Physical activity areas in urban parks and their use by the elderly from two cities in China and Germany

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Abstract

Urban parks have been recognized as important physical activity (PA) places for senior city residents. This research aimed to investigate PA areas in parks and their use by the elderly in a Chinese (Hong Kong) and a German city (Leipzig). PA areas and the PA executed by the elderly were observed in six parks in each city. Additionally, observers also surveyed overall PA, park-based PA and park accessibility of the active elderly in Hong Kong (HK) (n=317, Mean age = 69.96, SD = 6.81), and in Leipzig (L) (n=311, Mean age = 72.06, SD = 6.78) respectively. Results demonstrated that trails were the most often used PA areas by the elderly, where the elderly walk (in both cities) or cycle (only in L). Fitness stations and secure areas were more often found in HK parks, however, more lawn areas were found in L parks, making structured exercise possible. Sports fields were often used by HK elderly for sports and fitness exercising, but were rarely used by L elderly. Playgrounds were more often used by the HK elderly. In both cities, more males than female elderly were active and more often with low intensity. The elderly preferred accessing PA areas in parks by walking or cycling. Compared with L, the urban parks in HK were the primary locations for the elderly to engage in PA. Park planners should consider optimizing the functioning of PA areas to facilitate elderly physical activity in parks thus enhancing the health status of the elderly.

Keywords: Urban Parks; Physical Activity Areas; Elderly; Park-based Physical Activity; Health Enhancing Physical Activity

1. Introduction

Starting with the industrial revolution in Europe in the second half of the 19th century, urbanization has dramatically changed the world. As a recent report from the Worldbank (2017) indicates, globally, 54% of the population lives in urban areas. For example, about 56% of Chinese population and 75% of German population live in cities and this trend is expected to continue. Under such situations, the functions of parks integrated within these urban areas have been adjusted globally to function as the "ecological lungs" of the cities, as "social spaces" open to all citizens, and as "places for passive and active recreation" (Mertes & Hall, 1995; Thompson, 2002).

As physical inactivity has become a global pandemic among urban populations over the past few decades, urban parks are becoming more important for communities to engage in active and health-enhancing recreation. Especially, Health-Enhancing Physical Activity (HEPA) is a worldwide target that aims to reduce urban population's non-communicable diseases and improve physiological and psychological health (Kohl et al., 2012; Lee et al., 2012). It is proposed that an accumulated 120 minutes of at least moderate-intensity everyday life PA (e.g. brisk walking, cycling), exercise (e.g. fitness training, tai chi) and sport activities (e.g. tennis, volleyball) throughout the week (e.g., approximately 800 kcal/week) may be the lowest HEPA criterion for adults, including the elderly (Cavill, Kahlmeier & Racioppi, 2006; Duan et al., 2013). As a result, focusing on physical activity (PA) areas in urban parks to provide opportunities for HEPA participation is an important task for park planning. Sallis et al. (2016) investigated 14 cities worldwide and showed that the number of public parks is positively related to urban population PA and as such, public parks have the potential to substantially contribute to PA.

An important and vulnerable target group for HEPA participation are the elderly. Moreover, "active aging" together with "healthy aging" for older adults is a critical challenge in many societies (Bauman, Merom, Bull, Buchner, & Fiatarone Singh, 2016; Whittaker et al., 2017). Recent research has revealed that the elderly represented at least 20% of the population in many countries, however, no more than 5% were park users (Cohen et al., 2016; Evenson, Jones, Holliday, Cohen, & McKenzie, 2016). To this end, urban parks can play an important role when encountering this challenge. Important preconditions are expected, including park proximity as well as attractive and motivating PA areas in parks, where the elderly can engage in their favoured PA. The results of a review by Evenson et al. (2016) and other studies (Chow, McKenzie, & Sit, 2016; Cohen et al., 2016), revealed that there is a general positive relationship between park proximity/accessibility and active park use, and that the elderly prefer being active in the morning, and their preferred park PA intensity is "low" or "medium". Despite the variety of observations and classifications of PA areas, it seems that trails, walking circuits, fitness zones and exercise areas are park PA provisions frequently used by seniors (Chow, 2013; McCormack, Rock, Toohey & Hignell, 2010).

Based on various Eastern and Western traditions in park design over the years (Yang & Volkman, 2010), the planning and integration of PA areas in urban parks also varies. For example, the Leisure and Cultural Services Department of the Hong Kong Special Administrative Region of China, has a specific sub-section that governs recreation facilities in public areas, such as park fitness stations for the elderly (Chow et al., 2016). In Western cities like Leipzig of Germany, comparable institutions do not exist. In addition, urban conditions such as the building and population density influence the characteristics of parks (Adams et al., 2014). From the perspective of "learning from differences", it is important to determine the PA areas within parks and

how the active elderly use these areas across regions. This will provide insights which are helpful for the design of urban parks and for the promotion of health-enhancing park-based PA for the elderly.

In order to develop the literature around preferred PA areas and park-based PA of the elderly, the following research questions are addressed in this paper: (1) What is the proportion of active elderly in relation to all active people in parks? (2) How do the active elderly access the parks? (3) What are the park PA areas and how are they used by the elderly? (4) What are the types, intensity, frequency and temporal characteristics of elderly park-based PA? And how does general park-based PA and moderate and vigorous park-based PA contribute to the overall PA of the elderly? (5) With respect to the questions above, can the differences be found between two cities that vary in culture traditions and urban conditions?

2. Methods

The current study was a descriptive study using various methods. An observation approach was used to explore park-based PA, PA areas and urban conditions from an external point of view. In addition, a survey approach was used to investigate park-based PA, overall PA behaviour and the perception of the PA environment (e.g., park accessibility) from the individual perspective.

2.1 Selection of cities and parks

Two cities were chosen in this study to represent various cultural traditions and urban conditions including Hong Kong in China and Leipzig in Germany. Hong Kong is a city with a population of 7.35 million (23% are elderly with 60yrs and above), representing a high density of

buildings and population (6958 inhabitants/ km², 7.07 million people live in residential high-rises), and a mixture of international and Chinese cultures. Besides smaller recreation areas, 32 urban parks are managed by the Hong Kong Leisure and Cultural Services department, with a specific section that governs recreation facilities for the elderly. The mean size of the parks is 8.43 hectares (park size range: 1.76–22.0 hectares). Leipzig is a city with a population of 0.56 million (26% are elderly with 60 yrs and above), representing a relatively low density of buildings and population (1882 inhabitants/ km^2, very few residential high-rises), and European culture. Besides smaller recreation areas, 31 urban parks are managed by the city authorities. The mean size of the parks is 11.52 hectares (park size range: 0.4–42.4 hectares).

In both cities, similar park selection criteria were used. Only accessible parks that were built in varied geographic locations, of different sizes, and with active areas were selected as study settings (Cohen et al., 2012; Kaczynski et al., 2011; Ward et al., 2014). Parks under construction or renovation during study periods were also excluded (Ward et al., 2014). As a result, six parks were selected in each city. In Hong Kong, two parks were chosen from each of the three regions, with one park smaller than the mean size (8.43 hectares) of all Hong Kong parks and another larger than the mean size. In particular, Victoria Park (19.00 hectares) and Chai Wan Park (7.13 hectares) are located on Hong Kong Island, Lai Chi Kok Park (17.65 hectares) and Shek Kip Mei Park (8.00 hectares) are in Kowloon, as well as Shing Mun Valley Park (10.73 hectares) and Tsuen Wan Riviera Park (4.50 hectares) in the New Territories. In Leipzig, two parks were selected from the center region including Friedenspark (17.00 hectares) and Clara-Zetkin-Park (42.40 hectares), while the remaining four parks were selected from eastern (Stadtteilpark Rabet, 5.80 hectares), western (Volkspark Kleinzschocher, 40.00 hectares), southern (Lene-Voigt-Park, 5.60 hectares) and northern (Arthur-Brettschneider-Park, 7.30 hectares) regions. Three parks in

Leipzig were smaller than the mean size (11.52 hectares) of all Leipzig parks, and three parks were larger than the mean size.

2.2 Observation

Prior to park observation, park maps were established by GmapGIS for all selected parks. PA areas were then allocated by observers, which included areas with facilities and equipment designed for PA, such as basketball fields, walking/jogging circuits or fitness stations. In addition, other areas where PA could be observed were also included, such as places for group fitness, tai chi or dancing. After identifying PA areas, these were marked and coded by observers on the park maps, as well as were taken photographs. In this manner, 145 PA areas in Hong Kong and 100 PA areas in Leipzig were addressed.

The systematic observation of PA areas was based on a modified version of SOPARC (System for Observing Play and Recreation in Communities; McKenzie, Cohen, Sehgal, Williamson, & Golinelli, 2006). Gender and age group (youth: 0–17yrs; adults: 18–59yrs; seniors: 60yrs and above) of PA area users as well as accessibility of PA areas were observed and counted. In terms of PA intensity, sedentary behaviour such as sitting, standing, lying down, reading, eating, sleeping, card playing, and playing chess were not counted as any of the PA intensities. In this study, the classification of PA intensity (low, moderate, vigorous) was based on those developed by Ainsworth and colleagues (2011) which include codes, Metabolic Equivalent (MET) values of PA, and specific activities. PA with low-intensity (1.6–2.9 METs), moderate-intensity (3–5.9 METs), and vigorous-intensity (>=6 METs) were recorded. In addition, types of PA and the social situation of PA (groups or individuals) were added to the revised SOPARC sheet.

The revised SOPARC data were collected by six research assistants in Hong Kong and two research assistants in Leipzig. Before collecting data, all observers completed a 4-day training course which was offered by a research associate who works on the current project. In the first 2-day workshop, observers memorized the operational definitions of the behavioural dimensions and subcategories of these and then learned the data recoding procedures. This was followed by a further 2-day field practice observation. Training continued until an observer reached a high level of agreement (inter-observer agreement, IOA=80%; intraclass correlation, r =.75, McKenzie et al., 2006). In Hong Kong, 6 observers were divided into 3 groups. Each group rated two of the six parks. In Leipzig, 2 observers rated all 6 parks. The observation was conducted at different time periods (8:30 AM, 11:00 AM, 3:00 PM and 5:30 PM) on two weekdays and both weekend days in one week during two seasons (Autumn 2014 and Spring 2015). Each of the 245 PA areas were observed 32 times (four daily time slots * four days * two seasons). The observation of active people at all intensity levels consisted of 16867 observations in Hong Kong and 20809 in Leipzig, whereas the specific sample of "active elderly" consisted of 3185 observations in Hong Kong and 2622 in Leipzig.

2.3 Survey

The following variables were included in the questionnaire survey.

Personal variables: age, gender, education (low level: primary school; high level: high school & university/college), marital status (single, married), living city (Hong Kong, Leipzig), height and weight.

Park-based PA: The older adults were asked to report PA type, amount of PA (frequency and duration per week) and the intensity of typical PA (low, moderate and vigorous). Energy

expenditure per week (kcal) from park-based PA was then computed based on the amount and the intensity of PA (modified from Ainsworth et al., 2000; Brehm & Sygusch, 2008).

Stage of change for overall PA: A stage algorithm was employed to assess the stage of change for overall PA among older adults. The introductory text was stated as "Overall PA includes activities of daily life (e.g., brisk walking, climbing stairs) and sport activities or exercises (e.g., tennis, fitness-training, tai chi)". The participants were then asked, "Do you engage in PA for an accumulated time of at least 120 minutes per week with at least moderate intensity (some sweating and/or some breathlessness)?" followed by six statements to identify six PA stages including not considering, considering, preparing, fluctuation, exploring and maintaining (Duan et al., 2013). For the analyses in this study, six stages were classified into two categories to indicate whether individuals met the recommended activity levels (accumulated of 120 minutes per week with at least moderate intensity): (1) inactive stages consist of the first three stages, for which individuals did not meet the criterion; (2) active stages consist of the latter three stages, for which individuals met the criterion.

Park accessibility: Two items were used for park accessibility. Participants were first asked to assess the time it took them to get from home to the park (up to 10 minutes, 11–20 minutes, more than 20 minutes) (Spittaels et al., 2010). Subsequently, participants were asked which transportation method they had used to get to the park (on foot, bicycle, motor bike or car, public transportation).

The observers in the parks conducted the face-to-face questionnaire survey. Active adults aged 60 years or above who engaged in low, moderate or vigorous intensity PA (Ainsworth et al., 2011) during the observation were targeted and asked to complete a survey, which resulted in 60 people in each park of each city. A total of 720 active older adults were approached in Hong

Kong (n=360) and Leipzig (n=360). Each survey took approximately 20–25 minutes to complete. A total of 628 older adults in Hong Kong (n = 317, age range: 60–88 yrs, Mean $_{age}$ = 69.96, SD = 6.81) and Leipzig (n = 311, age range: 60–92, Mean $_{age}$ = 72.06, SD = 6.78) completed the survey. The response rates were 88% in Hong Kong (317/360=88%) and 86% in Leipzig (311/360=86%). The sample in Hong Kong differed from the Leipzig sample concerning age (Mean $_{Hong\ Kong}$ =69.96 yrs , Mean $_{Leipzig}$ = 72.06 yrs; t (609) = 3.82, p < .001), gender (females $_{Hong\ Kong}$ = 46.7%, females $_{Leipzig}$ = 58.5%; χ^2 (1) = 8.60, p = .003), education (high level $_{Hong\ Kong}$ = 45.2%, high level $_{Leipzig}$ = 32.1%; χ^2 (1) = 14.37, p = .001) and BMI (BMI $_{Hong\ Kong}$ =22.0, BMI $_{Leipzig}$ = 25.2; t (609) = 13.97, p < .001). No difference was found concerning marital status (p = .15), 25 % were single in both cities.

2.4 Statistical analyses

Data were analysed with SPSS 22.0. Descriptive analysis including percentages were used to present PA areas in parks and the PA characteristics of older adults within these areas (types, intensity, frequency, time period, week period and season) in both Hong Kong and Leipzig. In addition, the demographic differences between Hong Kong and Leipzig older adults were examined with Chi^2 tests. City differences in park accessibility, as well as in survey and observation measured PA were also compared by Chi^2 tests. Furthermore, the associations between cities and stage of change for overall PA was computed by Chi^2 test, whereas, the differences between cities and park-based PA energy expenditure was examined by t-tests.

3. Results

3.1 Sample proportion and social situation of active elderly in parks

A total of 77% and 76.3% of all visitors to the PA areas, respectively, were active visitors in Hong Kong and Leipzig parks. Observation of all active visitors across age groups demonstrated that the proportion of active elderly is higher in Hong Kong (18.9%) than in Leipzig (12.6%). In both cities more elderly males are active (HK 58.0%, Leipzig 52.8%) than elderly females (HK 42.0%, Leipzig 47.2%), but the discrepancy between male and female elderly in Hong Kong is larger than that in Leipzig ($\chi^2_{=}$ 16.46, p <.001). Concerning the social situation of active elderly, 72.8% elderly in Hong Kong and 47.6% elderly in Leipzig engage in PA by themselves, suggesting fewer elderly people are active with others or in organized groups in Hong Kong (27.2%) compared to Leipzig (52.4%) ($\chi^2 = 402.72$, $p < .001$).

3.2 Accessibility of parks for active elderly

The observation results indicated that PA areas in parks both in Hong Kong and in Leipzig are highly accessible (99%) during the daytime. Moreover, the survey data in Table 1 reveals that the perceived time distance to the park for most of the active elderly park users is relatively short, 75 % in Hong Kong and 65% in Leipzig live up to 10 minutes to the park. A higher proportion of the elderly in Hong Kong live within 20 minutes (94%) compared with elderly in Leipzig (86%) ($\chi^2 = 11.03$, $p < .01$). In addition, Table 1 shows that 89% of the elderly park users in Hong Kong and 85% in Leipzig get to the park by walking and cycling, which is the transportation method that expends the most human energy. Only 11% in Hong Kong and 15% in Leipzig use other transportation methods such as driving motor bikes or cars, or using public transport. However, there are still significant transportation method differences between Leipzig and Hong Kong ($\chi^2 = 41.69$, $p < .001$). A greater number of Hong Kong elderly get to the park by walking (84%) compared with Leipzig (64%), where the elderly cycle more often than in

Hong Kong. Furthermore, in Hong Kong (84%) and Leipzig (64%), the majority of walking elderly (67.5% out of 84% in Hong Kong; 48.5% out of 64% in Leipzig) indicated the perceived time taken to walk to the park was approximately 10 minutes.

----Insert Table 1----

3.3 PA park areas and their use by the elderly

Table 2 shows the PA areas observed in Hong Kong and Leipzig parks, and the PA participation in these areas.

----Insert Table 2----

Sports fields are defined as areas with special facilities such as basketball baskets, goals or nets, often within marked fields. The number of sports fields in Leipzig parks only accounted for one third of those in Hong Kong parks (24:73). Furthermore, the sports fields in Hong Kong are usually built and equipped according to the international rules of sport federations, whereas, in Leipzig this is often not the case (e.g. smaller fields). In particular, basketball courts and soccer pitches can be found in Hong Kong as well as in Leipzig. However, volleyball courts and table tennis courts are found in Leipzig, and tennis courts and gate ball courts are found in Hong Kong. With respect to how the active elderly use these sports fields, it was noted that the elderly, especially in Leipzig, very rarely engaged in vigorous sports, such as soccer or volleyball. However, in Hong Kong parks, basketball court, soccer pitch, gate ball and tennis courts were used by the elderly at moderate and vigorous intensities. Furthermore, the elderly in Hong Kong were also observed on the basketball and soccer pitches, not playing basketball or soccer, but engaging in fitness and dancing mostly with moderate intensity, or walking with low intensity or jogging with moderate or vigorous intensities. Also gate ball fields are used in different ways by the eld-

erly in Hong Kong, particularly to use the space to play ball games such as boules with moderate intensity.

Skate parks are built for different types of skating activities and are integrated in two parks out of six in each city. However, no elderly activities were observed in these PA areas.

Trails are important elderly opportunities for activity which either cross the parks or are designed as distinct walking and jogging circuits within the parks. Whereas, walking and jogging circuits are found more often in Hong Kong parks (6) than in Leipzig (1), trails crossing the parks are more often used as activity areas in Leipzig (11) than in Hong Kong (2). Moreover, walking with low and moderate intensities, and jogging with vigorous intensity, were the main activities in these PA areas in both cities. Cycling with moderate intensity was regularly observed in Leipzig but rarely in Hong Kong.

Within ***fitness stations***, exercise equipment enables functional exercise (see figures 1 & 2). There are 30 fitness stations in the 6 parks in Hong Kong, whereas, only 2 in Leipzig. In Hong Kong, the equipment in most of these fitness stations is designed especially for elderly use, where elderly mainly perform functional exercises with low and moderate intensities. In Leipzig, fitness stations are mainly used by the elderly to play with children at moderate intensity but are rarely used for fitness exercising.

----Figure 1 & 2----

In Hong Kong special ***secure areas*** (See Figure 3) are found, which are mostly paved and covered. These secure areas are used by the elderly for fitness exercise, dancing, and often for organized groups. Most of these exercises are performed at moderate intensities. Similar secure areas were not found in Leipzig parks.

----Figure 3----

Lawn areas are meadow areas, in most cases not specifically marked out (e.g. by bushes), active people or groups regulate their own activities in such areas. However, clearly there are preferred meadow areas in both cities where PA can be frequently observed. In Leipzig, more lawn areas are used for PA compared to Hong Kong (32:3). Lawn areas are used by the elderly in both cities for exercise, although mainly group exercise. In addition, Leipzig elderly also use lawn areas for walking and playing with children. All types of PA performed on lawn areas in both cities are performed at low and moderate intensities.

Playgrounds are spaces with special equipment designed for play, such as swings. There are more playgrounds for children in Leipzig compared to Hong Kong (28:20). The elderly can be found in playgrounds in both cities mainly to exercise and play with children. The PA behaviours performed in playgrounds are mainly at low intensities.

3.4 Type, intensity, frequency and temporal characteristics of elderly park-based PA

Table 3 demonstrates specific characteristics of the PA performed by the elderly in Hong Kong and Leipzig parks, from both survey and observation perspectives.

----Insert Table 3-----

Despite some differences, survey and observation data revealed similar tendencies. Concerning the type of PA, walking is the most common among the elderly both in Hong Kong and in Leipzig, and ranked 1st. Moreover, the survey data demonstrated that a higher proportion of females walked in both cities (Hong Kong: female = 47% vs. male = 39%; Leipzig: female = 71% vs. male = 63%). City differences were found for the other types of PA. In particular, fitness exercising ranked 2nd for the Hong Kong elderly but was less common in Leipzig. In terms of gender distribution, the survey data showed that in Hong Kong more females than males, and

more males than females in Leipzig engaged in fitness exercising (Hong Kong: female = 36% vs. male = 29%; Leipzig: female = 4% vs. male = 5%). Regarding the specific activities related to exercising, observation data showed the elderly in both cities often practised strength work, stretching, coordination and endurance exercise. However, holistic exercise such as Tai Chi, Wu Shu, was only performed by the elderly in Hong Kong. In addition, jogging or running ranked the 3rd most common PA for the elderly in Hong Kong, but was less common in Leipzig. The survey data showed a higher proportion of men jogged (Hong Kong: female = 14% vs. male = 22%; Leipzig: female = 3% vs. male = 6%) in both cities. Cycling was an activity performed almost exclusively for the Leipzig elderly ranking the 2nd most common form of PA. In addition, racket and ball games were rarely played by the elderly, but when they were, it was more often seen in Hong Kong than in Leipzig. Lastly, playing with children was also performed by the elderly in both cities under observation, but more commonly in Hong Kong. However, this information in Hong Kong was found only through observation but was not present in the survey data.

Low intensity PA (no sweating or exertion) was the most common PA intensity level for the elderly in both cities, which fits well with "walking" as the main activity as previously revealed. The survey data also showed that the gender distribution was almost equal in Leipzig, although in Hong Kong more females were active at a low intensity compared to males (Leipzig: female = 75% vs. male = 72%; Hong Kong: female = 52% vs. male = 38%). Although vigorous intensity is the least common elderly PA intensity level in both cities, there were city differences (Survey: $\chi^2 = 53.98$, $p < .001$; Observation: $\chi^2 = 484.27$, $p < .001$). Vigorous activities were more often found in Hong Kong and rarely in Leipzig (Survey: Hong Kong = 11% vs. Leipzig = 3%; Observation: Hong Kong = 21% vs. Leipzig = 3%). The survey data also revealed that the gender distribution was almost equal in Leipzig, but more males were active at a vigorous intensity compared to

298 females in Hong Kong (Leipzig: female = 3% vs. male = 5%; Hong Kong: female = 3% vs. male
299 = 18%).

300 Furthermore, the data from the survey revealed that the PA frequency was high in both cit-
301 ies, with around 50% of the elderly in both cities active in parks for more than two hours a week,
302 with 41% in Leipzig and 27% in Hong Kong active for up to two hours per week. In addition,
303 more Hong Kong elderly and less Leipzig elderly were active at a low PA frequency of 1–3 per
304 month ($\chi^2 = 30.65$, $p < .001$; Hog Kong = 25% vs. Leipzig = 9%).

305 With respect to the preferred time for PA, results from observation revealed that the differ-
306 ence between the two cities was significant ($\chi^2 = 193.91$, $p < .001$). That is, the elderly in Hong
307 Kong preferred being active in the morning, whereas, the elderly in Leipzig preferred the after-
308 noon. Across the week, the weekend was the slightly preferred choice for activity among the
309 elderly in both cities, although the difference between weekday and weekend PA was larger in
310 Leipzig compared to Hong Kong ($\chi^2 = 21.97$, $p < .001$). No differences were found with respect
311 to the season, with the elderly in both cities similarly active in parks during the autumn and
312 spring.

313

314 *3.5 Stages of change for overall PA and park-based elderly PA*

315 ----Insert Table 4----

316 Table 4 shows the summarized stages of change for overall PA, energy expenditure of over-
317 all park-based PA and energy expenditure of park-based moderate and vigorous PA (MVPA).
318 For the active elderly in parks in both cities, the overall PA for the majority reached the Health-
319 Enhancing PA (HEPA) criterion of 120 min or more per week, of at least moderate intensity, or
320 in total at least 800 kcal/week (92% in Leipzig, 65% in Hong Kong), but this was greater in

Leipzig than in Hong Kong ($\chi^2 = 76.11$, $p < .001$). In addition, the elderly in both cities who met the weekly HEPA criterion, their overall park-based PA contributed to overall PA, but the value in Hong Kong was significantly larger than in Leipzig (Hong Kong = 1138kcal/week vs. Leipzig = 756kcal/week; t = -5.91, $p < .001$). For those who were still at stages below the weekly HEPA criterion, the Hong Kong (35%) and Leipzig (8%) elderly park-based PA contributed to health related PA behaviour, however, no significant city differences were found (Hong Kong = 322kcal/week vs. Leipzig = 489kcal/week; t = 1.52, $p = .13$). Furthermore, around half (51.0%) and a quarter (25.5%) of active elderly, engage in park-based moderate and vigorous PA (MVPA) in Hong Kong and Leipzig, respectively. Among them, 74.5% of Hong Kong elderly and 97.5% of Leipzig elderly were found to be at the stages that meet the weekly HEPA criteria. The elderly MVPA contributed to overall PA, however, the value in Hong Kong was significantly larger than in Leipzig (Hong Kong = 1433kcal/week vs. Leipzig = 1152kcal/week; t = -2.57, $p < .05$). For those who were still found to be at stages below the criterion, Hong Kong (25.5%) and Leipzig (2.5%) elderly MVPA contributed to health related PA behaviour, however, no significant city differences were found (Hong Kong = 508kcal/week vs. Leipzig = 292.5kcal/week; t = -0.45, p = .66).

4. Discussion

In the current study, of all the active people in the parks, the percentage of active elderly was higher in Hong Kong (18.9%) than in Leipzig (12.6%), which indicated that elderly PA participation in Hong Kong parks is higher than Leipzig. Likewise, Chow et al. (2016) also revealed a high percentage of active elderly in Hong Kong parks (25.6%). One possible reason might be the efforts of the Leisure and Cultural Services Department of the Hong Kong Special Adminis-

trative Region, which has a specific sub-section that governs the recreation facilities in public areas, such as park fitness stations for the elderly (Chow et al., 2016). An alternative reason could also be the particular urban conditions in Hong Kong compared to Leipzig, for example, the warmer climate, higher population density and a greater number of high-rise buildings, with various opportunities to come into contact with nature. In addition, making use of parks to engage in PA has been a Chinese cultural tradition for a long time, whereas, in Germany sport clubs or gymnastic clubs are more often used to engage in PA.

This study has found that more male elderly are active in parks than females in both cities (Hong Kong: male 58%, female 42%; Leipzig: male 52.8%, female 47.2%), which is consistent with other studies (e.g., Evenson et al., 2016). The greater discrepancy between male and female PA participation in Hong Kong compared with Leipzig, might indicate a more significant gender pattern in China. Interestingly, fitness and health related PA such as walking and fitness exercising are especially attractive to females in both cities.

Park accessibility is an important factor related to park-based PA for the elderly in both cities across urban conditions. Elderly transportation methods mainly rely on human energy, for example, on foot (in both cities) or by bike (in Leipzig). Most of the elderly who access parks on foot in both cities get there within 10 minutes. As such, it is understandable that the most common time taken to get to to the parks is approximately 10 minutes. Some evidence can be found in other studies to demonstrate a positive relationship between park proximity or accessibility and active general park use, however, such data for the elderly has been limited until now (Kaczynski, Potwarka, Smale, & Havitz, 2009; Wong, 2009). This study suggests that walkability and easy access to parks by bike can contribute to enhancing elderly PA in parks. Therefore, to pro-

366 mote park use, it would be helpful to provide the elderly with detailed route information on how
367 to get to park on foot or by bike.

368 Until now, there has been limited research investigating the relationship between PA areas
369 in parks and their use by the elderly. In general, it has been suggested that trails can significantly
370 increase PA in parks (Hunter et al., 2015; McKenzie et al., 2006). The current study demon-
371 strated consistent results revealing that the elderly, in both cities, use trails almost exclusively for
372 doing activities such as walking. However, trails are more often constructed as circuits for the
373 specific purpose of walking and jogging in Hong Kong, whereas, in Leipzig trails are more often
374 built as an access route in and out of the park, and are used not only for walking and jogging but
375 also for cycling. As a consequence, more than 20% of the elderly in Leipzig travel to the park by
376 bike, which hints at the possibility of combining this transport method and physical activity
377 within the parks.

378 Regarding the fitness stations, several fitness stations can be found in each park in Hong
379 Kong with some constructed especially to fulfil the requirements of the elderly (Chow et al.,
380 2016). Under such conditions, variety of functional exercise is common for the elderly in Hong
381 Kong. This finding is supported by Wong (2009), who found that the most popular activities of
382 adult park users in Hong Kong, are exercising and taking leisurely walks. This is in contrast to
383 the parks in Leipzig, where only a few fitness stations are established with no specially designed
384 equipment. As a result, elderly exercising at fitness stations is uncommon in Leipzig. However,
385 elderly exercise can quite often be found on lawn areas in Leipzig, where most of are organized
386 and instructed group exercise sessions. Perhaps these places are more attractive for the elderly
387 when there are aesthetic surroundings, with such as flowers, trees and lakes.
388

The main PA areas for the elderly in Hong Kong are secure areas, most with paving and some with covers to protect against the sunshine and rain. These secure areas are used intensively by the elderly in Hong Kong to perform fitness exercise, practise eastern style traditional exercises based on beliefs of Chi energy (e.g. tai chi), as well as dancing, and are mostly organised, instructed groups.

Sports fields like basketball courts and soccer pitches can be found in both cities, but a greater number of them are often better equipped in Hong Kong. Additionally, tennis courts and gate ball courts were only found in Hong Kong. This may be due to the fact that in Leipzig, as in all German cities, such sport areas are normally integrated into sport clubs or communal sport sites. But in both cities, the sports that these areas support are used in different way by the elderly. In Hong Kong, these sport fields are not only used for doing sport but also used as secure areas by the elderly for fitness exercising, walking, jogging or dancing. In Leipzig, some sport fields are not used by elderly.

Playgrounds are common PA areas in parks for children in both cities. Due to the caring relationship between older adults and children, the elderly can also be observed to play football, basketball and other games with children, which is also evident in other research (Kaczynski et al., 2014). In addition, some elderly fitness exercises in these areas, suggesting the multi-use of playgrounds for the active elderly.

It can be stated that this age group was almost exclusively interested in fitness enhancing activities with low to moderate intensity levels such as walking, jogging, cycling and a wide variation of fitness exercise, which is in line with other studies (Pleson et al., 2014; Wong, 2009). In addition, many elderly engaged in MVPA under enhanced preconditions. For example, ball games and tennis played on basketball court, soccer pitch and tennis court, exercising within

fitness stations and secure areas in Hong Kong, or cycling on trails in Leipzig. This implies that park planning including such areas can contribute to the health-enhancing PA of elderly. The observed high frequency of park activity of up to two hours or more indicates that engaging in PA in parks is a stable habit for most of the active elderly in both cities, which may also confirm their focus of improving fitness and health. In both cities, the elderly PA is distributed over the whole day. However, the Hong Kong active elderly are more often observed in the morning compared to Leipzig. These findings are consistent with previous observation studies, that suggest morning is the most common time for PA for the Chinese elderly in parks (Pleson et al., 2014; Tu et al., 2015).

The findings of this study demonstrate that most active elderly park users are fulfilling the HEPA criterion of at least 800kcal/week of energy expenditure. However, the weekly energy expenditure of overall park-based PA and park-based MVPA are significantly higher in Hong Kong (1138 kcal/week; 1433.01 kcal/week) compared to Leipzig (756 kcal/week; 1152.37 kcal/week), which indicates that the active elderly in Leipzig may use other opportunities for health related activity besides park-based PA, provided by the 403 sport and gymnastic clubs in Leipzig (http://www.ssb-leipzig.de/stadtsportbund/profil/). Meanwhile, this result also implies that parks can contribute an important proportion of health-enhancing PA within a big sample of elderly in Hong Kong as well as in Leipzig.

This paper is the first to closely investigate specific PA areas in parks and their use by the elderly across different regions. The existing findings shed light on existing knowledge that park planning should integrate the more commonly used PA areas by the elderly in order to attract elderly visitors and to promote PA in parks. As such, multiple elderly PA promotion strategies may be conducted by health practitioners in parks in the future. For example, organizing and

instructing a variety of group exercise in parks. By comparison, park planners and policy makers in different regions may learn about good practice related to PA area planning for the elderly from each other. For example, Hong Kong experience reveals that one of the most efficient strategies to facilitate the elderly being active in parks, is to build appropriate and specialized fitness station facilities for the elderly.

Several limitations of this study should be addressed. With respect to the perceived time distance from park, there may exist some bias due to inaccurate recall of older adults. Additional measurement could be helpful at this point, such as employing GIS to map and spatially cluster the accessibility values of the residential blocks that older adults live in (Oh & Jeong, 2007). Furthermore, regarding the measurement of elderly park-based PA, although the questionnaire and the observation instrument used in this study have been validated, objective and direct measurement is still warranted. For example, using the combination of GPS and accelerometers would be helpful to accurately measure the PA energy expenditure of the elderly at particular locations in the parks (Krenn, Titze, Oja, Jones, & Ogilvie, 2011). In addition, elderly park-based PA differs on various demographic factors such as age, education level, marital status, and BMI. The current study did not explore any associations between these factors. Future study is necessary to examine this issue with advanced statistical models such as negative binomial regression. Besides, although the observations were made at different daily time periods, only a glimpse of PA was captured. Thus, longer study durations and continuous observations are required to strengthen the current findings. Finally, sedentary behavior of the elderly in PA areas in parks was not recorded in the observation, which might influence the comprehensive understanding on the prevalence of elderly PA in parks.

5. Conclusions

By using a combination of systematic observation and surveys, the current study provides a respectable view of PA areas in parks, elderly use of PA areas, and access methods to these areas in the cities of Hong Kong (China) and Leipzig (Germany). Various urban conditions and cultural traditions seem to be associated with the creation of these parks, e.g., the average size (Hong Kong 8,43 hectars, Leipzig 11,52 hectars), the quantity, the site, and the PA equipment in parks (Hong Kong had more variety across sites with better equipped areas). In addition, the access to the PA areas in parks seems to correlate with the urban conditions. In Leipzig many elderly approach the park by bike and also use their bike for PA in the park, whereas this is not the case in Hong Kong.

Meanwhile, some common features of elderly park-based PA can be found in both cities, which is informative for park planning and administration across different regions. First, elderly prefer accessing the PA areas in parks by walking or cycling, suggesting that park proximity should be considered. Second, the elderly focus on health-enhancing PA in parks, and many elderly engage in social group activities, which imply that organizing PA activities in groups or PA campaigns in parks could attract the elderly. Third, building good preconditions and facilities for various fitness related activities and MVPA can promote elderly PA in parks, such as increasing the number of secure areas with or without sun and rain protective covers, various trails designed for walking, jogging and cycling, suitably equipped fitness stations and sport fields.

Overall, PA areas in parks are key environmental sites to provide senior city residents opportunities to engage in PA. The characteristics of PA areas in parks and their use by the elderly are region-specific. Park planners and administrators should consider optimizing the function of PA areas and facilitating elderly park PA so as to enhance the health status of the elderly.

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Table 1: Accessibility of Parks for the Active Elderly (Time Distance & Transportation Methods)

	Hong Kong	Leipzig	χ^2	*p*
Time distance	(n=311) (%)	(n=310) (%)	11.03	.004
up to 10 minutes	75	65		
11 to 20 minutes	19	21		
more than 20 minutes	6	14		
Transportation Methods				
	(n=332) (%)	(n=311) (%)	41.69	.000
On foot	84	64		
Bicycle	5	21		
Motor bike or car	4	7		
Public transportation	7	8		

Table 2: Physical Activity Areas and Physical Activity Participation of Elderly in Hong Kong and Leipzig Parks

PA Areas	PA areas in Hong Kong (145) n (%)	PA areas in Leipzig (100) n (%)	PA participation of older adults in Hong Kong (n=3185)				PA participation of older adults in Leipzig (n=2622)			
			PA type (n)	PA intensity			PA type (n)	PA intensity		
				Low (n)	Moderate (n)	Vigorous (n)		Low (n)	Moderate (n)	Vigorous (n)
1. Sports field	73 (50.3%)	24 (24.0%)								
1.1Basketball court	16 (11.0%)	5 (5.0%)	Fitness exercising[1] (56) Walking (1) Jogging (3) Basketball (90)	3 1 -- 0	53 --- --- 49	--- --- 3 41	---	---	---	---
1.2 Soccer pitch	15 (10.3%)	3 (3.0%)	Fitness exercising[1] (59) Walking (7) Jogging (1) Soccer (91)	9 7 --- 1	47 --- 1 69	3 --- --- 21	Soccer (1)	---	---	1
1.3Volleyball court	---	6 (6.0%)	---	---	---	---	volleyball (1)	---	---	1
1.4Gate ball court	4 (2.8%)	---	Gate ball[2] (76) Game bowl (boule) (8)	--- ---	66 8	10 ---	---	---	---	---
1.5 Tennis court	4 (2.8%)	---	Tennis (153)	---	29	124	---	---	---	---
1.6 Table tennis court	--	10 (10.0%)	---	---	---	---	---	---	---	---
2. Skate Park	2 (1.4%)	2 (2.0%)	---	---	---	---	---	---	---	---

3.Trail	8 (5.52%)	12 (12.0%)	Walking (1197) Jogging (489)	1018 2	163 4	16 483	Walking (1466) Jogging (77) Cycling (1010)	1237 1 2	226 2 1008	3 74 ---
4. Fitness station	30 (20.7%)	2 (2.0%)	Fitness exercising[1] (727)	322	396	9	fitness exercising[1](2) Playing with children[3] (9)	--- ---	1 9	1 ---
5. Secure area	7 (4.8%)	---	Fitness exercising[1] (138)	11	127	---	---	---	---	---
6. Lawn area	3 (2.1%)	32 (32.0%)	Fitness exercising[1] (39)	10	29	---	fitness exercising[1] (28) Walking (10) Playing with children[3] (8)	2 10 ---	26 --- 8	--- --- ---
7. Playground	22 (15.2%)	28 (28.0%)	Fitness exercising[1] (42) Playing with children[3] (8)	37 ---	3 8	2 ---	Fitness exercising[1] (5) Playing with children[3] (5)	1 ---	3 5	1 ---

Note:
1: Fitness exercising includes stretching, tai chi, wu shu, dancing and muscle strength training.
2: Gate ball is a mallet team sport inspired by croquet. It is a non-contact, highly strategic team game, which can be played by anyone regardless of age or gender. (https://en.wikipedia.org/wiki/Gateball)
3: Playing with children refers to older adults and children play football, basketball or games together.
--- represents no data available.

Table 3: Elderly Physical Activity in Survey and in Observation

	Survey				Observation			
	Hong Kong (n = 317) (%)	Leipzig (n =311) (%)	χ^2	*p*	Hong Kong (n = 3185) (%)	Leipzig (n = 2622) (%)	χ^2	*p*
Type of activity[1]								
Walking	42	67	---	---	37.8	56.3	---	---
Fitness Exercising	32	5			33.3	1.3		
Jogging/Running	18	4			15.5	3.0		
Cycling	1	20			---	38.5		
Ball games[2]	4	3			8.3	0.1		
Racket games[3]	2	1			4.8	---		
Playing with children	---	0.8			0.3	0.8		
Intensity level								
low	45	74	53.98	<.001	49	49	484.27	<.001
moderate	44	23			30	48		
vigorous	11	3			21	3		
Frequency								
1-3 per month	25	9	30.65	<.001	---	---	---	---
up to two hours per week	27	41			---	---		
more than two hours per week	48	50			---	---		
Time period								
Morning	---	---	---	---	36	21	193.91	<.001
Noon	---	---			22	22		
Afternoon	---	---			22	32		
Evening	---	---			20	25		
Week period								
Weekday	---	---	---	---	48	42	21.97	<.001
Weekend	---	---			52	58		
Season								
Fall	---	---	---	---	50	50	0.08	.77
Spring	---	---			50	50		

Note:

1: Type of activity in survey is an open question with more than one statement.

2: Ball games include soccer, basketball, volleyball and gate ball.

3: Racket games include table tennis, tennis and badminton.

Table 4: Stages of Change for Overall Physical Activity (PA) and Energy Expenditure of Park-based Physical Activity among the Elderly

	Stages of change for overall PA[1]				Energy expenditure of overall park-based PA[2] Mean (SD) (kcal/week)				Energy expenditure of park-based moderate and vigorous PA[2] (MVPA) Mean (SD) (kcal/week)			
	Hong Kong (n=308) (%)	Leipzig (n=310) (%)	χ^2	*p*	Hong Kong (n=308)	Leipzig (n=310)	t	*p*	Hong Kong (n=157)	Leipzig (n=79)	t	p
Stages below HEPA criterion[3] (n=143)	35	8	76.11	<.001	322 (516.45)	489 (413.43)	1.52	.13	508.50 (672.50)	292.50 (0.00)	-0.45	.66
Stages that meet the HEPA criterion[3] (n=475)	65	92			1138 (744.25)	756 (575.58)	-5.91	<.001	1433.01 (742.18)	1152. 37 (748.46)	-2.57	.01

Note:

1: Self assessment to one of six stages of PA behavior. (1) Not considering: less than 120 minutes PA per week and not thinking about being more active; (2) Considering: less than 120 minutes PA per week but thinking about being more active; (3) Preparing: less than 120 minutes PA per week but preparing to be more active; (4) Fluctuating: usually at least 120 minutes PA per week but not regularly active every week; (5) Exploring: at least 120 minutes PA per week but for less than 12 months; (6) Maintaining: at least 120 minutes PA per week but for 12 months or more.

2: For the calculation of weekly energy expenditure of park activities, intensity is transferred to MET value with 4kcal/min for low intensity, 6.5kcal/min for moderate intensity and 9kcal/min for vigorous intensity. Energy expenditure of park-based PA (kcal/week) including overall park-based PA and park-based MVPA is calculated by multiplying time (min/week) and MET value (kcal/min) (Ainsworth et al., 2000; Brehm & Sygusch, 2008).

3: HEPA=health-enhancing physical activity. Stages below HEPA criterion include not considering, considering and preparing stages. Stages that meet the HEPA criterion include fluctuating, exploring and maintaining stages.