PHYSICAL ACTIVITY OF OLDER PEOPLE, THERAPEUTIC LANDSCAPES AND PUBLIC SPACES IN URBAN CHINA

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ABSTRACT

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The purpose of my dissertation research is to examine the far-reaching influence of physical activity practices among older Chinese people, in both their own community and in urban public life. The overarching research question, therefore, is two-fold: (1) How do social spatial environments influence older people's self-care practices and thus influence their health and wellbeing; and (2) How do the self-care practices of older people shape the social spatial spaces of aging in neoliberal urban China, in return? To answer these questions, I utilized a mixed-methods approach in two study sites, Laolongyan neighborhoods in Huainan City, a mid-sized city in China and Mudanyuan neighborhoods in Beijing, the capital and a large city in China.

This research consists of three objectives to address the goal of the dissertation. Each objective is a separate study representing an article in the dissertation. The first article examines the bi-directional relationships between physical activity and chronic disease in an older population in China. Drawing on a six-year longitudinal health survey data of older people in four neighborhoods in Huainan City and survival analysis and multilevel logistic regression, this study revealed that health disparities among older people may widen as those sedentary experience earlier onsets of chronic diseases and worse health trajectories, compared to more physically active people. The second article examines the pathways by which physical activity behaviors are impacted by the social and physical aspects of the built environment. Combining the Social Ecological Model and the Stage of Behavior Change Model within a mixed-method approach, I

found (a) that the liveliness of an apartment building is important in attracting sedentary older adults to initiate physical activity; (b) housing closeness to urban functional spaces is associated with the initiation of physical activity through social networks of neighbors; and (c) social networks of neighbors is the most important factor in regulating physical activity. The third article investigates physical activity spaces simultaneously as therapeutic and public spaces. Engaging with a combination of the concepts of therapeutic landscapes and public spaces, my case studies in Huainan and Beijing demonstrate the possibility and synergies of combining the two complementary approaches, -i.e., to help put health into public and build therapeutic landscapes for all. This article also demonstrates the possible active role of older groups in the making of therapeutic public urban spaces in China.

In summary, through this dissertation research, I demonstrated that the differential social and physical environments led by the commercialized health care and health promotion services markets can make a change in physical activities among older people, and therefore widen the health disparity among older people with different behavior patterns. In return, the older group occupies their physical activity practices and plays an active role in exploring and constructing their therapeutic and public spaces. Tackling the problem of increasing health inequality within the rapid demographic and social transitions in urban China requires considering the health and wellbeing of all social groups and deconstructing the subjectivity of vulnerable groups, particularly the older population. This dissertation enriches the discussions of the health belief model and built environment effects on health, and expands the theoretical and field boundaries of therapeutic landscapes and public spaces to define therapeutic public spaces.

This dissertation is dedicate to millions of ordinary (older) people.

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This dissertation is for my beloved family, my husband, my parents, and grandparents. I am fortunate to have such a supportive family, which taught me to love, understand, empathize, and reflect and have always respected my decision to be a scholar.

Finally, this dissertation is certainly for the millions of ordinary people in (and out of) my field, who are suffering in everyday life, but always choose to be kind and optimistic and make every effort to pursue a better life. We may not always recognize each other, but we can still make a little difference in each limited field, encouraging and benefiting each other.

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CHAPTER 1

INTRODUCTION

Aging Population and Physical Activity in Urban China

As a result of the decreasing fertility and the increasing life expectancy in the past half century, the proportion of people aged 65 and over years is growing faster than any other age group in almost every country (World Health Organization, 2015b). China is also experiencing a rapid demographic transition. In 2015, there were 14.4 million older people in China (Ministry of Civil Affairs of the People's Republic of China, 2016), equating to 10.5% of the total population. By mid-century, China's older population will increase to 34.1% of the total population, making China an important contributor to the global demographic transition (WHO, 2015b). With a rapidly increasing older population, there is also the concern that the prevalence of chronic diseases will also increase, as a result of aging, creating a greater social burden on the health care system, and society as a whole. In 2013, 49.5% of older people in China were diagnosed with at least one chronic disease, and the incidence is still increasing (WHO, 2006, 2015a). Since physical activity (PA) has been shown to prevent chronic disease and delay chronic disease onset in the middle-aged (54-64 years) and older people (aged 65 years and older) (US Department of Health and Human Service, 2008; Warburton, Nicol, & Bredin, 2006), it is important, to examine and further understand how to promote older people's PA from the individual to community and society levels.

To understand older people's PA in urban China, it is necessary to situate the PA behaviors in the context of transitional urban China. First, PA behaviors can be viewed as a compromising solution for older people whose health care needs are increasing, at the same time medicine and health care services are becoming more commercialized and expensive for ordinary older Chinese people. Since the Reform and Opening Up of China in the late 1970s, 'marketized' reform has led

to the ‘commercialization’ of health care services. Although a high percentage of older people’s health care costs are covered by health insurance and compulsory savings, they still have to pay a certain amount of those costs, out-of-pocket (Gu & Zhang, 2006). With only a limited pension, ordinary older people in China may not be able to afford the health care services that they need, and thus have to do their best to prevent disease, to delay or offset those costs. Since public leisure PA activity spaces and PA facilities are largely accessible in terms of close distance and of no cost, older Chinese people are choosing to practice PA outdoor to prevent geriatric syndromes and chronic disease and minimize their health care costs.

Second, PA behaviors can also be treated as older people’s compromising solution to their increasing daily needs in a rapidly urbanizing society. The informal daily care from family and community is also declining due to rapid urbanization. Although the tradition of filial piety, or *xiao*, emphasizes material provision and caregiving from younger generation to older, family caregiving cannot be guaranteed in this new generation (Zhan & Montgomery, 2003). While a large amount of labor outflow has decreased the availability of family caregivers in small cities, the heavy working load and the rigorously enforced one-child policy also discouraged young people from taking care of their older parents in large cities (Zhan, 2006). The commercialization of housing and the decline of traditional neighborhoods and *danwei* compounds has additionally disrupted social connections within communities, thus disrupting informal daily care from the community–i.e., older people’s neighbors and community social support system. The consequence of the increasing needs of daily services is an increasing culture of life-nurturing and increasing desire for leisure physical activities among older Chinese, featured in their everyday urban life (Farquhar & Zhang, 2012).

It is, therefore, important to examine **the influence of the urban environment on PA of older people, and understand the impacts of PA on the health and wellbeing of older people at the individual, community and societal levels in in China**. At the individual level, since older people's PA can be understood as a strategy to keep healthy at no-to-low cost in the commercialized health-care and health-promotion market, it is essential to **exam the influence of physical activity on older people's health status** in order to promote a healthy aging society in China.

At the built environment level, older Chinese are well known for their leisure physical activity behaviors in urban public spaces (Tong, 2013), and this phenomenon in public spaces can be attributed to the open access public spaces in China's urban built environment. From this perspective, **examining the spatial accessibility of physical activity spaces** can be helpful to encourage sedentary older people to begin physical activity and promote a high-quality built environment for PA practitioners.

In urban public spaces, the spectacle of leisure physical activity is both a health promotion behavior and a performance of social identity (Qian, 2014). **Investigating the potential capacity of older people in the making of urban therapeutic and public spaces** can contribute to transforming the older population from the stigma of a social burden to active social participants, thus contributing to the active aging process.

This study engages with three major bodies of literature. It first builds on the literature of health geography, gerontology and geriatrics. Theoretically grounded in the health belief model (Champion & Skinner, 2008), stages of behavior change model (Marshall & Biddle, 2001), social ecological model, and longitudinal analysis, this study examines the bidirectional relationships between older people's chronic diseases and PA behaviors in a non-Western country. It further

examines the bipolar health behavior trajectory between sedentary and physically active people in their later life. This study then builds on the literature of urban geography. Theoretically, it contributes to further examine the interactive effects of the built environment, neighborhood social networks and aging process upon the change of PA behaviors, which provide feasible suggestions for community health-promotion interventions. As a health-oriented study, it certainly builds on the literature of medical and health geography. While introducing the stages of behavior change model and social theories upon public spaces into health geography, it contributes to further remind health geographers about the potential active role of the older population within neoliberal cities. It also theoretically further develops the concept of therapeutic landscapes by emphasizing the collaboration between different social groups in order to make a therapeutic landscape for all.

Goal and Objectives

The goal of the dissertation research is to further understand the impacts of PA on the health and wellbeing of older people at the individual, community and societal levels in in China. In particular, this dissertation achieves this goal by answering three separate research questions:

1. How and to what extent does physical activity affect the onsets of chronic diseases among older people and how and to what extent do the onsets of chronic disease affect physical activity behaviors in return?

It is hypothesized that physical activity will delay the onset of chronic diseases among older people, and the onsets of chronic diseases may promote or reduce people's physical activity behaviors.

2. How and to what extent does the social and physical built environment affect older people's behavior to change their physical activity practices?

It is hypothesized that high quality social and physical built environments can encourage more older people to start and maintain regular physical activity.

3. How can physically active older people as a social group collaborate with other social groups in public spaces in the making a therapeutic landscape of all?

It is hypothesized that older people can collaborate with other groups and play an active role in the making of therapeutic landscapes and therapeutic public spaces.

Study Areas

This dissertation research conducts two case studies of older people in neighborhoods in one mid-sized city and another large city in China. Three neighborhoods in Huainan, Anhui Province (Figure 1) as the main case, and two neighborhoods in Beijing as the supplementary case. Huainan, one of the 120 most rapidly growing industrial cities since 1949, is selected for two reasons. First, while there is plenty of literature discussing older people's health and health-promotion behaviors in large cities (Cheng, Rosenberg, Wang, Yang, & Li, 2011; Hu, 2012), less is known about older people's health and health-promotion behaviors in medium and small-sized cities. Huainan had a population of 3,456,000 in 2016, of which 12.9% were older adults (National Bureau of Statistics, 2017). Huainan is a microcosm of the nation's rapid aging-demographic transition in most middle and small cities, characterized by a growing older population with limited healthcare services, and rise in chronic disease morbidity and related mortality. Second, Huainan is my hometown city so rapport had been built and research data sources were accessible. The older people in these neighborhoods were also open to talking with me about their activity spaces, their apartments and community social interactions.

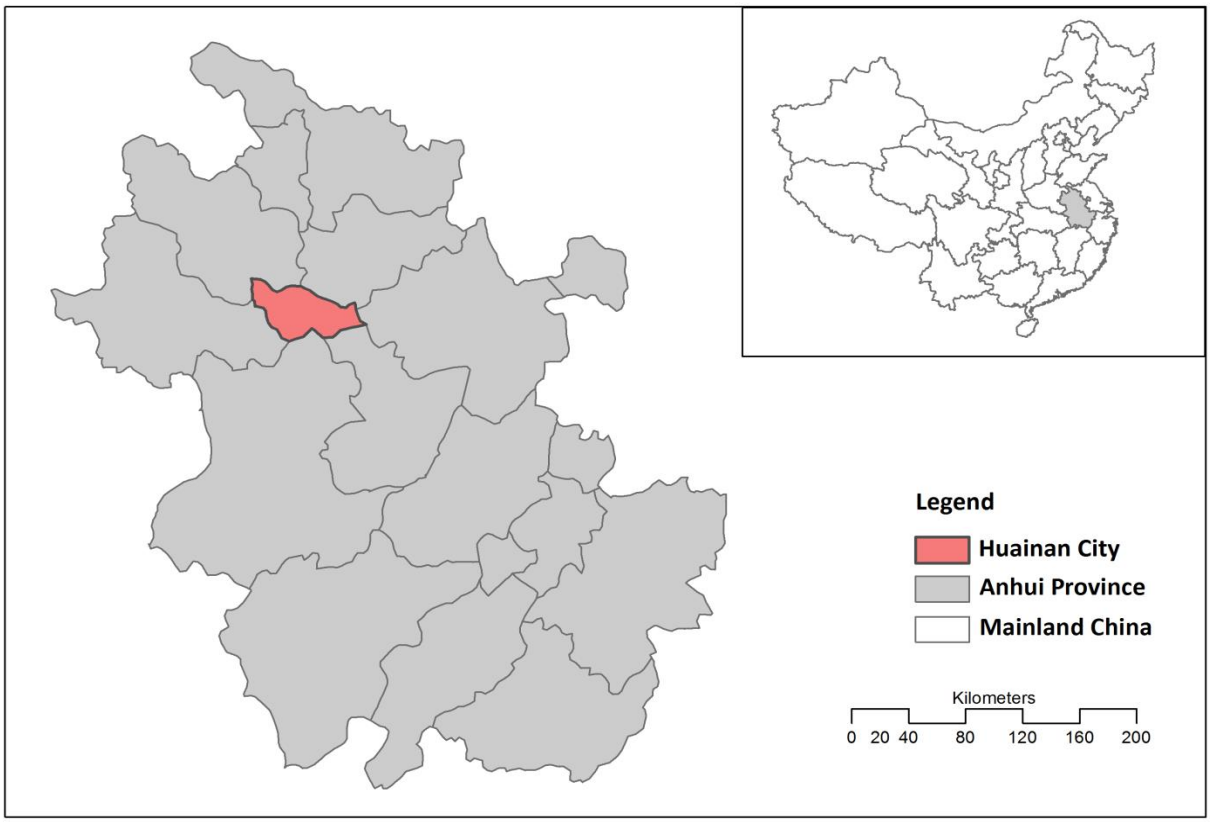

Figure 1: Location of Huainan City in Anhui Province, China.

Three neighborhoods located in the downtown city were selected as the study area according to our 'cluster' sampling criteria for this dissertation research (Figure 2): residential areas with a large number of older people and prevalent collective older exercise groups in public spaces. The three neighborhoods included one old inner-city neighborhood, one *danwei* compound, and one private *xiaoqu*, which are three typical types of neighborhoods in Chinese cities (Liu & Wu, 2006). Importantly, the health survey data, geographic data and self-care behaviors data were available in these three neighborhoods, and there were some well-known outdoor activity spaces, Laolongyan Park and City Stadium, to conduct participant observation.

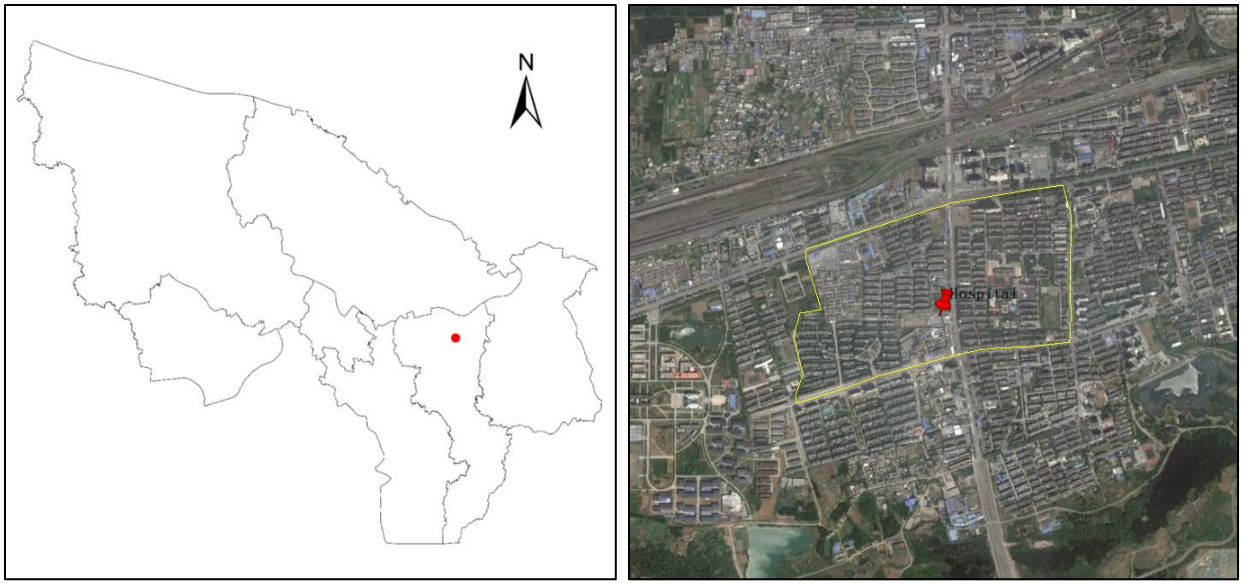

Figure 2: Huainan City (left) and landscape (right) of the three study neighborhoods.

To make the Huainan case representative and comparable to large cities, two neighborhoods in Beijing was selected as a supplementary case. As the capital of the nation, Beijing had a resident population of over 21.7 million and around 7.6 million immigrants in 2015 ("Beijing Municipal Bureau of Statistics and NBS Survey Office in Beijing," 2016). The health-promoting industries and facilities developed earlier and are more mature than in many other cities. The two study neighborhoods are Mudanyuan neighborhood and Olympic Center neighborhood. Both neighborhoods are famous for their popular outdoor physical activity spaces, -i.e., Yuan Dynasty City Wall Relics Park and National Stadium, respectively, which provide ideal fields for participant observation. Unfortunately, the health survey data, geographic data and self-care behaviors data in Beijing were not accessible so no statistical analyses could be conducted in Beijing, like the case study in Huainan.

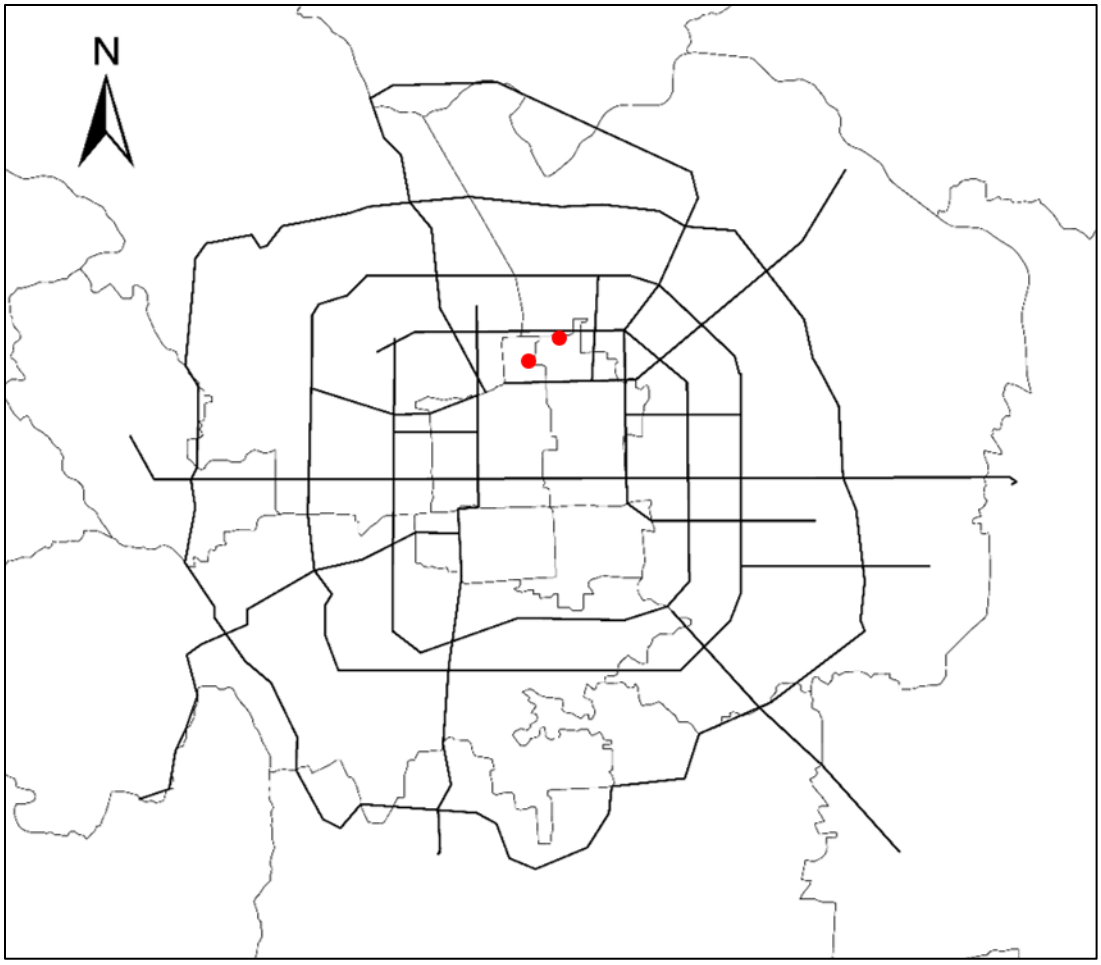

Figure 3: Location of Mudanyuan and Olympic Center neighborhoods in Beijing.

Methodological Notes

Based on the three research questions and hypotheses, a mixed-methods approach was selected in data collection and the analytical process (Johnson & Onwuegbuzie, 2004). A quantitative study was suitable for the first and second goals since the questions were based on already constructed theories, -i.e., health belief model and survival analysis for the first goal, and social ecological model and stage of behavior change model for the second goal. For the second goal, however, the particular social and physical aspects of the built environment needed to be identified before examining their influence on physical activity. Qualitative interviews were, therefore, conducted to involve subjects' perspective into the conceptual model. A qualitative

study was also conducted for the third goal so that the dynamic process of making the therapeutic landscapes between different social groups were able to be investigated in a contingent localized field.

Quantitative data included a six-year health survey dataset of 3,198 older people in three neighborhoods in Huainan, and GIS data on land use and land cover for the three neighborhoods were collected in summer 2015. Quantitative analyses were conducted during the summer, fall and winter of 2016. Qualitative field work was conducted from the summer of 2014 to the summer of 2016 in Beijing and Huainan. Field work in Beijing was conducted in the summers of 2014 and 2015 when I worked as a research fellow in the China National Health Development Research Center and lived in Mudanyuan neighborhood. Field work in Huainan was conducted in the spring and summer of 2016 when I was back home. Qualitative data analyses were conducted from the summer of 2016 until the spring of 2017. Both quantitative and qualitative parts of this research were approved by the Michigan State University IRB (# x15-413e) determined Exempt (April 24, 2015).

Summary of Dissertation Articles

This dissertation discusses the interactions between older people's health status and health promotion behaviors and urban spaces as both facilities and fields of their physical activity. The three articles address first, the bidirectional relationships between older people's physical activity and their chronic diseases, second, the influence pathway of the built environment upon their change of physical activity, and third, the potential role of older physical exercisers in the making of therapeutic public spaces collaborating with other social groups. Combining these three studies, this dissertation aims to link the literature of health geography, gerontology and geriatrics, health promotion behaviors, and urban geography together to ultimately provide new research and

applied directions and implementations that promote an active aging society in China and worldwide, wherein a demographic transition and with limited family/residential care and health care resources. Through this study, I also argue that in contrary to the dominant ageist discourse of considering the older population as a vulnerable dependent group, older physical activity practitioners in urban China serve as a positive group taking care of themselves and constructing a sharing therapeutic landscape in harmony with other generations of different social groups.

The first article, *Bidirectional Relationships between Physical Activity and Chronic Diseases: A Longitudinal Investigation*, examines the bidirectional relationships between physical activity and chronic diseases in an older population in China. Drawing on survival analysis to study the effects of physical activity on chronic disease onset and vice-versa, multilevel logistic regressions on the influence of chronic disease onset on physical activity, this study demonstrate a bipolar trajectory effect that older people who participate in physical activity are diagnosed with chronic diseases years later than sedentary people; post-diagnosis, physically active older people are more likely to increase their activity levels, while sedentary older people are less likely to begin physical activity. Health disparities among older people may widen as sedentary older people experience earlier onsets of chronic diseases and worse health trajectories, compared to physically active people. Based on these findings, I conclude that China is undergoing a rapid demographic transition and interventions to reduce the costs of aging should focus on the sedentary and less healthy older populations.

The second article, *Built Environment and the Change of Older People's Physical Activity: A Mixed-Methods Approach*, examines the pathways by which physical activity behaviors are impacted by the built environment. Utilizing a mixed methods approach, this article combines interviews and content analysis to identify individual and built environmental factors that impacted

older people's physical activity and a multilevel path analysis to demonstrate the pathways by which these factors led to the initiation, regulation, and maintenance of physical activity. This study found that the liveliness of an apartment building is important in attracting sedentary older adults to initiate physical activity. Housing closeness to urban functional spaces was associated with the initiation of physical activity through social networks of neighbors, while social networks of neighbors was the most important factor in regulating physical activity. Housing closeness to urban functional spaces was also important in maintaining physical activity, particularly for those with chronic diseases. Finally, those neighborhoods with the most physically inactive older people were identified for future intervention. Based on these findings, I conclude that to increase older people's overall physical activity, future interventions should focus on residential form and access to functional spaces, prior to investing in large-scale urban design interventions.

The third article, *Therapeutic Spaces for All—Putting Health into Public: Performance and Collaboration of China's Leisure Physical Exercisers in Public Open Spaces*, is written in front of the challenge of neoliberalism in the making of therapeutic landscapes and public spaces. This article argues that these challenges might be rethought within the fields of health and urban geography and that benefits can be gained through investigating how space can be simultaneously researched as therapeutic and public space. By a review of current work in health and urban geography that focus on urban public spaces for leisure activity, it first demonstrates the possibility and synergies of combining the two complementary approaches. Drawing on the case study in Huainan and Beijing, it shows how different social groups can collaborate in the contingent localized production of a therapeutic and public place. This study links the experience and encounter in outdoor leisure activity spaces with the demographic transition and the post-socialist neoliberal transition in contemporary China in order to explore the possible active role of the older

generation in response to the neoliberal transition. Based on the case study, I argue that the combination of the two approaches can expand the boundaries of both therapeutic landscapes and public spaces, and can help to put health into public and build therapeutic landscapes for all.

This dissertation focusing on the physical activity of older people in China contributes to a better understanding of medical and health geographies of the older population. It estimates the influence of physical activity upon the onsets of chronic diseases in China, a non-western country, and points out the bipolar health trajectory effect of physical activity on older people's health and life-quality in their later stage. This study also finds the differential impacts of the built environment upon physical activity behaviors of middle-aged versus older-aged groups, contributing to not only depicting a high-quality built environment for physically active older groups but also finding built environment factors that can encourage sedentary groups to begin physical activity practices. In addressing the social justice issue, this study builds on the work of Rosenberg (2014) that challenges the widely assumed facts that therapeutic landscapes and public spaces serve the middle-class by showing the possible collaborating relations of different social groups as a strategy in response to the global challenge of neoliberalism (Harvey, 2013).

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CHAPTER 2

PHYSICAL ACTIVITY AND CHRONIC DISEASES AMONG OLDER PEOPLE IN A MID-SIZE CITY IN CHINA: A LONGITUDINAL INVESTIGATION OF BIPOLAR EFFECTS

Introduction

The care of older people (65 years and older) with chronic disease has improved because of advanced medical technology and the promotion of healthy lifestyles. However, as mortality decreases and older people live longer, the prevalence of chronic diseases may increase, adding to the costs of a country's health care system (World Health Organization, 2014; Zeng, Feng, Hesketh, Christensen, & Vaupel, 2017). In China in 2015, there were 14.4 million older people (Ministry of Civil Affairs of the People's Republic of China, 2016) equating to 10.5% of the total population. By mid-century, China's older population is expected to increase to 34.1% of the total population, making China an important contributor to the global demographic transition (WHO, 2015a). In 2013, 49.5% of older people in China were diagnosed with at least one chronic disease (WHO, 2006; WHO, 2015b). In 2015, the Chinese National Health and Family Planning Commission developed the National Ageing and Health Strategy and Implementation Plan to improve the health of China's aging population through prevention programs that reduce the early onset of chronic disease, and increase wellbeing. The primary strategy of the Plan is to promote healthy lifestyles, through education on nutritious diets, smoking cessation, and participation in physical activity (World Health Organization, 2015a).

There are many studies that have investigated the impacts of physical activity (PA) on older people's health in China (Li, Xu, Chi, & Guo, 2014; Liu & Lou, 2016; Monda, Adair, Zhai, &

Popkin, 2007; Yu et al., 2009). However, only a few of these studies (Li et al., 2014; Liu & Lou, 2016) have focused on older people in mid- and small-sized cities. In these cities, residential care services are limited and there is a shortage of high-quality public health care services (Chen, 2011). In addition, older people's children may have moved out of the area, leaving their parents without family care support (Zhan & Montgomery, 2003). These two factors may be important barriers to promoting healthy lifestyle behaviors in older people in China. Studying the associations between PA and the onset of chronic disease in older people residing in mid- and small-sized cities in China can, therefore, help to target specific interventions to promote healthy aging, while also reducing the social and economic costs associated with chronic disease burden in China.

Studies have shown that regular exercise prevents chronic disease in middle-aged (54-64 years) and older people (Hughes et al., 2011; US Department of Health and Human Service, 2008; Warburton, Nicol, & Bredin, 2006). Regular PA has been shown to reduce the risk of cardiovascular diseases (Macera, Hootman, & Sniezek, 2003), hypertension and hypercholesterolemia (Myers et al., 2002), and Type 2 diabetes (Myers et al., 2002; Warburton, Gledhill, & Quinney, 2001) and serves as a therapy to prevent and postpone the onset of chronic disease, such as cardiovascular diseases (Franklin, Swain, & Shephard, 2003), diabetes (Gregg, Gerzoff, Caspersen, Williamson, & Narayan, 2003), and poor kidney function (Hawkins et al., 2011). For older populations, PA can also reduce the risk of injuries from falls (Nelson et al., 2007) and mobility disabilities (Pahor et al., 2014). Although the benefits of PA are widely cited (Genton et al., 2011; Warburton et al., 2006), sedentary lifestyles are still common among older adults, women and low-income groups worldwide (Hallal et al., 2012) and older adults without a high school education in China (Muntner et al., 2005). Importantly, people may have alternative health beliefs; some people may not believe that doing PA will benefit their health so they chose to live

a sedentary life in their younger years (Wang, Liu, Ren, Lv, & Li, 2015) attributing to a higher risk of chronic disease; some other people may only practice low-frequent and low-intensity PA for fun, therefore they are unable to achieve the full health benefits (Hallal et al., 2012; Muntner et al., 2005); some people believe that staying sedentary can reverse the disease process, thus reducing PA practice after a diagnosis of chronic disease, even though PA can attenuate or reverse the disease process to a certain extent (Watz et al., 2008). How different health beliefs translate into positive or negative PA behaviors may in part explain health gaps during later stages of life. The bidirectional relationships between PA and chronic diseases should therefore, be considered simultaneously to understand how PA practice affects the onsets and progression of chronic diseases and how chronic diseases affect people's PA behavior, resulting in a bipolar PA and chronic disease effect.

The purpose of this study is to investigate the bidirectional relationships between PA and different chronic disease onsets among older people in a mid-sized city in China. To study these bidirectional relationships, this study is informed by the Health Belief Model (Champion & Skinner, 2008). The Health Belief Model helps to distinguish attitudes and beliefs in regards to chronic disease risk and PA behaviors -e.g., older people with a chronic disease diagnosis might believe that PA will exacerbate their symptoms, worsening their disease and thereby, minimize their PA practices vs. the beliefs that PA will help to prevent or delay the onset of disease or following a diagnosis, improve their symptoms with increased PA practice. Through testing the bidirectional relationships between PA and different chronic disease onsets, future health trajectories for population groups may be inferred to inform future aging health policy and planning initiatives in China.

Methods

Study Design

This observational study utilizes a retrospective longitudinal study design to examine the bidirectional relationships between PA and the onset of seven different chronic diseases of 3,094 older residents in three neighborhoods. This study took place in three neighborhoods in Huainan City, a mid-sized city in Anhui Province, China. Huainan had a population of 1.61 million in 2014, with 16.2 % of the population over 65 years of age (National Bureau of Statistics, 2015). The researchers received permission from one tier-2 public hospital in Huainan City to analyze six longitudinal years (2010-2015) of clinic data, comprising older people's routine annual health care visits. This hospital was responsible for surveying the health of older people in their catchment area, which included three contiguous neighborhoods. There were N=3,198 older people in these three neighborhoods of which 97% (N=3,102) were included in this survey. These three neighborhoods are typical of Huainan City and China (Kiu & Wu, 2006), with one old inner-city neighborhood, one *danwei* compound, and one private *xiaoqu*. This study addressed the following questions:

(1) What were the prevalence of chronic diseases among older people in the three neighborhoods and how did PA vary across socio-demographic groups?

It was hypothesized that PA would vary by age, gender, education, income and the presence or absence of a chronic disease.

(2) How did the onset of a chronic disease trigger change in older people's PA practice levels?

The hypothesis was two-fold based on the Health Belief Model –i.e., the onset of chronic disease would increase the likelihood of sedentary and/or no change in PA, or increase PA practice.

(3) Whether and to what extent was PA associated with the later onset of chronic disease?

It was hypothesized that active older adults would have a later onset of chronic disease compared to sedentary older adults.

Data sources and population

In Huainan City, and many other cities in China, free annual medical exams begin at 55 years of age (General Office of the State Council of the People's Republic of China, 2015). Therefore, the longitudinal health survey data included adults over 55 years (range, 55 to 99 years) (n=3,102). Eight participants were excluded from the study because they only attended the clinic once –i.e., participated in the survey once and then dropped out. Other participants who visited the clinic 2 to 5 times –i.e., participated in the survey 2 to 5 times remained in the study, including older people with missing clinic visits (n=490)--right-censored and older people newly recruited (n=856)—left-censored. Since this study aims to study how the onsets of a chronic disease trigger changes in PA behaviors and how PA associated with the later onset of chronic diseases, only participants with two or more than 2 waves' records were considered. The mean number of clinic visits for those participants who did not complete all 6 years of visits was n=2.3. There were 1,756 participants who attended all six-years of clinic visits. The final dataset comprised 3,094 individual clinic visits, resulting in 13,636 observations for this study.

Measures

Information from the health survey dataset and the coding schemes used in this study, included:

Socio-demographic (see Table 1): five year age groups (55-59, 60-64, 65-69, 70-74, 75-79, 80-84, 85-89, 90-94 and 95-99 years), gender (0=male; 1=female), educational level (0=none-to-primary school; 1=middle school; 2=high school; and 3=college), and self-rated income (0=none-or-low

income; 1=high income). There is no specific cut-point by which to define none-low income and high income. On the original questionnaire, participants were asked to choose one out of the two direct options (A. None-low income; B. High income).

Chronic Disease: To assess chronic diseases, the following data were integrated: physical data from the physical exam (height, weight and blood pressure and electrocardiogram), and peripheral venous blood samples for several chronic diseases. Seven chronic diseases were studied including, overweight and obesity (OBT), hypertension (HTN), diabetes (DBT), hyperlipidemia (HTC), cardiovascular diseases (CD), liver and biliary system disease (LBSD), and poor kidney function (PK). Overweight and obesity were calculated using the body mass index (BMI) weight/height^2 of the individual (BMI 25.0 to 29.9=overweight and BMI=30 or greater=obese); hypertension was indicated by systolic blood pressure >140mmHg and diastolic blood pressure >90mmHg; diabetes was indicated by fasting plasma glucose (FPG)>126mg/dl; hyperlipidemia was indicated by serum total cholesterol (TC)>240mg/dl; cardiovascular diseases were indicated by abnormal electrocardiograph results (Yes vs. No); liver and biliary system disease was indicated by serum Alanine aminotransferase (ALT)>40U/L, total bilirubin (Tbil)>1.2mg/dl and direct bilirubin (Dbil)>0.4mg/dl; and poor kidney function was indicated by serum creatine (Cr)>1.39mg/dl and blood urea nitrogen (BUN)>23.3mg/dl. The normal range values provided by the hospital were used to determine if a test was normal or abnormal. These normal range values were checked against the same diseases provided in the Merck Manuals (Merck Manuals Professional Edition, 2013b, 2014a, 2014b, 2015, 2016a, 2016b) (See detailed classification standards at (Zhou, Grady, & Chen, 2017). For reference, the normal range values for Cr (<1.39mg/dl) and BUN (<23.3mg/dl) were slightly higher than the U.S. standards (1.2mg/dl and 20mg/dl, respectively) (Merck Manuals Professional Edition, 2013a). It was also recognized that some abnormal electrocardiography

findings (such as Sinus arrhythmia or change on one wave) may not have indicated a cardiovascular disease, thus only those abnormal electrocardiograph findings indicated by a cardiologist on the health survey record were coded as Yes (abnormal). These disease indicators were repeatedly measured at each of the six-year time points. When a new chronic disease appeared for the first time in a given year, that year was referred to as the onset of the chronic disease. Using the normal range values provided by the hospital, the prevalence rates of the seven chronic diseases were calculated within the (n=3,094) population, stratified by the socio-demographic groups.

Physical Activity (see table 1): To assess PA, the following data were integrated: (a) the self-reported frequency of PA per week, and (b) the self-reported length of time (in minutes) participating in PA. In the original questionnaire, PA frequency was measured as, 0=no activity; 1=irregular activity (randomly practicing PA); 2=regular activity less than three times a week (stable practice of PA but infrequent); and 3=regular daily activity (stable practice of PA and frequent); the length of activity in the survey was measured as, 0=no activity; 1=less than 20 minutes; 2=20 to 60 minutes; 3=60 minutes or greater. For this study, these two metrics were combined to calculate the metabolic equivalent (MET) minute of PA per week, based on which the annual repeated PA were categorized into four levels according to the International Physical Activity Questionnaire (Craig et al., 2003). The PA practice levels included, 0=no PA; 1=irregular PA (not included in IPAQ categories); 2=low PA (PA practice less than 599 MET-min/week); and 3=moderate PA (PA practice between 600-3000 MET-min/week) (IPAQ Research Committee, 2005). In this study, MET measures –i.e., PA levels mainly represented leisure PA, excluding domestic PA (housework as PA) and occupational PA (wage-earning occupation work as PA) (Monda et al., 2007). A PA level was assigned to each of the six-year time points, representing

the overall activity level in the year prior to the clinic visit.

Table 1: Description of variables and measurements of the 6-year longitudinal health survey data in Huainan.

Variable Names	Code for this study	Measurement in the dataset
Socio-demographic		
Age groups	0=55-59, 1=60-64, 2=65-69, 3=70-74, 4=75-79, 5=80-84, 6=85-89, 7=90-94 8=95-99 years	Same
Gender	0=male, 1=female	Same
Educational level	0=none-to-primary school, 1=middle school, 2=high school, and 3=college	Same
Self-rated income	0=none-or-low income, 1=high income	Same
Physical Activity Levels	0=no PA; 1=irregular PA (not included in IPAQ categories); 2=low PA (PA practice less than 599 MET-min/week); and 3=moderate PA (PA practice between 600-3000 MET-min/week)[1]	By frequency and length[2].

Notes. 1. The calculation of the metabolic equivalent (MET) minute of PA per week, based on which the annual repeated PA were categorized into four levels according to the International Physical Activity Questionnaire.
2. Frequency: 0=no activity, 1=irregular activity, 2=regular activity less than three times a week. Length: 0=no activity; 1=less than 20 minutes; 2=20 to 60 minutes; 3=60 minutes or greater.

Data Analyses

The statistical analyses were separated into three tasks: First, prevalence rates of disease and PA levels were estimated. Binominal logistic regression was used to estimate the relationships between the prevalence rates of each of the seven disease groups and the four socio-demographic categorical variables (age group, gender, education, and income). To study the PA levels and how PA varied across socio-demographic groups, two-level multilevel binominal logistic models were estimated with annual PA levels (Level-1) nested within each individual (Level-2) (Gelman, 2006) to predict (a) if older people were sedentary vs. practiced PA (PA level-0 vs all others), (b) if older people practiced irregular vs. regular PA (PA level-1 vs level-2 or 3, excluding level-0

observations), or (c) if older people practiced low-level vs. moderate PA (PA level-2 vs level-3, excluding level-0 or 1 observations). Since we aimed to compare sedentary (Level-0) with all other physically active groups (Level-1, Level-2 and Level-3), and to compare irregular (Level-1) with the regular PA groups (Level-2 and Level-3), three separate multilevel binominal models were estimated instead of a multinomial logistic regression model. The PA level was modeled as a fixed effect of age-group at Level-1 and of gender, education, and income at Level-2; since most individuals were retired or almost retired, there was no intrapersonal variation of income level over the six years. After deleting the participants with missing values, n=3,057 participants with N=11,742 observations in total were used.

Second, to study the impacts of chronic disease onsets on PA, logistic models were used to estimate the change in PA, before and after the onset of a chronic disease. Since one individual could have only one onset of a certain disease and only the following year after the onset of disease would be considered for each individual, the variation within each individual was zero; models were thus reduced to a one-level logistic model. As the survey data did not include a family medical history to identify risky populations, nor a medical history with the year of a disease diagnosis prior to the beginning of the survey, only older people who had no chronic disease at baseline, and the onset of a disease in the subsequent years (n=1,657) were studied. The following logistic models were constructed: First, for those older people who had *no* PA (Level-0) at baseline and an onset of disease in the subsequent year, the response in model 1 was whether PA was initiated vs. sedentary in the year following the diagnosis. Second, for those older people who practiced PA (Level-1,2,3) at baseline and experienced the onset of disease in the subsequent year, the response in model 2 was whether the individual changed their PA vs. their PA remained the same, in the year following the diagnosis. Third, for those older people who changed their PA level in the year

following their diagnosis in model 2, the response in model 3 was if they strengthened or lightened the intensity of their PA level, in the year following their diagnosis. For example, if the blood pressure of individual #17 exceeded the borderline value in Year 3, the onset of hypertension was allocated to Year 3, and Year 2 (baseline) and Year 1 were considered negative. These three models were estimated, controlling for age group, gender, education, and income levels.

Finally, two Cox proportional hazards models with time-varying covariates were used to examine the impacts of PA on the onsets of chronic diseases. The same initial data used in the second analysis was also used here—only older people who had no disease at baseline but reported an onset of chronic disease in the subsequent year (n=1,657). In both Cox proportional hazards models, the age of onset of a certain chronic disease was assigned to each individual as a survival time, since the incidence rate of chronic disease was a function of the aging process, instead of the onset time from baseline (Lamarca, Alonso, Gómez, & Muñoz, 1998). In model 1, the PA level was considered as a key independent variable. Since too few individuals (n=50) conducted low-level PA, the low and moderate level activity observations went into one group -i.e. regular low to moderate PA (RPA). Finally, the three groups in model 1 were RPA, no PA (NPA), and irregular PA (IPA). In model 2, the individuals' cumulative PA in years was calculated as the key independent variable. Since too few individuals participated in PA for over five years, Years 4, 5, and 6 were aggregated into one group. Finally, the five-year groups in model 2 were categorized as 0, 1, 2, 3, 4 or over. Gender, education and income levels were used as control variables. When a certain chronic disease was examined, all other diseases were also controlled to account for potential variation in co-morbidities. Schoenfeld residual plots were used to test the proportional hazards assumption. The statistical analyses were conducted in Stata Release 14 (StataCorp, 2015).

Results

Prevalence of chronic diseases by socio-demographic characteristics

In 2010, the highest chronic disease prevalence rates in the general population of older people were hypertension (51.4 per 100 older people), followed by cardiovascular diseases (38.3), overweight and obesity (31.2), diabetes (13.6), hyperlipidemia (8.9), liver and biliary system disease (7.5) and poor kidney function (4.8) (see Table 2). From the middle through older to oldest age groups, there was a statistically significant increase in prevalence of hypertension (48.2 middle age to 55.3 older to 57.7 oldest-old), cardiovascular diseases (31.9 to 43.0 to 48.9), diabetes (11.8 to 15.3 to 15.9), and poor kidney function (2.9 to 5.3 to 9.5). The prevalence of overweight/obesity and liver and biliary system disease significantly decreased after 75 years of age (31.2 to 31.9 to 26.6) and (8.2 to 7.5 to 5.7), respectively. Compared to males, females had a significantly higher prevalence of hyperlipidemia (11.3% vs. 6.6) but lower prevalence of hypertension (45.1 vs. 57.6), cardiovascular diseases (34.3 vs. 40.0), diabetes (11.5 vs. 15.4), liver and biliary system disease (5.8 vs 9.0), and poor kidney function (3.3 vs 5.8). There was not a significant difference in the prevalence of overweight and obesity by gender. After none-to-primary schooling, there was a negative linear relationship between higher education and the most highly prevalent diseases: hypertension (middle=53.4 to high=49.0 to college=47.1), cardiovascular diseases (36.8 to 35.9 to 33.4) and overweight and obesity (31.5 to 30.2 to 28.3). Compared to all other educational levels, college educated older people had a significantly lower prevalence of diabetes (12.3). Education levels did not have a significant effect on the prevalence rates of hyperlipidemia, liver and biliary system disease, and poor kidney function. Finally, the prevalence of overweight and obesity was slightly higher for older people who were poor compared to higher income (31.3 vs. 30.5). There was not a significant difference in the prevalence of other chronic diseases for high income vs.

none-to-low income groups, controlling for the other socio-demographic characteristics. These findings show substantial variability in chronic disease prevalence for older Chinese living in these three neighborhoods, with increasing age, male and lower education significant risk factors.

Table 2: Description[1] of baseline prevalence of chronic diseases in the three neighborhoods in Huainan.

		N[2]	**Prevalence of Chronic Diseases %**						
			OBT[3]	**HTN**	**DBT**	**HTC**	**CD**	**LBSD**	**PK**
Total		2553	31.2	51.4	13.6	8.9	38.3	7.5	4.8
Age	55-64	969	31.9	48.2	11.8	9.1	31.9	8.2	2.9
	65-74	1018	32.2	55.3***	15.3***	8.4*	43.0***	7.5	5.3***
	>=75	566	26.6***[4]	57.7***	15.9***	8.8*	48.9***	5.7**	9.5***
Gender	Male	1385	31.2	57.6	15.4	6.6	40.0	9.0	5.8
	Female	1168	31.2	45.1***	11.6***	11.3***	34.3***	5.8***	3.3***
Education	Primary	774	33.9	55.4	14.8	9.0	42.1	7.0	5.8
	Middle	852	31.5***	53.4*	13.0	8.6	36.8*	7.5	4.8
	High	206	30.2***	49.0***	14.6	8.4	35.9**	8.0	4.5
	College	695	28.3***	47.1***	12.3*	8.7	33.4*	8.2	3.5
Income	High	414	30.5*	51.1	14.6	8.3	38.9	7.7	4.6
	Low/no	2125	31.3*	52.1	13.2	8.8	37.2	7.5	4.8

Notes. 1. Logistic regressions were used for binominal analyses between the prevalence of chronic diseases and the four socio-demographic categorical variables.
2. N=2553 residents over 55 years living in the three neighborhoods at least six months and recruited in the baseline survey.
3. OBT: overweight and obesity; HTN: hypertension; DBT: diabetes; HTC: hyperlipidemia; CD: cardiovascular diseases; LBTD: liver and biliary system diseases; PK: poor kidney function.
4.*p<0.05, **p<0.01, ***p<0.001.

Physical activity and socio-demographic characteristics

Table 3 shows the estimated PA levels by socio-demographic characteristics. Importantly, as age increased, the odds that older people would practice PA was low –i.e., they were more likely to be sedentary. However, for those who practiced PA, their practice was regular (vs. irregular) and of moderate (vs. low) intensity, demonstrating a persistent and positive PA trajectory despite increasing age. In addition, the odds of PA practice for females (OR=0.81, 95%CI:0.81-0.93, $p<0.01$), middle (OR=0.77, 95%CI: 0.65-0.92, $p<0.01$) or college (OR=0.63, 95%CI: 0.58-0.87, $p<0.001$) educated, or older people of none-to-low income (OR=0.71, 95%CI: 0.58-0.87, $p<0.001$) were also low –i.e., they were more likely to be sedentary. However, for those who practiced PA, their practices were more likely to be regular, for females (OR=1.26, 95%CI: 1.14-1.40, $p<0.001$), college educated (OR=1.23, 95%CI: 1.04-1.44, $p<0.01$) and none-to-low income (OR=1.22, 95%CI: 1.04-1.41, $p<0.05$). There were no significant differences in PA intensity (moderate vs. low), for those practiced PA, except for college educated (OR=0.34, 95%CI: 0.16-0.73, $p<0.05$). These findings show that older people living in the three neighborhoods are primarily sedentary and those who practice PA, practice regularly but of varying intensity mainly by age group.

Table 3: Multilevel logistic regression[1] between socio-demographic features and physical activity level among older people 2010 to 2015.

		Physical Activity Level[2]					
		PA VS Sedentary		Regular VS Irregular		Moderate VS Low	
		Odds Ratio	95% CI	Odds Ratio	95% CI	Odds Ratio	95% CI
Age (years)	<55	1		1		1	
	55-59	0.32***[4]	0.25-0.42	3.53***	2.79-4.46	2.21	0.91-5.31
	60-64	0.26***	0.20-0.35	4.64***	3.65-5.90	3.04*	1.19-7.73
	65-69	0.26***	0.19-0.35	9.25***	7.15-11.95	6.20***	2.29-16.76
	70-74	0.37***	0.27-0.52	9.34***	7.15-12.19	7.04***	2.44-20.34
	75-79	0.28***	0.20-0.40	10.46***	7.85-13.93	6.65***	2.15-20.58
	80-84	0.17***	0.11-0.25	10.95***	7.64-15.68	6.13*	1.50-25.00
	>=85	0.13***	0.08-0.23	10.16***	6.13-16.86	18.39*	1.10-305.98
Gender	**Male**	1		1		1	
	Female	0.81**	0.71-0.93	1.26***	1.14-1.40	1.31	0.80-2.15
Education	**Low**	1		1		1	
	Middle	0.77**	0.65-0.92	1.05	0.92-1.20	0.73	0.37-1.43
	High	0.91	0.67-1.21	0.97	0.79-1.19	0.50	0.18-1.33
	College	0.63***	0.51-0.78	1.23**	1.04-1.44	0.34*	0.16-0.73
Income	**High**	1		1		1	
	Low	0.71***	0.58-0.87	1.22*	1.04-1.41	0.87	0.44-1.72
N of Observations[3]		11742		8340		5200	
n of Individuals		3057		2829		2234	

Notes. 1. In these two-level logistic regression models, the repeated PA level measure (level-1) were nested within each individual (level-2).
2. Dependent variables are if the individual did PA (level-0 vs all others) in model 1, if the individual had regular or irregular activity (level-1 vs level-2 and 3) in model 2, or if the individual had low-level or moderate activity (level-2 vs level-3) in model 3.
3. n=3057 individuals with N=11,742 observations in total were used.
4. *p<0.05, **p<0.01,***p<0.001.

When the PA intercept coefficients (data not shown) were plotted by their response variable (PA vs. sedentary, PA regular vs. irregular, and PA moderate vs. low) across all age groups, the proportion of older people practicing PA decreased (Figure 4a) but the proportion of older people practicing regular vs. irregular and moderate vs. low PA, increased with age (Figures 4b-c) supporting the findings above. Among those 65-79 years of age, there was a small but increasing trend in PA, but thereafter with increased age, PA decreased.

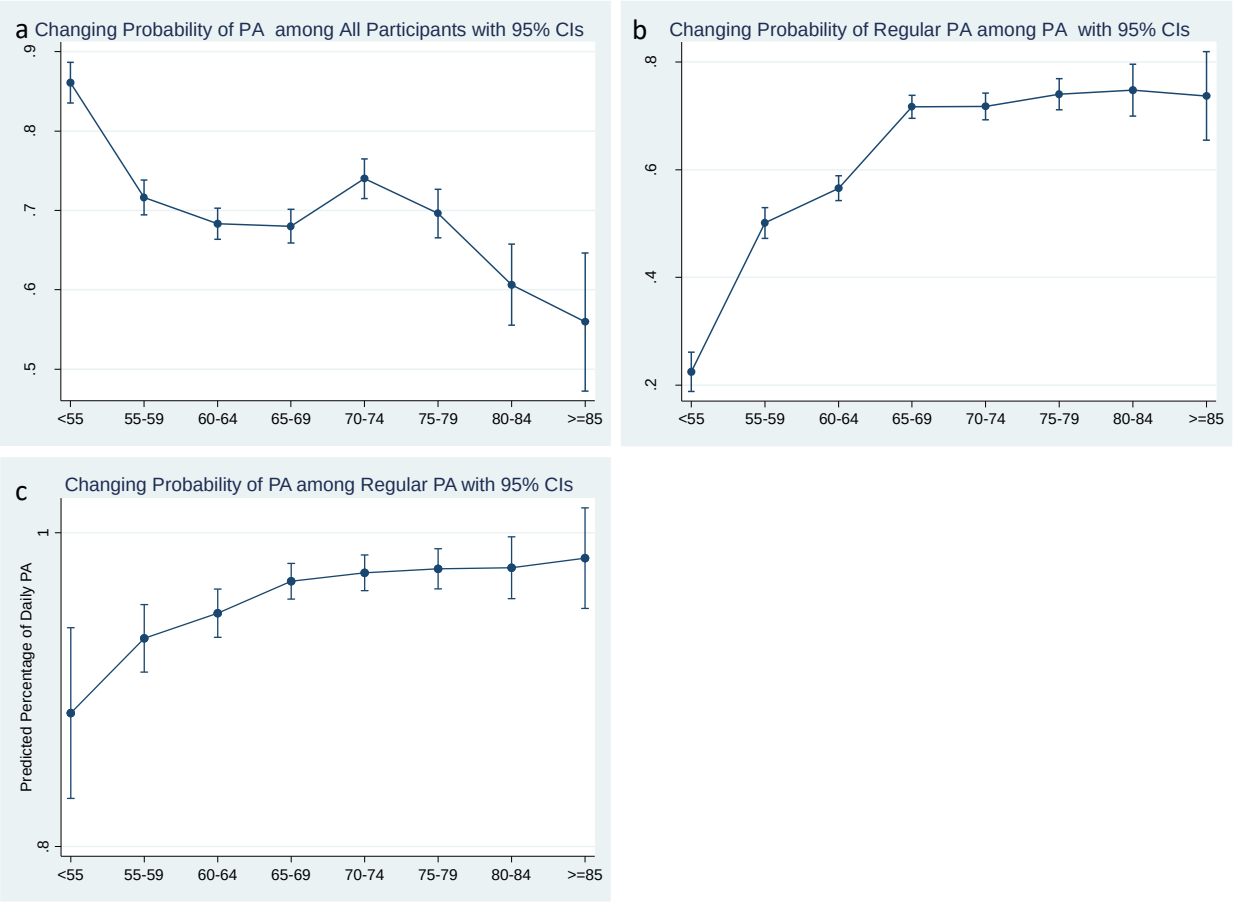

Figure 4: Changing odds ratios (ORs) of PA by increasing age groups. a: PA vs. sedentary; b: PA regular vs. irregular; and c: PA moderate vs. low.

Chronic diseases that trigger physical activity changes

Table 4 shows that for middle to older people who were sedentary at baseline, the onset of any chronic disease did not prompt them to initiate PA (OR=0.75, 95% CI: 0.57-0.97, $p<0.01$). In particular, the odds of initiating PA were lowest for older people diagnosed with cardiovascular disease (OR=0.64, 95% CI: 0.41-0.95, $p<0.05$) or liver and biliary tract disease (OR=0.39, 95% CI: 0.16-0.94, $p<0.05$) –i.e., were more likely to remain sedentary. However, for older people who practiced PA, the onset of any chronic disease prompted a change in PA practice (OR=1.23, 95% CI:1.09-1.38, $p<0.05$), in particular for hypertension (OR=2.44, 95% CI: 1.82-3.28, $p<0.001$), overweight and obesity (OR=1.99, 95% CI: 1.37-2.89, $p<0.01$), or hyperlipidemia (OR=1.59, 95% CI: 1.24-2.02, $p<0.01$); while the odds of changing PA practice was low for those diagnosed with

diabetes (OR=0.73, 95% CI: 0.57-0.96, $p<0.05$), poor kidney function (OR=0.59, 95% CI: 0.41-0.90, $p<0.01$), or cardiovascular diseases (OR=0.48, 95% CI: 0.39-0.58, $p<0.001$). Of those who changed their PA practices after the onset of any chronic disease, the odds of strengthening PA practice was high (OR=2.53, 95% CI: 2.08-3.08, $p<0.001$), particularly for diagnoses of hypertension (OR=3.22, 95% CI: 2.08-4.99, $p<0.001$), overweight and obesity (OR=2.86, 95% CI: 1.57-5.21, $p<0.001$), hyperlipidemia (OR=1.79, 95% CI: 1.25-2.58, $p<0.001$), or diabetes (OR=1.71, 95% CI: 1.04-2.84, $p<0.05$). These results were controlling for differences in age group, gender, education and income levels. In summary, these findings show that following a disease diagnosis, sedentary older people were less likely to change their PA practices, while older people who practiced PA, also strengthened their PA practice. The PA trajectories following cardiovascular disease diagnoses were variable, with sedentary and older people who practiced PA, unlikely to change their PA practice; but those who changed their PA practice, were more likely to strengthen their practice. Importantly, for the two other highly prevalent chronic diseases—hypertension and overweight and obesity, older people were more likely to change and strengthen their PA practices.

Table 4: Logistic regression[1] between the onset of chronic diseases and physical activity behaviors 2010 to 2015.

	Physical Activity[2]					
	Initiate PA vs. Sedentary		**Change vs. Remain**		**Strengthen vs. Lighten**	
	Odds Ratio	95% CI	Odds Ratio	95% CI	Odds Ratio	95% CI
Any onset	0.75**[3]	0.57-0.97	1.23*	1.09-1.38	2.53***	2.08-3.08
Onset of the First	0.77	0.45-1.31	0.83	0.62-1.10	1.95**	1.17-3.24
Onset of the Second	0.94	0.61-1.44	1.10	0.88-1.38	1.89**	1.29-2.77
Onset of the Third	0.60	0.35-1.00	1.23	0.98-1.55	2.13*	1.42-3.19
Types of Diseases						
Overweight	1.10	0.39-3.21	1.99**	1.37-2.89	2.86***	1.57-5.21
Hypertension	1.33	0.60-2.96	2.44***	1.82-3.28	3.22***	2.08-4.99
Diabetes	1.03	0.5202.04	0.73*	0.57-0.96	1.71*	1.04-2.84
Hyperlipidemia	1.11	0.59-2.08	1.59**	1.24-2.02	1.79***	1.25-2.58
Cardiovascular Diseases	0.64*	0.41-0.95	0.48***	0.39-0.58	0.89	0.63-1.25
Liver& Biliary System Diseases	0.39*	0.16-0.94	0.95	0.67-1.30	1.15	0.68-1.92
Kidney Function Disorder	0.45	0.16-1.24	0.59**	0.41-0.90	0.75	0.38-1.46

Notes. 1. Three logistic regression models were used to examine the association between the change in PA and the onsets of chronic diseases controlling for age, gender, education, and income.

2.For the sedentary individuals at baseline, the response in model 1 was if he/she initiate PA in the following year after the onset of their disease; for the individuals with PA behaviors, the response in model 2 was if he/she changed or remained at their PA level in the following year; for those who did change their PA level in model 2, the response in model 3 was if they increased or decreased their PA level in the following year after the onset of a certain chronic disease.

3.*p<0.05, **p<0.01, ***p<0.001.

Figure 5 shows the differential impacts of a new diagnosis of chronic disease on PA change. The left figure represents the odds of initiating PA vs. remaining sedentary, for sedentary people following a new diagnosis; and the right figure represents the odds of strengthening PA vs. lightening PA among those who were previously active, following a new diagnosis.

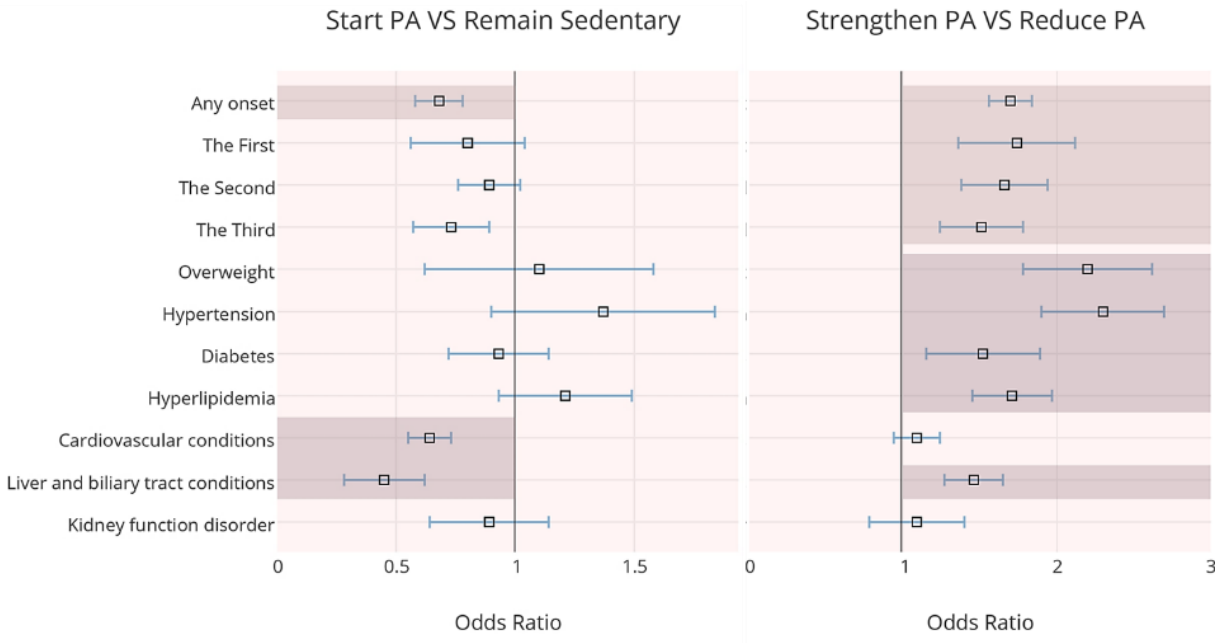

Figure 5: The impacts of the diagnosis of different chronic diseases upon changes in physical activity.
Notes. The left figure represents the odds ratio of initiating PA vs. remaining sedentary following a diagnosis of chronic disease, for those older people who were sedentary at baseline; the right figure represents the odds ratio of strengthening physical activity versus reducing physical activity following a diagnosis of chronic disease, among those older people who were physically active at baseline.

Physical activity and the onset of chronic disease

This last analysis (Table 5) shows that both regular and irregular PA were significantly associated with later onsets of chronic disease overall (Hazard Ratio (HR)=0.31), as well as the onsets of overweight and obesity (HR=0.43), hypertension (HR=0.26), hyperlipidemia (HR=0.21), diabetes (HR=0.17), cardiovascular diseases (HR=0.17), poor kidney function (HR=0.17) and liver and biliary system diseases (HR=0.13). According to the median age (MA) of any type of onset between physically active (MA=63) and sedentary groups (MA=56), PA practice was significantly associated with the later onsets of chronic diseases overall by 7 years; with the later onsets of overweight and obesity and diabetes diagnoses by 8 years; with the later onsets of hypertension and hyperlipidemia diagnoses by 7 years; with the later onsets of liver and biliary system diseases and poor kidney function diagnoses by 5 years; and with the later onsets of cardiovascular disease diagnoses by 4 years (see Figure 6). Furthermore, participating in PA over 3 year's duration was significantly associated with a later onset of chronic diseases overall (HR=0.21), and specifically for hyperlipidemia (HR=0.31), cardiovascular diseases (HR=0.16), poor kidney function (HR=0.15), hypertension (HR=0.14), and diabetes (HR=0.11) (see Figure 7). Interestingly, participating in PA for over 3 year's duration was not significantly associated with later onsets of overweight and obesity, nor liver and biliary system diseases.

Table 5[1]: Onset median age (MA) of chronic diseases and hazard ratio (HR) with different levels/years of PA.

		Model 1[3]: PA level			**Model 2[4]: Cumulative PA years**					**N of obs.**	**N of sub.**
		NPA	IPA	RPA	0	1	2	3	4		
All Onset	MA	56	63 ***[5]	65 ***	61	62	63 **	66 ***	66 ***	3414	1657
	HR[2]	1	0.31	0.4	1	0.8	0.63	0.46	0.21		
Obesity	MA	56	64 ***	66 ***	61	61	64	63	66	540	257
	HR	1	0.43	0.28	1	0.68	0.83	1.06	0.96		
Hypertension	MA	55	62 ***	67 ***	60	61 *	62 **	65 ***	67 ***	733	376
	HR	1	0.26	0.27	1	0.59	0.41	0.31	0.14		
Diabetes	MA	55	66 ***	63 **	63	60 *	64 ***	65 ***	68 ***	1069	472
	HR	1	0.17	0.6	1	0.61	0.46	0.27	0.11		
Hyperlipidemia	MA	56	63 ***	66 ***	62	64 **	63	66 *	66 ***	1143	515
	HR	1	0.21	0.28	1	0.57	0.77	0.52	0.31		
Cardiovascular diseases	MA	56	71 ***	61 **	62	63 **	62 ***	66 ***	68 ***	1965	849
	HR	1	0.17	0.71	1	0.67	0.53	0.36	0.16		
Liver and biliary system diseases	MA	57	66 ***	62 ***	62	63	63	66	66	675	292
	HR	1	0.13	0.44	1	0.97	1.59	1.49	0.95		
Kidney function disorder	MA	59	74 ***	65	68	67	67	68 *	68 **	94	39
	HR	1	0.17	0.8	1	0.7	0.52	0.3	0.15		

Notes. 1. Two Cox proportional hazards models with time-varying covariates were used to examine the impact of PA on the onset of chronic diseases controlling for gender, education level, income level and other types of chronic diseases.

2. For each disease, the two rows report the dependent variables-onset of different diseases by onset median age (MA) and hazard ratio (HR).

3. In model 1, the PA level was the independent variable (NPA: sedentary; IPA: irregular physical activity; RPA: Regular physical activity).

4. In model 2 the cumulated PA years was the independent variable.

5. *p<0.05, **p<0.01, ***p<0.001.

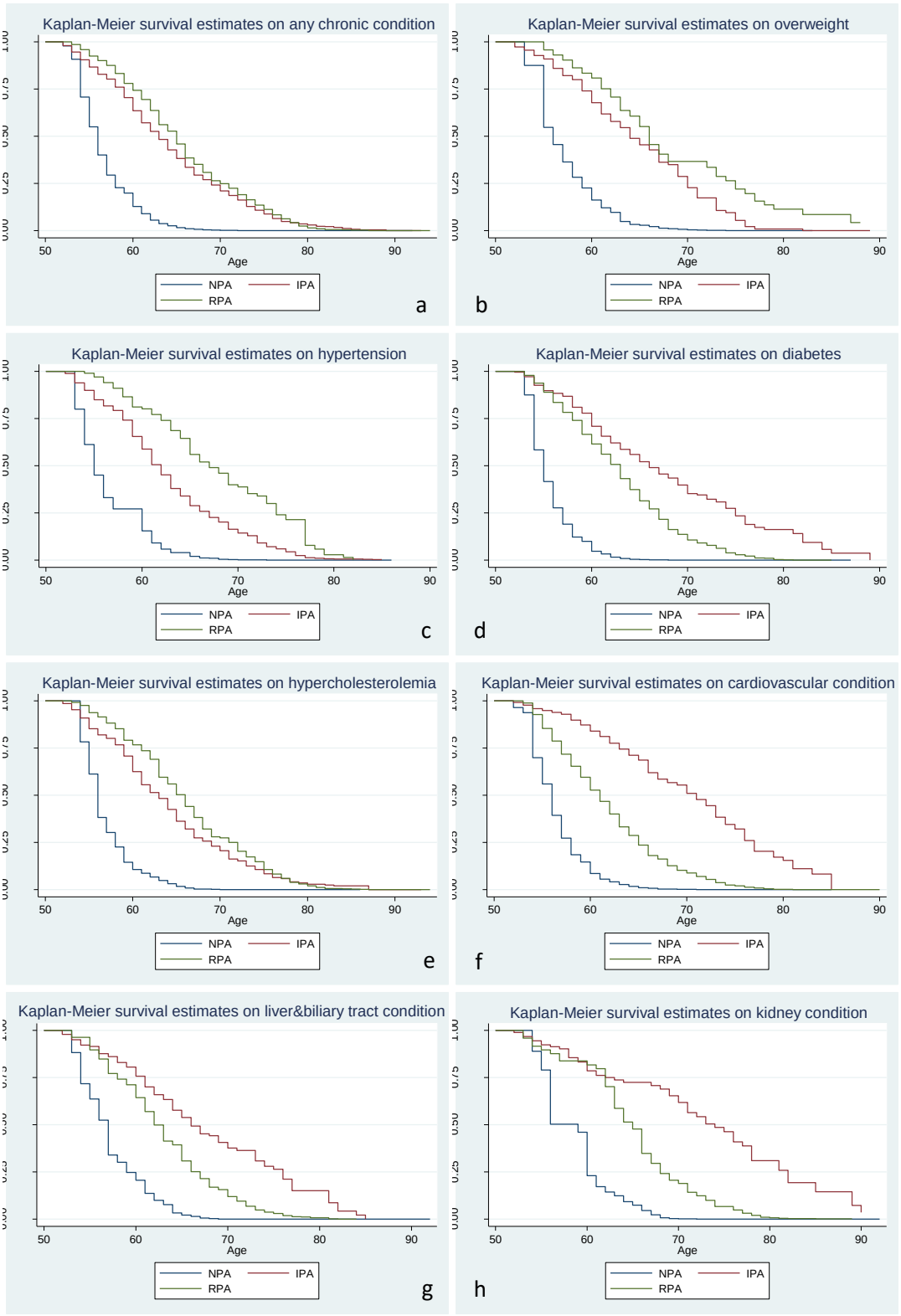

Figure 6: Survival estimates of different chronic diseases among people with different physical activity levels. a: any chronic diseases; b: overweight and obesity; c: hypertension; d: diabetes; e: hyperlipidemia; f: cardiovascular diseases; g: liver and biliary system diseases; h: kidney diseases.

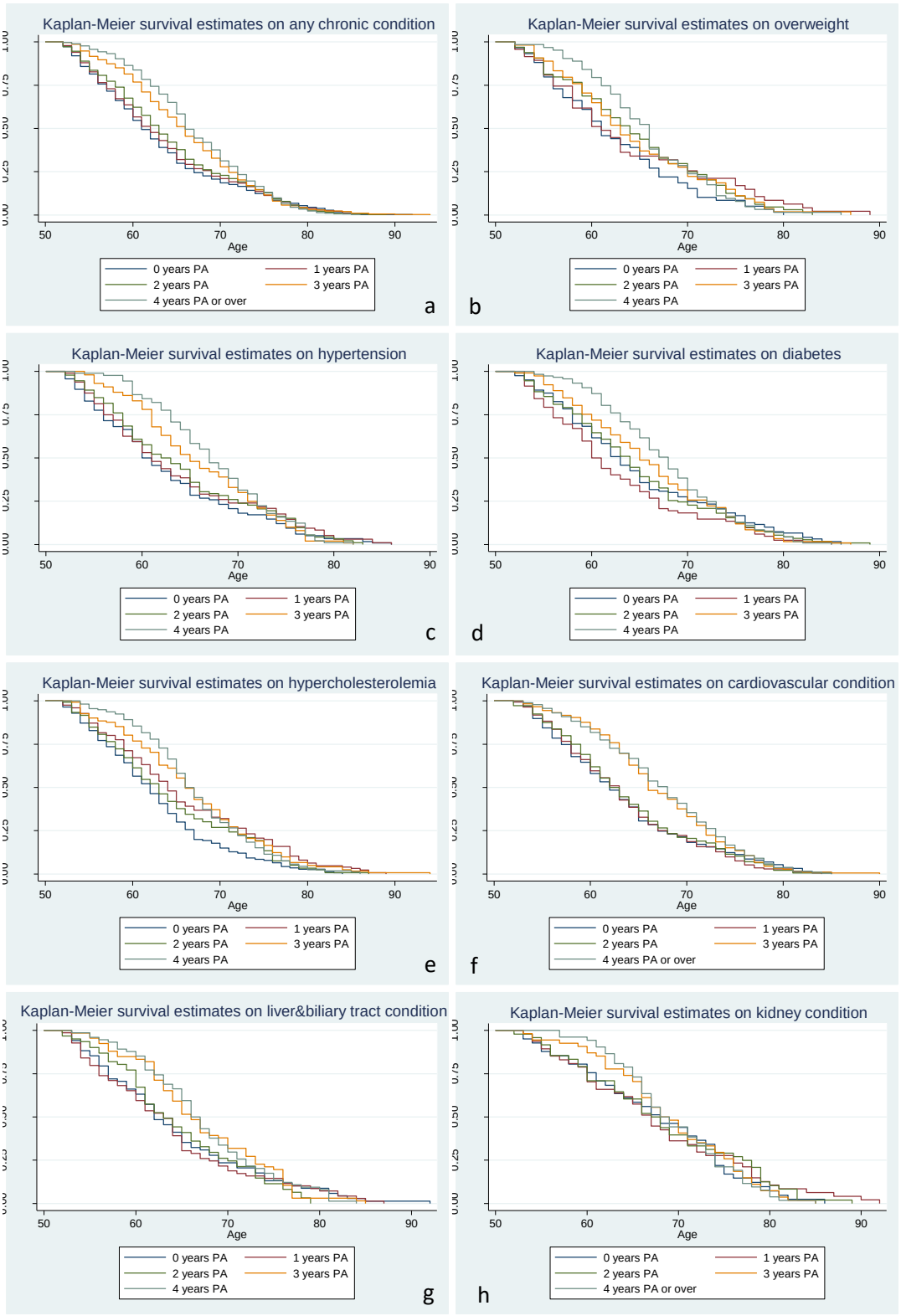

Figure 7: Survival estimates of onset of chronic diseases by age with different accumulative physical activity years. a: any chronic diseases; b: overweight and obesity; c: hypertension; d: diabetes; e: hyperlipidemia; f: cardiovascular diseases; g: liver and biliary system diseases; h: kidney diseases.

Discussion

This study is the first longitudinal study to assess the bidirectional relationships between PA and chronic diseases in an older population in a mid-sized city in China. There are three main findings from this research. First are the socio-demographic differences in the prevalence of chronic diseases and PA practices. Chronic diseases were higher among people > 65 years of age, men (excluding the diagnosis of hyperlipidemia), and those with less education. Only older people with none-to-low incomes had a higher prevalence of overweight and obesity compared to similar older people with higher incomes, but there were no significant differences in other types of chronic diseases between the two income groups. These findings suggest that early education as a prerequisite for income later in life was a primary socioeconomic driver of chronic disease burden in this older population.

There were also socio-demographic differences in PA practice, with sedentary behaviors more common with increasing age, among women, higher educated and lower income groups. However, of those women, higher educated and lower income groups who practiced PA, they were more likely to practice regularly, although of varying intensity. These findings are similar to those shown by studies at the national level in China (Muntner et al., 2005; Ng, Norton, & Popkin, 2009) and in studies worldwide (Bauman et al., 2012; Hallal et al., 2012). Reasons why older women are more sedentary than older men may be their home-life responsibilities, in particular, caring for their spouse or grandchildren. Reasons why older women who practice PA, practice regularly may have to do with their retirement age of 55 years (James, 2002), and more leisure time to conduct regular, and even daily PA. The findings on the educational and income disparities, parallel and further explain the patterns found in national studies of PA in other countries (Muntner et al., 2005). For example, this study demonstrated that low-educated older people were more likely to practice

PA than middle and college-educated ones, but less likely to practice PA regularly. Plausible reasons for this finding may be that older people with less education were more likely to work in labor-intensive industries with more occupational PA so that they had good physical health for PA but less belief in the need for regular PA. High-income people were more likely to participate in PA but less likely to practice regular PA. Applicable to China, non-manual labors usually have higher incomes than manual labors and the former retire 5 years later than the latter. Therefore, some older people with higher incomes in this survey may not be retired, and thus having less leisure time to conduct regular PA (James, 2002), but had higher motivation for PA to keep healthy, while poor older people may have been sedentary if their basic needs were not met, and they didn't have the physical or mental energy to practice PA. While statistical analyses in this paper are not sufficient to fully explain the educational and income disparities in PA, future studies could perhaps utilize qualitative methods to further explore these relationships.

The second main finding from this study showed that a chronic disease diagnosis was one of the most important triggers, bipolarizing PA practices between sedentary and physically active groups. In this study, a chronic disease diagnosis was associated with 32% of sedentary people remaining sedentary, indicating that sedentary older people perceived a new chronic disease diagnosis as a barrier to PA -e.g., fear that PA could exacerbate their disease symptoms and/or worsen their health. In contrast, older people who were physically active and subsequently developed a chronic disease were more likely to increase their PA level after a chronic disease diagnosis, indicating optimism that PA could reduce their symptoms of disease and/or improve their health. Enthusiasm to regulate and increase PA practice was strongest after the first chronic disease diagnosis. These findings demonstrate the complexity of attitudes and beliefs toward PA behaviors and practices for older people newly or otherwise diagnosed with a chronic disease.

Understanding the personal perceptions of disease risk to one's body following a chronic disease diagnosis, and how these perceptions differ for sedentary and active older people, may be fundamental to improving everyday PA practices in general, and following a disease diagnosis in particular, for older people (Crombie et al., 2004; King et al., 1992). Ultimately, it will be important to encourage sedentary older people to practice PA prior to a chronic disease diagnosis, to improve their health trajectory if or when a chronic disease develops.

Whether older people initiated PA or increased their PA after the onset of a chronic disease, depended on the type of diseases -i.e., in this study, people with onsets of cardiovascular and liver and biliary system diseases were less likely to be active. The attitudes and beliefs toward disease onset and progression and PA practice may be related to traditional health beliefs in China, that "people with certain diseases should relax more to keep their health" (personal observation-March 2016). Thus, education should target patients with chronic diseases, particularly those with cardiovascular and liver and biliary system diseases, so that they may still benefit from PA practices, messaging "even if the disease(s) cannot be cured". There are also older people diagnosed with hypertension, overweight and obesity, diabetes or hyperlipidemia, who were more likely to increase (strengthen) their PA following their diagnosis. There is an important need therefore, to further educate older people about the benefits of strengthening PA after the onset of a chronic disease, particularly cardiovascular diseases (Franklin et al., 2003; Warburton et al., 2006). This education could come from family, friends, neighbors, social networks and through community activities (Brewer et al., 2007; Rothman & Salovey, 1997)—similar types of communication messaging used to encourage PA in the general, older population.

The third main finding of this study showed that older people who were physically active had significantly later onsets of chronic diseases, compared to similar older people who were

sedentary. For the most prevalent chronic diseases, PA practice delayed overweight and obesity and diabetes by 8 years; hypertension by 7 years; and cardiovascular diseases by 4 years. Future PA promotion interventions should therefore, encourage sedentary older people in particular to initiate PA to delay the onset of these most highly prevalent diseases. Accurate and customized physical activity guidelines should be created and delivered to ordinary older Chinese people. Although it is not too late to initiate and regulate PA after the onset of a chronic disease, it can be more beneficial to encourage healthy people to maintain a regular PA lifestyle prior to the onset of a chronic disease (Macera et al., 2003; Warburton et al., 2006).

In summary, these findings show the bidirectional relationships between chronic disease onsets and PA, and the bipolar health trajectory effects of chronic disease onsets on PA. Under this scenario, it is likely that future health trajectories between physically active and sedentary older populations will widen as the population ages. When physically active older people were diagnosed with a chronic disease, their health trajectories appeared to be strong, as PA helped to maintain health while living with a chronic disease (Warburton et al., 2006). Comparatively, sedentary older people who experienced an onset of chronic disease, compared to their more active counterparts, were less likely to initiate PA. Although we do not know the underlying attitudes and beliefs toward disease risk and PA benefits, or physical explanations, the sedentary may have had a less healthy trajectory as their chronic disease progressed, and may therefore, need to be managed more carefully through therapeutic regimes of care.

There are some limitations of this study. The data used in this study was from a health survey in three neighborhoods in Huainan, a mid-sized city in China. Although comparisons have been made between the results of this study and other sampling studies at national level in China (Muntner et al., 2005) and at global level (Hallal et al., 2012), more case studies are needed in

different locations, different city sizes, as well as in rural areas to provide supportive evidence for similar patterns and impacts of PA among older Chinese people. In terms of measurement, this study applied a self-reported questionnaire to measure PA. However, through the use of this measure, domestic, occupational, and other types of PA were missing from this study (Craig et al., 2003; Monda et al., 2007). Furthermore, the abnormal electrocardiogram results reported by the physician was the sole indicator of cardiovascular diseases, and a more robust measure could be obtained with other diagnostic criteria such as blood work and other procedures –e.g., angiogram results. Moreover, this was an observational study, so only associations between PA and socio-demographic groups and chronic disease and PA, could be found. Since this dataset excluded the highest-risk patients –i.e., those diagnosed with diseases younger than 55 years, the results may be an underestimation of the true prevalence of chronic disease risk and an overestimation of survival time, which may vary by chronic diseases. However, it is still valid to compare the relative differences in survival time within the selected disease groups, which can also demonstrate the significant positive effect of PA. Finally, geriatric syndromes were not investigated in this study. Older people's perception of body may be experienced as more than the diagnosis of a certain chronic disease reflected in this study. As WHO's Global Strategies on Healthy Ageing suggests (World Health Organization, 2016), impairments and geriatric syndromes such as decreases in gait speed or muscle strength, which are often overlooked by health professionals, are easily perceived by older people as a problem. Reminding older people to pay attention to such syndromes could help those who are sedentary to initiate regular PA prior to the onset of chronic disease, after which it may be physically more difficult to initiate PA.

Conclusion

In conclusion, this study highlights the prevalence of chronic disease types and PA

practices by socio-demographic groups, in three neighborhoods in Huainan, a mid-sized city in China. The findings showed bidirectional relationships between chronic disease and PA, and bipolar health trajectory effects—some chronic disease diagnoses triggered PA practices, and PA practices delayed the onsets of most chronic diseases, in particular, the most highly prevalent chronic diseases—hypertension, cardiovascular diseases, overweight and obesity, and diabetes. While the National Ageing and Health Strategy and Implementation Plan aims to promote healthy lifestyles among older populations, the health beliefs that "adequate PA is not necessary to keep healthy" (Wang et al., 2015) and "PA may worsen the symptoms" (Watz et al., 2008) still commonly exist. Therefore, additional emphasis could be placed on addressing the bipolar health trajectories between physically active and sedentary older populations, identifying the differences in older people's perceptions of PA as a risk vs. benefit to chronic disease prevention and symptom control. To improve the quality of life of older people, while reducing the economic costs of chronic disease burden, public health recommendations to encourage PA among the sedentary, and those with certain chronic disease diagnoses will be beneficial as China's aging population increases during its rapid demographic transition. Future studies should continue to delve into the attitudes and beliefs of older people toward PA behaviors and practices. Customized physical activity guidelines could also be developed to address these attitudes and beliefs, and could be delivered to ordinary older Chinese people. These lessons from China may be applied to other countries also experiencing an increasing aging population.

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CHAPTER 3

HOW THE BUILT ENVIRONMENT AFFECTS CHANGE IN OLDER PEOPLE'S PHYSICAL ACTIVITY: A MIXED-METHODS APPROACH USING LONGITUDINAL HEALTH SURVEY DATA IN URBAN CHINA

Introduction

The global population of older adults is estimated to increase from 900 million in 2015 to 2.1 billion in 2050, with 30 percent of this increase attributed to the growing older population in China (World Health Organization, 2016). Hallal et al. (2012) reported that globally, older people are the least active population group. In China, only 45% of older adults meet the WHO recommendation for 150 weekly minutes of moderate-to-vigorous physical activity (PA) to achieve health benefits (Hallal et al., 2012). This percentage is even lower (9.8%) in urban China (Muntner et al., 2005; World Health Organization, 2010), which may in part explain the rising prevalence of chronic diseases in this population (J.-G. Wang, 2015; World Health Organization, 2006; Xu et al., 2013; Yang et al., 2012). Physical inactivity can be an important cause of chronic disease morbidity among older adults (Bauman et al., 2012), which also adversely affects life quality, community-based aging and ultimately increases social and economic burdens. Physical inactivity among older people in China and the rising health concerns in this population have prompted researchers and public health officials to identify key factors and generate new policies and interventions to promote PA among older adults, particularly in urban areas.

At the individual level, increasing age and chronic diseases can be key barriers to initiate and maintain PA (Brawley, Rejeski, & King, 2003). As age increases, people become less

physically active contributing to the onset of chronic disease. At the community level, the physical infrastructure and how older people perceive the built environment can also impact PA (Berke, Koepsell, Moudon, Hoskins, & Larson, 2007; Cunningham & Michael, 2004; Ding & Gebel, 2012; Kerr, Rosenberg, & Frank, 2012; Sundquist et al., 2011). Within a Social Ecological Framework (Centers for Disease Control and Prevention, 2017), both social and physical aspects of the built environment are considered to be important correlates of PA among older populations (Cunningham & Michael, 2004; King et al., 2011). In terms of the physical aspects of the built environment, features such as land use mix (Li, Fisher, Brownson, & Bosworth, 2005), walkability (Marquet & Miralles-Guasch, 2015) and density of services (Subramanian, Kubzansky, Berkman, Fay, & Kawachi, 2006) are known to promote PA, but it can take decades to redesign and reconstruct urban infrastructure. As older people walk in and out of their apartments every day, their social interactions with neighbors, as well as the physical aspects of their local community have the potential to influence their PA. Older people in urban China generally have control over their choice of housing (Zimring, Joseph, Nicoll, & Tsepas, 2005) with most older people living in apartment buildings, increasing their potential for social interaction with their neighbors, that can influence their PA.

While there is the potential of altering PA through housing, community and urban infrastructure, it remains, however, unknown whether an improved built environment will encourage sedentary older people to initiate PA or simply provide more convenience to those who are already physically active (Rosenberg, 2016; Schwarzer, 2008). In addition to initiating PA, there may be other challenges to promoting PA to meet the WHO guidelines for maintaining such behaviors (Van Cauwenberg et al., 2011). These challenges, also referred to as PA barriers are more likely to restrict older compared to younger people's daily activities. Triggers to initiate,

regulate and maintain healthy behaviors, including PA, have been studied using Stages of Behavior Change Models, such as the Transtheoretical Model (Marshall & Biddle, 2001) and the Precaution Adoption Process Model (Schwarzer, 2008). However, relatively few studies have examined how built environment interventions impact PA change (McNeill, Wyrwich, Brownson, Clark, & Kreuter, 2006; Schwarzer, 2008). Moreover, less is known about the effectiveness of social interaction and physical built environmental interventions on PA in older populations (Brawley et al., 2003), particularly among the growing and understudied older population, experiencing a rise in chronic disease prevalence in China (Ying, Ning, & Xin, 2015). The purpose of this study, therefore, is to improve our understanding of how individual and social and physical aspects of the built environment can motivate older people to initiate, regulate, and maintain their PA.

Data and Methods

Study Area and Population

This study was conducted in a mid-sized city, Huainan in Anhui Province in central eastern China. Huainan had a population of 3,456,000 in 2016, of which 12.9% were older adults(65+ years)(National Bureau of Statistics, 2017). Huainan is one of the 120 most rapidly growing industrial cities in China-a microcosm of the nation's rapid demographic transition, characterized by a growing older population, limited healthcare services, and a rise in chronic disease morbidity and related mortality (F. Wang, 2008). Like other industrial mid-sized cities in China, Huainan is different from large global cities as it remains walker-friendly with access to functional spaces from most residential locations. In this research, three contiguous neighborhoods in Huainan were selected to study because of research access to outpatient longitudinal health

survey records. The older people in these neighborhoods were also open to talking with researchers about their activity spaces and community social interactions.

Study Design

This study combined the Social Ecological Model and the Stages of Behavior Change Model to investigate intervention pathways by which characteristics of the individual and their social and physical built environments contributed to the initiation, regulation, and maintenance of PA. From a social ecological perspective, the social and physical aspects of the built environment are examined in order to recommend interventions in community engagement and neighborhood design. From a stages of behavior change perspective, three stages of PA -i.e., the initiation, regulation, and maintenance of PA are studied in order to identify features of the social and built environments that promote PA at each of these change levels.

This study applied a mixed-methods approach in data collection and the analytical process. In the qualitative phase, older adults were interviewed about their PA and content analysis was used to evaluate their responses. Subsequently, their activity spaces were mapped to show the approximate residential locations in relation to outdoor functional PA spaces and PA practice locations in the built environment. Information gained in regards to the motivators and barriers for PA were used to build a conceptual model by which to test factors associated with the initiation, regulation, and maintenance of PA from a population perspective. In the quantitative phase, six years of longitudinal health survey records comprising 97% of older residents were obtained from the hospital serving the three neighborhoods. Multilevel path analyses were conducted to estimate the associations between individual and social and physical built environment characteristics and changes in PA, including the mediating effects of chronic diseases and physically active neighbors.

In addition, random slope path analysis was used to examine the moderating effects of age in these relationships (Rouquette et al., 2015). The process of mixed-methods integration is shown in Figure 8 and described more fully below. Finally, the residential locations of sedentary older adults were identified and mapped to show where to begin community interventions. To protect the confidentiality of all the participants, all identifiable information was removed from the final datasets. The qualitative and quantitative data collection procedures were approved by the Michigan State University Internal Review Board (IRB#x15-413e).

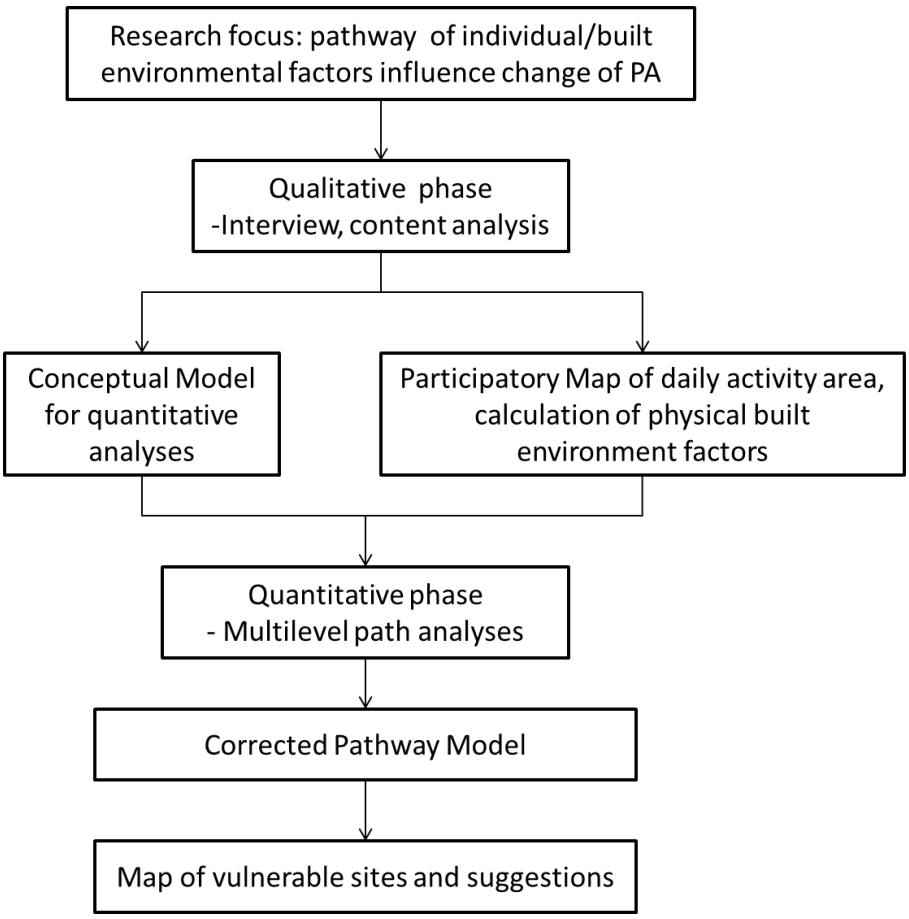

Figure 8: The process of mixed-methods integration.

Qualitative Phase

Sampling and Interviews

The aims of the qualitative interviews were to identify individual and social and built environment factors within older people's activity spaces, that helped to motivate or were barriers for the initiation, regulation, and maintenance of PA, ultimately integrating information from both scholars' and subjects' perspectives. Forty-two interviews were conducted from February to August 2016 in the three neighborhoods. Quota sampling was used to ensure a representative sample of men(n=22) and women (n=20), middle (55-64 years, n=21) and older (65+ years, n=21) aged adults and relatively healthy and less-healthy participants, because the construction of knowledge and everyday activity varies within these population groups (Bernard, 2011). The less-healthy group was defined as middle-aged or older adults reported to have more than three types of geriatric syndrome(n=40) or chronic disease(n=27) that affects the frequency and intensity of their daily activities. In the qualitative study, geriatric syndromes included delirium, incontinence, frailty, dizziness, sleep problems, falls, and osteoporosis (Inouye, Studenski, Tinetti, & Kuchel, 2007). Chronic diseases included obesity, hypertension, diabetes, hyperlipidemia, cardiovascular conditions, stroke, cancer, liver and biliary system conditions, and poor kidney functions (Marrero, Bloom, & Adashi, 2012). At least 5 people were interviewed from within each gender by age and health group. The interviews were mainly conducted in public parks near the three neighborhoods; however, because it was difficult to find less-healthy older adults who participated in PA, these interviews were conducted in local clinics.

All interviews were conducted in the local language, Mandarin. Figure 9 shows the flow of questions for the structured interviews. After introducing the research aims and obtaining oral

consent, each interviewee was asked about their socio-demographic, physical and behavioral histories, including age, education level, income level, if they had any geriatric syndromes or chronic diseases, and the type, frequency, and length of time spent on their PA. Those interviewees who conducted PA were asked to give the reasons or motivators for initiating, regulating and/or maintaining their PA. Those who were sedentary, or used to be active but gave up PA, were asked to talk about their motivators and/or barriers to initiating and/or regulating their PA, or reasons that made them give up PA after they had started. After answering these questions, each interviewee was asked to point out their daily activity space on a printed map from Google Earth for use in the construction of their activity space and for use in the content analysis (Figure 9).

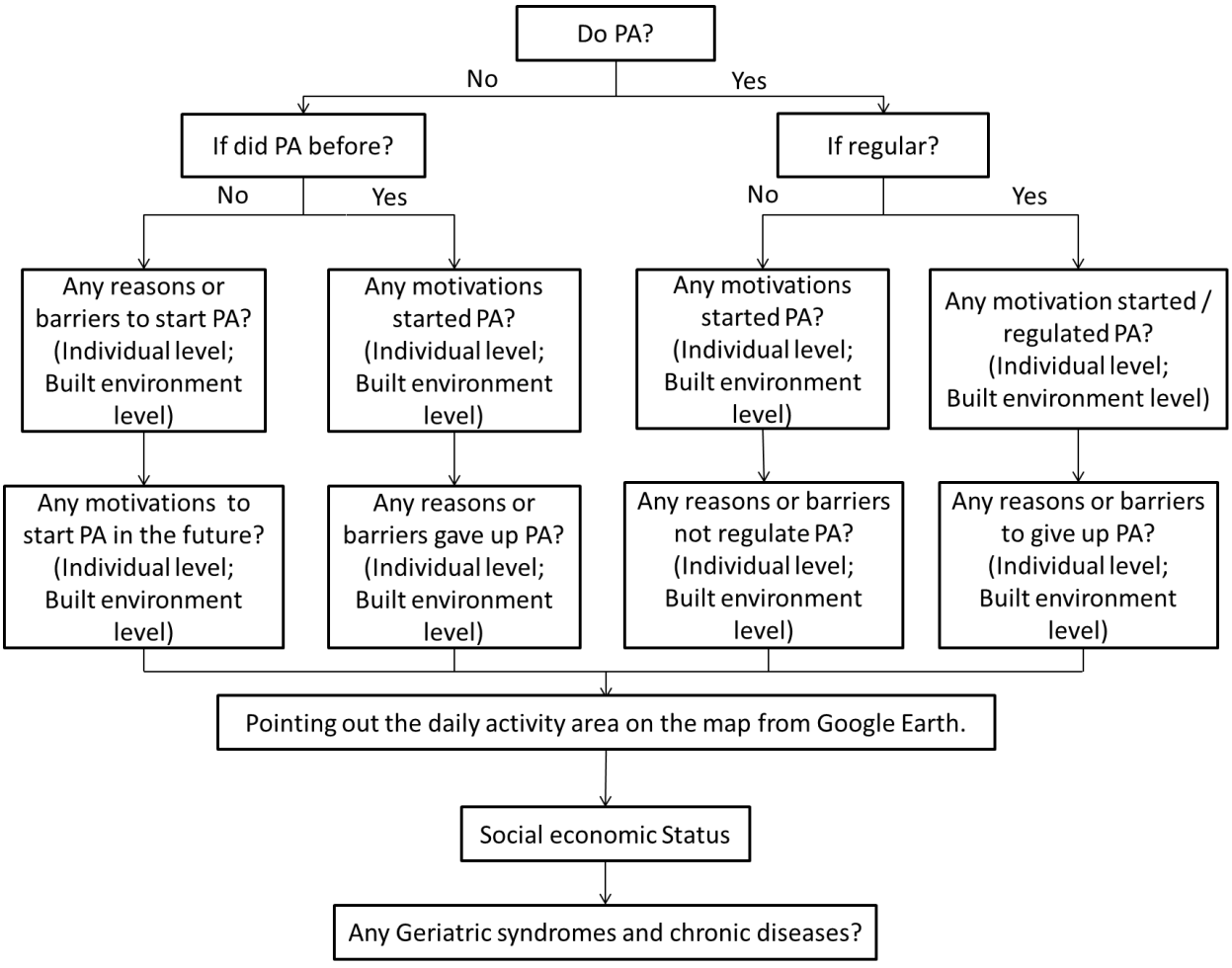

Figure 9: Question flow of Structural Interviews on n=42 middle age to older adults.

Content Analyses

The qualitative analysis was led by the researchers who conducted the interviews. Studies regarding factors that could affect PA were reviewed to guide the content analysis' coding process (Ding & Gebel, 2012; Li et al., 2005; Ying et al., 2015). The interview records were first transcribed into text in Mandarin and then coded into two categories (Table 8). The first category of codes included individual and built environment factors that may have affected a change in PA with additional descriptors as subcategories. The second category of codes included the role of these factors as the motivator or barrier for initiating, regulating or maintaining PA. These subcategories of codes were generated from the frequently mentioned themes/phrases within the interviews (Elo & Kyngäs, 2008). The frequencies and percentages of each code category out of all of the interviews were generated. Finally, the main individual and social and physical built environment characteristics reported by the interviewees were used to generate a conceptual model outlining potential individual and social and physical environmental pathways of PA influence in the population-based quantitative analysis using the health survey data.

The additional output from the qualitative analysis was a map of older people's daily activity spaces—the aggregate of their spaces is referred to as the daily activity area within the three neighborhoods, for use in the quantitative analysis(Figure 10). The daily activity area in the three neighborhoods was defined as the area extent within which walking was accessible for all of the interviewees. After acquiring this area, the land use and land cover used for daily activity were digitized in ArcGIS v.10.4 (ESRI, 2016). The digitalized features included the apartment footprints for the three neighborhoods, networks of pedestrian paths, and functional spaces including, functional services, such as fast-food stores, farmer's markets, supermarkets, pharmacies, schools,

hospitals, PA facilities and natural and human-made water bodies. Google Earth was used to define the boundaries of the street network, functional spaces, and daily activity area. To improve the accuracy of the locations of functional spaces, a survey on Street View in Google Earth and a land-use survey performed by the investigator in the field in the spring of 2016, were also conducted.

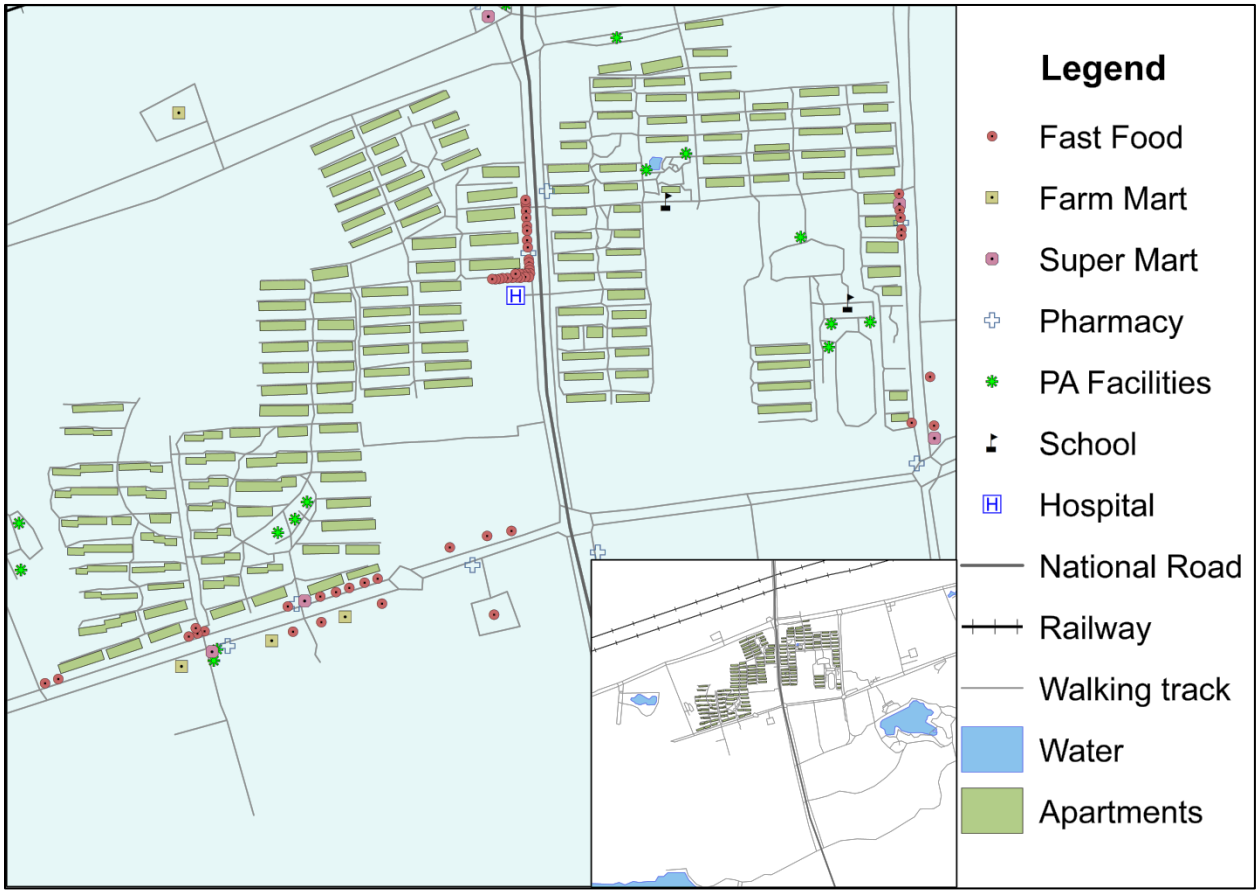

Figure 10: Map of daily activity area for older residents in the three neighborhoods.

Quantitative Phase

Data Sources

The aim of the quantitative phase was to examine the proposed pathways of influence between older individual-level characteristics, social and physical built environment factors and change in PA from a population perspective. A six-year longitudinal health survey dataset(2010-2015) of older adults was obtained from the local hospital serving the three neighborhoods. Included in the dataset were data on individual's socio-demographic characteristics (gender, age, education and income levels), home address, clinical data from the physical exam (height, weight and blood pressure), diagnostic results for several chronic diseases and importantly, the PA level. Since the annual medical exams for urban residents over 55 years is covered by basic health insurance (General Office of the State Council of the People's Republic of China, 2015), 97% of middle(n=1,177) to older(n=1,925) aged residents (total =3,102)(herein referred to as 'older') in the three neighborhoods participated in the survey. Over the six-year survey, some older residents did not complete the six-year survey(n=490) and others(n=856) were newly recruited during the six year time period, reducing the number of survey respondents to n=3,094, and observations N=13,636. Each individual's characteristics were coded per below and spatially assigned to an apartment according to their home addresses. The geographic data generated from the qualitative phase were measured within the daily activity area.

Physical Activity Measures

In the longitudinal health survey, PA was measured by the frequency of PA per week, the length of time participating in each activity, and the intensity of each activity during the year. Based on this combined information, PA for each observation were coded into three levels,

0=sedentary; 1=irregular or regular PA but did not meet the WHO recommendation; and 2=Regular PA that met the WHO recommendation (World Health Organization, 2010). The 13,636 observations over the six years were then separated into three groups for assessment in individual models. The first group (N=5,931 observations) included observations who initiated PA vs. remained sedentary, -i.e., those reporting sedentary at baseline (level-0) and later changing their PA from level-0 to level-1 or level-2 (positive response for initiating PA). The second group (N=4,256 observations) included those who regulated PA vs. remained level-1 PA, -i.e., those beginning at level-1 PA (baseline) and later changing their PA from level-1 to level-2(positive response for regulating PA). The third group (N=4,251 observations) were those who gave up PA vs. maintain PA, -i.e. older people beginning at level-2 PA (baseline) and later changing their PA from level-2 to level-1 or level-0(negative response for maintaining PA). Some observations were repetitively calculated in more than one group. For example, older people could initiate PA (level-0 to level-1) in a certain year and then regulate PA (level-1 to level-2) in the next year; in such situations the observation level-1 was a positive response in the initiation of the PA model and baseline in the regulation PA model.

Individual-Level Measures

There were two types of individual-level measures: socio-demographic and health features. The socio-demographic characteristics were coded: gender(1=female; 0=male); age groups(0=55-64; 1=65-74; 2=75 or over), education level(0=primary school or below; 1=middle school; 2=high school; 3=college) and income(1=high income; 0=no or low income). Health features included 7 chronic diseases indicated by the physical exam and laboratory records according to the normal range values provided by the hospital (Zhou et. al., in preparation), including overweight and

obesity, hypertension, diabetes, hyperlipidemia, cardiovascular conditions, liver and biliary system conditions, and poor kidney functions. The normal range values (Table 6) were checked against the same diseases provided in Merck Manuals (Merck Manuals Professional Edition, 2013b, 2014a, 2014b, 2015, 2016a, 2016b). Those observations within the normal range value for a chronic disease were coded as 0 (negative); and those surpassing the normal range values, suggestive of a certain disease were coded as 1 (positive). For a given year, the onset of a chronic disease was coded as 0 if it was 'negative' and was coded as 1 if it was 'positive', for the first time.

Table 6: The reference value of seven chronic diseases (International Classification of Diseases Tenth Revision) (ICD-10)[1].

	OBT[2]	**HTN[2]**	**DBT[2]**	**HTC[2]**	**CC[2]**	**LBTC[2]**	**KF[2]**
ICD-10 Codes	E66	I10	E08-11	E78.5	N/A	N/A	N/A
Reference of the survey	BMI>25	SBP>140mmHg DBP>90 mmHg	FPG>126 mg/dl	TC>240 mg/dl	Abnormal ECG excluded arrhythmias.	ALT>40U/L Tbil>1.2mg/dl Dbil>0.4mg/dl	Cr>1.39 mg/dl BUN>23.3mg/dl
Reference value from Merck Manuals	BMI>25	SBP>140mmHg DBP>90 mmHg	FPG>=126mg/dl	TC>240 mg/dl	N/A	ALT>40U/L Tbil>1.2mg/dl	Cr>1.3 mg/dl BUN>20mg/dl
Prevalence (%)	31.2	51.4	13.6	8.9	38.3	7.5	4.8
Prevalence over 60 in China (%)	43-57 in 2015	41.9 in 2002	14.1-15.5 in 2010	11.1-17.5 in 2008	N/A	N/A	N/A

Notes. [1]World Health Organization, 2017.
[2]OBT: overweight and obesity; HTN: hypertension; DBT: diabetes; HTC: hyperlipidemia; CC: cardiovascular conditions; LBTC: liver and biliary, KF: kidney failure.

Built Environment Measures

The built environment comprised the activity area, including 166 apartment buildings and an array of functional spaces as described above in the three neighborhoods. The social aspect of the built environment was measured using the percentage of physically active residents in an apartment building, as an indirect indicator of the social networks within the apartment site. The physical aspects of the built environment included two measures: the liveliness of an apartment site and the closeness of an apartment site to functional spaces. In this study, the liveliness of the apartment was defined as the *metric choice* (prediction of population movement) between selected origins (residence) and destinations (functional spaces) (Turner, 2007). The *metric choice,* or *betweenness centrality,* was calculated by counting the number of times each apartment or functional space fell on the shortest paths between all pairs of origins and destinations within the street network in the daily activity area (Turner, 2007). Frequently used nodes were assigned a high value and less frequently used nodes were assigned a lower value. Assuming that apartments with greater pedestrian movement flow were 'livelier' than those with less pedestrian movement flow, the metric choice was used to indicate the liveliness of the apartment site. The second measure, *closeness centrality* between selected origins and destinations was used to reflect the closeness of apartment sites to functional spaces. The closeness centrality was calculated by the reciprocal of the total distance of shortest paths between all pairs of origins and destinations within the street network of the daily activity area (Turner, 2007). Apartments close to functional spaces were assigned high values and apartments farther away were assigned a low value. These two indices were calculated in NetworkX version 1.11 package (Hagberg, Swart, & Chult, 2008) in Python 3.6 (http://www.python.org).

Path Analyses

Each of the three PA measures was used as a dependent variable in separate path analyses. The independent variables as described above were conceptualized from the content analysis. Two-level path analyses were estimated, where the within-level represented the observations and the between-level represented their corresponding apartment sites, -i.e., observations nested within apartment sites. In all three models, the individual-level variables included age group and the onset of chronic disease, controlling for gender, education, and income; and the built-environment-level included the percentage of physically active neighbors in an apartment site, the liveliness of the apartment site, and the closeness of the apartment site to functional spaces. The onset of chronic disease was modeled as a mediator since older-aged adults experience more chronic disease than middle-aged adults. The percentage of active neighbors was also modeled as a mediator, since high quality built environments can attract more physically active residents.

Finally, the moderating effects of age on built environment characteristics and maintenance of PA relationship was modeled, since each of the built environment characteristics could operate differently, -i.e., as a motivator or barrier to maintaining PA in middle vs. older-aged residents. First, cross-level interaction terms, age group*built environment characteristics were estimated to predict a negative response to PA maintenance (the random slope coefficients were studied). Second, the middle and older age groups were stratified to estimate in separate models the effects of the built environment characteristics on PA maintenance.

Since the observed variables were not normally distributed, weighted least-squares parameter estimates (WLSMV) were used in the three models. Goodness-of-fit indices tested, included the Bentler Comparative Fit Index (CFI>0.95), Tucker-Lewis Index (TLI>0.95), and

Root Mean Square Error Of Approximation (RMSEA<0.06) for the binary outcomes (Hu & Bentler, 1999). Standardized path coefficients were presented to facilitate observable comparisons between the coefficients. The multilevel path analyses were applied in Mplus Version 7.1 (Muthen & Muthen, 2012).

Results

Descriptive Analyses

The interviewees and health survey population data were diverse by gender, age, educational, income, health conditions and PA levels (Table 7). In general, the proportion of subgroups between those interviewed and surveyed were relatively similar with some differences in gender, income level and presence of chronic disease. These findings show that the older population in the three neighborhoods was slightly poorer (no/low income: 83% vs. 68%) and less healthy (chronic disease: 88% vs. 64%) than the sample of those interviewed; which was expected because those less healthy were more difficult to find outside of clinics. In summary, the qualitative information gained from the interviews and content analysis was substantive in terms of informing the population-based PA models.

Table 7: Comparisons of interviewees and health survey population of research sites.

Characteristics		Interviewees[1] (n=42)	Population[2] (n=3102)
Gender	Male	22 (52%)	1683 (54%)
	Female	20 (48%)	1419 (46%)
Age	55-64 years	21 (50%)	1177 (38%)
	65-88 years	21 (50%)	1925 (62%)
Educational Level	Illiterates/Primary School	15 (36%)	940 (30%)
	Middle School	18 (43%)	1035 (33%)
	High School or above	9 (21%)	1094 (35%)
Income Level	No/Low income	29 (69%)	2582 (83%)
	High income	13 (31%)	503 (16%)
Geriatric Syndromes[3]	Yes	40 (95%)	N/A
	No	2 (5%)	N/A
Chronic Diseases[4]	Yes	27 (64%)	2730 (88%)
	No	15 (36%)	46 (12%)
Physical Active	No	11 (26%)	895 (29%)
	Yes–Irregular	13 (31%)	826 (27%)
	Yes–Regular	18 (43%)	1381 (44%)

Notes. [1]Interviews conducted in summer 2016; [2]Survey population at baseline.
[3]Geriatric syndromes include delirium, incontinence, frailty, dizziness, sleep problems, falls, and osteoporosis.
[4]Chronic diseases include obesity, hypertension, diabetes, hyperlipidemia, cardiovascular conditions, stroke, cancer, liver and biliary system conditions, and poor kidney function.

Content Analyses

The results were summarized by the three individual-level factors, including age or aging process, onset of chronic disease, and family responsibilities; and four social and physical built-environment-level factors, including social networks of neighbors, liveliness of apartment sites, closeness to functional spaces, and air quality according to their roles(motivators or barriers) in initiating, regulating and maintaining PA(Table 7). Although air quality was not a major focus of this study, it was important to learn if air pollution was a barrier to PA prior to the study of social and physical built environmental factors. After counting and categorizing the frequency of each

factor, aging process as a potential moderator to regulate and maintain PA were investigated, since a high percentage(55%) of sedentary interviewees considered age as a barrier to initiating PA. Importantly, the polarizing effect of age on the decision to initiate, regulate or maintain PA was also related to the onset of chronic disease. For example, there was a large percentage of sedentary interviewees, whose onsets of chronic disease became a barrier to initiating PA. Finally, three interviewees reported that they could not conduct regular PA because they had family responsibilities, such as taking care of their grandchildren or doing housework for their offspring.

At the built environment level, over one-half of interviewees mentioned that social networks among their neighbors were a motivator to initiate, regulate, and maintain PA. They reported that physically active neighbors attracted them to start PA and they monitored each other to regularly conduct PA throughout the year. The following two quotations show how the social aspect of the built environment affected the interviewees' initiation and maintenance of PA.

> "I did not exercise right after retirement. Lei's mom (a neighbor) invited me to play with them. She even gave me a sports suit.... It is hard to maintain for one person. But we are a group." (Nin, female, age 68, physically active, healthy).

> "No reasons to give up. It's good to exercise with my old neighbors every morning." (Hua, male, age 80, physically active, stroke victim).

A group of interviewees also mentioned that the liveliness of their apartment site was a motivator to start PA. For example:

"I lived next to the main street. Many people walk through there. I can see them from my balcony. It's…lively. I like lively places." (Yong, male, age 67, physically active, Alzheimer & lung cancer).

"It's (outside) very lively at this time of a day. Once the voice begins, I leave home." (Ying, female, age 62, physically active, diabetes).

Some interviewees felt that the location of their apartment affected their PA. Living close to a functional space was a motivator to initiate PA, while living far away from a functional space was a barrier to maintain PA. This finding was mostly generated from those interviewees over 70 years. For example:

"My home is close to everywhere. Outdoor is the farmer's market. Very convenient. I often exercise along with buying food for my rabbit and my family." (Fang, female, age 64, physically active, healthy).

"Look, I live here (an inconvenient place). Now (I'm) getting older and cannot walk far. (I) exercise sometimes. Less than before." (De, male, age 70, physically inactive, osteoporosis and fragile).

However, living close to a functional space was also considered to be a barrier to PA for a few interviewees:

"For myself, I think living close is good. It's convenient so I go out every day. But I think it may be a double-sword for some people. Living too close makes him (her husband) lazy." (Jie, female, age 63, physically active, hypertension).

"No exercise. Why exercise? I don't. There is a playground out of my apartment. Noisy, dirty, crying kids…I have plenty of housework at home." (Fen, male, age 62, physically inactive, heart disease).

Although it was suspected that poor air quality would impact older people's PA, only two interviewees mentioned that air pollution "May have kept them at home for a few days during the winter season."

Table 8: Content analysis coding results: Factors at individual and built-environment levels that affect older people's physical activity change.

Factors	Initiate PA		Regulate PA		Maintain PA	
	Motivators (n=42)	**Barriers (n=11)**	**Motivators (n=18)**	**Barriers (n=13)**	**Motivators (n=18)**	**Barriers (n=24)**
Individual level						
Aging process	1 (2%)	6 (55%)	4 (22%)	N/A	5 (28%)	6 (25%)
Onset of chronic disease	33 (79%)	7 (64%)	11 (61%)	N/A	2 (11%)	N/A
Family responsibilities	2 (5%)	1 (9%)	N/A	3 (23%)	N/A	2 (8%)
Built environment level						
Social networks of neighbors	22 (52%)	N/A	13 (72%)	N/A	11 (61%)	N/A
Liveliness of apartment sites	11 (26%)	N/A	N/A	N/A	2 (11%)	N/A
Closeness to functional spaces	4 (10%)	N/A	N/A	N/A	16 (67%)	N/A
Air quality	N/A	N/A	N/A	2 (15%)	N/A	N/A

Figure 11 generates a conceptual model from the results of content analysis. At the individual level, increasing age was shown to be a barrier for sedentary older people to initiate PA, but a motivator for physically active older people to regulate and maintain PA. However, as age increased, older people in general appeared to be less likely to maintain PA because of their increasing geriatric syndromes. Thus, the onset of chronic diseases appeared to be a mediator in

the age and PA change relationship. At the built environment level, the liveliness of an apartment site appeared to attract older people to initiate PA., while the apartment's closeness to functional spaces helped to maintain PA. The liveliness of an apartment site and its closeness to functional spaces may also have contributed to an increase in the number of physically active neighbors. Thus, the physically active neighbors may have operated as a mediator in the physical built environment and change in PA relationship. Finally, the different opinions of middle and older-aged interviewees toward PA indicated that age might operate as a moderator in the closeness of an apartment to functional spaces and PA maintenance relationship.

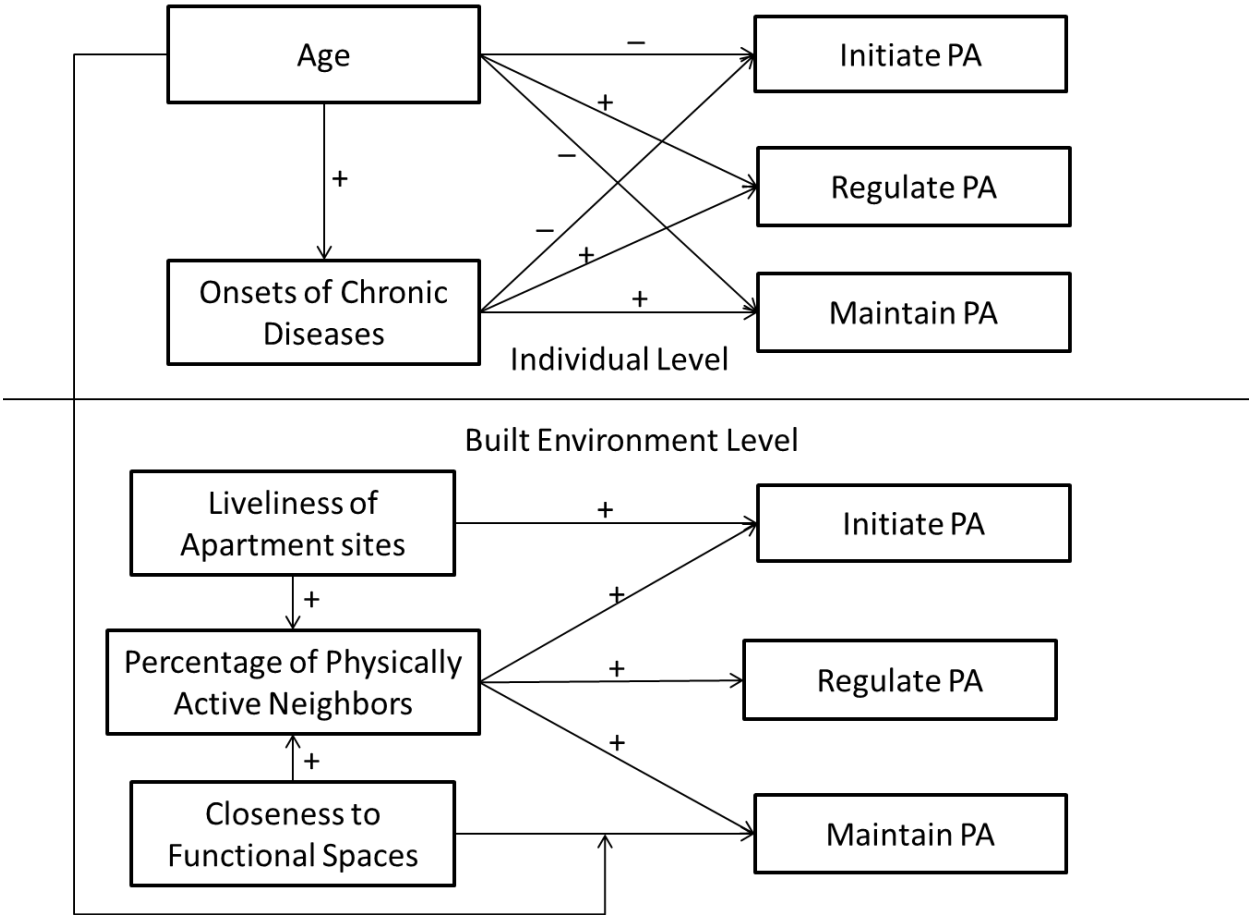

Figure 11: The Conceptual Model of individual, social and physical built environment correlates of physical activity.

Path Analyses

The results of multilevel path analyses are shown in Figure 12. For the three models -i.e., the initiation, regulation, and maintenance of PA, the CFI (1.00>0.95), TLI (1.00>0.95) and RMSEA (0.000<0.06) demonstrate the fitness of the models. At the individual-level, age was negatively associated with PA initiation (b=-.133, SE=.034, p<.001), -i.e., as age increased, people were less likely to start PA. However, age was positively associated with PA regulation (b=.192, SE=.028, p<.001) and PA maintenance (b=.094, SE=.020, p<.001) although the effect of age on PA maintenance was relatively small. Thus, as age increased PA became more regular and more likely to be maintained. However, age also affected the change in PA indirectly through the mediator–onsets of chronic diseases, as age was positively associated with the onset of chronic diseases (b=.116, SE=.031, p<.001). The onset of chronic diseases were negatively associated with PA initiation (b=-.116, SE=.055, p<.05), positively associated with PA regulation, with a high path coefficient (b=.326, SE=.065, p<.001) and negatively associated with the maintenance (b=-.186, SE=.048, p<.001) of PA.

At the built environment level, the liveliness of apartment sites (b=.308, SE=.163, p<.05) and the percentage of physically active neighbors (b=.651, SE=.097, p<.001) were positively associated with PA initiation. Apartment closeness to functional spaces appeared to in part, explain the strong effect that the percentage of physically active neighbors has on those relationships (b=.144, SE=.014, p<.001). The percentage of physically active neighbors was also positively related to PA regulation (b=.582, SE=.139, p<.001).

The random slope for age was significant(b=-.933, SE=.072, p<.001)(not shown), indicating that the association between the percentage of physically active neighbors, the closeness

to functional spaces and the maintenance of PA varied across ages. Separate models between middle and older age groups showed that the percentage of physically active neighbors was positively associated with the maintenance of PA, both among the middle-age group(b=.910, SE=.202, p<.001) and the older-age group(b=.785, SE=.081, p<.001). While the closeness to functional spaces was negatively associated with the maintenance of PA for the middle-age group(b=-.116, SE=.039, p<.001), it was positively related to the maintenance of PA among the older-aged group(b=.517, SE=.108, p<.001).

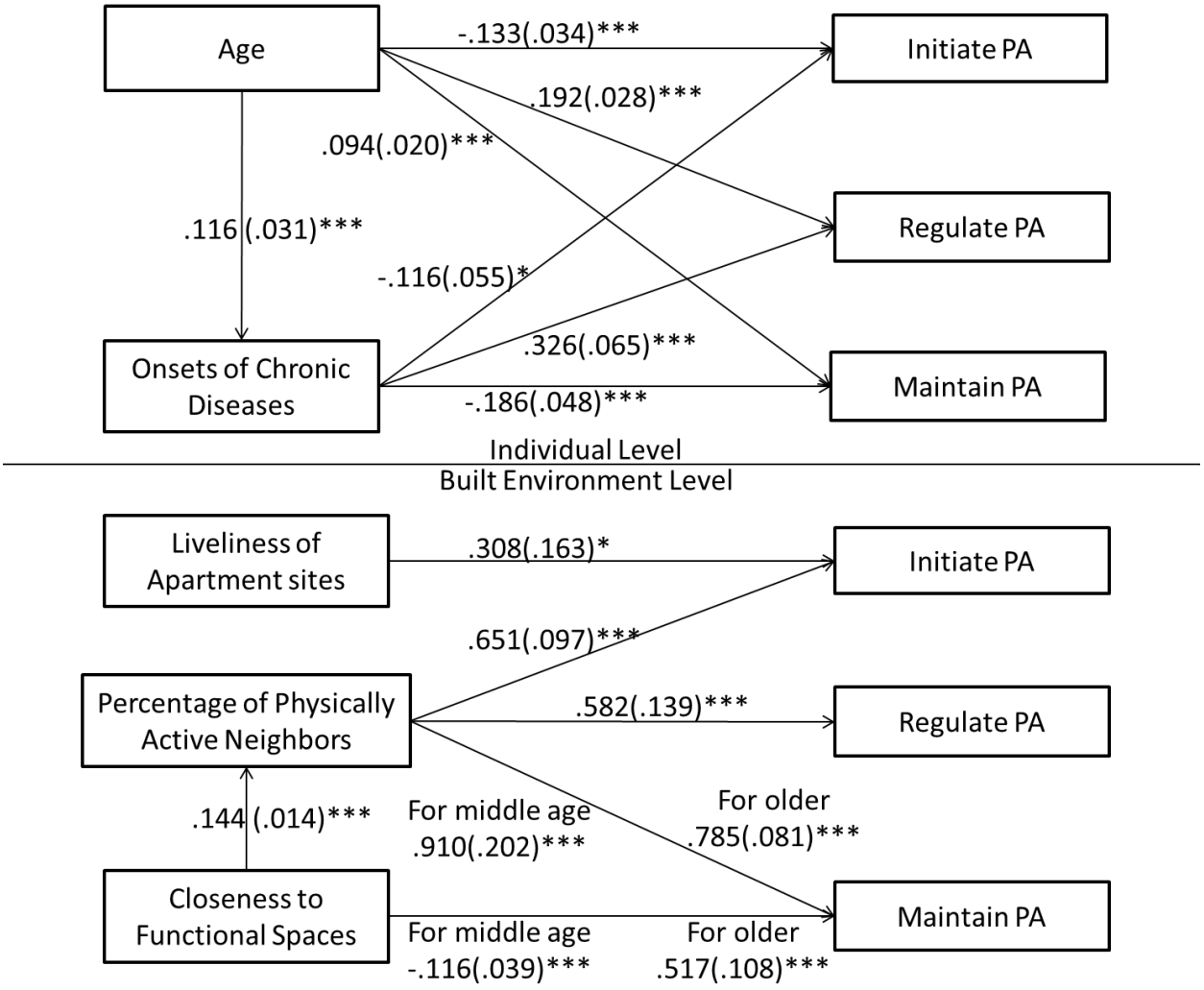

Figure 12: Results of multilevel path analyses testing individual and built environment effects on older adults' initiation, regulation, and maintenance of physical activity.
Note.*p<0.05;**p<0.01;***p<0.001.

According to the results of the path analyses, three types of intervention sites were defined by integrating and overlapping the information regarding the percentage of physically active residents, apartment closeness to functional spaces, and the prevalence of chronic diseases in the three neighborhoods (Figure 13). First, the color range representing percentage of physically active residents in apartment sites is divided using a standard deviation classification scheme. The average(olive yellow) represents apartments within one standard deviation of the mean. The active(light green) and less active(light yellow) represent apartments above and below the average between one and two standard deviations, respectively. The highly active(dark green) and highly inactive(orange) represent apartments greatly above and below the average beyond two standard deviations, respectively. Second, the color range representing apartment closeness to functional spaces using walking tracks, is divided into five classes using a natural break classification scheme. The darkest track represents those walking paths that are farthest from functional spaces, and the lightest track represents closest to functional spaces. Third, the lattice represents the health of residents in their apartment sites. Unhealthy apartments were defined as those with a prevalence of chronic diseases below the mean. Type 1 intervention sites(red boundary) were defined as those apartments with unhealthy and least physically active residents, located on a track far from functional spaces. In these apartments, physical inactivity is already associated with chronic diseases and interventions are urgently needed. Type 2 intervention sites(orange boundary) were defined as those with healthy but least physically active residents, located on a track close to functional spaces. In these apartment sites, PA can be promoted to prevent and delay the onset of chronic diseases among older people. Finally, Type 3 intervention sites(blue boundary) were defined as those with unhealthy, but highly physically active residents. In these apartments,

physical inactivity may not be the main cause of chronic disease and thus, further studies are needed to learn more about the health of these residents.

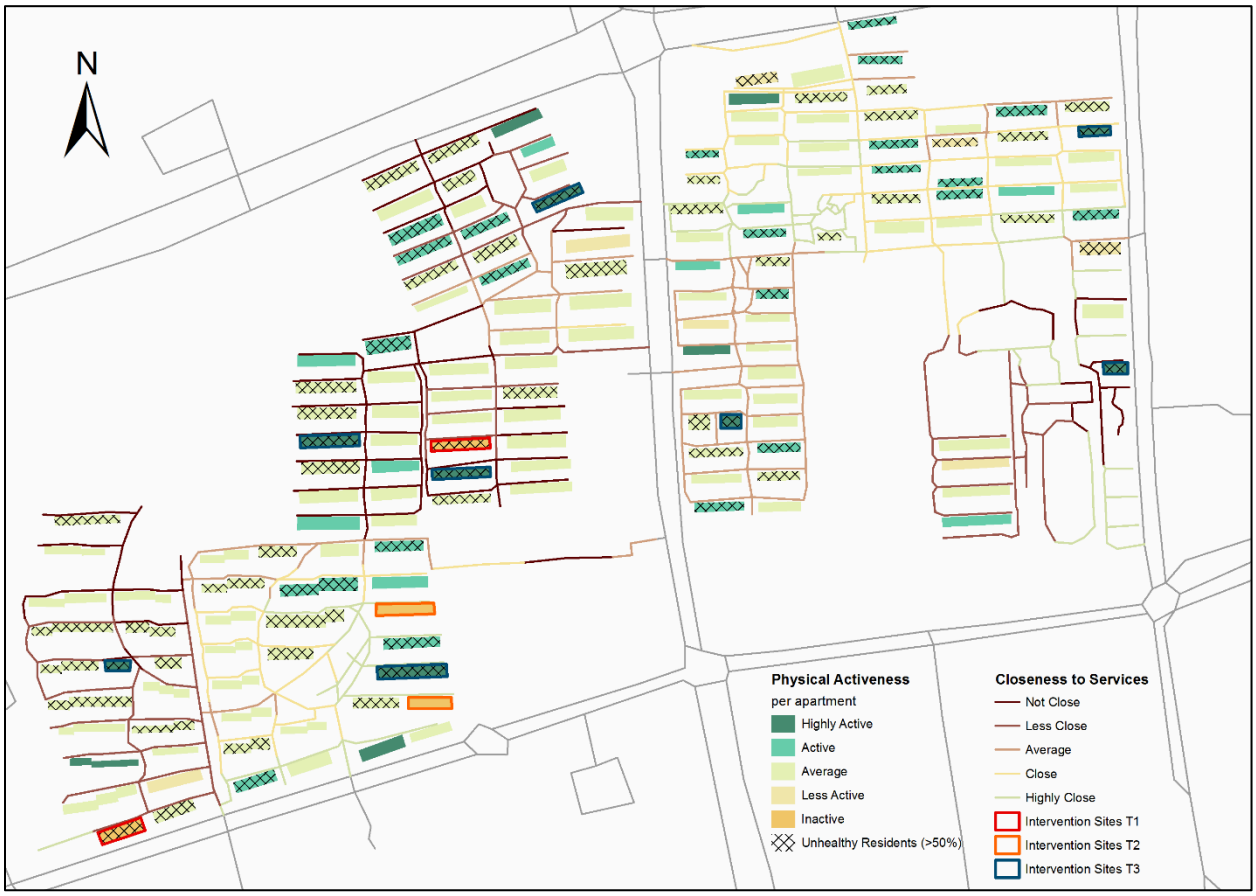

Figure 13: Map of daily activity area and built environment characteristics and recommendation for future intervention sites.
Notes. Type 1 intervention sites (red boundary) were defined as those apartment sites with unhealthy, least physically active residents located on a tract farthest from functional spaces. Type 2 intervention sites (orange boundary) were defined as those apartment sites with relatively healthy but least physically active residents located on a track closest to functional spaces. Type 3 intervention sites (dark blue boundary) were defined as those apartments with relatively unhealthy but highly physically active residents.

Discussion

Paralleling other studies in Western countries (Annear, Cushman, & Gidlow, 2009; Giles-Corti & Donovan, 2002; King et al., 2011), this study demonstrates the important impacts of social

networks among neighbors, -i.e., physically active neighbors can initiate, regulate and maintain PA, for both middle and older-aged adults in China). This finding suggests that physically active individuals in neighborhoods can empower other residents to participate in PA through their social networks in apartment buildings and surrounding neighborhoods. Physically active residents, particularly those who have retired, are willing and have great potential to cultivate a physically active atmosphere among their neighbors. Empowering this group can be an effective and economical strategy to promote PA among older residents in neighborhoods.

Another important finding from this study is the differential effects of the physical built environment on initiating and maintaining older adults' PA. The liveliness of the apartment site can promote sedentary older people to initiate PA, while the closeness of an apartment to functional spaces can affect older people's decisions on whether to maintain or give up on PA. Efforts could be made to improve the liveliness of apartment sites to help sedentary older people initiate PA. Given the important findings of the moderating effects of age, more attention should be given to older populations, particularly those with geriatric syndromes and chronic diseases who live far from functional spaces, as they are more likely to give up PA because of their inaccessible apartment locations. A fundamental and flexible solution is to intervene before the onset of chronic diseases. Guiding and assisting older people to select their retiring apartments close to functional spaces, may increase the likelihood of their PA and delay the onset of the aging process. In addition, while investment in large-scale urban design and infrastructure can take time, increasing the accessibility of functional spaces would also be beneficial to the older population.

There are some limitations to this study. First, there were some differences in individual characteristics between the interviewees and longitudinal survey data, thus it is possible that

selective-interview bias entered into the quantitative analysis. However, the PA between the two groups were similar, and given the difficulty of data collection in China, the sample of older people obtained for the interviews was a highly successful attempt to acquire new information for this study. Second, since the longitudinal health survey data were collected from a local hospital, some important factors related to PA revealed in the interviews could not be examined in the quantitative model. For example, data on the attendance and location of PA were lacking. Third, the effect of other local factors that might affect PA, such as urban sprawl and the temporal variation in urban pollution could not be investigated. Fourth, to simplify the quantitative models, the built environment was defined as the apartment site, yet physical activity may also be affected by social and physical aspects of a nearby apartment or a neighborhood. Finally, this study is among the first to investigate the impacts of individual and social and physical built environment factors on older adults' PA change in a mid-sized city in China; comparisons with other case studies in other cities and in other countries would be very beneficial.

However, strengths of this study were to combine the Social Ecological Model and the Stages of Change Model to point out residential forms, where changes could be made in community engagement, neighborhood design and the location choice of older people's apartments (Giles-Corti & Donovan, 2002; James F. Sallis et al., 2006). In addition, separating PA into three stages(initiation, regulation, and maintenance) helped to identify interventions to promote PA at different stages of PA (Marshall & Biddle, 2001). Another strength of the study was the mixed-methods approach. On the one hand, qualitative interviews and content analysis allowed for the identification of a daily activity area, within which factors pertaining to individuals and the built environment (motivators and barriers) were identified from both scholars' and subjects' perspectives. These informed findings were then used to test causal relationships, instead

of vague associations. Importantly, also were the multilevel path analyses that incorporated findings from the content analysis to demonstrate significant direct and indirect causal relationships, -i.e., how individual and social and physical built environment characteristics acted independently and interactively to affect PA change) (James F. Sallis et al., 2006) and consider the cross-level interactions without overstating the statistical significance of the built environment level predictors (Rouquette et al., 2015). This approach led to informed evidence-based interventions to promote PA and healthy aging. Previous studies on PA and the built environment in China (Ying et al., 2015) and Western countries (Bancroft et al., 2015; Ding & Gebel, 2012; Frank, Schmid, Sallis, Chapman, & Saelens, 2005) describe what a health-promoting built environment should look like to promote PA. This study advances that line of research by proposing interventions that can not only encourage sedentary older people to begin PA (Rosenberg, 2016), but can also help older people to regulate and maintain their PA. Based on these findings, intervention sites were defined and the most vulnerable populations were identified through the mapping. The next step in this study would be applying the interventions on the targeted populations.

Conclusion

This study builds on the built environment and health behavior literature by combining the Social Ecological Model and Stages of Behavior Change Model and examining the causal relationships between the built environment and PA among middle-aged and older adults, through a mixed-methods approach. The findings from this study provide informed interventions at both individual and built environment levels, which will promote healthy PA among older adults in urban China. Three types of intervention sites were defined, specifically to increase older people's

overall PA. Future interventions should focus on empowering physically active residents to promote sedentary neighbors to remain active on a regular basis; residential form and access to functional spaces could be changed through individual decision-making, prior to investing in large-scale urban design interventions.

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CHAPTER 4

THERAPEUTIC PUBLIC SPACES FOR ALL: PERFORMANCE AND COLLABORATION OF LEISURE PHYSICAL EXERCISERS IN URBAN CHINA

Introduction

Both health geographers and urban geographers emphasize the increased need for social justice in their work (Harvey, 1992; Rosenberg, 2014). Health geographers contribute to this aim by promoting the health of marginalized and vulnerable populations in society -e.g., older people, minority populations, and social deprivation (Guagliardo, 2004; Wolch, Byrne, & Newell, 2014). Since the healing places, -i.e., therapeutic landscapes, are largely privatized and have differential proximities for different social groups, the discussion of therapeutic landscapes in the literature is largely limited to those of mid-to-upper classes and misses marginalized and vulnerable populations (Rosenberg, 2016). A theoretical framework that expands the meaning and value of therapeutic landscapes, as healing and health promoting places for all people, -i.e., rich and poor, young and old, local and immigrant populations, requires further development in the field (Rosenberg, 2016) and is an aim of this paper.

In contrast, urban geographers contribute to the social justice literature, by focusing on how urban spaces can serve all people, especially in reference to parks, squares, and boulevards (Harvey, 2013; Young, 2011). This literature also describes and interprets the conflicts and segregation between social groups within public spaces (Harvey, 1992), -e.g., fears of attending parks in poorer areas, and the poor not feeling welcome in parks in upper-income neighborhoods. These studies highlight the growing disparities in access to urban public spaces, such as through the gentrification of neighborhoods and the privatization of parks and other public spaces (Mitchell,

1995) but missing from the literature is how this untoward trend will impact the health of the marginalized and vulnerable populations. There is a need therefore, to find common ground between the work of health geographers and urban geographers, to find therapeutic meaning in urban public spaces, while addressing the conceptual and practical barriers of inclusion for all people in these 'healing' places.

This study aims to contribute to the gap in literature between health geography and urban geography by combining the concepts of therapeutic landscapes and public spaces. In particular, therapeutic landscapes will be viewed as a collaborative construction between different demographic (young and old) and social (rich and poor, local and immigrant) groups, with therapeutic benefit resulting from the construction of new social identities by bringing together disparate groups, through the creation of harmonious atmospheres, within these public spaces. Emerging from this discussion is a new concept that we refer to as "therapeutic public spaces." China has a large and growing older population, who are dependent upon outdoor exercising to meet their daily physical and social needs. Therefore, a case study of older people practicing activity in outdoor urban spaces in one large city (Beijing) and one mid-sized city (Huainan) in China is presented to highlight the need and value of therapeutic public spaces.

This study has two objectives. First, this study will attempt to show the synergies between the therapeutic landscape and public space approaches to understand the possible collaboration between different social groups in the making of therapeutic—public spaces. This study will followtherapeutic landscapes studies and emphasize the interactions between different groups, and then build upon the public spaces literature by adding the pursuit of health as a way of engaging public life. This paper juxtaposes the healing functions and identity construction functions as people's dual aims of physical activity practice in therapeutic public spaces, and shows how they

construct their identity by a spectacle of health promotion practices (physical activity) and how they pursue their health by constructing their identities. By doing so, this paper argues that different groups of populations participating in activities together in public spaces, will enhance each other's practice and create a "therapeutic landscape for all".

Second, this paper links the Chinese long-lasting traditions of filial piety, life-nurturing movements (including physical activity in public spaces) with the newly emerging rapid demographic and neoliberal transition in recent years. I argue that physically active older people play a fundamental role in creating a "therapeutic landscape for all" and successfully "escape without leaving" the commercialization of everyday life in neoliberal China. Although relying on limited pensions after retirement, older people contribute to society by constructing their active identity and working with other exercisers in the making of public spaces. In the following sections, I will first introduce the combined therapeutic public approaches and then introduce the Chinese long-lasting and newly emerging contexts, before introducing the case study.

Making Therapeutic Spaces for Public/Putting Health into Public Spaces

In this section, I will first introduce the origins and development of the therapeutic landscapes and public spaces approaches followed by their contributions to social justice, and then introduce the three foundations of the combined approaches. Therapeutic landscapes were developed as an approach to examine "how places can be harnessed with healing functions to promote the health and wellbeing of people within these places" (Gesler, 1992; Smyth, 2005). Originally proposed as an approach to study the relationships between the natural environment and human health with "a lasting reputation of healing" (Gesler, 1993; Gesler, 1992), the concept also discuss various forms of human-made landscapes, including institutional spaces, such as hospitals

(Curtis, Gesler, Fabian, Francis, & Priebe, 2007), asylums (Philo, 1997), residential care facilities (Cheng, Rosenberg, Wang, Yang, & Li, 2011), and everyday spaces, such as public parks (Milligan, Gatrell, & Bingley, 2004), neighborhoods (Wakefield & McMullan, 2005), and home (Williams, 2002). When talking about human-made everyday spaces, therapeutic landscapes often include green and blue spaces and assume that the inherent meanings of such blue or green elements, such as trees, gardens, lakes and fountains, are therapeutic for both physical (Bancroft et al., 2015) and mental (Völker & Kistemann, 2011) health, -e.g., the physical and mental benefits from exercising and participating in recreational activities.

Therapeutic landscape studies have emphasized the importance of social justice in two ways. First, studies ask to what extent market-oriented green/blue spaces reduce accessibility for all, leading to disparate uses of these spaces by different social groups (Kearns & Collins, 2000; Wolch et al., 2014). Since social inequality can occur in space in the healing function itself, and in the ways in which therapeutic spaces are provided (Smyth, 2005), therapeutic landscapes studies have started to focus on the interpersonal communications and encounters within the spaces (Conradson, 2005; Foley & Kistemann, 2015). These studies, however, by in large take place in neoliberal Western societies and serve a relatively homogeneous group. For example, studies have shown how patients of similar socio-economic status attend hospitals of similar quality (Kearns, Barnett, & Newman, 2003); exercisers of similar incomes purchase gym memberships of similar status (Foley, 2015); and older retirees with time find leisure in gardens (Milligan et al., 2004). Aside from a few studies that describe the insecurity of people as they encounter different social groups (Philo, 2014; Poland, 1998), there is a need for further studies that describe the positive collaboration between people perceived as different. Moreover, vulnerable groups, such as older people, or socio-economically vulnerable, such as by race, ethnicity or low income and refugees,

are often either absent or stereotyped in a relatively negative role within the same spaces (Laws, 1993; Sampson & Gifford, 2010). The remaining questions here are whether and how to build a therapeutic landscape with different majority and vulnerable groups of people who are pursuing their health and wellbeing without conflicts, even collaborating their practices with each other.

Researchers on public spaces, instead care about social justice by reflecting on how places can adapt to construct the social identities of social groups. Originally emerging from a place where "bourgeois publish their public opinions among aristocrat" (Habermas, 1991), the concept gradually widens itself by shedding more lights on people with lower social status, including the working-class (Fraser, 1990) , homeless (Mitchell & Staeheli, 2006), refugees (Malone, 2002) and LGBTs (Hubbard, 2001). The definition of 'public' has also been extended from Habermasian political claims to a Goffmanesque stage where people of different social backgrounds construct their own identities by performing in front of others in cafes, along sidewalks, and in parks and shops (Goffman, 1959, 1963, Laurier & Philo, 2006b, 2006a; Qian, 2014). Such public spaces with encounters from different social groups are declining since the public spaces are being privatized and commercialized through gentrification and banishing people with lower social status out of previously public spaces (Harvey, 2013; Mitchell, 1995). A small but visible group of research focuses on the strategies and tactics of people at lower strata in public spaces, suggesting the possible contributions they make in the maintenance of public spaces (Amster, 2008; Duneier & Carter, 1999). Missing from this literature is that people not only attend public spaces to construct their social identities, but they are also motivated by more practical reasons such as businessmen visiting a cafe to meet clients; white-collar workers waiting at bus stops for commuting; retirees visiting parks for exercises; and venders selling used-books on sidewalks to make a living. Simply by pursuing these fundamental needs, people can engage in politics and

construct identities (Farquhar & Zhang, 2012; Rose, 2007), and only when people of different social groups achieve their ultimate needs in front of others can public spaces be maintained. Concern for the decline of public spaces is, therefore, that people will not have access to their livelihoods to achieve their fundamental needs in such spaces (Mitchell, 1995). In other words, people's ultimate needs in public spaces, such as promoting health or making a living, should not be neglected in the maintenance of public spaces. Pursuing physical, mental and emotional health and wellbeing as dimensions of health and employment as a basic livelihood should not be underestimated in public spaces studies.

Work exploring the origins and development of therapeutic landscapes and public spaces above suggest that a marriage of these two approaches is not only possible, but also a beneficial solution to the dual problem of social justice. A combined approach, therapeutic public spaces, is built upon the following three common foundations of the two approaches. First, it is possible to combine because of their similar focus on open spaces in urban areas. While therapeutic landscape studies in urban areas have paid more attention to blue/green spaces (Rosenberg, 2016), the concept of public spaces can expand the foci of therapeutic landscapes to include more ordinary spaces, such as sidewalks, bus stops –i.e., places where "the healing process can work itself out" (Wilbert M. Gesler, 1992, p. 743). On the other hand, with the focus on health and healing in public spaces, urban geographers may begin to explore spaces traditionally thought to be 'therapeutic' such as heritage sites, national parks, and public gyms.

Second, both approaches focus on the roles of different groups of people within the spaces. Therapeutic landscapes studies argue that while the role/identity of different groups can influence the local atmosphere (Duneier & Carter, 1999) and then influence people's pursuit of mental and emotional health (Glenda Laws, 1993), people of all age groups and social backgrounds should

be able to acquire the sense of healing on a physical, mental and emotional level (Poland, 1998; Sampson & Gifford, 2010). Public spaces studies have primarily emphasized that people of different social strata should be able to construct their own social identities in the same arena (Harvey, 2013). By combining the two approaches, the subjectivity of people in therapeutic public spaces should be defined by both their socio-economic and their fundamental needs in the place of healing -i.e., the pursuit of health for their body and mind.

Third, both approaches have paid attention to the symbolic interactions between people of different ages and social groups, and their surrounding environments. Therapeutic landscapes has its long lasting interests on the symbolic meanings of the local physical environments -i.e., where people work, live, play and heal, such as water, plants, room design of hospitals, that experienced and encountered by different groups of people within the spaces (Foley, 2015; Völker & Kistemann, 2013; Zhou & Grady, 2016). Such symbolic interactions have the potential to promote the collaboration of different groups in the same spaces, if the ultimate needs of health are commonly desired and/or achieved, although conflicts may also occur if some symbols obstruct the achievement of health (Zhou & Grady, 2016). However, few studies discuss the possible collaboration between different social groups in the making of therapeutic landscapes. Comparatively, studies on public spaces often apply multiple social theories to study the symbolic meanings of appearance, gestures, and conversations during the interactions (Goffman, 1963; Laurier & Philo, 2006a; Qian, 2014). Therapeutic landscape studies can inspire public spaces with its emphasis on physical and psychosocial health as one of the most important needs in public spaces (Low, Taplin, & Scheld, 2009), thus addressing the decline of public spaces in neoliberal society. Simultaneously, public spaces studies can inspire therapeutic landscapes with its deep ground of social theories, not limited to inter-subjectivity and non-representational theories (Foley,

2015; Foley & Kistemann, 2015), but also the performativity and ethnomethodology approaches (Garfinkel, 1963, 2002, Goffman, 1963, 2009), thus opening a discussion of collaboration of different groups in the making of therapeutic landscapes. Applying such a combined approach, this paper is a blueprint of therapeutic public spaces constructed by the collaboration of different social groups in every possible spaces of Chinese cities, reflecting and hopefully expanding the boundaries of therapeutic landscapes and public spaces in previous studies.

Physical Exercisers in a Transitional China

The overwhelming majority of conceptual and empirical studies of therapeutic landscapes, and public spaces take place in Western contexts. In contemporary China, older people's leisure physical activities in public spaces can be understood from recent to historical contexts-the recent rapid demographic transition, neoliberal transition after the Reform and Opening Up, collectivist ideology in the socialist period, and the long-lasting filial piety tradition in history.

Since the 21st century, the older population has grown rapidly in China as well as many other countries of the world. China had over 14 million older people over the age of 65 years, and by the end of 2015 older people will comprise approximately 10.5% of the total population (World Health Organization, 2015). In line with the rapid aging transition are increasing health and social burdens, including increasing chronic disease and geriatric syndrome prevalence, and hospitalization and institutionalization costs. In response to this, the World Health Organization (WHO) (World Health Organization, 2002) and Chinese government developed multiple programs to encourage older people to engage in physical activity, which in turn will maintain and promote their health and wellbeing of life and reduce societal costs. Since the late 1990s, a life-nurturing

movement, including leisure physical activities and hobbies, has been observed among Chinese middle-aged and older populations in urban public spaces (Farquhar & Zhang, 2012).

Outdoor physical activity is an inexpensive type of health-promotion practice in the commercialized health promotion market of China's neoliberal society after the Reform and Opening Up (Farquhar & Zhang, 2012). To transfer the burden of rapid aging costs from the state to individuals and society, the market developed a health-related industry from the diverse needs of older people for health-related consumption products, under the guidance of the government (Zhang & Ong, 2008). In no more than ten years, health-related industry has surpassed many other economic sectors and has become the fifth largest economic sector in China's economy (Sun, 2015). The mushrooming of care facilities and institutions for the older population, including physical activity courses, rehabilitation trainings, as well as residential care institutes for older people with disabilities or dementia, are high-priced and inaccessible for ordinary older retirees with limited pensions. The expensive health care facilities provide services for high-income customers and do not offer financial assistance to those with only a retirement pension, in particular in poor provinces and small cities, thus creating large health disparities between those who receive care and those who do not (Lin, 2009, p. 200). In addition, the large labor outflow in these declining cities has caused a great scarcity on older family-caregivers. Therefore, the popularity of leisure physical activity in public spaces is not only an extension of a life-nurturing tradition, but also a fundamental mission of the large number of ordinary older people (in their own words) – because "we are not rich to use high-priced care facilities, we have to promote (at least maintain) our health and pursue some kind of wellbeing in an inexpensive way" (Zhou personal communication, February 2016). Although leisure physical activity in public spaces is not totally free, a monthly

payment of 5-20 RMB crowdfunding for facilities and clothes is affordable for those on a limited pension (Qian, 2014).

Apart from the neoliberalism after the reform, the collectivist ideology generated before the reform in the socialist period also shape older people's physical activity practices. The older generations grew up in socialist period and spent most of their young age in the early stage of Reform and Opening Up period, and finally got old in the neoliberal era. In the socialist period, organizing and practicing collective physical exercise was a top-down biopolitics from the state to the local level with the aim of maintaining the collective ideology and health of socialist labor (Farquhar & Zhang, 2012; Qian, 2014). While experiencing the social transition over their lifecourse, many older people still hold a collectivist sense and emphasize the honor of 'collective' life (Yu & Rosenberg, 2017). Interestingly, many older Chinese exercisers like to follow the state-organized leisure activities in socialist China (Huang, 2006) and still conduct their physical activities together in public spaces in almost every large, mid and small sized cities (Chen, 2003). Moving across to this new era, this generation consider old-style collective outdoor physical activity as an important way of constructing social identities (Qian, 2014). Inherited from the socialist period, such an inexpensive way of practicing leisure physical activity and crowdfunding strategies is not an innovation but an idiomatic strategy appropriated from the socialist period in response to the phenomenon of health inequality in the neo era.

In addition to the new time contexts described above, older people's physical activity is also deeply rooted in the tradition of filial piety or *xiao*, a long-lasting Confucian idea. This idea emphasizes offspring's material provision and physical caregiving to their older, weak, and dependent family members; the energy and creativity of older people in China is largely neglected (Sharps, Price-Sharps, & Hanson, 1998; Zhan & Montgomery, 2003). The dependent role of older

people has been additionally extended to the community and the entire society, suggesting respecting and taking care of all older people as if they were family. Nowadays, aging related projects in China are called feeding older (*yanglao*) projects, demonstrating the old stereotype of China's older population in the new era. While continuously constructing the vulnerable appearance of older people in Chinese society, the traditions of filial piety paradoxically deliver a gerontocratic idea to the older group, -i.e., older means respectful and knowledgeable and should be able to govern the younger generation, the whole family, and even the society. In this light, the idea of filial piety in contemporary urban China empowers older groups to influence their life world. They are willing to construct their social identities and participate in public life through performance in public spaces, although their real influence can be different from their expectation.

The backgrounds of then and now led me to consider the leisure physical activity in public spaces as both a health-promoting practice of a growing aging population in response to commercialized health care services, and a performance about collective identity construction with ambitions to influence other groups in public spaces.

Methodological Notes

The analysis in this paper is based on my fieldwork in public parks in both Beijing (summer 2014-2015) and Huainan city (spring and summer 2016). A large and a mid-sized city were studied because different patterns of physical activities were expected between large and mid-sized cities. Large cities attract more immigrants, and the health-promoting industries and facilities developed earlier and are more mature than in small cities. Comparatively, the demographic transition is more rapid in mid-sized cities but care-giving from family members is more scarce because of the

large amount of emigration to large cities and relatively small amount of immigration from local rural areas (Gu & Zhang, 2006).

Two public parks were chosen in Beijing (Yuan Dynasty City Wall Relics Park and National Stadium) and Huainan (Laolongyan Park and City Stadium). According to the pilot study, these parks are green spaces with reputations for healing across their respective cities thus attracting ample exercisers and hobbyists of diverse backgrounds, children, young and older people, rich and poor, local residence and immigrants. Most of the activity groups were welcome to participate, and the interactions between individuals and groups were, therefore, easy to observe. Although diverse groups were welcome to practice physical activity in the same parks, people of similar backgrounds tended to conduct similar activities in a certain time period. For example, square dancers and hobbyists were mostly middle-and older-aged and often exercised in the early morning and late afternoon; joggers were mostly young people and often jogged in the evening; and tourists were also welcome during the weekends. Since the primary author was a young woman with no children, she was welcome to visit the sites as joggers or visitors are welcome to do so. The study sites also included sidewalks and the front square of groceries near these parks, since leisure physical activities were not always nested within green spaces; instead they commonly occurred on sidewalks and in front of some groceries.

The fieldwork, including participant observation and in-depth interviews, were conducted in the morning, afternoon and evening when leisure physical activities and recreations occurred. I started with regular jogging in the study sites to avoid the sense of hostility from my observing groups (Philo, 2014), although there was one jogger who was a bit too active than others who usually jogged only in the evening. Participant observations focused on the performance and interactions between three groups: (a) 20 stationary exercise groups or individuals including square

dancing *dama*, *tai-qi* groups, Latin dance groups and choruses, individual exercisers and hobbyists, (b) 21 mobile exercisers including joggers and bicyclists, and (c) 10 retailers including venders, craftsmen and shop assistants in the groceries nearby. Since people perform through various modes, not limited to language but also through appearance, gaze, gestures, body actions (Goffman, 1959; Laurier & Philo, 2006a) and their arrangement of spaces (Zhou & Grady, 2016), these multiple modes of performance were observed and documented. The observation results were recorded in field notes and photographed with consent.

The in-depth interviews consisted of 43 open-ended interviews and several informal interviews among the observed groups of people, including stationary leisure exercisers and hobbyists (n=23), mobile exercisers (n=11), and venders and retailers (n=9), which were suggested to be saturated in qualitative studies (Guest, Bunce & Johnson, 2006). Stationary exercisers were randomly selected from the observed groups and individuals before the start of their activities to avoid disturbing their daily activities. Interviews with this group were conducted to learn why they practiced a certain type of activity, why they selected the current activity spaces, how they constructed their identity with appearance and arrangement of surrounding spaces, and how they reflected on their interactions (conversation, collaboration, or conflicts) with other encounters. To promptly capture mobile exercisers such as joggers and pedestrians, walk-along interviews (Carpiano, 2009; Kusenbach, 2003) were conducted with this group with consent. Interviews with them were similar to those with stationary exercisers but almost none of these mobile exercisers made any changes to the surrounding environments. Venders and shopping assistants were recruited after purchasing their products and with consent. Interviews with this group focused on why they selected the space to do their business and how they reflected on the interactions with the physical exercisers there.

Although the interview questions were structure-designed, the interview process was actually semi-structured and open-ended since the interview itself became an opportunity for the participants to perform and construct their identities (Ezzy, 2010). It would have been ideal to recruit more respondents for in-depth interviews but time constraints and difficulty approaching retailers limited the sampling size and the length and depth of some interviews. Besides the 43 respondents, many of the interviews could only be treated as informal interviews as the respondents refused to be recorded or could not complete their entire interviews. These informal interviews, which were not recorded or interrupted, were used to compare with the recorded interviews to ensure saturation of the sampling (Yeung, 1997) –i.e., no new information was obtained from additional interviewees.

In addition, observation notes, interview records, and photos were integrated into a thematic analysis, searching for common and divergent performances and reflections on other encounters and the activity spaces. Individual level data were compared within and between groups (Glaser & Strauss, 2009) and triangulated between different research sites in the two cities (Yeung, 1997). Based on these analyses, I analyzed the role of each group of participants in the making of therapeutic public spaces for themselves and for other encounters. In the next section, I present my findings in three parts, detailing the performance of three groups of physical exercisers, -i.e., stationary physical exercisers and hobbyists, mobile joggers and pedestrians, and the supportive retailers. For each group, I interpret the symbolic meanings of the appearance and the environment they built-up, experienced and encountered, following a reflection on the role each group played in the making of therapeutic public spaces and the relationships between such a physical activity practice and the Chinese context. Since there were no obvious distinctions between the two cities (except there were more immigrant participants in Beijing), I do not present a comparison between

cities. The research was approved by the Michigan State University IRB (# x15-413e) determined Exempt (April 24, 2015).

Results

Stationary Leisure Exercisers and Hobbyists: Mid- and Older-aged Pathfinders

Leisure exercisers and hobbyists selected many places as their 'stations' where they practiced activities at a fixed time every day. Most of the participants were middle to older aged adults and were retired or almost retired from their work. With ample and restless leisure time, they occupied the spaces regularly and frequently. Inviting several old colleagues and going out to practice leisure physical activities, every day had become their obligatory course of later life. There were four typical types of exercise and recreation stations. The first type was public space with forests (Jingshan Park, Beijing) or surface water (Laolongyan Park, Huainan) as reputable healing elements for outdoor leisure (Figure 14a). Second, Chinese pavilions were an important choice as places of leisure physical activities and recreation.

Such pavilions are designed following the old types of architecture in traditional fairs and Chinese royal gardens (Hsu, Chiang, Tsai, & Wang, 2002). A pavilion is normally open structure with a rectangle steeple supported by pillars. Pavilions in ancient times were commonly used as theaters for royal and local opera performances. In contemporary public parks, such pavilions are designed to provide pedestrians a seating place for sightseeing and rest. For the leisure exercisers and hobbyists, however, a pavilion is considered as a perfect stage for their performance. In Yuan Dynasty City Wall Relics Park, Beijing and Laolongyan Park, Huainan, almost all of the pavilions have been occupied by ballroom dancers, *qi-kong* players, Peking Opera clubs, and choruses (Figure 14b).

"We are singing opera on this stage (the pavilion)." (Yun, female, retired, a member of chorus, Yuan Dynasty City Wall Relics Park, Beijing)

"The music works well here (in the pavilion)." (He, male, a Jinghu player in a Peking Opera club, Laolongyan Park, Huainan)

In addition to pavilions, squares, frontages and glades near pedestrian tracks within the parks were also popular spaces for leisure physical activity and recreation. While large troops of square dancers and choruses assembled in larger squares in front of the National Stadium and City Stadium, *diabolo* players and Karaoke singers showed up in smaller glades and frontages in Yuan Dynasty City Wall Relics Park and Laolongyan Park (Figure 14c). Importantly, different from western concepts of urban green/blue spaces, Chinese leisure physical exercisers and hobbyists also expanded their activity venues out of the parks, forests, and surface water to ordinary urban public spaces-frontages of gated communities, restaurants, groceries, and schools next to sidewalks. For these exercisers, public blue/green spaces and pavilions were too far from their homes, or maybe these spaces were limited because they were occupied by other groups at a certain time of a day, so instead they occupied the next best places, which were the most convenient. Lacking the typical healing elements of vegetation and water, frontages next to sidewalks were less beautiful and perhaps less therapeutic, since there was much more air and noise pollution. Exercisers valued these spaces however, for their convenience, open-access, and free light in the evening. In Beijing and Huainan, square dancers were observed in front of gated communities, banks and restaurants (Figure 14d).

Day after day, these spaces gradually became the territories of exercisers and hobbyists for a certain time of day. Compared with them, walkers utilized the tracks and spaces in the parks, but

their mobility made it hard for them to ultimately occupy a specific space. By saying territories here, I mean that middle to older aged people actually acquired a spatial and temporal jurisdiction over spaces. Every morning and evening, such a space was reserved by a certain group. People always came to the space on time to practice their activity and recreation in a fixed time period. They usually brought their crowdfunded facilities such as microphones, outdoor speakers and instruments, and then took them home after the activity. Their activities were never interrupted by weather, -i.e., outdoor winds drizzly, chilly or smog, except when there were rainstorms. Beyond the performance of physical exercise and hobbies, the people also administered the space by taking the responsibility to keep the space nice and sanitary, displace the illegal parking, and watch the security of surroundings. For a certain time of a day, these spaces were commonly considered by passersby as these exercisers and hobbyists' territory.

Notwithstanding a territory, it is an open sharing territory with a low threshold of entry where almost anyone is welcome to join the exercisers' group with permission, and most importantly, all of the performance of exercisers and hobbyists needed audiences. The four types of spaces were selected because of their convenience for audience watching and listening to the performances (Figure 14a-d). The pavilions provided perfect audience seats around the center of the stage. Pedestrians often stopped by squares and frontages to rest and watch the physical activities and recreation. The applause and enjoying faces encouraged exercisers and hobbyists to perform well through all kinds of practice. Some groups started to wear uniforms and invite professional artists to teach and improve their performance. Within the groups, peers criticized and helped each other to make progress and the best performer was elected to lead, guide, and monitor the performance of every member. Different activity and hobby groups also competed and compared their performances with each other by peer-reviewing uniforms, body movements, and

their maintenance of surroundings. A number of competitions were held in front of the National Stadium for square dance groups across the country (Fullerton, 2016).

Figure 14: a: Physical exercisers near a lake. b: A pavilion with Peking Opera Club. c: *Tai-qi* in a front of a park track. d: Square dancers in front of banks and restaurants.

Through all kinds of performance to the public, these middle to older aged exercisers and hobbyists produced open sharing spaces for public leisure, and a collective identity as an active group. Although coming from different socio-economic strata, they had all labeled themselves and had been labeled in their groups. Such a consistent identity was defined by their simple aims of performance to promote health and to perform as active lively collectives in their later life, strengthened by their consistent uniforms and sports suits obscuring their individual differences.

In such an exercise and recreation space, age identity tended to be more important than socio-economic identity.

> "(We are) All *daya* (grandpas) and *dama* (grannies) come to exercise together. It is not only about individuals, we are a collective and should have collective sense of honor." (Xiang, male, retired worker, a tai-qi player, the City Stadium, Huainan)

> "Some day we will all belong to the crematorium. (No matter if you) rich or poor, (you will become) a pile of soil." (Yi, male, retired banker, a tai-qi player, Yuan Dynasty City Wall Relics Park, Beijing)

The consistent identity was also confirmed by other participants of the spaces. In addition to collective active and lively groups which self-identified themselves as such, in contrast other participants treated the exercisers as an old weak group. By saying 'weak' they meant the middle to older age adults were getting biologically weak so that they did not have that much energy and motivation to harm themselves. Compared with the identity of insecure strangers for some encounters in Western public spaces (Philo, 2014), such an assemblage of simple, active and weak elements of the body coincidently guaranteed the security and friendliness of these localized spaces in contemporary urban China. Moreover, the performers and audience were relatively fixed-most of them attended at a fixed time of day and tended to be acquaintances day after day-which served as eyes on the street to watch for possible risks and dangers from strangers (Jacobs, 2016).

In public parks and pavilions, parents walking with their children were not hesitant to allow their children to play around the dancing groups so that they could have more private relaxed time for themselves (Figure 15a). Children were welcome to play near the groups or join the dancing

groups with older exercisers. Older hobbyists on the frontages of sidewalks in the evening also provided a lively and secure track for late commuters (Figure 15b).

> "They are *daye* and *dama* coming for physical exercise. And many people come and go and watch (each other)." (Jun, mother of a 4-year-old girl, doctor, Yuan Dynasty City Wall Relics Park, Beijing)

> "They just come for exercise, and they are a group of people." (Yuqin, female, young commuter, the National Stadium, Beijing)

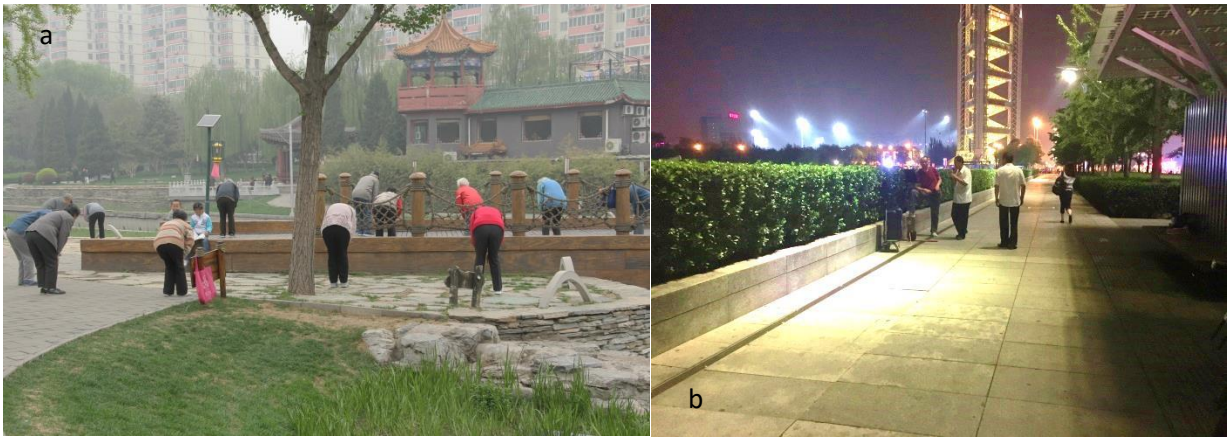

Figure 15: a: Children freely play around the square dancer on the frontage. b: Old Karaoke singers provide a lively and safe track for late commuters.

According to the observations and interviews, I concluded that the stationary exercisers and hobbyists created the *foundation* for therapeutic public spaces in both research sites. They first occupied an undefined open space, harnessing it with a therapeutic function by adapting it into a nice clean space for collective physical activities. Some healing elements such as water, vegetation, and Chinese gardens were grabbed to create a therapeutic environment, spaces without such elements were also occupied for their ultimate aims of promoting health. Such therapeutic spaces were created not only for their pursuit of health but by adding the healing function to the space, these exercisers and hobbyists constructed an identity of an active older collective obscuring socio-

economic strata and backgrounds, which attracted many other exercisers together as the eyes of street maintaining security for children, pedestrians and commuters. Such a secure atmosphere then attracted more social groups to accomplish their physical, mental and emotional demands, develop their identities, and orient the space towards a more therapeutic and public dimension. A description of these other social groups follows.

Mobile Exercisers: Audiences and Consumers

The mobile exercisers were a heterogeneous group of various ages and socio-economic backgrounds. In this study, I selected the three most common groups to estimate their mutual intersections and roles with other participants in the production of therapeutic public spaces. The first group were joggers, individuals and groups. Many individual joggers ran during a fixed time of day following a fixed track in the park. They often wore professional sports suits and running shoes with sports bracelet to monitor various biological functions, such as heart rate. They often wore earphones and seldom talked with each other due the strenuous nature of the activity. Joggers also organized jogging clubs and exercised together. Similar to square dance *dama,* jogging clubs also had uniforms (Figure 16a); different from them though, were jogging clubs where relatively dynamic groups with new and old joggers rotated in and out depending upon their stamina. If the stationary middle to older aged exercisers encouraged other older people to be active, the median age of joggers was relatively young, as they performed and created an identity of younger intensive athletes that tended to be more attractive and exciting for younger people.

The second group is the oldest-old walkers. This group could only spend a limited time during the day to have a short walk in the park or along the near street because they may have heavy family responsibilities such as taking care of children or have physical syndromes that do

now allow them to group exercise. These oldest-old walkers, walk short distances and slowly, never trying to compete with anyone else for speed (Figure 16b). They come to the park on the way to the farmer's market, and have to leave before their grandson's (or granddaughter's) school ends. Generally, they are the most loyal audience watching their younger peers (middle to older aged) perform. Even though the middle-aged exercisers and hobbyists try their best to perform well, most of them are obviously amateurs and just practice for health. Such performances therefore cannot attract a young audience. Young audiences may stop by to enjoy the performance but only to be nice, but the oldest-old audiences appear to admire their peers. They admire these exercisers and hobbyists for their courage, body strength and leisure time to practice the activities and recreations that younger people enjoy and benefit from. A couple of quotes from the oldest-old walkers illustrates how they differ from younger audiences.

> "I'm old and don't have energy to dance. I danced better than them when I was young. I used to be a dance shower in the annual convention of my company." (Cuifen, female, 69, coronary heart disease, Laolongyan Park, Huainan)

> "I don't have time. I have to take care of the kid. His parents don't have time. Buy food, cook the meal, and take the kid from and to school. Look at my stomach, I'm getting fat since taking care of it." (Rong, female, 67, Yuan Dynasty City Wall Relics Park, Beijing)

The third group is parents walking with their children (Figure 16b). The aim of this group is no longer for intensive physical training. Instead, they hope to attach their children to nature and diverse hobbies in such a lively space and thus build intimate relationships between parents, children, and their lifeworld. In other words, the parents consider the public parks and sidewalk frontages as ideal spaces to pursue the wellbeing of family life. They teach their children

knowledge and skills that relate to nature such as plant knowledge in the spring when the flowers bloom; they let their children play with pets on the grass; they take their children to fly kites in the wind; they take their children to watch performances of various hobbies such as *diabolo*, calligraphy, *Tai-qi* and Peking Opera and hope their children can be inspired and cultivate their own hobbies; and some parents simply walk with their children to enjoy the leisure chatting time. For such a group, natural elements, such as plants, grass, water and pets serve as important therapeutic symbols to produce their family's sense of wellbeing.

> "Take the kid to feel the nature so that he can feel relaxed from the city of reinforced concrete." (Jia, female, mother of a grade 1 pupil, Yuan Dynasty City Wall Relics Park, Beijing)

> "I take her to learn the name of these flowers. This is the first time I teach her about that. I'm too busy." (Xiaoshu, female, mother of a 4-year-old girl, dentist, Yuan Dynasty City Wall Relics Park, Beijing)

For the children, this is valuable leisure time with their parents and also provides space to escape from their school's homework, the everyday norms in the classroom and home and to be themselves, which is a mental and emotional healing process for them.

> "Boys of his age are full of energy. They want to run and jump and sweat. School teacher always forbid them to avoid any damage. But he really needs it. If I forbid him, he will get fatter." (Qiong, male, father of a grade 3 pupil, the National Stadium, Beijing)

The parents group was the easiest to build rapport and conduct interviews. They were also the easiest group to start conversations with each other. As mentioned before, many parents liked to sit near the stationary exercisers and hobbyists and let their children play, while conversations

naturally occured. After confirming their identities as parents for each other, the conversations often started with the grade, personality, hobby, and education of their children. The core function of the talks was to better educate their children. After several encounters, different parents and children became acquaintances. Families of similar socio-economic backgrounds tended to build rapport because of their similar attitudes and opinions on education. Parents and children are the main consumers in these spaces. Children wanted food and water after sports and were curious about new things. This market has been captured by the low-end retailers and craftsmen vendors.

Figure 16: a: A group is jogging fast in the evening. b: an old walker, following a mother with two children.

In summary, the mobile exercisers expanded the range of participant groups from the youngest-young to the oldest-old, and also helped to produce a more diverse, vigorous, and mobile healing process for physical, mental, and emotional health, -i.e., for the tired bodies and minds of the city. They are the beneficiaries of the secure and lively spaces created by stationary exercisers and the blue/green elements provided by urban planners and highlighted by health geographers. They also contributed to becoming the supporters and audiences of their middle to older aged peers and produced a diverse and energetic atmosphere to the healing spaces in return. Although long lasting in-depth relations were not expected to be created between people of different socio-

economic strata, rapport was naturally built among different parents with similar backgrounds and small talk naturally occurred between different social groups. Also importantly, the large number of parents and children attracted low-end retailers and craftsmen vendors, which created another type of collaboration between different social encounters in the same public space.

Low-end Retailers: Supporters

As another group of participants, the low-end retailers and vendors did not come to these spaces to pursue their health and wellbeing, rather they came to make a living. The role of this group is important and essential for the production of therapeutic public spaces. In this paper, I categorize low-end retailers into stationary retailers and mobile vendors according to their different roles in the production of spaces. The stationary retailers provided low-end commercial activities, including small restaurants, low-end groceries and farmer's markets near the activity space (Figure 17a), many of which were developed ahead of the production of public parks or activity frontages. While many middle to older aged retirees had more leisure time than younger people, they could not walk as long as young people and they also had to achieve multiple purposes in a limited spatial area (Su, Schmöcker, & Bell, 2009). Some of the retailers may go out early in the morning, practice physical activity in the park, have breakfast in the small restaurants near the park, and then go shopping in the groceries or farmer's markets nearby. As a result, parks and frontages near these stationary retailers were more likely to be selected as activity spaces for some retirees to exercise and subsequently shop and accomplish some other tasks in one trip. In return, some low-end groceries chose to locate next to the leisure activity spaces (Figure 17b).

The patterns of multi-purpose travel of retirees influenced the agglomeration of low-end retailers near leisure activity and hobby spaces, but the collaboration was even more than that. As

the main customers of these low-end retailers, middle- to older-aged exercisers were largely supported by these retailers. Many low-end retailers allowed *dama* to dance at the frontages of the groceries or restaurants who provided lights and free access to toilets because these people were their main customers underpinning their business. The lobby in the grocery store even became a rest space for these older people (Figure 17b).

> "There are always many people here (in the lobby). Today is hot and stuffy, so even more (people). We have air conditioner here. What can we do?" (Shop assistant, female, Good and More Grocery Store, Huainan)

> "Most of them (customers) are *daye* and *dama* coming exercise…every day." (Restaurant keeper, male, Yuan Dynasty City Wall Relics Park, Beijing)

A second group of retailers, the mobile vendors, represented those venders selling snacks, used books and videos, toys, and craftsmen who only attended the activity spaces during a particular time of the day when the spaces were lively and with adequate potential consumers (Figure 17c). For example, used book vendors may only attend during the weekends to attract young customers; craftsmen and snack vendor may attend later in the afternoon when children are out of school; and commodity vendors attend in the evening when most middle to older exercisers visit their usual public spaces. Many of these mobile vendors were immigrants or unemployed who would participate in retaill temporarily to make a living. They may have other jobs during the other time periods or follow their potential customers from one activity space to another throughout the day.

"I am here every morning, then go to Laolongyan in the afternoon. It is lively there in the afternoon." (Craftmen, sugar artists, male, the City Stadium, Huainan)

Although leisure exercisers and hobbyists could only create temporary localized small markets in their activity spaces, such a series of small markets fed a growing low-end commerce. From 2014 to 2016, more types of retailers occupied the study sites—from simple craftsmen and second hand businessmen to sports facilities, supplementary food, herbal medicine, tourism and residential care advertisers (Figure 17d). The mobile retailers enriched the functions and diversity of the activity spaces. To target those with pensions, most of the products were low-end and affordable. Vendors and their customers attended the space every day and often carried out business, while gradually growing to know each other.

Figure 17: a. farmer's market next to Yuan Dynasty City Wall Relics Park. b. Good and More Grocery Store open next to Laolongyan Park. c. a sugar artist next to the walking track. d. a dad just bought a kite for his son.

Stationary low-end retailers attracted older exercisers occupying spaces nearby. The growing physical exercise and recreation groups provided a series of temporal localized markets for low-end retailers. The agglomerative low-end retailers around the activity spaces provided exercisers with convenience, services, and interests in leisure so that the therapeutic functions of such spaces were enriched. Although the current relationships between exercisers and retailers were collaborative and the wave of gentrification had not yet caused hostility between exercisers and retailers, the experiences could be different in different situations within the same space. While exercisers, no matter whether they were rich or poor, came to perform and to pursue health and wellbeing, craftsmen and book sellers had to follow their customers day by day without time to enjoy the healing elements of the spaces. Although considering the spaces as lively and therapeutic, vendors identified themselves as businessmen to make a living instead of the users of therapeutic spaces. While getting familiar with some vendors, I observed that the intersection between exercisers and vendors was no more than business. Little is known about the exercise practices of these vendors.

Discussion: Rethinking Public Spaces and Therapeutic Landscapes

This study aimed to integrate concepts of public spaces and therapeutic landscapes to explore a potential therapeutic public space serving people of different age groups, socioeconomic status, local or immigrant. Combining the concept of public spaces and therapeutic landscapes, this study achieved the first goal by showing the collaboration between different ages and social groups in the production of healing functions in urban public spaces. Based on my findings in two Chinese cities, both the concept of public spaces and therapeutic landscapes are expanded. First, this study revisits the role of blue/green elements in the production of healing functions. Different from the arguments from Western cases that the blue/green elements essentially promote physical

activity (Völker & Kistemann, 2011), this study argues that the symbols of Chinese garden (pavilion as a theater) as well as the supportive low-end retailers can also provide an ideal atmosphere to promote health where a large number of exercisers compete to occupy space. Even without all these therapeutic elements, physical exercisers will still find other convenient spaces to practice their activities and experience the healing function within those spaces, because the physical activity itself is ultimately a self-intended behavior to promote health, construct identity, purse a better quality of life, and reduce the individual and family burdens of care, while the blue/green elements are just a potential resource to realize these goals. This conclusion may explain why only a small number of studies have shown a positive association between parks and physical activity (Bancroft et al., 2015) – these elements are like the icing on the cake, but not always essential.

Second, the findings from this study are akin to Western cases of therapeutic landscapes in that people achieve their sense of healing not only through experiencing the therapeutic process, but also through encountering healing elements. Such healing elements can be surface water delivering relaxed feelings to visitors (Foley & Kistemann, 2015), or the energetic exercise and enjoyable activities of other older peers encouraging the oldest-old pedestrians (in this study). Although the oldest-old cannot experience the body movements and sweat, the performance still encourages them to keep going out and walk every day for the same purpose, bringing them a sense of satisfaction and accomplishment. However, encountering green/blue elements and the energetic exercise may not be able to heal the mobile vendors. The oldest-old experience and encounter for the same purpose – to perform themselves and keep healthy; but the vendors come to make a living and see others pursue higher needs they may not be able to pursue. In other words,

even if these vendors encounter some healing elements, these elements may not provide them a sense of healing.

Therefore, the third expansion of the study on therapeutic landscapes is to draw attention to both the groups who achieve a sense of healing and those who cannot achieve that in the same space. It raises a further question whether the divergent feelings of different groups lead to a sense of insecurity and hostility (Philo, 2014). While the majority and minority physical exercisers acquire a sense of security and healing, do the immigrants, unemployed, and low income persons acquire insecurity and hostility instead? The therapeutic spaces in this study have undoubtedly done a great job admitting people of different social strata to the same space, collaborating with each other to achieve their own needs, and it is also undoubtedly that all the participants contribute to the production of therapeutic public spaces. The pursuit of health and wellbeing here becomes affordable and no longer a privilege of middle and upper classes. However, it appears to the low-end retailers, in particular those immigrant and unemployed vendors; that they help to create a therapeutic space for others, but the carnival excludes themselves. Moreover, it is also necessary to consider how to at least support current vendors in the space and avoid what Harvey (2013) refers to as “the wave of gentrification further dissimilating the current beneficiaries”.

This study also expands the current discussion on public space by adding the pursuit of health and wellbeing as an essential aims of public life. In this study, people from different socio-economic strata and of different ages and health statuses share the same space for their health and wellbeing. They perform through a spectacle of physical activity and support others as audiences. Because of the simple purpose is to promote health, labels of different socio-economic strata become vague and misted by age and health status. Compared with the insecure and hostile atmosphere between different social groups in Western urban spaces (Philo, 2014), the assemblage

of energetic but weak older groups, kind parents and vigorous young groups in this study create a sense of security and liveliness for each other, no matter where they come from, what they do, and whether they are poor or rich. In this light, older people with different levels of pensions can wear the same uniform and dance in the same troop; children of different backgrounds can play football together; professional and amateur singers can perform different tones in the same chorus; healthy and unhealthy people can practice their own exercises in the same park. The affordable services provided by low-end retailers also helped to blur the socio-economic differences. Poor or rich, the products they buy will not distinguish them from others.

This study achieves the second goal by revisiting older people's role in urban public life within the demographic and neoliberal transition contexts. Paralleling Laws' studies (Laws, 1995; Laws, 1993), this study reveals the positive role of older people in the production of urban public spaces. In addressing the conflicts between their needs of health promotion and health care services and the increasing commercialization of these services, these older people occupy the urban public spaces as their everyday battlefields, escaping without leaving neoliberal society. Their health-promotion practices not only benefit themselves but also all the exercisers and hobbyists by merging the social deviation between different socio-economic groups. In such a therapeutic public space, a new social norm has been built based on whether a person makes an effort to keep healthy and perform rather than whether or not they can afford expensive items.

However, it is still too optimistic to conclude that a therapeutic public space for all has been created or to generate this type of therapeutic public space to everywhere. While the presence of immigrants and unemployed enrich the interests of the space, they are only accepted as service providers instead of the service customers of the space. It remains a puzzle how this space influences these people's identity construction and health status. In addition, low-end vendors is a

developing group and thus it is hard to predict whether and when the wave of gentrification will engulf the current achievements of current exercisers and retailers. Moreover, the belief of collectivism among the older generation plays a key role in the production of these therapeutic public spaces. Older people enjoy their collective performance and harness their collective energy to occupy spaces and construct their identities in front of others as a remarkable group. The sense of filial piety may also play a role shaping other people's attitudes of these older exercisers and hobbyists increasing value to their identity. Whether this specialty of Chinese older people is essential to maintain the liveliness of this type of space, also needs further exploration.

Conclusion

This paper has demonstrated the possibility and benefits of combining public spaces to study and therapeutic landscapes to promote therapeutic public spaces for all. It expands the boundaries of therapeutic landscapes in everyday urban spaces by rethinking the role of blue/green elements in promoting the sense of healing and reconsidering the healing process as a production through the experience and encounter of people. It also expands the boundaries of public space by adding age and health into the consideration of public life. The combination of the two concepts anticipates the possible challenges of neoliberalism posed by current health and urban geographies and proposes a possible solution to this problem.

Since people's occupancy and production of therapeutic public spaces are mainly motivated by their needs for health promotion and the healing function may come from blue/green elements and other factors, urban designers should revisit their city plans, following the preferences of outdoor exercisers and adapting their activity spaces towards a more 'health promotion and healing' direction. To protect current collaborative therapeutic spaces, future

studies should continue to pay attention to groups who are excluded from the healing process of the public space, and provide them with opportunities to also participate in the healing process. If possible, urban administrators should also monitor and guide the development of low-end service industry and avoid the wave of gentrification engulfing them. The health of this population within urban areas will require further investigation.

In this study, Chinese older exercisers have successfully constructed an identity of a remarkable social group fundamentally underpinning current therapeutic public space. Before generalizing their role into other places with various occasions and cultures, it is worthwhile to evoke, empower, and emplace the energy of the older population in contemporary China. Encouraging such a growing population to contribute to society can not only relieve the social burdens of care-giving, but may also find strategies and tactics in response to the neoliberal society with increasing social inequality.

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CHAPTER 5

CONCLUSIONS

Main Conclusions

The first article, *Physical Activity (PA) and Chronic Diseases among Older People in a Mid-size City in China: A Longitudinal Investigation of Bidirectional Relationships*, can be considered a gerontological study which examines the bidirectional relationships between PA and chronic disease onset among older people with socio-demographic disparities. Engaging with a health belief model, such discussions contribute to a better understanding of the PA as a health promotion practice and its practical impacts on older people's health. There are two main conclusions from this study. It first parallels the findings from previous studies that physical inactivity is highest among older, male, low educated and high income people (Hallal et al., 2012; Muntner et al., 2005), and further reveals the education and income disparities of PA, -i.e., people with little education are more likely to participate in PA than middle and college educated people but less likely to practice regular PA; while low-income people were less likely to participate in PA but more likely to practice regular PA.

As one of the first longitudinal studies to assess the bidirectional relationships between PA and chronic diseases in China, this study demonstrates the bipolar health trajectories between physically active and inactive older populations. Physically active people are reported to be diagnosed with chronic diseases years later than their physically inactive counterparts. Even after being diagnosed with a chronic disease, their PA behaviors can help to maintain their health (Warburton, Nicol, & Bredin, 2006). Comparatively, sedentary people are reported to experience an earlier onset of chronic disease, and are less likely to initiate a PA after the diagnosis. Their

later life, therefore, will have to rely on therapeutic regimes of care with additional costs to families and the nation.

The second article, *How the Built Environment Affects Change in Older People's Physical Activity: A Mixed-Methods Approach Using Longitudinal Health Survey Data in Urban China*, is a geographic study which examines the pathways by which older people's PA are influenced by the built environment intersected with social networks. Engaging with the social ecological framework and stage of behavior change model (Schwarzer, 2008), I analyze how the physical built environment intersects with social networks of neighbors and affect older people's PA behavior change. Importantly, this study finds the various effects of the built environment between sedentary and physically active groups: a lively apartment environment can encourage sedentary to start PA while living close to functional spaces can influence physically active people to maintain their PA, and highlights the special needs of older population compared with other age groups; and living close to functional spaces is more important for older people to maintain PA than other age groups.

The first and second articles are closely related to one another. The conclusion of the first article is the biological foundation of the second article (when PA is proved to be helpful for health among the studied population, the benefit of encouraging PA through built environment interventions can be guaranteed). Family and community engagement, and large-scale urban design, therefore, find their ways to promote health in a rapidly aging society. In this way, the second article supports the relevance of the first article, -i.e., making the biological findings useful in health promotion practice.

While the first and second articles consider older population as a beneficiary of PA and health-promoted built environment, the third article, *Therapeutic Spaces for All—Putting Health*

into Public: Performance and Collaboration of China's Leisure Physical Exercisers in Urban Public Spaces, examines the benefits that the older population can make to the surrounding built environment through their PA practice. Using case studies in two Chinese cities, it narrates how older PA practitioners find, occupy, and produce and share PA in urban areas, how PA practitioners of other age groups join and enrich the PA spaces, and how different social groups support each other in their PA practices and ultimately make therapeutic public spaces together. Such discussions parallel with Law's (1993) emphasis on the positive role of the older population in the making of both public spaces and therapeutic landscapes, instead of solely considering older people as the passive beneficiary. Embracing the concept of therapeutic landscapes in health geography (Gesler, 1992) and the concept of public spaces in urban geography (Harvey, 2013) I also conclude that older people can collaborate with other social groups in urban public spaces and help to put health into public and build therapeutic public spaces for all.

Contributions to the Literature

This dissertation contributes to the literature in four main fields. In the field of health behaviors, it enriches the discussions of the health belief model (Champion & Skinner, 2008). The first article finds the bipolar health trajectories between physically active and inactive groups, reflecting the opposite results of two distinct health beliefs. On the one hand, older people who believe the benefits of PA will experience a high quality of life and achieve benefits from their PA practice. On the other hand, older people who do not believe the benefits of PA will experience early onsets of chronic diseases and a relatively low quality of life. The findings of the distinct health trajectories between physically active and inactive groups will help further understanding of people's attitudes and beliefs of health and their influence on health behaviors.

Second, this study develops the literature on the built environment and neighborhood effects in the second article. Adding the stage of behavior change model to the social ecological model provides a combined framework to understand how particular factors of the built environment and social networks of neighbors can shape and change PA behaviors at different stages. This new framework contributes to addressing the theoretical challenge of the current literature on built environment and neighborhood effects, -i.e. it can not only depict a high-quality built environment for the physically active group but also delineate a built environment that can encourage more (sedentary) people to become physically active (Rosenberg, 2016). As a result, studies within this combined framework may provide more feasible interventions on community engagements and urban design to ultimately benefit older people's health.

Third, this study develops the concept of therapeutic landscapes in health geography. While blue and green spaces play an important role in making a sense of healing in western countries (Völker & Kistemann, 2011), the third article demonstrates that a therapeutic landscape can also be created in other convenient spaces without blue/green elements as long as the spaces are widely accessible and the healing function is facilitated. This study also emphasizes the multiple ways of making sense of healing, through both experiencing and encountering process (Foley, 2015) by both beneficiaries and non-beneficiaries. Importantly, this study points out the supportive groups, particularly those immigrants and unemployed vendors, whose attitudes and situations await further study in order to achieve an ultimate goal of health geographers-making therapeutic landscapes for all (Rosenberg, 2014).

The third article also enriches the discussion on public space in urban geography. In my two research fields, because of the simple purpose to promote health and wellbeing, people's biological backgrounds, such as their age and their bodies, mist their socio-economic labels. The

weak identities of the main participants-the aging exercisers, the joggers, parents, and the children, have nothing to do with the sense of insecurity and hostility which are ruining public spaces in western countries (Philo, 2014). By showing the comradeship between people of different social strata in the making of therapeutic landscapes, this study provides an alternative solution to the decline of public spaces in western countries, -i.e., considering the pursuit of health and wellbeing as an aim of public life may save the fragile public spaces in neoliberal societies.

Methodologically, this study uses a mixed-methods approach to qualitatively define the possible role of the older population in therapeutic landscapes and the role of the built environment on older people's PA behaviors, and to quantitatively examine the bidirectional association between PA and chronic diseases as well as the pathway in which the built environment intersects with the social networks of neighbors to influence older people's PA behaviors. This study demonstrates the strength of the mixed-methods approach in health behavior studies (Wisdom, Cavaleri, Onwuegbuzie, & Green, 2012). For qualitative components -e.g., the role of the built environment, mixed methods studies reflect the objectivity of the study by declaring the data collection procedures and triangulating the qualitative findings. For quantitative components, mixed methods studies reveal the practical causal relationships behind the significant associations between the built environment factors and changes of PA behaviors by involving participants' voices in conceptual models. While only a few health behavior articles use mixed methods (Wisdom et al., 2012), this approach may be a future sword thrusting into the essence of human health behaviors.

Practical Implications

This dissertation provides implications for health promotion intervention among older populations in two ways. First, the article on the bidirectional relationship between PA and chronic

diseases provides implications on what information should be delivered to the older population to promote their health. Given the findings that physically active and inactive older people may experience distinct health trajectories, which deeply influence their quality of later life, more accurate health knowledge should be delivered to older people in order to promote their PA behaviors in an early stage. Since it is easier to change people's PA behaviors before the diagnosis of chronic diseases, health promotion interventions may be more effective among middle-aged than older-aged adults. To maintain the progression of chronic diseases and reduce the medical costs, however, interventions should also be conducted among older people with a diagnosis of chronic diseases, messaging "you can still benefit from a certain amount of PA even if the diseases cannot be cured".

Second, this dissertation provides implication on the built-environment pathway of health promotion. The article on the built environment and PA behavior change parallels other studies in Western countries, suggesting that physically active neighbors can play an important role empowering residents to participate in regular PA. Since older people retire early in China, they are available and willing to conduct health promotion interventions among their neighbors. Empowering this physically active group can be an effective and economical strategy to promote PA among older populations in China. The article additionally shows the differential effects of the built environment in shaping and maintaining older people's PA, implicating PA promotion interventions at different levels. A feasible and flexible solution at the individual level is to guide older people to select apartments with high spatial accessibility to services. In the long run, designing more lively and spatial accessible apartments can promote PA behaviors for a larger number of older people.

In response to the draft global strategy and plan of action on ageing and health proposed by the World Health Organization (2016), this dissertation examines the achievements of the plan from a local level. By evaluating the health conditions of an older population after health education and survey were given, the first study demonstrates the effectiveness of health education and survey that the plan suggests, but also identifies the remaining problems of health disparities between sedentary and physically active populations. By evaluating the impacts of built environments and neighborhood effects in shaping older people's physical activity, the second study delineates the outline of health-promoting cities and human settlements for older people that the plan aims to build, but also identifies the potential issues which may affect older people's health. Future policy interventions should pay more attention to the effect of built environment factors on older people's health, which may be different from that on other populations; future policy should also make efforts to eliminate the health disparities by drawing more attention on sedentary people and those with chronic diseases at an early stage.

This dissertation provides a new direction to promote "inclusive, safe, resilient and sustainable" cities as the plan suggests (WHO, 2016) and also addresses the possible problem caused by a rapidly aging population. While older people in some areas of China (Bai, Lai, & Guo, 2016) and Western countries (Laws, 1993) are largely stigmatized as a social burden, this study challenges this ageist opinion on older people and argues that older people can make a contribution to the society. The article on the built environment and PA behaviors suggests that older physically active residents can serve to cultivate a physically active atmosphere in order to promote health and wellbeing in their neighborhoods. The article on the older PA practitioners points out the active role of older population in urban public life. These older PA practitioners are the pioneers to explore, invade, and cultivate a sharing therapeutic space through their performance and spectacle

of PA behaviors and collaboration with other physically active groups. Empowering a large number of older people and making full use of their capacities in health promotion practices may become an effective and economical strategy in addressing the challenges from a rapidly aging population. Moreover, since many older people are voluntarily providing health promotion interventions by example, empowering this population may help to address the increasingly distinct health trajectories caused by exacerbating socioeconomic inequalities of the neoliberal China.

Future Research Directions

This dissertation addresses one of the most prevalent social issues-the (rapid) demographic transition in both China and worldwide. The increasing older population provides many opportunities but may also cause problems for governments, industries, and everyone within the transitional society. Moving forward from this dissertation research, four directions are purposed for my future research. First, to provide accurate and evidence-based health promotion interventions for the older population, more empirical case studies can be conducted to find the environmental factors at various levels, which may significantly affect older people's health promotion and health care practices. For example, in the case of Huainan, the liveliness of apartment serves as a significant motivator that attracts older people to initiate PA. Detailed and quantified index of the liveliness should be built in future empirical studies to support older-friendly community design at built-environment level. Methodologically, more effective prediction models, such as agent-based models and participatory methods can be used to examine the practical effectiveness of certain interventions at a population-based level.

Second, some innovative technologies, such as smartphone apps and intelligent devices, are widely used in middle- and older-aged populations for health promotion in my study area.

While visible obstacles exist in innovative health promotion and health care (Herzlinger, 2006), it is undoubtedly necessary to study the development and influence of such new technologies among people's health for two reasons. On the one hand, better or worse, some smartphone apps, such as Fitness, or Pokemon Go on IOS and some smart sports equipment have dramatically shaped the types and patterns of physical activities among both young and old population. Evaluating the efficiency and effectiveness of such products can contribute to regulating and improving the current innovative health promotion industry, and hopefully, finding a technological solution to the increasing socioeconomic disparity in contemporary China. On the other hand, the prevalence of these technologies also produces rich biological and behavior data for research. Obtaining and making full use of these data can help scholars further understand health behaviors and provide effective and feasible health promotion interventions.

Third, this dissertation is a start to reflect and redefine the identity of the older population. While older people are socially constructed as a dependent vulnerable group awaiting caregiving in Western society (Laws, 1993), such a stereotype of older people is also deeply rooted in the tradition of filial piety in China (Zhan & Montgomery, 2003). However, I point out in the third article that filial piety tradition also delivers a gerontocratic identity of the older generation, empowering Chinese older population to become an energetic group in public realms. While this study has demonstrated the active effect of older PA practitioners in urban public life, more studies may be proposed to further understand the potential active role of older people in other public realms, including the circumstances highly exposed to older people, -e.g., healthcare spaces, tourism industries, and food and medicine industries.

While exploring the optimistic potential of the aging population, I am also concerned with the pessimistic face of this group, which is commonly revealed in my field work. Identifying

themselves as a vulnerable but energetic group who are willing to participate in almost every realm of public life, older people's achievements may not be able to meet the expectations of young people. For younger generations, they are too busy to give daily care and not rich enough to provide adequate financial support to the older generation. The young generation also widely accepts the individualist value in the new era and on some level, expects to live their own life without interruptions from the older generation. On the contrary, older people, ironically, expect daily care, company, and sincere respect from the younger generation and are more than willing to participate (sometimes interrupt) younger people's life. The distinct willing and expectation between older and younger generations may cause various contradictions in between. Conflicts are more likely to occur as responding behaviors after an old person acquires incurable diseases or geriatric syndromes, reminding themselves that they are less capable while also experiencing fear that they will be abandoned. While conflicts between generations become a problem (Dennis, Basañez, & Farahmand, 2010), intergenerational segregation can be another problem (Hagestad & Uhlenberg, 2005). Addressing the existing and potential intergenerational conflicts and segregation –e.g., through reducing the stress in the family with aging parents and encouraging the older people to an active lifestyle, will become an essential project for geographers of aging in the rapid aging society.

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