PROXIMITY TO AN EXERCISE FACILITY AND PHYSICAL ACTIVITY IN CHINA

Ruopeng An[1] and Jiakun Zheng[2]

[1]Department of Kinesiology and Community Health, College of Applied Health Sciences, University of Illinois at Urbana-Champaign, Champaign, Illinois, USA; [2]School of Sport Leisure, Recreation and Arts, Shanghai University of Sport, Shanghai, PR China

Abstract. Physical inactivity is a major risk factor for premature morbidity and mortality. We studied the relationship between proximity to an exercise facility and leisure time physical activity in China. We conducted a questionnaire-based survey of 10 provinces in China during 2012 among 5,000 respondents with a completion rate of 82.1%. Respondents were asked about leisure time physical activity, defined as any exercise during the week. Respondents were also asked if they lived within 10 minutes walking distance from an exercise facility. The association between proximity to an exercise facility and physical activity were examined with multivariate regression analysis while attempting to control for sociodemographic factors and province of residence. Proximity to an exercise facility was found to be positively associated with leisure time physical activity. Individuals living within 10 minutes walking distance from an exercise facility were 6.79% (95% confidence interval: 3.67-10.01) more likely to have any leisure time physical activity than those who lived more than 10 minutes walking distance from an exercise facility. Physical exercise among females, younger adults, people with a higher education and urban residents appeared to have a greater association with distance to an exercise facility. Improving accessibility to an exercise facility might increase the likelihood of leisure time physical activity, especially among working-age urban Chinese.

Keywords: exercises, physical activity, facility access, distance perceptions, China

INTRODUCTION

Physical inactivity increases the risk of various adverse health outcomes, such as coronary artery disease, type 2 diabetes mellitus, and breast and colon cancers, and is a major risk factor for premature mortality worldwide (Lee *et al*, 2012). Proximity to an exercise facility is consistently linked to increased physical activity in studies from the US (Popkin *et al*, 2005). In China, a nationally representative survey conducted during 2000-2001 reported insufficient and predominantly work-related physical activity among adults 35-74 years old, with a low prevalence of leisure time physical activity, especially among urban residents (Muntner *et al*, 2005). China's Twelfth Five-Year Plan (2011-2015) for the Sport Industry aims to promote leisure time physical activity at the population level by improving

Correspondence: Ruepeng An, George Huff Hall Room 2013, 1206 4th Street, Champaign, IL, USA, 61820.
Email: ran5@illinois.edu

the community-based physical activity infrastructure (General Administration of Sport of China, 2012). Quantifying the impact of proximity to an exercise facility on leisure time physical activity could be informative for such a policy.

Recent studies investigated the relationship between neighborhood environment and physical activity in China. Sallis *et al* (2009) and Ding *et al* (2013) found access to low-cost recreation facilities was associated with increased physical activity in an international survey of 11 countries, including Hong Kong, China. Cerin *et al* (2013) examined the association between environmental attributes (*eg*, neighborhood safety, availability of parks and recreational facilities) and leisure time physical activity among the elderly in Hong Kong during 2007-2008. Zhou *et al* (2013) reported the impact of residential density, street connectivity and traffic safety on transportation and leisure time physical activity among middle-aged residents in Shanghai. Those studies typically had limited geographical coverage (one city), small sample size (up to a few hundred) and homogenous subjects (elderly urban residents only).

This study investigated the relationship between proximity to an exercise facility and leisure time physical activity in China using cross-sectional survey data. In 2012, a questionnaire-based survey was conducted in 10 provinces located in all 3 Chinese regions (East, Central and West). In each county, 2-4 urban areas and 1-2 rural areas were selected. A total of 5,000 survey questionnaires were administered with a completion rate of 82.1%. The association between proximity to an exercise facility and leisure time physical activity was examined with multivariate regression analysis while attempting to control for sociodemographic factors and province of residence.

Various hypotheses indicate heterogeneous relationships between proximity to exercise facility and physical activity in various population subgroups. Economists emphasized the role of opportunity cost for individual decision making. Because leisure time activity is more expensive among the working-age population and people with a higher income, their participation in physical exercise may be more sensitive to commute time to an exercise facility. Leisure time physical exercise may be more constrained by proximity to the facility among urban residents compared to their rural counterparts, who tend to exercise more frequently in their own backyard. The study size and socio-geographical variability of the study sample allowed us to examine the potential heterogeneity of the relationship between proximity to an exercise facility and leisure time physical activity by gender and in various age groups, education levels and location of residence.

MATERIALS AND METHODS

Survey participants

The study sample came from a cross-sectional survey conducted by Shanghai University of Sport during October-December 2012. The study was approved by the University Institutional Review Board. The survey covered all 3 regions of China: 4 provinces in the East (Shanghai, Zhejiang, Shandong and Liaoning), 3 provinces in Central (Anhui, Hunan and Hubei), and 3 provinces in the West (Gansu, Yunnan and Chongqing). In each province, 2-6 counties with a medium economic development level (based on county-level gross domestic product per capita for that province) were selected, and within each county, 2-4 urban districts and 1-2 rural

villages were randomly chosen. A survey was conducted using trained interviewers who were sent to each district/village. The survey opportunity was advertised in local mass media and open to all residents in the district/village. Participation was voluntary; a $2 gift was offered upon receipt of the completed questionnaire. A total of 5,000 questionnaires were distributed (3,000 to urban residents and 2,000 to rural residents). In urban districts, 2,532 questionnaires were returned and 2,446 were validated; in rural villages, 1,784 questionnaires were returned and 1,661 were validated. Statistical analyses were performed on the validated sample of 4,107 responses.

Measures

Leisure time physical activity was evaluated by asking, "How often do you exercise during your leisure time?" Possible answers were: "more than 3 times per week", "1-3 times per week", "occasionally" or "never". The outcome variable on multivariate analysis was participation in any leisure time physical activity, corresponding to the answers of "more than 3 times per week", "1-3 times per week" or "occasionally".

Proximity to an exercise facility was evaluated by walking distance to the nearest exercise facility. The corresponding question was: "How long does it take to walk to the nearest exercise facility?" Possible answers were: < 10 minutes, 10-30 minutes, 30-60 minutes or > 60 minutes. The main independent variable on multivariate analysis was living within 10 minutes walking distance from the nearest exercise facility. The typical walking speed is 1.4 meters per second (Burnfield and Powers, 2006). Walking for 10 minutes gave a distance of approximately half a US mile.

Other independent variables on multivariate analysis were: female sex (male sex was the reference group), age group (18-30 years old, 31-45 years old, 46-59 years old and 60 years and older, with age < 18 years old being the reference group), education level (graduate degree, college degree, and high school or middle school, with primary school or lower as the reference group), urban residence (with rural residence as the reference group), and province of residence during the survey (10 provinces in total with one being the reference group).

Statistical analyses

On multivariate analysis, leisure time physical activity was evaluated for proximity to an exercise facility, controlling for other independent variables: gender, age, education level, urbanicity and province of residence. We used Poisson regression with robust error variance proposed by Zou (2004) to estimate relative risk (*ie*, relative likelihood of any leisure time physical activity). An odds ratio reported by logistic regression may give a misleading approximation of relative risk if initial risk, outcome prevalence, is high (Davies *et al*, 1998). We thus preferred estimating the relative risk directly. To determine sensitivity, we performed logistic regressions on the data and converted the estimated odds ratios to relative risks. These were fairly close to the relative risks estimated with Poisson regression with robust error variance. All statistical analyses were conducted using R, version 3.0.1.

RESULTS

The descriptive statistics of the survey sample are shown in Table 1. Thirteen point four percent of respondents (12.1% of males and 14.6% of females) did not

Table 1
Descriptive statistics of study subjects (N=4,107).

Variable	Proportion
Any leisure time physical activity	86.6%
Home within 10 minutes walking distance to nearest exercise facility	31.5%
Female sex	51.4%
Urban residence	59.6%
Age	
<18 years old	11.9%
18-30 years old	30.7%
31-45 years old	34.3%
46-59 years old	15.2%
≥60 years	8.0%
Education	
Primary school or lower	13.3%
High/middle school	46.2%
College	36.6%
Graduate	3.9%

participate in any leisure time physical exercise. Sixty-eight point five percent of respondents reported no exercise facility within 10 minutes walking distance from home. Distance to an exercise facility appeared to be linked to physical activity. Eighty-nine point two percent of respondents living within 10 minutes walking distance from the nearest exercise facility had leisure time physical activity, whereas 81.2% of respondents living greater than 10 minutes walking distance from the nearest exercise facility had leisure time physical activity. The prevalence of leisure time physical activity differed noticeably between urban (91.5%) and rural (79.4%) residents. Substantial variations were also present across age and education.

Table 2 shows the results of multivariate analysis. Proximity to an exercise facility positively predicted leisure time physical activity. Compared to those living further away, individuals within 10 minutes walking distance to an exercise facility were 6.79% (95% confidence interval: 3.67-10.01) more likely to have some leisure time physical activity. Rural residents, those aged ≥ 18 years, and those with a primary school or lower education level were less likely to have leisure time physical activity than urban residents, those aged < 18 years, and those with a middle school or higher education.

Table 3 shows the results of subgroup analysis. The association between proximity to an exercise facility and leisure time physical activity varied considerably by gender, age, education and location of residence, although the differences were not always statistically significant. Females who lived within 10 minutes walking distance from an exercise facility were 8.3% more likely to have leisure time exercise than those who did not, which was greater than males (4.7%). The relationship between proximity to exercise facility and

Table 2
Associations with leisure time physical activity on multivariate regression analysis (*N*=4,107).

Independent variable	Adjusted relative risk for leisure time physical activity (95% confidence interval)
Home within 10 minutes walking distance to nearest exercise facility (no facility within 10 minutes walking distance from home as reference)	1.0679 (1.0367 - 1.1001)
Female sex (male sex as reference)	0.9796 (0.9573 - 1.0023)
Urban residence (rural residence as reference)	1.0912 (1.0634 - 1.1197)
Age (< 18 years old as reference)	
18-30 years old	0.9017 (0.8715 - 0.9330)
31-45 years old	0.8461 (0.8165 - 0.8768)
46-59 years old	0.8547 (0.8187 - 0.8923)
≥ 60 years old	0.7769 (0.7227 - 0.8352)
Education (primary school or lower as reference)	
High/middle school	1.1639 (1.0977 - 1.2341)
College	1.2792 (1.2070 - 1.3557)
Graduate	1.2562 (1.1719 - 1.3465)

leisure time physical activity was greater among working-age adults (18-59 years old) than retirement-age adults (60 years and older). The relationship between proximity to an exercise facility and physical activity was greater with a higher education level. Those with a primary school or lower education level who lived within 10 minutes walking distance from an exercise facility were 2.8% more likely to have leisure time physical activity than those who lived greater than 10 minutes walking distance from an exercise facility. Those with a college degree or graduate degree who lived within 10 minutes walking distance from an exercise facility were 5.3% and 10.3%, respectively, more likely to have leisure time physical activity than those who lived greater than 10 minutes walking distance from an exercise facility. This difference was significantly greater among urban dwellers (8.0% more likely to have leisure time physical activity) than rural dwellers (3.1% more likely).

DISCUSSION

This study examined the relationship between proximity to an exercise facility and leisure time physical activity in China

Table 3
Estimated relationships for proximity to exercise facility and leisure time physical activity by gender, age, education and location of residence.

Variable	Number	Adjusted relative risk for leisure time physical activity (95% confidence interval)
All	4,107	1.0679 (1.0367 - 1.1001)
Male	1,996	1.0467 (1.0052 - 1.0890)
Female	2,111	1.0832 (1.0375 - 1.1308)
Urban residents	2,446	1.0799 (1.0436 - 1.1175)
Rural residents	1,661	1.0310 (0.9786 - 1.0862)
Age		
<18 years	487	1.0416 (0.9805 - 1.1066)
18-30 years old	1,260	1.0351 (1.0016 - 1.0698)
31-45 years old	1,409	1.1077 (1.0393 - 1.1806)
46-59 years old	623	1.0903 (0.9982 - 1.1909)
≥60 years old	328	1.0440 (0.8853 - 1.2312)
Education		
Primary school or lower	546	1.0282 (0.9897 - 1.0667)
High/middle school	1,897	1.0549 (1.0058 - 1.1064)
College	1,504	1.0533 (1.0215 - 1.0861)
Graduate	160	1.1025 (0.9750 - 1.2467)

using data from a large cross-sectional survey. Self-reported proximity to an exercise facility was positively associated with participation in leisure time physical exercise, but varied by sociodemographic subgroup.

This observational study had important limitations. It did not adopt a random sampling design due to budget and personnel constraints. This limits the generalizability of the findings to the population level. The levels of physical activity were self-reported and the sub-types inexact. Duration of exercise was classified by large intervals, and no questions were asked regarding exercise

intensity or work-related physical activity. Distance was limited to walking time to the nearest exercise facility from home, whereas proximity from workplace may be just as important. No data were collected regarding transportation mode to and from the exercise facility.

Both leisure time physical exercise and distance to the nearest exercise facility were self-reported and subject to errors and bias, but the direction of bias remains unclear. One study reported the perceived versus objective proximity to parks found a mismatch between the two; the agreement was greater among those who reported engaging in some park-based physical activity (Lackey and Kaczynski, 2009). In our study, individuals who regularly engaged in leisure time physical exercise may have been more likely to report being close to an exercise facility because of their familiarity with the location, resulting in an underestimation of the distance and overestimation of the association between proximity and physical activity. McCormack *et al* (2008) compared perceived and objective walking distances, and found distances to most destinations close to home were overestimated, while distances to those farther away were underestimated. If that applies to exercise facilities, the association between proximity and physical activity in this study may have been underestimated.

Our finding of a positive relationship between proximity to an exercise facility and leisure time physical activity in mainland China coincides with study results from the US and other countries. Reed and Phillips (2005) found increased duration and intensity of physical activity among American college students residing close to exercise facilities. Jilcott *et al* (2007) found perceived distance to gyms to be negatively associated physical activity among low-income, middle-aged women in the US. Hanibuchi *et al* (2011) found proximity to parks or green spaces to be positively associated with physical activity frequency among older Japanese adults. Edwards *et al* (2014) found proximity to parks and beaches to be positively associated with use of those environments for physical activity among Australian adolescents.

The association between proximity to an exercise facility and leisure time physical activity tended to be strongest among females, working-age adults, people with a higher education and urban residents. The different social role of females (*eg*, housework, childcare, shopping) and safety concerns may deter them from using exercise facilities far from home (Garcia Bengoechea *et al*, 2005). The opportunity cost of leisure time exercise among younger adults and people with a college or higher degree is likely to be greater than among their older and less-educated counterparts, which could explain the greater importance of distance to an exercise facility. An investigation of this hypothesis could be difficult because of inadequate information about work patterns and income. In our survey, only 16.3% of urban residents engaged in some physical exercise in their home or backyard compared to 44.8% of rural residents. Urban residents might rely more on facilities for leisure time physical exercise.

Improving the availability of local exercise facilities in communities has become a national policy, as highlighted in China's Twelfth Five-Year Plan (2011-2015) for the Sport Industry (General Administration of Sport of China, 2012). It includes building new exercise facilities (*eg*, community fitness centers, parks, roadside open spaces with exercise equipment) and enhances the accessibility of existing facilities (*eg*,

extending the operating hours of school gyms/playgrounds and opening them to the public). Our study suggests this policy could be effective for promoting leisure time physical activity, especially among urban working-age residents. However, its effectiveness may be less beneficial among rural residents, where supplemental activities (*eg*, physical exercise education programs and organized sporting events) need to be sought to improve engagement.

Research regarding the relationship between proximity to an exercise facility and physical activity is relatively recent in China. In any new field of investigation, early results may require modification, the need for which is only detectable through replication, a central principle of the scientific method. This observational study had sampling and measurement limitations. Future research incorporating a larger representative sample with objective measures is warranted to confirm these findings.

In summary, living near an exercise facility was associated with greater leisure time physical activity. Physical exercise among females, younger adults, people with a higher education and urban residents appeared to have a greater association with distance to an exercise facility. Improving accessibility to an exercise facility may increase the likelihood of leisure time physical activity, especially among working-age urban Chinese. This study had sampling and measurement limitations and the results warrant further investigation.

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