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Insights from an observational assessment of park-based physical activity in Nanchang, China

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ABSTRACT

Internationally, parks have been shown to be an important community asset for physical activity (PA), but little is known about the relationship between park usage and physical activity in China. The purpose of this study was to determine the association between park user characteristics and PA in Nanchang, China. In June 2014, 75,678 people were observed in eight parks over 12 days using SOPARC, a validated systematic observation tool. A logistic regression analysis was used to determine the association between PA and park user characteristics. Most park users were older adults (53.5%) or adults (34.6%). Overall, 55% of park users engaged in moderate-to-vigorous physical activity (MVPA). Fewer women were observed in parks than men, but were 66% more likely to be engaged in MVPA than men. Park users were more likely to be observed in MVPA between 6–9 am and when the temperature was below 30 °C. Chinese park users were more active (55%) than US studies in Tampa (30%), Chicago (49%), and Los Angeles (34%). More research is necessary to identify features of parks that are associated with greater PA so that effective interventions can be developed to promote active park use in Chinese citizens.

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Introduction

Rapid economic development in China has been accompanied by a corresponding increase in obesity. In China, the prevalence of overweight adults has been reported as high as 17.7% with adult obesity at 5.6% (Li et al., 2005), while results from a recent survey indicated an obesity rate of 10% among Beijing youth ages 7–18 years-old (Working group on obesity problems in China (WGO), 2004). Physical activity is a behavior of paramount importance, as engaging in recommended levels of physical activity can contribute to the prevention of chronic diseases, optimal mental health, and high quality of life (Warburton et al., 2010). Insufficient physical activity and sedentary behavior are associated with early death, depression, hypertension, coronary heart disease, stroke, type 2 diabetes, and obesity (Warburton et al., 2010; Owen et al., 2010). Despite these remarkable health benefits, longitudinal studies have found that physical activity rates are declining among Chinese residents (Ng et al., 2014; Ng et al., 2009). In particular, weekly physical

activity among adults fell by 32% between 1991 and 2006 (Ng et al., 2009). This rapid decline is of both public health and economic importance, as one study estimated that China will spend nearly 9% of its GDP for prevention and control of chronic diseases related to diet, physical inactivity, and obesity by 2025 up from less than 4% in 2000 (Popkin et al., 2006).

One effective strategy in the promotion of physical activity is the provision of safe, accessible, and free places for physical activity to occur, such as public parks (Kaczynski and Henderson, 2008). Parks have been consistently shown to be an important community asset for physical activity over several studies in developed nations (Kaczynski and Henderson, 2008; Floyd et al., 2008; Cohen et al., 2007; Mowen et al., 2007). Parks are often free, open to the public and play an important role in promoting residents' physical activity (Mowen et al., 2007; Timperio et al., 2008). It has been repeatedly reported that residents' participation in leisure time physical activity is highly correlated with the characteristics and conditions of parks facilities (Van Dyck et al., 2013; Prince et al., 2011), but the overwhelming majority of these studies have been conducted in western populations. If Chinese public health officials are going to effectively leverage parks to promote physical activity, an understanding of who uses parks and the characteristics of the parks that encourage use and physical activity is imperative if to inform the development of parks that promote active use.

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China is undergoing a rapid process of urbanization. This greatly increases the number of people for whom parks are the only safe, free place for physical activity in the community. One study showed that the presence of parks in the community is related to walking among Chinese adults (Jia et al., 2014). However, no studies using observational methods to assess park use and physical activity have been conducted in mainland China. The present study was conducted in Nanchang, a city in the southeast of China. It is the largest city in the Jiangxi province with a population of just over five million in 2010 (Nanchang Municipal People's Government and Nanchang Economic Information Center). It is one of the most underdeveloped provinces in China with a GDP per capita of only ¥25,884 (about US\$4000) compared to the national GDP per capita of ¥41,908 (about US\$6700) (China National Bureau of Statistics, 2013). However, Nanchang is representative of mainland China, and information gathered about environmental supports for physical activity in Nanchang may have implications for millions of Chinese citizens in similar urban areas. Therefore, the purpose of the present study was to determine the association between park user characteristics and physical activity in parks located in Nanchang, China.

Methods

Park selection

Parks were purposefully selected in order to capturing the parks serving the largest portion of the population in the city. The research team identified a total of 15 parks located within the greater city limits of Nanchang. Of these 6 were eliminated from consideration because they fell outside of the urban area of the city. Another park was removed because it was under construction with more than half of its green space obstructed. The remaining eight parks were selected for inclusion. Parks ranged greatly in size, with three parks between 34–40.5 km² in size, two parks between 40.5–60.7 km², and two parks ranging from 235 km² to 324 km² (Table 1).

Instrumentation

The System for Observing Play and Recreation in Communities (SOPARC) was used to measure physical levels and individual characteristics of park users. SOPARC has been shown to have good reliability and validity in several previous studies (McKenzie et al., 2006; Chung-Do et al., 2011; Parra et al., 2010). For the present study, no changes were made in the coding of physical activity, but minor changes were made to the data collection instrument to ensure relevance in China. Adaptations were made, in accordance with a prior study using SOPARC conducted in Taiwan (Pleson et al., 2014). Adaptations included: adding and subtracting activity codes to better reflect activities in Chinese parks (e.g., tai chi, dance, and mahjong); and inclusion of daily average Air Quality Index (AQI) scores to capture air pollution levels in the city (US Environmental Protection Agency). The AQI is reported daily by the city government in Nanchang and was recorded each morning of data collection. A score below 100 is considered acceptable, while scores from 101–150 are rated unhealthy for sensitive groups including children and older adults, and scores above 150 are rated as unhealthy for all (US Environmental Protection Agency). Because most, if not all, park users in Nanchang are Chinese, racial/ethnic background was not relevant, nor recorded.

Data collection

Twelve graduate and undergraduate research assistants from Nanchang University collected the data under supervision of the senior investigators (JBM, JEM). Prior to the start of the study, data collectors underwent a comprehensive SOPARC training in a classroom setting and then had two practice observation days in parks before official data collection began in accordance with published SOPARC protocols

to ensure acceptable inter-rater reliability (McKenzie and Cohen). Weekly meetings were held to answer any questions throughout the data collection process and minimize observer drift.

Each park was divided into specific target areas of varying size, chosen for their likelihood to capture physical activity. Their boundaries were decided and mapped by members of the research team prior to the start of data collection. Target areas included open green spaces, walking paths, badminton courts, outdoor exercise equipment, seated game areas, pavilions, playgrounds, running tracks and open developed spaces.

Parks were observed four times per week (two weekdays and two weekends), four times per observation day, over a period of three weeks in mid-June 2014 (12 days and 48 total observations per park). Authors of previous studies have recommended this level of observation to obtain a robust estimate of park users and physical activity (Cohen et al., 2011). Observations took place over 4 time blocks: 6 am–9 am, 10 am–1 pm, 2 pm–5 pm, and 6 pm–9 pm. Two observers went to the parks during each time period. Observers split the target areas of their assigned parks and conducted scans simultaneously. Because some parks were within close proximity to one another, observers could assess two parks per time block maximizing efficiency.

During each target area scan, pertinent information was obtained (e.g., temperature, sex, age group, activity intensity level, and type of activity). Activity levels were recorded as sedentary, walking, or vigorous. If park users were lying down, sitting, or standing still they were recorded as sedentary. Activities more intense than walking at the time of observation were recorded as vigorous (McKenzie et al., 2006). Age categories included children (0–12); teens (13–20), adults (21–59) and older adults (60+) (McKenzie and Cohen). Participants were rated as either participating in organized or unorganized activity. Organized activities included those with a group leader, uniforms or officials. Observers entered each target area and observed all participants in the area. Eight scans were completed from each area by sex and age category (e.g., 1. Female child; 2. Female teen).

Statistical analysis

All data analysis were conducted in Stata 13.1 (StataCorp LP, College Station, TX). Moderate/Vigorous Physical Activity (MVPA) was calculated by combining walking/moderate activity with vigorous activity. Chi-square tests were used to assess differences in MVPA (0 = No, 1 = Yes) by categorical variables (e.g., sex, age group, time period). The results for the chi-square tests were used to inform the multivariable analyses, as only those variables showing independent associations with MVPA were included in the regression model. Specifically, multivariable logistic regression was used to assess the relationship between significant variables from the unadjusted analyses and MVPA in the final model.

Results

A total of 75,678 individuals and an average of 788.3 observations per park per day were observed. AQI was rated as acceptable on 8 of the 12 days of data collection. However, on two days AQI levels were rated unhealthy for sensitive groups and on two additional days AQI was rated as unhealthy for all. Over half of park users were male (52%); park users varied in age and were grouped into four categories: older adults (53.4%), adults (34.6%), teenagers (2.9%) or children (9.1%). Most (71.5%) of park users participated in unorganized activities, while only 28.5% were organized. Older adults were more likely to participate in organized activities (33.5%), than adults (25.2%), teens (12.7%) and children (15.8%; $p < .001$). Parks were most frequently used in the early morning (34%) and afternoon (28.6%) with less use at mid-day (17.8%) and evening (19.6%). In addition, more people used the parks when the temperature was less than 30 °C (72.7%). Parks were used most on days when AQI was above 150 ($n = 7845$ users per day), followed by days when the AQI fell between 101–150 ($n = 7271$).

Table 1
Characteristics of parks.

Park name	Map	Posted hours	# of Entrances	Bus stop	Parking	Surrounding land use	Walking trails (n)	Fitness areas (n)	Green spaces (n)	Lake	Restrooms	Picnic areas	Vending	Shade (%)	Size (km ²)
People's	Yes	Yes	2–5	Yes	Lot	Commercial	2	2	3	Yes	Yes	Yes	Yes	25–75%	326.0
Bayi Par	Yes	Yes	2–5	Yes	Street	Residential/Commercial	3	1	7	Yes	Yes	No	Yes	>75%	237.0
Ruziting	No	Yes	2–5	No	Lot/Street	Residential	1	1	2	Yes	Yes	No	No	>75%	40.3
Hongdu	No	No	2–5	Yes	Lot/Street	Residential/Commercial	5	1	4	No	Yes	Yes	No	25–75%	39.0
Xianshi Lake	No	Yes	2–5	Yes	Street	Residential	1	0	0	Yes	Yes	Yes	No	25–75%	45.3
Xiuxian	No	Yes	2–5	Yes	Street	Commercial	3	2	7	No	Yes	No	No	<25%	60.0
Hubing	No	No	More than 5	Yes	None	Residential/Commercial	6	0	7	Yes	No	No	No	25–75%	35.0
Sports	No	No	More than 5	Yes	Street	Residential/Commercial	2	3	11	No	Yes	No	No	25–75%	96.2

Days with acceptable air quality had the least number of people observed in parks per day ($n = 5681$). Demographic characteristics of park users are shown in Table 2.

Physical activity behaviors

Nearly half (45%) of the park users were sedentary, while 38.8% were observed walking or engaged in moderate activities, with only 16.2% observed performing vigorous physical activity. Walking (25.7%) was the most common form of physical activity, while other popular forms of physical activity were dancing (13.8%), using of exercise and strength training equipment (9.8%), and playing badminton (3.0%). There were also many sedentary activities recorded, including sitting (15.3%), board games and cards (12.7%), and standing (7.6%). Other behaviors (9.8%) included some traditional activities, like qigong, tai chi, sword dancing, and square dancing.

Bivariate relationships with moderate and vigorous physical activity (MVPA)

Females (63%) were significantly more likely to be active than males (47.7%; $p < .001$). Teens (60.8%) and adults (60.6%) were more active than children (53.4%) and older adults (51.4%; $p < .001$). People were

more likely to be active when the temperature was below 30 °C (58.8%) than above 30 °C (45%; $p < .001$). Park visitors were most active in the morning (70.8%) and least active between 2–5 pm (37.3%; $p < .001$). Park users were significantly more likely to be engaged in MVPA on weekdays compared to weekend days (55.4 vs. 54.4%; $P < .05$). MVPA levels observed in parks ranged from 43.9% to 72.6% ($p < .001$). No differences in MVPA were seen at different levels of the AQI. Table 3 displays the relationship between these variables and MVPA.

Multivariable relationship with MVPA

A logistic regression assessed the relationship of the significant variables above to MVPA. The overall model was significant, $\chi^2(15) = 9665$, $p < .001$ and correctly classified 65.4% of cases. Sex was significantly associated with MVPA, with women 66% more likely than men to be observed in MVPA. Teens were 30% more likely to be engaged in MVPA than youth, while older adults were 32% less likely. Participants were 5% less likely to be observed engaging in MVPA on days where the temperature exceeded 30 °C. MVPA was less likely after 9 am than 6–9 am. Odds ratios for the complete analyses are presented in Table 4.

Table 2
Characteristics of park users ($N = 75,678$).

Variables and attribute levels	n	%
Participating in organized activities?		
No	54,144	71.5
Yes	21,534	28.5
Sex		
Female	36,346	48.0
Male	39,332	52.0
Age category		
Child	6855	9.1
Teen	2157	2.9
Adult	26,187	34.6
Older adult	40,479	53.4
Temperature		
<30 °C	55,029	72.7
≥30 °C	20,649	27.3
Time of day		
6–9 am	25,737	34.0
10 am–1 pm	13,439	17.8
2 pm–5 pm	21,643	28.6
6–9 pm	14,859	19.6
Air quality index		
≥100 (8 days)	45,447	60.1
101–150 (2 days)	14,542	19.2
151 ≤ (2 days)	15,689	20.7
Physical activity level by observed participants		
Sedentary	34,032	45.0
Moderate	29,381	38.8
Vigorous	12,265	16.2

Table 3
MVPA by demographics and park variables.

Variable	% Participants engaged in MVPA	P-value ^a
Sex		<.001
Males	47.7	
Females	63.0	
Age category		<.001
Child	53.4	
Teen	60.8	
Adult	60.6	
Older adult	51.4	
Temperature		<.001
<30 °C	58.8	
≥30 °C	45.0	
Time of day		<.001
6–9 am	70.8	
10 am–1 pm	47.2	
2 pm–5 pm	37.3	
6–9 pm	60.6	
Park		<.001
#1	67.0	
#2	48.5	
#3	63.6	
#4	47.0	
#5	43.9	
#6	53.1	
#7	72.6	
#8	52.0	
Air quality index		=.05
<101	54.9	
101–150	55.9	
150+	54.6	

^a Pearson chi-square tests of demographic/park variables by MVPA category.

Table 4

Results of a logistic regression analysis of MVPA as the dependent variable and demographic and park variables as independent variables.

Variable	Odds ratio	95% Confidence Interval	
Sex			
Male	REF		
Female	1.66	1.61	1.72
Age category			
Child	REF		
Teen	1.30	1.17	1.44
Adult	0.98	0.93	1.04
Older adult	0.68	0.65	0.72
Temperature			
<30 °C	REF		
≥30 °C	0.95	0.91	0.99
Time of day			
6–9 am	REF		
10 am–1 pm	0.35	0.34	0.37
2 pm–5 pm	0.26	0.25	0.28
6–9 pm	0.64	0.61	0.67
Park			
#1	REF		
#2	0.52	0.50	0.55
#3	0.98	0.93	1.04
#4	0.57	0.54	0.60
#5	0.44	0.41	0.48
#6	0.57	0.51	0.63
#7	1.34	1.22	1.48
#8	0.57	0.53	0.62

Discussion

This study represents the first report of to observe park users' physical activity levels and demographic characteristics in China using systematic observation. Results of this study show some major differences between the associations of park users, types of physical activity and level of activity compared to the similar observational park studies reported previously from Brazil, Taiwan, Australia, the United States, and Belgium (Floyd et al., 2008; Van Dyck et al., 2013; Chung-Do et al., 2011; Parra et al., 2010; Pleson et al., 2014). Most of the park users in Nanchang were older adults (53.5%); while very few teens (2.9%) and children (9.1%) were observed. This finding is similar to findings reported in a sample of park users in Taipei, where 61% of park users were older adults (Pleson et al., 2014). However, this is quite different from non-Asian cities that found few older adults in parks including Ghent, Belgium (5.2%), Los Angeles (2.4%), San Diego (1.6%), Michigan (2.1%), North Carolina (5.5%) and Recife, Brazil (11%) (Van Dyck et al., 2013; McKenzie et al., 2006; Parra et al., 2010; Reed et al., 2012; Floyd et al., 2011). This finding could be due to the demographics of the region, as the median age of China's population in 2010 was 35 (Feng et al., 2012). By 2050, it is predicted that the figure will shift toward 50, and the population over the age of 60 will increase by more than three-fold (from 10.9% to 35.8%), and above 80 will increase by four times (from 1.8% to 6.8%) (Feng et al., 2012).

Slightly more males than females were observed in parks. This is consistent with studies in Tampa, Michigan, Ghent, Chapel Hill, and Recife (Floyd et al., 2008; Van Dyck et al., 2013; Parra et al., 2010; Reed et al., 2012; Floyd et al., 2011). Studies conducted in large American cities (i.e., San Diego, Chicago, Honolulu, and Los Angeles) have consistently found that more than 60% of park participants were male (Floyd et al., 2008; Van Dyck et al., 2013; McKenzie et al., 2006; Chung-Do et al., 2011). This is contrast to a study conducted in Taipei where a majority of park users were females (56%) (Pleson et al., 2014).

Many factors can affect the park use. Our observation showed that more than a third of park users came to the park in the morning. Several possible factors may contribute to this observation, including a traditional preference to exercise in the morning or cooler temperatures. The average high temperature in Nanchang in June is 29.4 °C, which supports this presumption. There was a clear relationship between temperatures

below 30 °C and park use; however, parks tended to be slightly busier on days when the AQI was higher. The reason is unclear, but the Chinese population appears to be indifferent to the AQI level unless there are extremely high levels of pollution. In addition, the AQI might vary from city averages due to distance from traffic or differences in airflow, but we were unable to assess AQI variability in the current study.

More than half of Chinese park users were active (55%), which compares favorably to several American studies in Tampa (30%), Chicago (49%), San Diego (47%) and Los Angeles (34%) (Floyd et al., 2008; Van Dyck et al., 2013; McKenzie et al., 2006). Physical activity levels were similar to samples observed in Ghent and Chicago (55%) (Floyd et al., 2008; Van Dyck et al., 2013). MVPA was highly related to time of day, as was temperature, but AQI level was not. MVPA levels are similar to attendance rates, which suggests that temperature directly affects resident's choice to go to the park whereas air pollution does not. High levels of attendance and physical activity were observed in the early morning. Activities such as organized dancing and tai chi were prevalent in this time period. For example, over 13% of the sample was engaged in dancing. This is an organized activity led by an instructor and was highly popular among older adults in China.

Afternoons were the least active times. During this time, most park users observed were older adults playing cards and other sedentary activities. Females were more active than men. This appeared to be linked to the type of activity they engaged in. Women were most often seen dancing or walking, while men were engaged in discussions and games. This apparent difference in activity preference may explain the differences in MVPA by sex, which are inconsistent with results from western populations, where men are typically more active than women (Floyd et al., 2008; Chung-Do et al., 2011). Future research should examine activity preference in Chinese adults to confirm this observation. Significant differences were observed between parks. Future studies utilizing mixed-methods approaches are needed to subjectively and objectively assess what encourages and supports physical activity in Chinese parks.

Limitations

There are several limitations to this study. SOPARC uses momentary ecological scans, which can miss variations over time. The data were collected in June when temperatures are high and could negatively or positively affect park usage. If data had been collected throughout the year, the results might be quite different from June. Data regarding activity relative to shade coverage were also not collected and might have influenced areas where physical activity occurred. The results are representative of urban Nanchang but might be quite different in suburban and rural areas. Also, the AQI is reported daily for the entire city of Nanchang. We were unable to assess if AQI differed throughout the day or in park areas. Handheld monitors would be needed to assess local and time specific air quality levels, and these monitors were not available for the present study.

Conclusions

This study found that environmental variables and park user characteristics were significantly related to park-based physical activity in park users using direct observation. As China's population becomes more dependent on motorized transportation and sedentary jobs become more common, parks may become more important in providing safe, convenient places to engage in physical activity. As teens and children were infrequently observed in parks during the reported observation periods, while more than half of the observed park users were over 60, it is unclear if parks have lost popularity, or will lose popularity among youth, over the next few decades. Future studies are needed to understand which park features can attract a diverse pool of users and/or positively affect the physical activity of park users.

Conflicts of interests

The authors declare that there are no conflicts of interests.

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