Pasa and Yedi Eylul neighborhoods were identified to be "Very Safe," while Osman Yozgatli neighborhood was found to be "Safe." In line with the clothing entanglement hazards score, Ilicabasi neighborhood was found to be "Very Safe," while Fatih neighborhood was identified to be "Unsafe." Regarding the dangerous plant material score, Veysi Pasa neighborhood was found to be "Very Safe" and Mesudiye neighborhood "Very Unsafe." The safety level of Aydin city was determined according to the important risk factor scores of the playgrounds it has. While Aydin was identified to be "Very Safe" in terms of the fall/equipment height score, it was identified to be "Unsafe" in terms of the fall (use) zones score. The safety levels of neighborhoods and Aydin were evaluated by considering the safety scores of the playgrounds they have. Whereas Yedi Eylul neighborhood with the highest safety score was found to be "Safe," Osman Yozgatli neighborhood with the lowest score was identified to be "Moderately Safe." The city of Aydin was determined to be "Safe" with its safety score (Table 2, Figure 1).

As the socioeconomic status of neighborhoods increases, their compliance with the standards in terms of protective surfaces

and fall/equipment height increases, and the safety levels of playgrounds in the city also increase (Table 4). Among the playgrounds with the highest safety score, whereas Metin Oktay park playground in Mimar Sinan neighborhood was identified to be "Very Safe," Besalet Surur Yavuz Park playground in Ilicabasi neighborhood was found to be "Moderately Safe." In accordance with the safety score, the safest playground in Aydin was found to be Metin Oktay Park playground in Mimar Sinan neighborhood (4.41 points), while the unsafest playground was Doksanmıncı Yıl Park playground in Osman Yozgatli neighborhood (2.30 points) (Figure 2).

### Conclusion

Falls from playground equipment such as climbers, monkey bars and slides make up the most important cause of injuries in playgrounds (Rece & Sege 2000; AIHW *et al.* 2006). Severe fractures, dislocations and concussions establish a significant part of injuries occurring because of falls from playground equipment (Loder 2008; Vollman *et al.* 2009). Shock-absorbing surfaces should be provided under playground equipment to prevent serious injuries that may occur because of fall (Standards Australia 1996; Little & Eager 2010). Rubber tiles a protective surface in playgrounds because they reduce head injuries caused by falling from equipment because of their shock-absorbing properties (Huang & Chang 2009). Children living in Adnan Menderes, Ata, Fatih, Girne, Kemer, Mimar Sinan, Orta, Veysi Pasa and Yedi Eylul neighborhoods, where rubber tiles or unitary synthetic surfaces are used as a protective surface in playgrounds, are at the low risk of severe injuries, particularly head injuries, caused by falling from playground equipment. Falling onto concrete or asphalt surfaces results in a five-fold higher risk of injury compared to falling onto rubberized surfaces (Mott *et al.* 1997). Children playing in playgrounds in Ilicabasi and Osman Yozgatli neighborhoods with low socioeconomic status, where most of the protective surfaces are concrete, are at a five-fold greater risk of injury occurring because of fall compared to children playing in playgrounds in Girne and Mimar Sinan neighborhoods with high socioeconomic status, where all of the protective surfaces are rubber tiles or unitary synthetic surface.

When the playground equipment in Aydin playgrounds is not to comply with the fall (use) zones safety standards, children may be at the high risk of injury because of strikes by moving objects such as swings. The height of playground equipment is related to the number of fractures caused by falls (Mott *et al.* 1997). Since all slides and climbers among the examined playground equipment and 95.92% of swings follow safety standards in terms of fall/equipment height, they do not pose a significant risk to the safety of children. Other causes of rare deaths observed in playgrounds are asphyxiation and strangulation because of head entrapment or clothing entanglement (Drago *et al.* 1997; Mowat *et al.* 1998). Among the examined playground equipment slides are the playground equipment that may cause head entrapment hazards or clothing entanglement hazards. Slides, so, pose a severe life threat for children playing in playgrounds in Aydin city. Plants, of which leaves and fruits are toxic, can poison children when eaten by them, thorny and prickly plants can harm children and injure them. Of the examined playgrounds, 31 had plants with toxic fruits, and 18 had plants with thorny branches. Most of the playgrounds in Aydin are not safe in terms of dangerous plant material.

The risk map was showed that there were significant differences between the neighborhoods in terms of playground safety and that these differences in safety were because of socioeconomic indicators. There are more unsafe and fewer playgrounds in cabasi and Osman Yozgatli neighborhoods where a higher percentage of the population lives below the poverty level. These results are like the results of the study carried out in Chicago on Playground Safety and Quality (Allen *et al.* 2013). The results also confirm the hypothesis of this study, which argues that “the safety level of playgrounds in neighborhoods with low socioeconomic status will also be low.” The recommendations of the study will fill a significant gap by providing more correct information to policymakers. Although the results of the study show that there are many unsafe playgrounds in Aydin, they express that the situation is not hopeless. The study suggests that the safety of playgrounds should be improved. Poverty zones in Aydin are experiencing policies of “benign neglect.” The concrete protective surfaces of playgrounds in Ilicabasi and Osman Yozgatli neighborhoods with low socioeconomic status should be made safe by transforming them to rubber tiles or unitary synthetic surfaces, as they are in Girne and Mimar Sinan neighborhoods with high socioeconomic status. In this way, the safety standards in the relevant playgrounds will be increased, serious injuries and even deaths that may occur because of falls may be prevented, and service inequality among the neighborhoods will also be reduced.

In Aydin city, the safety of playgrounds, found to be “Very Unsafe” and “Unsafe” in terms of fall (use) zones, can be increased by increasing the fall (use) zone standards of playground equipment. For this, a minimum 1.83 m fall (use) zone should be created in each direction where there are not any obstacles around slides, swings, seesaws and climbers. Creating fall (use) zones compatible with the standards will prevent injuries that may occur because of fall by tripping and collision. Slides should be examined and fixed in terms of gaps or 'S'-shaped hooks and protrusions that may cause asphyxiation and strangulation. In this way, making slides safe in terms of head entrapment hazards and clothing entanglement hazards will reduce the risk that threatens the lives of children playing in playgrounds in Aydin city. In particular, plants with thorny stems and branches and with toxic fruits used in the playgrounds in Adnan Menderes, Ata, Girne, Kemer, Mesudiye, Mimar Sinan and Orta neighborhoods, which aggregate seven of the twelve neighborhoods examined within the study in Aydin city, should be reduced, and species that may be shade trees should be used. Making the playgrounds of Aydin city safe in terms of dangerous plant material will attract more children to playgrounds. In Ilicabasi and Osman Yozgatli neighborhoods with low socioeconomic status, the safety of playgrounds, which were identified to be “Very Unsafe” and “Unsafe” in terms of protective surfaces, fall (use) zones, and elements that could cause head entrapment hazards, should be increased and brought to the same level with those in Girne and Mimar Sinan neighborhoods with high socioeconomic status. More and much safer playgrounds should be established in Ilicabasi and Osman Yozgatli neighborhoods with low socioeconomic status. By increasing the number of safe playgrounds, differences in the number and safety level of playgrounds between the neighborhoods, especially Girne and Mimar Sinan neighborhoods with high socioeconomic status, will be eliminated. Increasing the safety of playgrounds in Aydin city will prevent severe injuries and even deaths and reduce inequality in service between the neighborhoods. A

new study should be conducted after 2 or 3 years to determine changes in the safety levels of playgrounds in Aydin and the effects of the recommendations made in this study. Local authorities in Aydin should make public playgrounds safer. Local initiatives should be developed at a national level.

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