Relationship Between Physical Activity and the Availability of Exercise Facilities in an Urban Elderly Population: Cross-sectional Results from China

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Abstract

BACKGROUND: Sports facilities have great potential in promoting physical activity. Few studies have explored this relationship in the elderly. Therefore, this study explored the relationship between the community availability of sports facilities and physical activity levels in the elderly.

METHODS: Overall, 569 elderly individuals (56.9% female) were randomly selected from 32 communities in Nanjing City. Participants were given accelerometers to wear for 4 consecutive days. A global positioning system and ActiGraph GT3+ device ware used to track, measure duration, and determine spatial details of outdoor activities. It was used to measure the availability of sports facilities within a 500-m buffer zone around the residence of the elderly. Sociodemographic variables and community types were included as covariates.

RESULTS: Elderly individuals having 6–7 sports facilities in their buffer zone spent 9.19 minutes (95% confidence interval: 0.05–18.33) longer exercising than did individuals without facilities. Sex, age, and community type significantly influenced the duration of physical activity. After controlling for confounding factors, the physical activity standard reaching rate of the elderly with access to 6–7 sports facilities was 118% higher than that of elderly individuals without access. Further, the compliance rate of the elderly aged 60–65 years and the marginal community was relatively higher. The availability of sports facilities was associated with the probability of achieving the recommended amount of physical activity and moderate to high outdoor physical activity levels of the elderly.

CONCLUSIONS: We show that the promotion of physical activity and the improvement of health status are based on facility availability, which in turn affects the physical activity levels of the elderly.

1 Introduction

The increasing ageing of the population and the ensuing huge social and economic pressure have become a severe test for China's society today and will also influence China for a long time in the future[1]. It is estimated that the number of elderly people aged > 60 years in China will increase from 15.5% (212 million) in 2014 to 28.0% (402 million) in 2040, and the number of elderly people aged > 80 years will increase from 22.6 million in 2013 to 90.4 million in 2050, allowing China to become the country with the largest number of elderly individuals in the world[2]. Considering the increasing ageing population and the fact that the prevalence of diseases is closely related to age, it is hypothesized that any increase in dysfunction will reduce the physical activity of the elderly. Physical inactivity is the second most variable risk factor after smoking and one of the major causes of global mortality[3]. Nearly 1.9 million people die every year due to insufficient physical activity. It is estimated that by 2020 [4], 70% of the chronic diseases in the world will be caused by insufficient physical activity[5]. Research shows that regular physical activity can reduce the incidence rate of chronic diseases, improve the physical and mental health, and delay senility. Therefore, increasing the proportion of sports population of the elderly is a highly important public health task.

A social ecological model has made great contributions to improving physical activity behaviour, in which a built-up environment plays an important role in promoting physical activity[6]. Although previous studies have explored the relationship between a built environment and walking and moderate and high-intensity physical activity, many built-up environmental characteristics have been found to be positively correlated with physical activity, such as street connectivity, in addition to the utilisation rate of mixed land, accessibility of recreational facilities, and sports facilities[7]. However, the results of the study on the relationship between the availability of sports facilities and physical activity are still controversial. In 2008, a literature review found that there was almost no evidence supporting a correlation between the availability of sports facilities and transportation or recreational walking; studies in the United States found that there was a negative correlation between the density of sports facilities and their prevalence rate[8]. A positive relationship has been reported in different studies between the number of sports facilities available and physical activity, particularly high-intensity physical activity[9, 10]. However, most previous studies used self-reported physical activity measurements and also self-reported on the availability of community sports facilities, which may have led to homologous bias and false correlations. In addition, studies investigating the relationship between physical activity and community sports facilities in western countries have mainly focused on adolescents and residents, while research on the elderly is relatively limited.

This study uses the urban community elderly as the survey object. The USA ActiGraph GT3+, a three-dimensional accelerometer, was used to objectively measure the moderate to vigorous physical activity (MVPA) of the elderly, and the outdoor activity track was measured using a Global Positioning System (GPS). The availability of sports facilities in an individual's buffer zone was measured using GIS software. Our objective was to assess the influence of availability of sports facilities in urban communities on the MVPA of the elderly and whether these factors allow to achieve the recommended levels of physical activity. These results provide important insights for optimising the planning layout of urban sports facilities and provide reference for other large cities at home and abroad.

2 Materials And Methods

2.1 Study design

The data used in this cross-sectional study were collected in Nanjing from June 2017 to March 2018. According to a white paper, the elderly population in Nanjing in 2017 reached 1.4189 million, accounting for 20.85% of the total population, and can be stratified as deep ageing and included 224,630 (24.37%) individuals in the Gulou District, 189,206 (26.04%) in Qinhuai District, 103,375 (22.25%) in Xuanwu District, 98,822 (20.12%) in Qixia District, and 59,310 (17.88%) in Jianye District. Therefore, five districts were selected, namely the districts of Gulou, Qinhuai, Xuanwu, Qixia, and Jianye. Therefore, a stratified random sampling method was used to follow the structure of each administrative district from community (comprehensive community, unit community, traditional society) of 32 representative districts in Nanjing selected as the research area. 30 subjects were recruited in each community. The eligibility criteria of the subjects were as follows: age > 60 years, residents (> 6 months), able to carry out daily

activities, and normal cognitive ability. In order to ensure the uniformity and representativeness of the sample distribution, elderly individuals aged 60–65, 66–70, 71–75, and 76–80 years, with equal numbers of men and women, were selected as the study subjects.

2.2 Survey samples

The total sample comprised over 15,000 individuals, which represents a relatively large population sample. The estimated population proportion fell within ± 0.05 of the sample estimated value. The confidence degree of the survey estimation value was 95%, the estimated sample recovery rate was 70%, and the effective rate was 60%[11]. The formula for calculating the initial sample size was

$$\frac{Z_{\alpha/2}{}^2\pi(1-\pi)}{E^2}$$

, the initial sample size n_0 was 384, and following adjustment of the initial sample, the final sample size was 915. A total of 960 study samples were planned for enrolment, which could effectively represent the overall population of the elderly in Nanjing. Ultimately, 569 elderly individuals were included in the study, including 245 males and 324 females.

2.3 Index selection and measurement

2.3.1 Basic information on the study subjects

The age, sex, education level, socioeconomic status, self-assessment of health, chronic diseases, living alone status, and community-dwelling status of the elderly were collected by self-reported questionnaire. The health status of the elderly included physical health, mental health, and social adaptation. Self-rated health status can reflect the overall health status of the interviewees and reveal the quality of life of the elderly to a certain extent.

2.3.2 Outdoor physical activity measurements

Physical activity estimates were gathered using the ActiGraph GT3X + accelerometer (Beijing SYG Technology, United States), which provides valid assessments of walking, running, and daily activity through the measurement of vertical accelerations or activity counts. Participants wore the accelerometer at their right hip during all waking hours, except when showering or swimming, for seven consecutive days. They were instructed to return the device immediately after this period. We determined physical intensity using cut-off points previously developed for adults aged 60–69 years. We utilised the physical intensity categories of Miller et al. based on the mean number of minutes of physical activity per day: MVPA > 1952 counts per minute [12]. We defined the non-wear time as at least 60 minutes of 0 activity counts. For a participant's accelerometer data to be considered valid for the analysis, at least eight hours of wear time must have been ensured for up to three or more days per week[13]. We validated wear time using ActiLife 6 Version 5.5 software and used the algorithm developed by Troiano et al[14]. Accelerometer physical activity variables were reported in mean daily minutes and in 10-minute bouts[15]. We allowed for interruptions of 1 or 2 minutes below the threshold in the 10-minute bout. Objective

physical activity variables included mean daily minutes of unbouted MVPA. Participants were divided into two groups based on the World Health Organization (WHO) recommendations for older adults (< 150 min/week, ≥ 150 min/week).

2.3.3 Measurement of sports facilities

The availability of exercise facilities was objectively measured using GIS. To assess the area of exposure, neighbourhoods were defined by creating a buffer zone originating from the residential address of each participant using the Network Analyst extension in ArcGIS/ArcInfo 10.2 (ESRI Inc., Redlands, California, USA). According to the GPS activity trajectory in Fig. 1, which shows the frequency statistics of the distance between the family's residence and the location where outdoor physical activity was carried out, and based on a group spacing of 100 m, the frequency percentage of 500 m reaches 60.13%, indicating that most outdoor physical activities of the elderly in urban communities were located within a distance of 500 m from home. Therefore, the buffer radius was defined as 500 m. Objective sports facilities data included squares, fitness paths, table tennis courts, badminton courts, and a small number of indoor venues, all of which were free of charge. Exercise facilities, as well as facilities not offering any exercise opportunities on site, were excluded by another exercise facility category (Private facilities).

2.4 Statistical analyses

For statistical analyses, the number of sports facilities in the community was ranked by quartiles; the quartiles were 3, 4, 6, and 8. The physical activity of the community elderly in these quartiles was compared to the physical activity of the community elderly who did not have access to any sports facility. All analyses were performed using STATA 12.0 (StataCorp, College Station, Texas, USA). Descriptive statistics (mean ± standard deviation (SD) or percentage) were used to analyse the relationship between the number of sports facilities available and the time of physical activity in the elderly. Model 1 consisted of a univariate regression analysis of the number of sports facilities available and MVPA of the elderly. Model 2 included social demographic information, such as sex, physical activity, average monthly income, highest level of education, health self-assessment, community type, chronic disease, and lifestyle.

Based on current guidelines, middle-aged and elderly individuals should be given at least 150 minutes of MVPA per week[16]. Therefore, in this study, if the MVPA of the elderly was ≥ 150 minutes per week, it was considered that they met the WHO recommended value; otherwise, they were considered to have not completed the recommended amount of physical activity. The MVPA was defined as 10 minutes or more of physical activity, with counts ≥ 1952 times per minute. During each physical activity, the count per minute was allowed to fall below this cutoff for 1–2 minutes.

3 Results

3.1 Descriptive statistics

A total of 569 valid study samples were included, of which 57.52% were female. The average duration of physical activity was 21.9 minutes per day. The duration of physical activity for male elderly subjects was 24.9 minutes. Social demographic information, such as age, monthly income level, education level, self-assessment of health, history of chronic diseases, and living alone, is shown in Table 1.

Table 1
Descriptive analysis of variables

	Population (mean / share)	Male (mean / percentage)	Female (mean / percentage)
sample size	569	245(43.1)	324(56.9)
MVPA (days / min)	21.9 ± 25.9	24.9 ± 30.6	19.5 ± 21.4
Accelerometer wearing time / min	774.6 ± 110.3	702.8 ± 106.3	776.0 ± 113.5
Age / year			
60□65	33.5	24.5	40.1
66□70	31.3	38.7	25.8
71□75	21.4	21.7	21.3
76□80	13.8	15.1	12.9
Monthly income			
Below ¥1000	14.2	10.9	16.7
¥1001–2000	12.2	7.5	15.7
¥2001 or more	73.6	81.6	67.6
Education level			
Elementary school	20.8	11.8	27.5
Junior high school	33.3	33	33.4
Senior high school	32.3	32.1	32.4
University school	13.6	23.1	6.6
Self-assessment of health			
unhealthy	9.0	8.0	9.8
commonly	56.3	59.0	54.4
healthy	34.7	33.0	35.8
Are you sick			
yes	64.1	68.2	61
no	35.9	31.8	39
Mode of residence			
Living with children	37.9	35.4	39.7

	Population (mean / share)	Male (mean / percentage)	Female (mean / percentage)
to live alone	62.1	64.6	60.3

3.2 MVPA time

Table 2 shows the relationship between the availability of sports facilities in the individual's buffer zone and the MVPA duration. From Model 1, it can be seen that elderly individuals with 6–7 sports facilities in the buffer zone spent 9.19 minutes per day (95% CI: 0.05–18.33) more on physical activity than did those without any sports facilities available. When sex, age, monthly income, highest education level, health self-assessment, community type, chronic disease, and lifestyle were included in the model, the differences were still statistically significant (Model 2). There was no significant difference in the outdoor MVPA time between the elderly with access to 1–3, 4–5, or ≥ 8 sports facilities and the elderly without access to sports facilities in the buffer zone. From Model 2, we can see that the outdoor MVPA time of male elderly individuals was higher than that of females (regression coefficient = 5.38, 95% CI: 0.95–9.81), and elderly individuals aged 60–65 years spent more time on MVPA than those aged 66–70, 71–75, and 76–80 years. Model 2 also showed that with increasing age of the elderly subjects, the outdoor MVPA time decreased. The MVPA time of the elderly in the marginal community was significantly higher than that in a traditional community setting, indicating that there was no significant difference between community and unit communities and traditional communities. Other social demographic characteristics did not change the relationship between the availability of sports facilities and the outdoor MVPA time of the elderly.

Table 2
Linear regression analysis of MVPA predictors

	Model 1	Model 2
Number of facilities available		
0	reference value	reference value
1~3	2.26(-6.20 ~ 10.72)	2.03(-5.82 ~ 9.86)
4~5	3.84(-4.26 ~ 11.95)	2.24(-4.52 ~ 9.00)
6~7	9.19*(0.05 ~ 18.33)	9.08*(0.08 ~ 18.24)
≥ 8	4.41(-4.10 ~ 12.93)	4.12(-3.96 ~ 12.20)
Gender		
female		reference
male		5.38*(0.95 ~ 9.81)
Highest education		
Elementary school		reference
Junior high school		-3.39(-9.80 ~ 3.03)
Senior high school		-0.74(-7.36 ~ 5.88)
University school		0.19(-8.04 ~ 8.41)
Average monthly income		
Below ¥1000		reference
¥1001–2000		0.32(-8.25 ~ 8.92)
¥2001 or more		5.50(-1.59 ~ 12.59)
Age / year		
60~65		reference
66~70		-8.47**(-13.88 ~ 3.06)
71~75		-9.63**(-16.08~-3.07)
76~80		-16.12**(-23.37~-8.87)
Mode of residence		
Living with children		reference

Note: * means P < 0.05; **means P < 0.01; the outdoor MVPA time of the elderly is taken as the dependent variable, unit: min; the value is the regression coefficient (95% confidence interval).

	Model 1	Model 2
to live alone		-0.43(-5.04 ~ 4.19)
Are you sick		
yes		reference
no		-1.51(-6.08 ~ 3.06)
Community type		
Traditional community		reference
Integrated community		5.64(-3.12 ~ 14.41)
Unit community		0.69(-7.85 ~ 9.24)
Marginal community		14.85**(5.58 ~ 24.12)
Self assessment of health		reference
unhealthy		
commonly		-1.41(-8.72 ~ 5.89)
healthy		-1.47(-9.16 ~ 6.23)
Note: * means P < 0.05; **means P < 0.01; the outdoor MVPA time of the elderly is taken as the dependent variable, unit: min; the value is the regression coefficient (95% confidence interval).		

3.3 Achievement of the recommended level of physical activity

The single factor logistic regression in Model 1 (Table 3) showed that compared to the elderly individuals with no sports facilities in their buffer zone, those with 6–7 sports facilities in the buffer zone were more likely to achieve the recommended level of physical activity. The recommended level of physical activity increased by 121% (OR = 2.21, 95% CI: 1.05–4.67), while the recommended rate of physical activity increased by 100% (OR = 2.06, 95% CI: 1.02–4.15). After adjusting for sex, age, average monthly income, highest education level, self-assessment of health, community type, chronic disease, and lifestyle, only 6–7 sports facilities were significantly different (OR = 2.18, 95% CI: 1.08–4.64) (Model 2). Compared with individuals aged 60–65 years, the standard rate of physical activity of individuals aged 66–70 years decreased by 40%, that of individuals aged 71–75 years decreased by 55%, and that of individuals aged 76–80 years decreased by 74%. As age increased, the standard rate of physical activity of the elderly gradually decreased, although the physical activity standard rate of the elderly in the marginal community was higher than that in traditional community, which was 200%. The other explanatory variables did not alter the relationship between the availability of sports facilities or the ability to achieve the recommended value of physical activity.

Table 3
Logistic regression analysis of predictors meeting the recommended value of physical activity

	Model 1	Model 2
Facilities available		
0	reference	reference
1~3	1.45(0.72 ~ 2.91)	1.12(0.63 ~ 2.85)
4~5	1.39(0.71 ~ 2.73)	1.26(0.67 ~ 1.61)
6~7	2.21*(1.05 ~ 4.67)	2.18*(1.08 ~ 4.64)
≥ 8	2.06*(1.02 ~ 4.15)	1.98(0.98 ~ 4.09)
Gender		
female		reference
male		1.08(0.75 ~ 1.57)
Highest education		
Elementary school		reference
Junior high school		0.66(0.38 ~ 1.12)
Senior high school		0.78(0.45 ~ 0.35)
University school		0.90(0.45 ~ 1.80)
Average monthly income		
Below ¥1000		reference
¥1001–2000		1.10(0.53 ~ 2.26)
¥2001 or more		1.73(0.95 ~ 3.15)
Age / year		
60~65		reference
66~70		0.59*(0.38 ~ 0.91)
71~75		0.45**(0.26 ~ 0.76)
76~80		0.26**(0.14 ~ 0.50)
Mode of residence		

Note: * means P < 0.05; ** means P < 0.01; whether or not the recommended amount of physical activity, which is the dependent variable of logistic regression, was met; the value is or (95% confidence interval).

	Model 1	Model 2
Living with children		reference
to live alone		1.13(0.77 ~ 1.66)
Are you sick		
yes		reference
no		1.05(0.71 ~ 1.53)
Community type		
Traditional community		reference
Integrated community		1.50(0.70 ~ 3.20)
Unit community		1.12(0.53 ~ 2.36)
Marginal community		3.00**(1.35 ~ 6.68)
Self assessment of health		
unhealthy		reference
commonly		0.67(0.37 ~ 1.24)
healthy		0.67(0.35 ~ 1.29)
Note: * means P < 0.05; ** means P < 0.01; whether or not the recommended amount of physical activity, which is the dependent variable of logistic regression, was met; the value is or (95% confidence interval).		

4 Discussion

The health conditions of the elderly are a widespread concern worldwide, and studies focusing on the improvement of health status by increasing the time spent performing a physical activity on a middle or large scale has attracted the attention of researchers in China and abroad. Creating an environment conducive to physical activity can improve the lifestyle behaviour of the elderly, reduce their huge demand for healthcare, enable them to maintain good health for a longer time, and delay or avoid disability, thus reducing the medical costs of families and society. Therefore, this study mainly explored the relationship between the urban layout of sports facilities in the 500 m buffer zone and the time spent performing physical activities and achieving the recommended level of physical activity for the elderly. Our results provide theoretical support for healthy urban planning and the transformation of the urban layout of sports facilities to promote elderly MVPA to improve health, and provide decision-making auxiliary information for achieving the strategic development goal of a ‘Healthy China 2030’.

This study found that compared with elderly individuals with no access to sports facilities in the 500-m buffer zone, elderly individuals with access to 6–7 sports facilities spend more time engaged in physical

activities in China. In buffer zones with 1–3, 4–5, or > 8 sports facilities, the time spent on physical activity only increased. The results showed that there are 6–7 sports facilities in the buffer zone, which is more conducive to physical activity of the elderly. The results of this study are consistent with those of previous studies. Eriksson et al. conducted a cross-sectional survey of 32 communities and found that after controlling for sex, income, age, and other factors, participants with more than 4 sports facilities in the 1000-m buffer zone spent 5.4 min more performing physical activity per day than those with no sports facilities available[17]. In addition, after adjusting for potential confounding factors, participants living in the higher tertile place of source density were more likely to report performing physical activity weekly compared to those living in the lowest tertile regions with resource density[18]. Some studies have also found that there is a significant correlation between the objectively assessed sports facility density and the self-reported exercise frequency in the circular buffer zone[19]. However, a study in the United States found no relationship between the density of sports facilities in the 805-m (0.5 mile) buffer zone and self-reported physical activity[20]. This study measured the availability of sports facilities at the provincial level, and the concentration of measurement areas may explain the lack of association. Compared with previous studies, this study used objective measurement to assess the availability of sports facilities and physical activity of the elderly in order to eliminate bias associated with self-reporting; thus, the research results are more reliable. After controlling for confounding factors, there was still a significant relationship between the large adherence to habitual physical activity practices of the elderly and the availability of 6–7 sports facilities. Therefore, it is very important to create a suitable number of sports facilities to encourage the elderly to engage in physical activities more frequently, and it is helpful for policymakers to formulate policies for the construction of communities promoting physical activity in Nanjing and other cities with similar populations and social and economic conditions. Recent studies have shown that age may change the association between constructed environments and the levels of physical activity[21]. This study found that the relationship between the availability of sports facilities and the amount of physical activity was significantly higher in the elderly aged 60–65 years than in the other three groups ($P < 0.01$); this showed that the amount of physical activity in the elderly gradually decreased with increasing age. This may be due to the decreased muscle strength and muscle mass in elderly individuals with increasing age; muscle strength will decrease by 12–15% every 10 years after the age of 50 years[22]. Therefore, the elderly often feel powerless, which leads to their unwillingness to engage in moderate to high intensity physical activity. There is also a positive association between outdoor physical activity and the availability of sports facilities to individuals aged > 80 years, according to this study. Although the mobility of the elderly decreases, the availability of sports facilities in the buffer zone can still promote outdoor activities[23]. The study also found that the duration of outdoor physical activities in male elderly individuals was significantly longer than that in females ($P < 0.05$). The results show that there are sex differences with regard to the impact of the urban layout of sports facilities in the buffer zone on the outdoor physical activities of the elderly. This may be due to the limitations of the female elderly who engage in assisting their children and take care of their children and perform other family tasks, as well as maintain social contact. They have fewer opportunities for outdoor activities, resulting in less outdoor physical activities than the male elderly. In addition, the study found that community type is also an important factor affecting the relationship

between the outdoor physical activity and the availability of sports facilities. Compared with the traditional community, the amount of moderate and large outdoor physical activity performed by the elderly in marginal community is significantly higher, and the outdoor medium and large physical activity performed by the elderly in the comprehensive community and unit community shows an increasing trend. Through field investigation, it was found that the total number of sports facilities is in the decreasing order of marginal community (60), unit community (43), comprehensive community (37.5), and the traditional community (6). This shows that the elderly in marginal communities are more likely to obtain physical activity resources than those in a traditional community, which means that the elderly in marginal communities have more opportunities to carry out outdoor physical activities, allowing them to achieve higher levels of physical activity. It is also possible that most of the elderly in marginal communities migrate from rural areas, where they had to perform more physical labour such as planting vegetables or flowers, and assist the community in different roles, such as managing the parking. Moreover, the marginal communities are situated far from traffic stations (Such as bus stations, metro stations, public transportation), which increases their travel time and improves their physical activity outdoors. In addition, the elderly in marginal communities have good neighbourhood relations and have close contact with each other. They are also willing to chat, walk, and engage in recreational activities in public places. However, because of the high density of buildings and the conflict between people and land in the traditional community, there is a serious shortage of buildings and equipment for the elderly; therefore, the level of physical activity of the elderly is low. This study found that monthly income, education level, living style, chronic diseases, and self-rated health factors did not change the relationship between outdoor physical activity and the availability of sports facilities.

A Swedish study comprising 2037 adults found that adults with access to more than 4 sports facilities within 1000 m from their homes were 69% more likely to complete the recommended amount of physical activity (OR = 1.69, 95% CI: 1.39–2.05)[17]. However, Halonen et al. suggested that adults living near more than three sports facilities did not show an association with the completion of the recommended amount of physical activity[24]. This study found that the elderly with access to 6–7 or > 8 sports facilities in the 500-m buffer zone were more likely to reach the recommended value of physical activity than were those without access to sports facilities, and their compliance rate was increased by 120% and 100%, respectively. However, when there are 1–3 or 4–5 sports facilities in the buffer zone, the physical activity standard reaching rate of the elderly only increases. After controlling the combined factors of sex, age, average monthly income, highest education, self-assessment of health, community type, chronic disease, and living style, the physical activity standard rate of the elderly with 6–7 sports facilities in the buffer zone can still be increased by 118%. The results show that an increase in the availability of sports facilities can effectively improve the standard rate of physical activity of the elderly. When 6–7 sports facilities are available, it would be beneficial to improve the standard rate of physical activity of the elderly, which would provide a threshold to increase the availability of sports facilities. When the threshold is exceeded, the effect on improving the physical activity standard rate of the elderly will decrease. The reason for the inconsistency between the previous research results and the results of this study may be the difference in the research objects; the elderly exhibit greater viscosity, limited movement

range, and most of the elderly remain in the community. Therefore, the availability of sports facilities in the 500-m buffer zone is more meaningful in order for the elderly to achieve the recommended level of physical activity. However, adults are busy with work and often travel between work and residential areas, which may lead to differences in the results between the availability of sports facilities and physical activity. The impact of the availability of sports facilities on the compliance rate of the elderly is as follows: 1) easy access to sports facilities reduces the psychological and physical barriers of exercise; the distance from home is a common obstacle for the elderly to exercise, and reducing commuting time can increase the motivation of the elderly to use facilities more frequently; 2) the increase of the availability of nearby facilities is conducive to the elderly to find a suitable exercise method; 3) the existence of sports facilities can be used as visual stimulation for all elderly people, so as to improve the overall level of physical activity in the community as a whole, rather than just exercise in the facilities[25–27].

This study found that age is an important factor affecting the rate of reaching the recommended levels of physical activity in the elderly. The probability of obtaining the recommended level of physical activity for a 60–65-year-old is 40% higher than that of a 66–70-year-old, 55% higher than that of a 71-75-year-old, and 74% higher than that of a 76–80-year-old. It shows that the rate of reaching the standard of physical activity gradually decreases with increasing age, which seriously threatens their health. Therefore, in order to improve the physical activity levels of the elderly, in addition to improving the availability of sports facilities, the intrinsic motivation of the elderly to exercise should not be ignored, and the attractiveness of improving outdoor exercise environment should be improved, so as to reduce the decline of physical activity caused by aging and improve their health level.

The study also found that different types of communities also affected the relationship between the availability of sports facilities and the recommended level of physical activity. The physical activity compliance rate of the elderly in marginal communities was significantly higher than that in traditional communities, which increased by 200%. The elderly in marginal communities have more facilities to use, convenient access to resources, and have more opportunities to engage in physical activities, which improves the compliance rate and promotes the level of health of the elderly. Some studies also show that the leisure time of the elderly can be increased by 1.3 minutes and the duration of physical activity of the middle and large usually can be increased by 1.4 minutes for each additional sports facility[28]. This study found that an increase in the availability of sports facilities can significantly increase outdoor physical activity and the exercise motivation of the elderly. This study found that the average monthly income, education level, lifestyle, chronic diseases, and self-rated health factors did not change the relationship between the recommended amount of physical activity completed by the elderly and the availability of sports facilities ($P > 0.05$).

Although acceleration measurement of physical activity can overcome the shortcomings of self-reporting, there are still some limitations in this study. Because this was a cross-sectional study, the causal relationship between factors could not be determined. In addition, there may have been a combination of factors that were not controlled for in this study (i.e. residual mixing may have occurred). Future research will continue to explore the relationship between the construction of sports facilities, accessibility and

physical activity of the elderly, and the impact of perceived facility quality, environmental quality, and safety on physical activity of the elderly.

5 Conclusion

The availability of sports facilities determined by an objective measure is associated with the duration of the physical activity and the probability of reaching the recommended level of physical activity in the elderly. Age and community type are also important factors affecting the physical activity standard rate of the elderly; the duration of physical activity of men aged 60–65 years and residence in a marginal community represents a relatively long travel distance to facilities.

The results of this study calls on government policymakers and urban community planners to focus their attention on the construction of sports facilities with the elderly in mind. It is suggested that 6–7 sports facilities should be built within a 500-m buffer zone. The convenient use of sports facilities can stimulate motivation to improve the fitness levels of the elderly, making them maintain or improve the participation rate in regular physical activities, which is conducive to the health status of the elderly. It can also promote the realisation of the healthy China strategy and achieve a people-oriented and green urbanisation objective. At the same time, the community should regularly promote healthy lifestyles to achieve the health benefits of recommended levels of physical activity, so as to attract the elderly to carry out outdoor activities, reduce sedentary time, and reduce the decline of physical activity caused by aging, thereby improving the standard rate of physical activity of the elderly and promote their health level. Due to the rapid spread of urbanisation in China around 2000, which reached 37.5%, many new communities have been established. However, the construction of supporting sports facilities has been neglected, resulting in the inadequacy of sports facilities in traditional communities and unit communities. It is suggested that the relevant government departments should pay special attention to the construction of sports facilities in traditional communities and unit communities, so as to increase or transform activity venues and improve the level of physical activity. The community is a reasonable and potential intervention place, which can affect the elderly for a prolonged time and can increase the overall physical activity of the elderly in the community. Therefore, in order to improve the level of physical activity, planners should increase the density of community sports facilities, provide an appropriate urban layout of sports facilities, and improve accessibility and indirectly promote the health of the elderly.

Declarations

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Availability of data and materials

The datasets generated and/or analyzed during the current study are not publicly available due to maintain participant privacy and confidentiality requirements but are available from the corresponding author on reasonable request

Author contributions

WHL and WZJ drafted the manuscript. ZXH, HDY, and WHL assisted with the data collection and participated in study coordination. WZJ and WZY modified and approved the final version. All authors took part in research meetings concerning data analysis goals, strategies and challenges. All authors have read and approved the final manuscript as submitted.

Ethics approval and consent to participate

This study does not involve invasive interventions on the human body. It is only a survey, so it was approved by the Humanities Research Ethics Committee of Nanjing Normal University (202003005). All participants read a statement that explained the purpose of the survey and provided written informed consent before participation in the study. As the relatives of the participants also provided consent. For those not willing to take part in the study, their right was respected to withdraw from the study. The study did not adversely affect the rights and welfare of the subjects and no financial compensation or provision was made.

Consent for publication

Not applicable.

Competing interests

The authors declare that they have no competing interests.

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Figures

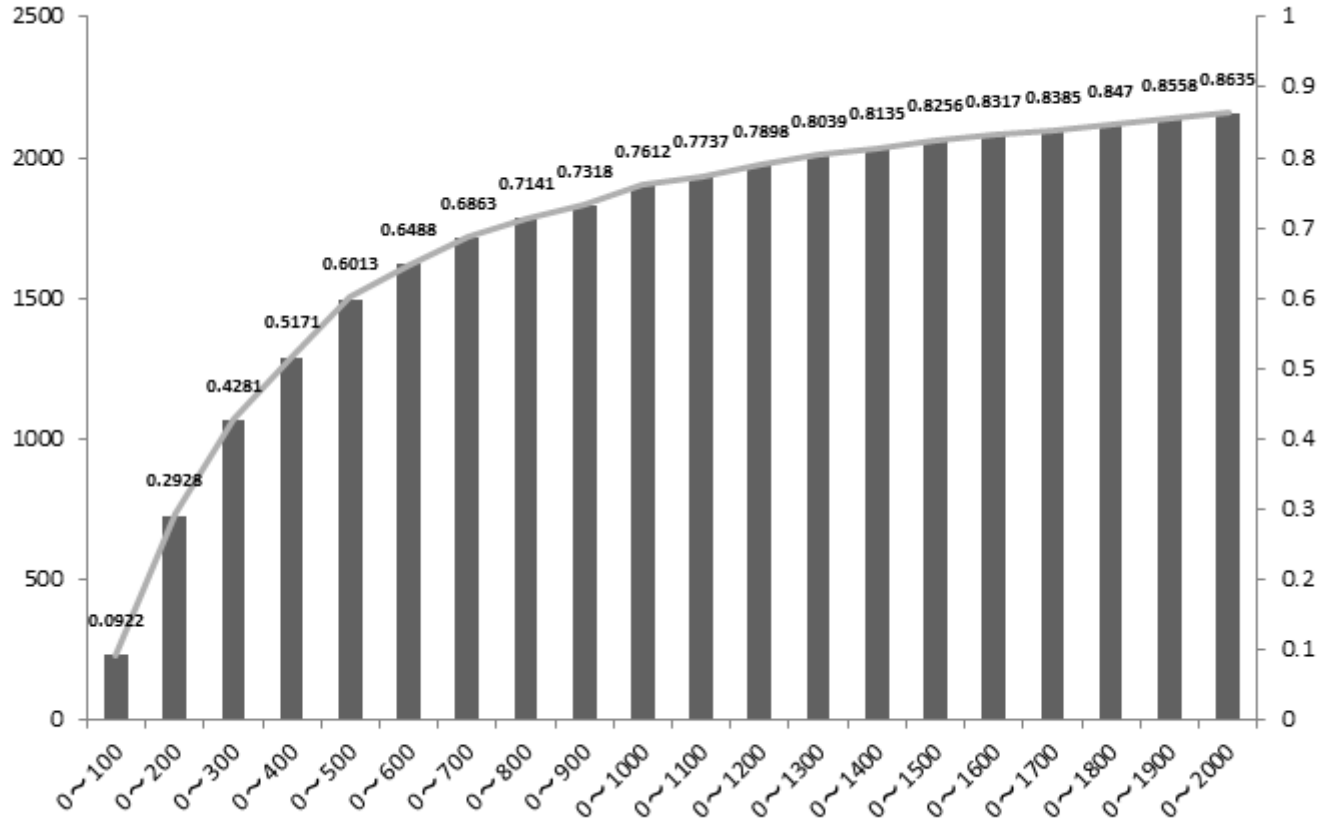

Figure 1

Frequency of activities in different regions