

## THE EFFECTS OF PARK IMPROVEMENT ON PARK USE AND PARK-BASED PHYSICAL ACTIVITY

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**Abstract.** Park is considered as one of the necessary settings in the urban area to promote physical activity and a healthy lifestyle. It provides opportunities to engage in park-based physical activity to a wide range of users. Studies have found that park improvement is a sustainable way to increase the urban population's physical activity levels. This study explores the effects of park improvement on park use and park-based physical activity using Benjakitti Park, one of the major district parks in Bangkok, Thailand, as the case study. The park improvement was designed and constructed from October 2016 – January 2017. A System for Observing Play and Recreation in Communities (SOPARC) observations were used to observe the changes in park use and park-based physical activity before and after the park improvement. It was found that park improvement changed users' characteristics and the patterns of park use and park-based physical activity. The park improvement was associated with an increasing number of children and elderly visitors and a 4.1% and 17.6% increase in cycling and running. The project shows that even a tiny improvement in the built environment can change people's attitude and behaviour towards physical activity and a healthy lifestyle.

**Keywords:** public park, physical activity, urban landscape, urban health, SOPARC, landscape architecture.

### Introduction

Parks hold an essential role in providing settings for the urban population to be physically active because they offer equal opportunities for facilitating physical activity to a wide range of users of different age, ethnocultural, and socioeconomic groups (Arifwido, 2020). Empirical evidence has shown that modifying the park's physical environment, such as optimizing the design, can increase park visits and park-based physical activity (Duncan et al., 2021). Studies have also found that park quality and specific park features are essential factors associated with achieving the recommended levels of physical activity. A study in Australia found that more attractive parks had more diverse types of park-based physical activity and had other co-benefits to mental health (Veitch et al., 2014). Hence, an active park or park that can support the park-based physical activity should be a standard recommendation in park planning, design and management (Topothai et al., 2016).

Understanding specific park features that attract users is increasingly crucial in park planning and design.

A growing body of literature has attested that park features such as park size, amenities and facilities, organized activities, and aesthetics are essential for encouraging park-based physical activity (Han et al., 2013). On the other hand, park with inadequate maintenance was considered unattractive and had less active park use (Schultz et al., 2017). However, previous evaluation on how park improvement can increase physical activity have mixed results. Studies in the U.S. found that park renovations were associated with increased park use and local physical activity (Cohen et al., 2012, 2015; Schipperijn et al., 2013). These studies suggest that renovating skatepark and playground increased daily users' number and their associated physical activities. On the other hand, Lindberg and Schipperijn (2015) found that overly-designed park facilities may not bring benefits to increase physical activity in the park.

Despite the importance of the topic on park improvement and physical activity, little research has been conducted to understand whether improving park amenities and facilities can increase the population's physical activity

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in the context of Asian cities. Studies related to how park improvement can increase park users' physical activity levels were primarily found in the U.S. and European cities (Veitch et al., 2014, 2018; Schultz et al., 2017). Different geographical, cultural and socioeconomic contexts can result in various types of active park use. For example, tropical cities can limit park use due to the hot weather during the afternoon (Arifwidodo & Chandrasiri, 2020b; Arifwidodo, 2014). This particular study attempted to examine the effects of park improvement on park use and park-based physical activity in Bangkok, Thailand. Understanding how park improvements can increase park use and park-based physical activity can inform local and national governments how to direct the investments in park planning and design and raise awareness of professionals on how to mainstream physical activity in architecture and landscape architecture in general.

## 1. Methods

### 1.1. Study setting

The study was part of an action-research project funded by the Thai Health Promotion Foundation (ThaiHealth) in examining the impacts of minor physical improvements in the public park in Thailand. Benchakitti park was selected for the study because it is one of Bangkok's most prominent and oldest district parks. It can be easily accessed by different modes of public transportations such as bus and underground train and private cars. The park's total area was 130 hectares, with a retention pond for water recreation covered one-third of the area. In 2020, the park area was expanded and are currently undergoing a construction process. Biking and jogging track are surrounding the park, with the west part of the park consist of park facilities such as a playground, fitness equipment, amphitheater, and skateboard park (Figure 1).



Figure 1. Satellite image of Benjakitti Park (source: Google Map, 2020)

### 1.2. Park improvement process

In February 2016, a steering committee to oversee the park improvement was established, including the Bangkok Metropolitan Administration (BMA), Thai Health Promotion Foundation, Sports Authority of Thailand, community leaders, non-government organizations, landscape architect professionals the research team. After conducting observational surveys, park audit, and a series of focus group discussion on the scope of renovations (considering budget and timeframe), three main design objectives were agreed upon. First, park improvement should be able to increase the number of children and elderly in the park. Second, the improvement should increase the light physical activity since this public park was meant to accommodate different activities, including sedentary and light physical activities.

After several iterations of the design, the steering committee approved the final design in April 2016. It was decided that the park improvement was prioritized in three areas:

1. Redesigning the bike lane area. The objective of the improvement was to reduce accidents. A series of Focus Group Discussion (FGD) with different stakeholders, including park users, revealed that accidents happened almost every day in the park due to the curves and intersections, which can be dangerous for both cyclists and non-cyclists. During the focus group discussion, it was revealed that one of the reasons why not many children in the park were because parents were afraid their children were hit by cyclists. The improvement in this zone included covering the bike lane with an anti-slip surface, providing bollards and barriers to separate bike lane and jogging track, and installing signage and wayfinding in the area to direct the flow of runners and cyclists.
2. Redesigning the walking and jogging track. The objectives of the improvements were: first, to separate running, jogging and walking. The second was to create a sense of direction in the jogging track. Before park improvement, there were complaints that some users walked or ran clockwise around the track, and some others did the otherwise, resulting in accidents among runners. We repainted the jogging track as well as installed signage and wayfinding to separate walkers and runners.
3. Renovating playground. The improvement's objective was to increase the number of children visitors in the park, as the existing playground was too small and not well-maintained. We added new play equipment and amenities (water fountain, tables, and sitting area for parents).

Table 1 summarizes the improvement conducted in the park. The construction was started in September 2016 and finished in January 2017. The research team worked together with the BMA and park manager to make sure that the park did not have to close during the construction period.

Table 1. Summary of park improvement conducted for the study

Location	Types of improvement	Description of improvement
East zone	None	–
West zone	None	–
Playground zone	Renovating playground	Installing new play equipment to increase active play among children; installing new amenities such as water fountain, tables, and sitting areas for parents; renovating the surrounding to improve safety and security in the playground
Bike lane/jogging track	Redesigning bike lane area	Covering the bike lane with a non-slippery surface; separation of the bike lane and jogging track using elevated surface and bollards; installing signages to reduce cyclists' speed
	Redesigning walking and jogging track	Installing signage of walking and running to create a sense of direction; repainting the jogging track to separate walking and running; installing signage and bollards at the intersection of the bike lane and jogging track

### 1.3. Measuring the effects of park improvement

To understand the effects of park improvement to park use and park-based physical activity, we conducted two measurements. Baseline data (before improvement) were collected during 6–9 August 2016, and a follow-up assessment (after improvement) were completed during 9–12 April 2017. The System for Observing Play and Recreation in Communities (SOPARC) was used to complete the direct observation of park visitors and their physical activity levels (Mckenzie et al., 2006). It is a widely used instrument specifically designed to assess physical activity levels in the park and other types of public open spaces (Evenson et al., 2016). A previous study in assessing physical activity in parks in Bangkok used a similar method (Chandrasiri & Arifwidodo, 2017). Adjustments to physical activity types in the SOPARC form were made to reflect the Thai context, following the study conducted by Arifwidodo and Chandrasiri (2020a).

For SOPARC observation, the park was divided into four zones (Figure 2):

1. The east zone, next to the Ratchadapisek Road, mainly were consisted of gardens with no open spaces for activity. This zone was traversed by the jogging track and bike lane.

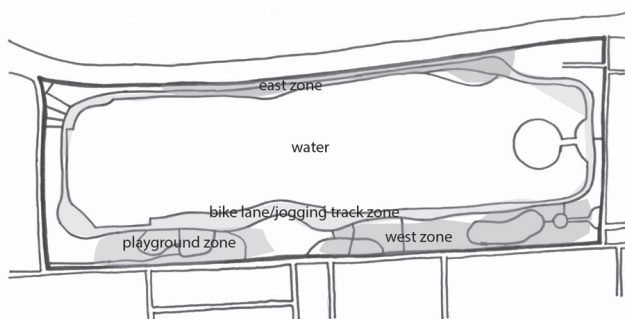


Figure 2. The SOPARC observation zones

2. The west zone, which was most of the activities in the park, occurred both active and non-active uses.
3. The playground zone, where we conducted the renovation of the playground.
4. Bike lane and jogging track, where we conducted the physical improvement on the bike lane and jogging track.

We recruited four trained assessors for the observation. Each person was responsible for scanning and coding physical activity levels in each zone. The park was observed four days before and after the improvement, representing two typical weekdays and weekends. Each period of observation was divided into four rounds in the morning (06.00, 07.00, 08.00) and four rounds in the evening (16.00, 17.00, 18.00, 19.00). In both observations, park users' characteristics such as gender (i.e., female, male), age group (children, adolescents, adult, and elderly) and primary activities (i.e., walking, sitting, jogging) were recorded by the observers. Physical activity levels were coded into three categories: sedentary (sitting, sleeping, picnic, and reading), light physical activity (such as walking), and moderate to vigorous physical activity (MVPA) such as running, cycling, and other strenuous exercises. These categorizations were part of the standard procedure in conducting SOPARC observation (Bai et al., 2013; Tu et al., 2015).

Descriptive statistics were used to highlight the difference in the total number of visitors and their physical activity levels during observation periods (before and after the park improvement). Two binomial logistic regression models (odds ratio = OR and confidence interval CI = 95%) were constructed to understand the changes in physical activity characteristics and patterns before and after park improvement. These models' dependent variables were the level of physical activity in the park, categorized into "active use" and "non-active use" for the analysis. Active use represented light, moderate, and vigorous physical activity, while non-active use was categorised as sedentary behaviour.

## 2. Result

A follow-up observation recorded a total of 12,506 users, which shows a 10% increase from the baseline data before the park improvement (11,239 users). There was a significant increase in sedentary and light physical activity. More elderly and children were observed in the park after the improvement, with most children were found in zone 3, where the playground was installed. Similarly, elderly users were found walking in the newly-designed jogging track. The follow-up observation also found a significant increase in the total number of users during the weekends, while no significant difference was found during weekdays. Table 1 summarizes the result.

Table 2 presents the comparison of the total number of users stratified by types of the park's main activity. It shows that the park improvement changes the activity structure in the park. Confirming the increase of sedentary behaviour in the park, more people were reading and picnic during the follow-up observation. A 49% increase in yoga and tai chi confirmed the increasing number of elderly users conducting activities in the park after the improvement. A 4.1% increase in cycling and running activities were also recorded.

Table 1. The number of visitors before and after park improvement

Criteria	Before (%)	After (%)	Changes (%)
<b>Zone</b>			
1 east side	3758 (33.2)	5117 (40.9)	36.2%
2 west side	4641 (41.0)	4432 (35.4)	-4.5%
3 passive/play	2098 (18.5)	2364 (18.9)	1.2%
4 bike lane/jogging	832 (7.3)	593 (4.7)	-28.7%
<b>Nationality</b>			
Thai	10222 (90.2)	10579 (84.6)	3.4%
Non-Thai	1107 (9.8)	1925 (15.4)	73.8%
<b>Gender</b>			
Male	6635 (58.6)	7116 (56.9)	7.2%
Female	4694 (41.4)	5390 (43.1)	14.8%
<b>Age group</b>			
Children	440 (3.9)	532 (4.3)	20.9%
Teen	1235 (10.9)	745 (6.0)	39.6%
Adult	8065 (71.2)	9093 (72.7)	12.7%
Elderly	1589 (14.0)	2136 (17.1)	34.4%
<b>Physical activity level</b>			
Sedentary	1179 (10.4)	1759 (14.1)	49.1%
Light	4802 (42.4)	5429 (43.4)	13.0%
Moderate-vigorous	5348 (47.2)	5318 (42.5)	-0.5%
<b>Week</b>			
Weekend	5992 (52.9)	6284 (50.3)	4.9%
Weekdays	5247 (47.1)	6222 (49.7)	18.6%
<b>TOTAL</b>	<b>11329 (100)</b>	<b>12506 (100)</b>	<b>10.0%</b>

Table 2. Comparison of the total number of users stratified by activity

Activity	Baseline (%)	Follow-up (%)	% of changes
Sitting/laying down	1272 (11.2)	1235 (9.9)	-2.9
Chatting	195 (1.7)	119 (1.0)	-39.0
Reading	24 (0.2)	98 (0.8)	308.3
Picnic (with food)	16 (0.1)	82 (0.7)	412.5
Other sedentary	169 (1.5)	225 (1.8)	33.1
Walking	4190 (37.0)	4561 (36.5)	8.9
Yoga, tai chi	255 (2.3)	380 (3.0)	49.0
Using exercise equipment	488 (4.3)	370 (3.0)	-24.2
Skateboard	11 (0.1)	97 (0.8)	781.8
Other light physical activity	80 (0.7)	21 (0.2)	-73.8
Bicycling	778 (6.9)	810 (6.5)	4.1
Running	3751 (33.1)	4412 (35.3)	17.6
Boating	64 (0.6)	91 (0.7)	42.2
Rowing	1 (0.0)	3 (0.0)	200
Other medium to vigorous physical activity	35 (0.3)	2 (0.0)	-94.3

Table 3. Comparison of active park use before and after park improvement based on System for Observing Play and Recreation in Communities (SOPARC) data

Variable	Before OR (95% CI)	After OR (95% CI)
<b>Zone</b>		
1 east side	ref	ref
2 west side	4.033 (2.832-5.742)*	8.550 (6.966-10.495)*
3 playgrounds	0.739 (0.522-1.046)	4.922 (4.047-5.987)*
4 bike lane/jogging	0.892 (0.605-1.315)	1.215 (1.004-1.472)*
<b>Nationality</b>		
Thai	ref	ref
Non-Thai	1.198 (0.962-1.491)	4.065 (0.999-4.184)
<b>Gender</b>		
Female	ref	ref
Male	1.516 (1.334-1.721)*	1.506 (1.352-1.677)*
<b>Age group</b>		
Teen	ref	ref
Children	0.602 (0.450-0.805)*	1.447 (1.106-1.845)*
Adult	1.146 (1.119-1.898)*	1.407 (1.325-1.509)*
Elderly	1.113 (0.925-1.339)	1.804 (1.688-1.939)*
<b>Week</b>		
Weekdays	ref	ref
Weekend	1.198 (0.962-1.491)	1.591 (1.365-1.855)*

Note: \*  $p$ -value < 0.005. Dependent variable: active park use;  $n$  (before) = 11,329,  $n$  (after) = 12,506.

Table 3 presents the changes in physical activity patterns and characteristics before and after the park improvement. There was a statistically significant association of active use after the park improvement in various variables. Playgrounds and bike lane/jogging track were found significantly associated with active park use compared to before the improvement. More children and the elderly were also significantly associated with active park use (OR = 1.447 and 1.804). Although the improvement did not specifically address the adult age group, it showed an increase in the probability of being active in the park (1.146 before and 1.407 after the improvement). After the improvement, people were more likely to be engaged in physical activity during weekends (OR = 1.591). Male park users were more likely to be physically active than female before and after the improvement (1.516 before and 1.506 after).

### 3. Discussion

This study is one of the few studies in Asian cities in a tropical climate to examine the effect of park improvements on active park use. Two main findings were highlighted in this study. First, park improvements change the characteristics of park users. More elderly and children were observed in the park and more likely to engage in park-based physical activity. The findings were dissimilar to previous studies in Bangkok, where children and the elderly were less prominent, although park facilities and amenities were available (Arifwidodo & Chandrasiri, 2020; Chandrasiri & Arifwidodo, 2017). Before the park improvement, children were the least active group. However, after the construction of the playground, the likelihood of being active for children was significantly increased. This finding shared similarity with the study conducted in Australia, which found that installing park amenities for children can substantially increase children's park-based physical activity (Dobbinson et al., 2020). The study also suggested that improving the playground can increase the number of park visitors since it was not uncommon that children visited the park with parents and family.

Similarly, the separation of walking and running in the jogging track increased the likelihood of being active for elderly users. On the other hand, consistent with previous research, adult and male users were the most active group, which indicated specific attention to increase park-based physical activity for female users. There were no significant changes in the likelihood of nationality since the park improvements were not intended to increase the number of non-Thai users. The redesign of the bike lane saw a 4% increase in cycling activities in the park. It was also found that installing signage and bollards had reduced the average speed of cycling in the park was reduced to a maximum of 20 kilometres per hour. After the park improvement, no cycling accidents were reported during the observation period.

The second main finding was that park improvement also saw the different patterns of active park use and park-based physical activity. Active park uses were more likely to happen in different zones of the park, especially at the bike lane and jogging track. More light physical activity such as walking was observed after the improvements, especially in the zones that received physical improvements. More sedentary activities such as reading and picnic were also observed in all zones after the improvements. The improvements also changed the time of the park visit. Before the improvement, there was no significant difference between weekend and weekdays in terms of the number of people conducting the physical activity. However, there was a substantial difference during weekdays and the weekend after the park improvement. Further analysis of the data showed that most of the increase was from children and elderly conducting light physical activity during the weekend.

In many cities of developing countries, including Bangkok, a higher dependency on private motorized vehicles has created fewer opportunities to increase transportation-related physical activity. People tend to use private cars instead of walking, cycling, or using public transport. An increasingly warmer temperature in Bangkok also exacerbated the situation (Arifwidodo, 2014; Arifwidodo & Chandrasiri, 2015). On the other hand, it is difficult to increase physical activity at work due to the nature of urban jobs, which rely on sedentary behaviours. Parks can provide a safe and convenient place to engage in physical activity and a healthy lifestyle for urban residents. A growing body of evidence in parks and physical activity usually proposes two recommendations: first, build more parks to increase the accessibility of different population groups in the urban area to have the opportunity to be physically active (for example, see Kaczynski et al., 2008; Rigolon, 2016). However, in Bangkok, it is currently difficult for the local government to procure land to supply the green open spaces due to urban densification and rising land prices (Arifwidodo et al., 2021). The second recommendation would be investing in a better quality of the physical environment in the park. This study's findings echo what has been established in the literature that improving the physical environment can have significant effects to increase park use and park-based physical activity (Cohen et al., 2020; Veitch et al., 2021). A small design intervention can significantly affect active park use when it has a straightforward design objective and involves all the relevant stakeholders in the design process (Duncan et al., 2021). In this study, although the main objectives of the park improvement were to increase the number of children and elderly in the park and increase light physical activity, it had also increased the number of moderate to vigorous physical activity in the park. Although it was not intended, the improvement also increased the number of people engage in sedentary behaviours. However, they may also benefit from the range of social and mental health benefits (Francis et al., 2012).

The strengths of this study include the use of a validated SOPARC instrument to measure the effect of park improvement objectively. Comparisons between before and after the improvement can highlight the changes in terms of users' characteristics and patterns of physical activity in the park. Another strength is the multi-stakeholders involvements in the design process. Local government, national health promotion agencies, researchers, and landscape architect professionals worked together with the communities and park users to find the balance between catering to the community needs and the budget and time constraints of the park improvement. Limitations of the study include the lack of a comparison park, which limits the interpretation of the magnitude of the park improvement when compared to a park with similar characteristics without the improvement. The physical improvement of the park was also limited to small renovation and upgrading due to limited funding. The SOPARC observation method was unable to further identify users' sociodemographic characteristics, such as income, employment, and proximity of residence, which were significant individual factors in determining park use and park-based physical activity.

## Conclusions

This study examines the effects of park improvement to park use and park-based physical activity in Bangkok, Thailand. The findings in this study were consistent with the existing evidence in the literature. We found that park improvement contributes to the intended changes of park users. More children and the elderly were found engaging in physical activity. The improvement also saw that active park use was more likely to happen in physically improved zones. These findings provide encouraging evidence for urban planners and designer, and local governments that a small improvement of parks' physical environment can benefit urban residents. Future research should be addressed to understand the needs of specific park users and how much accessing parks can improve their physical activity levels and health outcomes in general. Combining survey questionnaire of people surrounding the park with SOPARC observation would be essential in future studies. In addition to using a more sophisticated method, more research should address whether physical improvement could be further enhanced if the intervention was combined with organized activities and programs in the park.

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