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Leisure Time Physical Activity Preferences, Behaviors, and Hypertension: Evidence From the China Health & Nutrition Survey, 2004-2011

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LEISURE TIME PHYSICAL ACTIVITY PREFERENCES, BEHAVIORS, AND HYPERTENSION: EVIDENCE FROM THE CHINA HEALTH & NUTRITION SURVEY, 2004-2011

by

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Abstract

LEISURE TIME PHYSICAL ACTIVITY PREFERENCES, BEHAVIORS, AND HYPERTENSION: EVIDENCE FROM THE CHINA HEALTH & NUTRITION SURVEY, 2004-2011

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Background: Physical activity has been continuously declining in China. At the same time, prevalence of hypertension has dramatically increased. The associations between leisure time physical activity preference, behavior, and development of hypertension in Chinese adults remained not fully understood and few studies have examined these associations using longitudinal data.

Objectives: This dissertation examined the interrelationships among leisure time activity preference, behavior, and the incidence of hypertension using longitudinal data from 2004 to 2011 in the China Health and Nutrition Survey. It also assessed the urban-rural disparities.

Methods: A total of 2,687 adults were included in the analysis. Multivariate logistic regressions and proportional hazard regressions were performed to assess the associations after adjusting for age, sex, ethnicity, marital status, community types, region of residence, education, employment status, annual household income, smoking

status, alcohol consumption, current health status, health insurance coverage, and BMI. Urban-rural differences were also investigated by stratified analysis.

Results: In the sample, 62.3% were from urban, 47.4% were men, and the mean age was 40. Adjusted estimates show that leisure time activity preference was a significant predictor of actual behavior (OR = 1.05, 95% CI = 1.01-1.09); leisure time activity was a significant protector from developing hypertension (HR = 0.60, 95% CI = 0.41-0.87); changes in (reduced) leisure time activity preference were associated with higher incidence of hypertension (OR = 1.92, 95% CI = 1.13-3.28). These correlations were found to be significant among urban residents (OR = 1.06, 95% CI = 1.01-1.10, HR = 0.57, 95% CI = 0.38-0.87, and OR = 2.19, 95% CI = 1.04-4.60 respectively) not in rural participants.

Conclusions: Leisure time physical activity preference, behavior and development of hypertension were significantly correlated with each other. Changing people's preference for leisure time activity may be helpful in hypertension prevention and control in China. In addition, health interventions in rural areas may increase residents' access to exercise facilities and maintain their activity preference through social modelling. In urban areas, educating healthy diet and occupational physical activity pattern might be helpful.

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List of abbreviations

CI	Confidence Interval
OR	Odds Ratio
HR	Hazard Ratio
BMI	Body Mass Index
CHNS	China Health and Nutrition Survey
OA-ESI	Older Adult Exercise Status Inventory study
SES	Socio-Economic Status
WHO	World Health Organization
SD	Standard Deviation
SPSS	Statistical Package for the Social Sciences

Introduction

Background

Physical activity and hypertension in China

Since the industrial revolution, the development and use of new technologies have enabled people to reduce the amount of physical activity needed to accomplish many tasks in their daily lives (Hallal et al., 2012). However, most of the human body's systems (e.g. skeletal, muscle, metabolic, and cardiovascular) have to be stimulated by physical activity to develop and function in an optimum way (Booth, Laye, Lees, Rector, & Thyfault, 2008). Although many populations all over the world have benefited from new technologies, physical inactivity has contributed to the worldwide epidemic of non-communicable diseases (Alwan, 2011). In 2009, physical inactivity was identified as one of the leading risk factors for non-communicable diseases and contributed to more than 3 million preventable deaths (World Health Organization, 2009). A recent study showed that 31.1% of adults are physically inactive worldwide, ranging from 17.0% in Southeast Asia to about 43% in the Americas and the eastern Mediterranean (Hallal et al., 2012).

Compared to other populations in the world, Chinese people are relatively physically active (Deng et al., 2008; Hallal et al., 2012). In China, the proportion of adults reporting walking to work, cycling to work, or using any type of active transportation is over 20%, 20%, and 40% respectively (Hallal et al., 2012). During leisure time, the level of

walking among Chinese is higher than that of people in Western countries and Mediterranean populations (Lam et al., 2010). Nevertheless, many studies revealed that the amount of time people spend in regular physical activity has been declining continuously in China (S. W. Ng, Norton, & Popkin, 2009; Sallis, Alcaraz, McKenzie, & Hovell, 1999), possibly because the effects of urbanization, environments and neighborhood on people's physical activity (Craig, Brownson, Cragg, & Dunn, 2002; Frank, Saelens, Powell, & Chapman, 2007; Gordon-Larsen et al., 2004; S. W. Ng et al., 2009). Specifically, one study found that average weekly physical activity among Chinese adults fell by 32% from 1991 to 2006, and the decline was strongly associated with urbanization (S. W. Ng et al., 2009).

Populations around the world are experiencing a rapid epidemiological shift from communicable to non-communicable disease (Alwan, 2011). Hypertension, as an important non-communicable disease risk factor (Lloyd-Sherlock, Beard, Minicuci, Ebrahim, & Chatterji, 2014), is highly prevalent in many countries. A recently conducted study found that the prevalence of hypertension among adults for Canada, the United States, and England were respectively 19.5%, 29.1%, and 30.0% (Joffres et al., 2013). In many low-income and middle-income countries, the prevalence of hypertension is even more severe. During 2007 to 2010, the prevalence rate is as high as 52.9% (ranging from 32.0% in India to 77.9% in South Africa) among older populations in countries including China, Ghana, India, Mexico, the Russian Federation and South Africa (Lloyd-Sherlock et al., 2014). In China alone, during the past several decades, both the prevalence and

cases of hypertension have increased dramatically (Gu et al., 2002). Studies suggest that the prevalence of hypertension in the Chinese population has increased from 5.0% in 1959 to nearly 19.0% in 2002, and to 26.6% in 2008 (Gao et al., 2013; Wu et al., 2008).

Reasons for the increasing prevalence of hypertension in China are still unclear, but studies conducted in other countries have suggested that changes in physical activity levels associated with urbanization have played an important role (Janus, Postiglione, Singh, & Lewis, 1996; Popkin, 1999). Furthermore, a number of studies indicated that physical activity may independently decrease the risk of developing obesity and even hypertension (Howard, Gordon-Larsen, Herring, Du, & Popkin, 2014; G. Hu et al., 2004; G. Ma et al., 2008). Specifically, people who were physically active had a 50% less risk of overweight/obesity when compared with those who were sedentary (G. Ma et al., 2008). Regular physical activity was significantly associated with a reduced risk for hypertension, independent of gender, age, socioeconomic factors, urbanity and region, smoking, alcohol consumption, history of diabetes, BMI, and blood pressure at baseline (Howard et al., 2014; G. Hu et al., 2004). Therefore, studies focusing on the association between physical activity and development of hypertension are needed, especially among the Chinese population who are experiencing a significant transition in terms of physical activity level and hypertension prevalence.

Leisure time physical activity preference and behavior

Findings from a number of studies have suggested that food preference is a better indicator than actual food intake and even have established the relationship between food preference and cardiovascular disease (Drewnowski & Hann, 1999; Duffy et al., 2007; Harvey-Berino et al., 1997; Ricketts, 1997). Exploring the association between physical activity preference and physical activity behavior thus appears to be promising and necessary. Studies on sedentary activity preference indicated that preference for sedentary activity was a significant predictor of lower physical activity level (Salmon, Owen, Crawford, Bauman, & Sallis, 2003; Temple, 2007), and preferences for physical activity and psychological variables such as anxiety, depression and avoidance explained significant physical activity changes among children (Sallis et al., 1999). But to the best of our knowledge, no studies have examined the direct relationship between leisure time physical activity preference and behavior in adults. To further understand determinants and predictors of leisure time physical activity behavior, investigating the association between leisure time physical activity preference and behavior becomes necessary, especially by using a longitudinal data to examine the causal effects.

Changes in leisure time physical activity preference and hypertension

As mentioned before, reduction in physical activity level has been identified as a problem associated with urbanization in China. Among adolescents, a steep decline in physical activity is found among both boys and girls (S. Kimm et al., 2000; S. Y. Kimm et

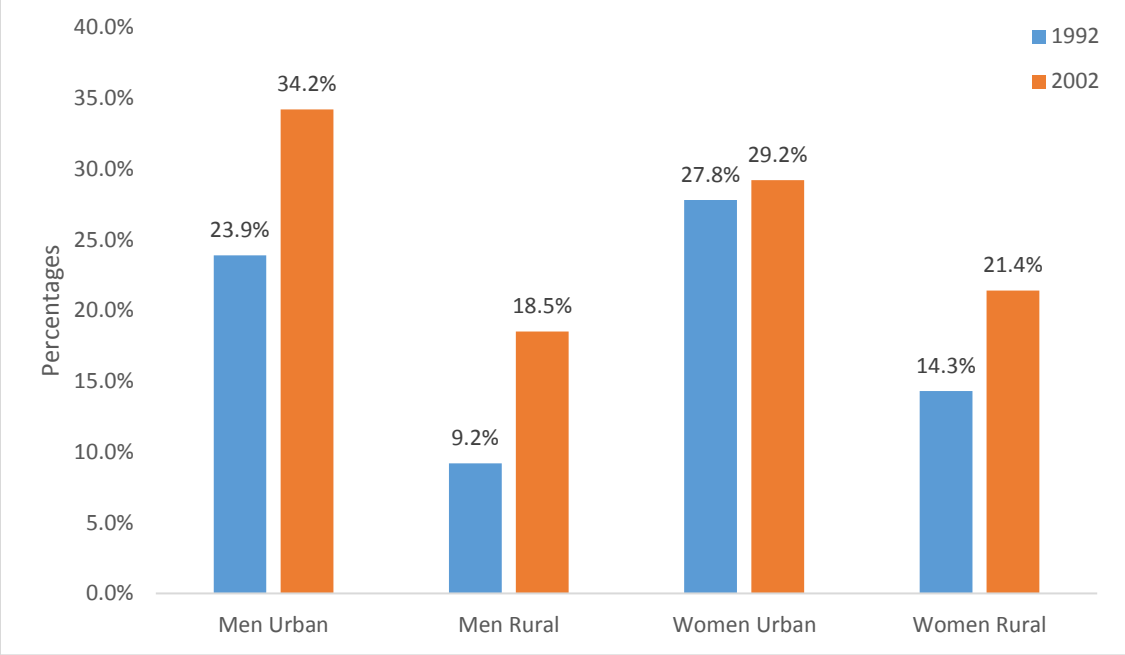
al., 2005; Sallis et al., 1999). The situation is even more severe in adults. Specifically, average weekly physical activity among adults fell by 32% from 1991 to 2006 (S. W. Ng et al., 2009). Previous studies have indicated that changes in physical activity are significantly related to heart disease and all-cause mortality (Paffenbarger Jr et al., 1993; Wannamethee, Shaper, & Walker, 1998; Young, Haskell, Jatulis, & Fortmann, 1993). Moreover, the increase in physical activity over time is found to be favorably associated with changes in major cardiovascular disease risk factors in both men and women. Nevertheless, little research has been done on changes in physical activity preference, and their effects in development of chronic diseases such as hypertension. Thus, studies are needed to explore the relationship between changes in leisure time physical activity preference and development of hypertension.

The urban-rural disparities

A growing number of studies have been focused on the urban-rural disparities in physical activity and other risk factors of cardiovascular disease. In China, urban residents were more likely to be overweight and obese relative to their rural counterparts. Therefore, urban residents appeared to be at higher risk as compared to those from rural areas (Hou, 2008; GS Ma et al., 2005; Reynolds et al., 2007; Wang, Mi, Shan, Wang, & Ge, 2007; Xu et al., 2005). However, studies also have shown that the prevalence of overweight and obesity in rural residents increased much faster than in those who were living in urban areas (GS Ma et al., 2005; Wang et al., 2007). As indicated

in Figure 1, in urban residents, the prevalence of overweight and obesity in 2002 was 1.43 (34.2%/23.9%) and 1.05 (29.2%/27.8%) times higher than that of in 1992 among men and women respectively. However, in rural areas, the percentages of people with overweight and obesity in 2002 was 2.01 (18.5%/9.2%) and 1.50 (21.4%/14.3%) times higher than that of in 1992 in males and females (Wang et al., 2007).

Figure 1. Overweight and obesity by gender and residence



Note: Adapted from "Is China facing an obesity epidemic and the consequences? The trends in obesity and chronic disease in China" by Wang et al., 2007.

The heightened prevalence of obesity inevitably led to increased prevalence of cardiovascular diseases (X. Zhang, Lu, & Liu, 2008). Due to the disparities in prevalence of obesity, it was not surprising to see the discrepancy in prevalence of cardiovascular diseases and cardiovascular diseases related mortality rate between urban and rural areas (Du, Lu, Zhai, & Popkin, 2002). Specifically, urban adults had a higher chance of

having cardiovascular diseases and had higher cardiovascular diseases related mortality rate (Du et al., 2002; Hou, 2008; Yang et al., 2008). In 2010, the crude death rate of cardiovascular diseases was 94.9 per 100 000 in urban residents and 71.3 per 100 000 in rural citizens (S. S. HU et al., 2012). However, similar to the situation in obesity, the increase of mortality rate of cardiovascular diseases in rural residents was greater than that in their urban counterparts (S. S. HU et al., 2012; Wang et al., 2007).

The disparities in the prevalence of obesity, cardiovascular diseases, and even in the rate of cardiovascular diseases related mortality between urban and rural areas were found to be in parallel with differences in their lifestyle (diet and physical activity). Regarding physical activity, occupational physical activity and leisure-time physical activity are discussed separately. Firstly, studies using multilevel models found that occupational physical activity among Chinese has declined significantly during recent decades (Monda, Gordon-Larsen, Stevens, & Popkin, 2007; Shu Wen Ng, Howard, Wang, Su, & Zhang, 2014). Specifically, occupation of urban adults shifted from vigorous activity pattern to light activity pattern; in rural residents, even though they held multiple jobs and spent more intensive effort than urban residents, their farming activities decreased due to the use of machinery (Ding et al., 2011; Du et al., 2002). Since the energy expenditure from occupational physical activity has decreased more rapidly in urban residents than in rural adults, urban people have gained more weight than their rural counterparts from this source (Monda, Adair, Zhai, & Popkin, 2008). However, in leisure-time activities, urban adults were more physically active than their

rural counterparts (A. Bauman et al., 2011). Specifically, urban adults exercised more regularly, while TV set ownership increased more considerably in rural areas (Du et al., 2002; Yang et al., 2008). To summarize, occupational physical activities have decreased significantly in China, with a faster decrease among urban residents. Although urban adults had leisure-time physical activities more often than their rural counterparts, there is no evidence showing that leisure time physical activities have increased dramatically and significantly in neither urban nor rural residents. Together with the fact that urban residents had consumed more processed foods that are commonly high in fat, salt and refined sugar (Guo, Mroz, Popkin, & Zhai, 2000), urban residents had worse lifestyle comparing to their rural counterparts.

Furthermore, research believed that the changes in lifestyle could explain the change of prevalence of overweight and obesity to a large extent (Shu Wen Ng, 2009). Specifically, a study conducted in China found that dietary fat intake increase and declines in physical activity are positively related to weight gain, and that 30% of the weight gain was due to declines in physical activity, while 20% was due to higher fat intake (Shu Wen Ng, 2009). The causation still hold even taking into consideration the urban and rural difference. According to the same study, lifestyle factors (cigarette smoking, alcohol consumption, and physical activity) explained 52.5% - 56.8% of the excess risk of overweight or obesity and 44.8% - 62.1% of the excess risk of central obesity in urban areas by regarding the rural residents as reference group (Shu Wen Ng, 2009).

Given the great urban-rural disparities in the physical activity pattern, changes in physical activity, and prevalence of obesity and cardiovascular disease in China, this dissertation seeks to assess associations among leisure time physical activity preference, behavior, and incidence of hypertension in urban and rural residents separately by conducting stratified analysis.

Specific aims and hypothesis

The objectives of this research project (assessing the associations between leisure time physical activity preference, behavior, and incidence of hypertension) will be achieved by pursuing the following three specific aims and working hypotheses:

Specific Aim 1: To determine the association between leisure time physical activity preference and behavior, and assess if the association differs between urban and rural areas.

Hypothesis 1.1: Leisure time physical activity preference is highly and positively related to leisure time physical activity behavior, after adjusting for possible confounding variables (age, sex, ethnicity, marital status, community types, region of residence, education, employment status, annual household income, smoking status, alcohol consumption, current health status, health insurance coverage, and BMI); it is also hypothesized that the association is significant in urban residents, not in rural people.

Specific Aim 2: To study the effect of leisure time physical activity behavior on the incidence of hypertension, and potential differences between urban and rural areas.

Hypothesis 2.1: Leisure time physical activity is a significant protector against developing hypertension, after adjusting for possible confounding variables (age, sex, ethnicity, marital status, community types, region of residence, education, employment status, annual household income, smoking status, alcohol consumption, current health status, health insurance coverage, and BMI); it is also hypothesized that the association is significant in urban residents, not in rural people.

Specific Aim 3: To examine the association between changes in leisure time physical activity preference and incidence of hypertension between 2004 and 2011, and the association difference between urban and rural areas.

Hypothesis 3.1: There is a significant relationship between changes in leisure time physical activity preference and incidence of hypertension between 2004 and 2011, after adjusting for possible confounding variables (age, sex, ethnicity, marital status, community types, region of residence, education, employment status, annual household income, smoking status, alcohol consumption, baseline physical activity, current health status, health insurance coverage, and BMI); it is also hypothesized that the association is significant in urban residents, not in rural people.

The expected outcome of this dissertation is a substantial increase in the currently limited knowledge of the associations among leisure time physical activity

preference, changes in leisure time physical activity preference, leisure time physical activity behavior, and incidence of hypertension. This outcome is expected to have a significant positive impact in contributing to the knowledge base needed by researchers and policy makers as they strive to develop evidence-based interventions and strategies for physical activity promotion.

Conceptual Framework

Currently, a large number of studies have examined physical activity and the risk of cardiovascular disease including hypertension (G. Hu et al., 2004; Kohl 3rd, 2001; G. Ma et al., 2008). Some researchers have assessed the factors influencing physical activity while other studies have explored the beneficial effects of physical activity on cardiovascular disease (A. E. Bauman et al., 2012; Wannamethee et al., 1998).

Below is a literature review of factors impacting physical activity and cardiovascular disease (hypertension).

First of all, factors influencing physical activity are discussed. Specifically, studies used a comprehensive framework to explain physical activity, proposing that determinants at all levels—individual, social, environmental, and policy—are contributors. A key principle of this comprehensive framework was that knowledge about all types of influence can inform the development of multilevel interventions of physical activity to reduce the prevalence of cardiovascular disease (Sallis, Owen, & Fisher, 2008). At the individual level, psychological (cognition, beliefs, and motivation) and biological factors (genetic factors and evolutionary physiology) are playing an important part. At the interpersonal level, social support (from family, from friends, and at work) and cultural norms are critical factors. Although environmental, policy, and

global level variables haven't been studied very deeply, social environment, built environment, transport systems, urban planning, and economic development appear to have widespread effects on physical activity (A. E. Bauman, Sallis, Dzewaltowski, & Owen, 2002; Ding & Gebel, 2012; Sallis, Floyd, Rodríguez, & Saelens, 2012).

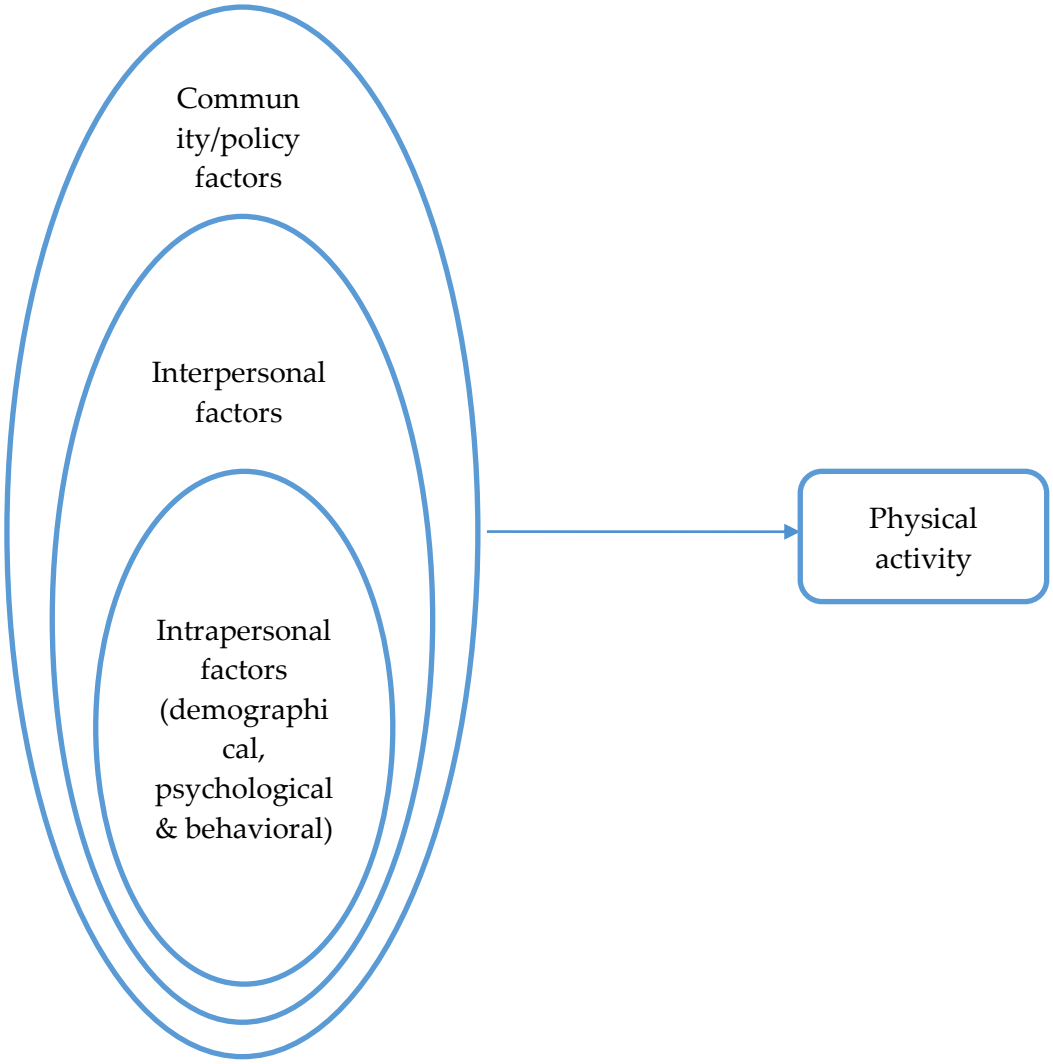
Furthermore, mediating factors impacting the link between physical activity and cardiovascular disease have been investigated. One study used a twin cohort to explore the effect of genetic factors on the association between physical activity and cardiovascular disease caused mortality. The beneficial effect of physical activity remained after controlling for the genetic factors (Kujala, Kaprio, Sarna, & Koskenvuo, 1998), which means genetic factors appear not to be a mediating factor. Changes in blood pressure and blood lipid content have also been examined for their mediating effects. Likewise, the beneficial effects of physical activity do not appear to be mediated by changes in blood pressure and blood lipid content (Shaper, Wannamethee, & Weatherall, 1991). However, other physiologic factors (at individual level) such as metabolic, endocrine, and immune systems have been proved to be on the pathway between physical activity and cardiovascular disease (A. E. Bauman et al., 2002; Department of Health and Human Services, 1999; Van Gaal, Mertens, & Christophe, 2006).

Taking those into consideration, perceived behavior control and the Ecological Model of Heath Behavior are suitable for framing the relation between physical activity and hypertension (Glanz, Rimer, & Viswanath, 2008). Reasons are presented below:

A previous study showed that sociodemographic variables (i.e. age, sex, education, employment status, and income) have impacts on perceived behavioral control, and perceived behavioral control also serves to motivate healthy lifestyle behaviors (Bailis, Segall, Mahon, Chipperfield, & Dunn, 2001). Perceived behavioral control may play a significant role in the pathway from socioeconomic and demographic variables to physical activity. Therefore, the sociodemographic variables were incorporated in the study to explain the impact of construct of perceived behavior control on physical activity behavior. Specifically, socioeconomic and demographic variables (age, sex, race, marital status, education, employment status, and annual household income) were adjusted in the data analysis. In addition, researchers proved that socioeconomic status is clearly related to the health insurance status (Adler & Newman, 2002), so participants' health insurance status was examined in the data analysis as well.

Ecological models incorporate multiple levels of influence and with emphasis on the environmental and policy contexts (Sallis et al., 2008). Specifically, factors at the intrapersonal level (demographical factors, and behavioral factors), interpersonal level, and community and policy levels are related to physical activity behavior. See Figure 2.

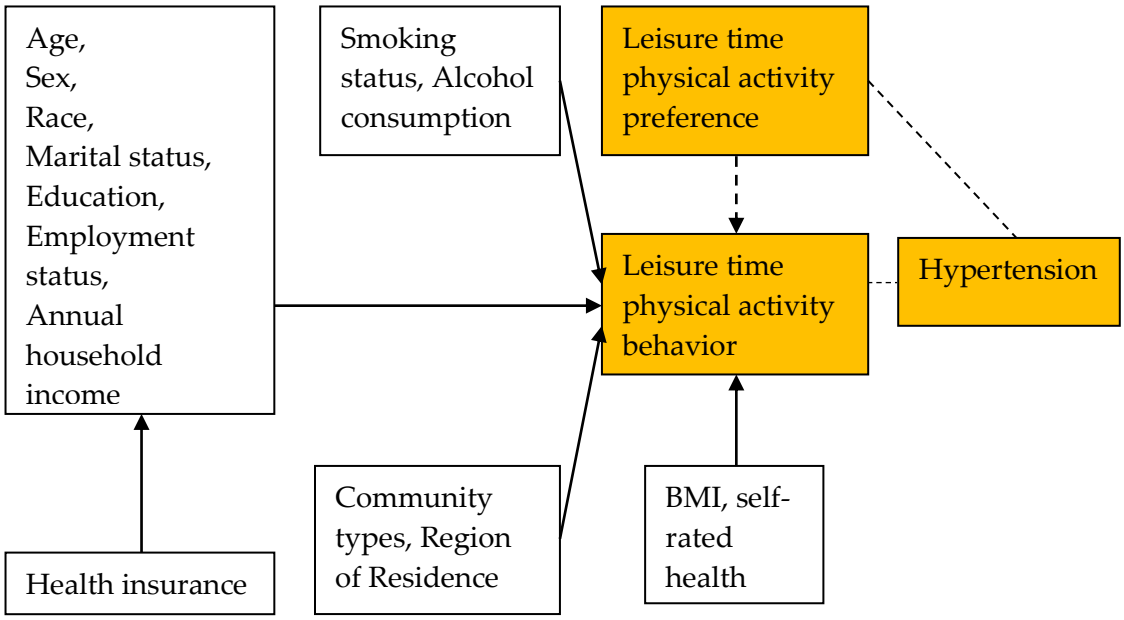
Figure 2. Ecological Model. Graph from Sallis, J. F. et al. (2008). Ecological models of health behavior. Health behavior and health education: Theory, research, and practice, 4, 465-486.



In this study, because demographical factors (age, sex, race, SES and marital status) have already been incorporated, behavioral factors and community/policy level factors need to be added into the final framework. Specifically, smoking and alcohol consumption as representatives of behavioral factors are available in the dataset; community types and region of residence can serve as proxy of community and policy level factors.

Since socioeconomic status and demographical factors have been proved to be associated with health status or health outcomes (Bailis et al., 2001; Harwood, Salsberry, Ferketich, & Wewers, 2007), hypertension, Body Mass Index (BMI), and self-rated health as examples of health status or health outcomes were studied.

Figure 3. Conceptual Framework



As shown in Figure 3, Conceptual Framework for the dissertation study has been established. Variables in orange boxes are the three key factors that need to be tested. Dashed lines indicate the relationship between those three variables. Specifically, it is hypothesized that leisure time physical activity preference is predictive of actual behavior, so the direction of this association is presented; since low level of leisure time physical activity preference and behavior may lead to development of hypertension, and having hypertension or not can also impact leisure time physical activity preference and behavior, the direction of the two associations are not hypothesized.

By applying the conceptual framework, the factors affecting the links between leisure time physical activity preference and behavior, and incidence of hypertension could be easily integrated into the analysis model. Specifically, socioeconomic and demographic variables (age, sex, race, marital status, education, employment status, and annual household income), behavioral factors at the intrapersonal level (smoking status and alcohol consumption), community level factors (community types and region of residence), health status variables (BMI and self-rated health), and health insurance were adjusted to ensure the validity of analysis models.

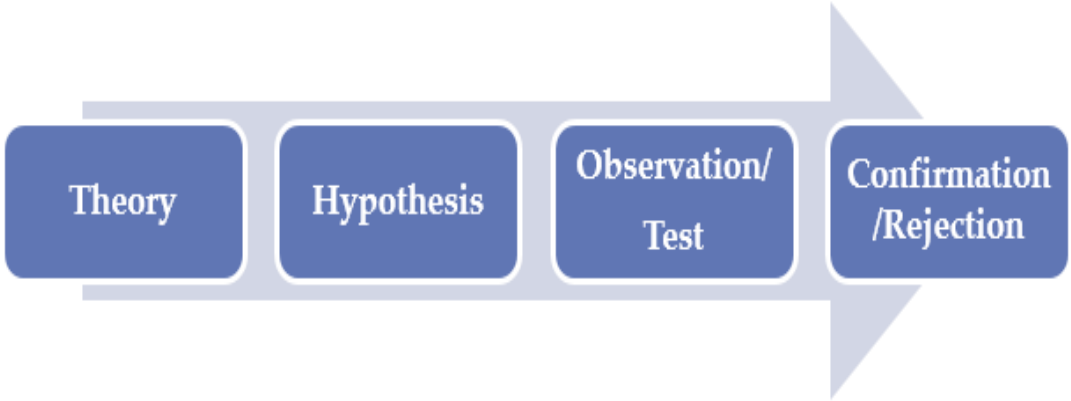
Methodology

Overall Research Approach

Deductive Approach:

By applying the Conceptual Framework mentioned above, three research hypotheses were formulated to determine the associations between leisure time physical activity preference and leisure time physical activity behavior, to study the effect of leisure time physical activity behavior on the development of hypertension, and to examine if the changes in leisure time physical activity preference are associated with incidence of hypertension. Then, by conducting quantitative analyses, the three hypotheses would be able to be confirmed or rejected (Khanzode, 2004). See Figure 4.

Figure 4. Deductive Research Approach



Overall Research Population

The source of data comes from the China Health and Nutrition Survey (CHNS). The China Health and Nutrition Survey (CHNS), an ongoing open cohort, international collaborative project between the Carolina Population Center at the University of North Carolina at Chapel Hill and the National Institute of Nutrition and Food Safety at the Chinese Center for Disease Control and Prevention, was designed to examine the effects of the health, nutrition, and family planning policies and programs implemented by national and local governments and to see how the social and economic transformation of Chinese society is affecting the health and nutritional status of its population. The impact on nutrition and health behaviors and outcomes is gauged by changes in community organizations and programs as well as by changes in sets of household and individual economic, demographic, and social factors.

The survey data were conducted by an international team of researchers whose backgrounds include nutrition, public health, economics, sociology, Chinese studies, and demography. The study took place over a 3-day period using a multistage, random cluster process to draw a sample of about 4,400 households with a total of 26,000 individuals in nine provinces that vary substantially in geography, economic development, public resources, and health indicators.

The study recruited most participants in Year of 2011, and most of them were followed-up from Year of 2004. Furthermore, 7 years is a reasonable time period to

observe the development of hypertension under the possible impact of exposure such as physical activity. The dissertation study thus used the CHNS data from the two years. Specifically, there were 8,969 adults in 2004 and 12,235 in 2011. The base population of the study included 5,685 participants who participated in both the 2004 survey and 2011 survey, which mean 3,284 out of 8,969 participants in 2004 lost follow-up. Since 2,998 participants did not express preference on physical activities in 2004, the sample size for data analysis was 2,687. Table A in Appendix is the comparison of samples with and without those did not express physical activity preference. No substantial difference observed between them.

The attrition of samples is large because of substantial migration out of rural China since the 1980s, and the young, aged from 15 to 40, make up a large proportion of participants that attrite from the study between 2004 and 2011 (J. Zhang, 2012). Nevertheless, studies suggested that the potential bias associated with the attrition should not be a grave concern, because among large-scale surveys in developing countries, the China Health and Nutrition Survey is one of the most successful panel studies in terms of keeping attrition low (Thomas, Frankenberg, & Smith, 2001; Z. Zhao, 2007).

Chapter 1: Association between leisure time physical activity preference and behavior: An urban-rural perspective

Methods

Research Aim:

To determine the association between leisure time physical activity preference and behavior, and the association difference between urban and rural areas in China.

Research Approach:

Because a number of studies pointed out food preference is a better indicator than actual food intake (Drewnowski & Hann, 1999; Duffy et al., 2007; Harvey-Berino et al., 1997; Ricketts, 1997), it is hypothesized that leisure time physical activity preference is also predictive of leisure time physical activity behavior. Then, Spearman Correlation Coefficients were used to determine if the two variables (leisure time physical activity preference and leisure time physical activity behavior) are related to each other, and logistic regressions were conducted to test if leisure time physical activity preference in 2004 can predict leisure time physical activity behavior in 2011. Stratified analysis was conducted in urban and rural residents.

Measurements:

Leisure time physical activity preference

In the China Health & Nutrition Survey questionnaire, respondents were asked if: he or she likes very much, likes somewhat, neutral, dislikes somewhat, or dislikes very much each activity. The activities listed are: Walking, Tai Chi, Sports (ping pong, badminton, tennis, soccer, basketball, volleyball), Body building, Watching TV, Playing computer/video games, surfing the internet, and Reading.

Chen (2013) developed a grading scale for physical activity preference for the participants. As shown in Table 1, participants in the survey provided their preference to three kinds of activities: walking and Tai Chi, Sports, and watching TV. They were graded from 0 to 3 in each item according to their answers to preferences to either "good" or "bad" activities (Walking, Tai Chi, and Sports are "good" activities; Watching TV is "bad" activity) (did not participate in "good" activity = 0, dislike "good" activity = 1, neutral to "good" activity = 2, or like "good" activity = 3; did not participate in "bad" activity = 3, dislike "bad" activity = 2, neutral to "bad" activity = 1, or like "bad" activity = 0).

Table 1. Chen's grading for physical activity preference (2013)

Physical activity preference	**Dislike very much**	**Dislike**	**Neutral**	**Like**	**Like very much**	**Did not participate**
Walking, Tai Chi	1	1	2	3	3	0
Sports (ping pong, badminton, tennis, soccer, basketball, volleyball)	1	1	2	3	3	0
Watching TV	2	2	1	0	0	3

As indicated in Table 2, the grading scale was adjusted to better fit the study. Specifically, "did not participate = 0" was deleted (resulted in smaller sample size of 2,687 because those chose "0" were excluded from the analysis), in consideration that those participants expressed no preference. In addition, "Body building" was added to, but "watching TV" was removed from the grading, taking into account that this grading scale is intended to measure physical activities (not sedentary activities) only. Furthermore, the way that physical activity preferences were scored was altered, such that the extent to which participants liked or disliked physical activity was rated on a scale from 1-5 with 1 indicating strongly disliking physical activity and 5 indicating liking physical activity very much. Finally, sedentary activities were not included in the study, since previous studies had already examined the relationship between sedentary activity preference and sedentary activity behavior among adults.

Participants' physical activity preference was determined by adding all three scores (Walking and Tai Chi; Sports; Body building). Therefore, the range of physical activity preference for each participant is between 3 and 15.

Chen's (2013) physical activity preference assessment tool was never tested regarding reliability. Plus, the grading scale was adjusted to better fit the study. Therefore, estimation of the reliability of tests in the study was determined; the Cronbach's alpha reliability coefficient was 0.70, suggesting good internal consistency.

Table 2. Grading for leisure time physical activity preference

Leisure time physical activity preference	**Dislike very much**	**Dislike**	**Neutral**	**Like**	**Like very much**
Walking, Tai Chi	1	2	3	4	5
Sports (ping pong, badminton, tennis, soccer, basketball, volleyball)	1	2	3	4	5
Body building	1	2	3	4	5

Note: Adapted from "Parent-Child fat intake correlation in China, explanation from Social Cognitive Theory" by Han Chen, 2013, p 17.

Leisure time physical activity behavior

Leisure time physical activity behavior was coded into two different types: binary and continuous. Continuous variable was examined in Spearman Correlation Coefficients test, while binary variables was used in multivariate logistic regressions.

Continuous: In the CHNS study, participants had been asked to answer "Do you participate in this activity?", with response options: "yes", "no", and "unknown". If they

chose “no” or “unknown” to a certain item, they were guided to skip down to the next one. If they selected “yes” to that item, they were then asked to further indicate how much time they spent during a typical day. In consideration of the difference of time devoted to physical activity between workdays and weekends, participants listed the time they spent each day during workdays and weekends separately. Similar to questions regarding physical activity preference, the following activities were asked: “Martial arts (Kung Fu, etc.)”, “Gymnastics, dancing, acrobatics”, “Tracking and field (running, etc.), swimming”, “Soccer, basketball, tennis”, “Badminton, volleyball”, and “Other (ping pong, Tai Chi, etc.)”. Table 3 is comparing these activities to those in preference section. Overall, activities match well, since activities in both sections include light, moderate, and high intensities of activities.

Table 3. Activities comparison

Activities in behavior section	**Activities in preference section**
Martial arts (Kung Fu, etc.)	Body building
Gymnastics, dancing	Body building
Acrobatics	Walking, Tai Chi
Tracking and field (running, etc.), swimming	Sports
Soccer, basketball, tennis	Sports
Badminton, volleyball	Sports
Other (ping pong)	Sports
Other (Tai Chi, etc.)	Walking, Tai Chi

For each type of activity, the average time per day was calculated (“0” was given to those did not participate):

Average time = (Time spent on each workday*5 + Time spent on each weekend day*2)/7

Then, total average time of leisure time physical activity per day was determined by adding the three activities' average time.

This measurement for leisure time physical activity behavior is similar to that of the Older Adult Exercise Status Inventory study (OA-ESI); OA-ESI is a seven-day physical activity recall that uses age-appropriate activities and cues to improve recall (Wilson & Spink, 2009). Respondents were asked to report each type of physical activity and length of time spent in that activity for each day during the past week. The duration, frequency, and type of activity were used to calculate the level of physical activity for each adult (Ainsworth et al., 2000). The feature of this measure is that it includes lower intensity activities (e.g. walking) often performed by older adults. The validity and test-retest reliability has been proven to be acceptable (Brien-Cousins, 1996; Chogahara, 1999).

Because the measurement of leisure time physical activity behavior in the study is similar to the OA-ESI method, the validity and test-retest reliability in the study should be met.

Binary: Participants had been asked if they participate in the following activities: Martial arts (Kung Fu, etc.), Gymnastics, dancing, acrobatic, Track and field (running, etc.), swimming, Soccer, basketball, tennis, Badminton, volleyball, Other (ping pong, Tai Chi, etc.). If they answered "yes" to any of those activities, their responses would be coded as 1, otherwise 0.

Potential confounding variables

Potential confounding variables were measured in 3 constructs: sociodemographic variables, health behaviors, and health-related variables. Sociodemographic variables include age, sex, ethnicity, marital status, community types (urban vs. suburban vs. town vs. village), region of residence (north vs. south), education, employment status, and annual household income (Chinese Yuan Renminbi - RMB: ¥; Yuan-US Dollar exchange rate was 6.4588 Yuan per U.S dollar in 2010; annual household income was grouped into four levels according to quartiles: 0-8000, 8001-15000, 15001-25000, and over 25000). Region of residence was divided into north and south based on Huai River policy, since 5.5 years of disparity in terms of life expectancy between north and south China had been observed in previous study (Y. Chen, Ebenstein, Greenstone, & Li, 2013). Health behaviors were indicated by smoking status and alcohol consumption. Health-related variables included current health status (self-report), health insurance coverage, and Body Mass Index (BMI). A unique BMI criterion was applied recognizing that Chinese have different body shapes and skeletons compared to westerners as a growing number of studies reveals that Chinese and several populations from other Asian Pacific countries have an increased risk for obesity-related chronic diseases or conditions at a lower BMI than Caucasians (Bassett & Organization, 2000; Bei-Fan & the Cooperative Meta-analysis Group of Working Gro, 2002; Deurenberg-Yap & Deurenberg, 2003; Misra, 2003; Nishida, 2004; Zhou, Kessler, &

Su, 2016). It also has been argued that the WHO BMI cut points are developed primarily based on data from Western populations (Wang et al., 2007). The Chinese BMI cut points were developed based on data collected in 239,972 Chinese adults in the 1990s. In this criterion, underweight is <18.50, normal weight is 18.50-23.99, overweight is 24.00-27.99, obesity is 28.00 and over ("Criteria of weight for adults," 2013).

Statistical Analysis:

A univariate analysis was conducted to depict the distribution of all explanatory and control variables. Spearman Correlation Coefficients were used to test associations between leisure time physical activity preference in 2004 and leisure time physical activity behavior in 2004 and 2011.

The association between leisure time physical activity behavior in 2011 and preference in 2004 was also assessed by conducting multivariate logistic regressions adjusting for age, sex, ethnicity, marital status, community types, region of residence, education, employment status, annual household income, smoking status, alcohol consumption, current health status (self-report), health insurance coverage, and BMI. All covariates were from data in 2004. In addition, to explore potential urban and rural differences, analyses were conducted separately for urban residents and rural residents. To test for possible mediation through BMI and current health status (self-report), models were run with and without these mediating variables. Odds ratios (ORs) and 95% confidence intervals (95% CIs) were reported. The association was considered to be

statistically significant if the 2-sided p value is less than 0.05. All analyses were performed using the SPSS for Windows, version 21.0 ("SPSS," 2012).

Results

Table 4 shows descriptive statistics for all outcome variables and covariates among the whole sample, urban residents, and rural residents. Overall, prevalence of leisure time physical activity in 2011 was low in the sample (14.1%), and it was much more prevalent among urban residents (20.2%) than their rural counterparts (4.0%). Participants did not strongly prefer physical activity in 2004 (mean preference score is 6.16 in the whole sample; the possible preference score is between 3 and 15); urban residents were more likely than rural citizens to report higher physical activity preference (6.58 vs. 5.45). In terms of ethnic composition, Han dominated the sample (almost 90% of respondents were Han ethnicity across different community groups), which is consistent with the national ethnic distribution in China. Urban residents were more likely to be widowed than rural population (2.7% vs. 1.6%). Education level was low in the sample. Specifically, less than one third (30.3%) of the sample received a high school of above education. The disparity between urban and rural residents was substantial. Thirty nine point two percent (39.2%) of urban residents reported high school or above education, as compared to only 15.6% among rural residents. Over one third (37.7%) of the whole sample was from rural area (village), while 62.3% of them was from urban areas (including urban, suburban, and town). Urban residents were less

likely to be smokers (31.7% vs. 34.1%), and more likely to drink alcohol (36.0% vs. 32.7%) than their rural counterparts. Urban residents also tended to have higher Body Mass Index (BMI). Specifically, they were less likely to be underweight (3.1% vs. 5.1%) and have normal weight (49.0% vs. 58.2%), and more likely to be overweight (37.7% vs. 29.3%) and obese (10.9% vs. 7.4%). They (urban residents) were more likely to be covered by health insurance than rural people (43.6% vs. 22.3%).

Table 4. Variables in Analysis of Leisure Time Activity Preference and Behavior in the Sample (N = 2,427), Urban (n = 1,528) and Rural (n = 899) Residents

	Whole Sample		**Urban Residents**		**Rural Residents**	
Variables	Number	Mean or Percentage (SD)	Number	Mean or Percentage (SD)	Number	Mean or Percentage (SD)
Dependent variable (2011)						
Leisure time activity						
No	2268	85.9	1313	79.8	955	96.0
Yes	373	14.1	333	20.2	40	4.0
Independent variables (2004)						
Leisure time activity preference						
Prefer activity	2638	6.16 (3.07)	1641	6.58 (3.17)	997	5.45 (2.77)
Demographics						
Age	2645	40.49 (12.84)	1648	42.35 (13.38)	997	37.42 (11.26)
Sex						
Male	1253	47.4	773	46.9	480	48.1
Female	1392	52.6	875	53.1	517	51.9
Ethnicity						
Han	2391	90.4	1523	92.4	868	87.1
Others	254	9.6	125	7.6	129	12.9
Marital status						
Never married	108	4.1	72	4.4	36	3.6
Married	2448	93.0	1513	92.3	935	94.3
Divorced	16	0.6	11	0.7	5	0.5
Widowed	60	2.3	44	2.7	16	1.6
Community types						
Urban	482	18.2	482	29.2	-	-
Suburban	640	24.2	640	38.8	-	-
Town	526	19.9	526	31.9	-	-
Village	997	37.7	-	-	997	100.0

	Whole Sample		Urban Residents		Rural Residents	
Variables	Number	Mean or Percentage (SD)	Number	Variables	Number	Mean or Percentage (SD)
Region of residence						
North	1268	47.9	747	45.3	521	52.3
South	1377	52.1	901	54.7	476	47.7
Socioeconomic status						
Employment						
Unemployed	570	21.6	479	29.1	91	9.1
Employed	2072	78.4	1167	70.9	905	90.9
Annual household income (Yuan)						
0-8000	520	19.9	242	14.8	278	28.4
8001-15000	643	24.6	356	21.8	287	29.3
15001-25000	601	23.0	380	23.3	221	22.6
Over 25000	850	32.5	656	40.1	194	19.8
Education						
Illiterate	464	17.6	233	14.2	231	23.2
Primary school	593	22.5	291	17.7	302	30.3
Middle school	781	29.6	473	28.8	308	30.9
High school or above	799	30.3	644	39.2	155	15.6
Health behavior						
Smoking status						
Nonsmoker	1781	67.4	1125	68.3	656	65.9
Smoker	861	32.6	522	31.7	339	34.1
Alcohol consumption						
No drinking	1726	65.3	1055	64.0	671	67.3
Drinking	919	34.7	593	36.0	326	32.7

	Whole Sample		Urban Residents		Rural Residents	
Variables	Number	Mean or Percentage (SD)	Number	Variables	Number	Mean or Percentage (SD)
Health-related variables						
BMI categories						
Underweight	96	3.8	49	3.1	47	5.1
Normal weight	1313	52.4	773	49.0	540	58.2
Overweight	855	34.1	583	37.7	272	29.3
Obese	241	9.6	172	10.9	69	7.4
Current health status (self-report)						
Very good	433	16.4	244	14.8	189	19.0
Good	1185	44.9	761	46.2	424	42.6
Bad	872	33.0	553	33.6	319	32.1
Very bad	151	5.7	88	5.3	63	6.3
Health insurance coverage						
No	1699	64.5	925	56.4	774	77.7
Yes	936	35.5	714	43.6	222	22.3

Abbreviation: SD, standard deviation; —, not applicable.

Table 5 shows the Spearman correlation coefficients between leisure time physical activity behavior (in 2004 and 2011) and leisure time physical activity preference in 2004. Time of physical activity participants spent in 2004 was positively and significantly related to their physical activity preference in the same year among the entire sample, urban residents, and rural residents. But the association was stronger in urban residents. Furthermore, time of physical activity in 2011 was positively and significantly associated with physical activity preference in 2004 among the whole sample and urban residents, but not in rural people.

Table 5. Spearman Correlation Coefficients between Leisure Time Physical Activity Behavior and Leisure Time Physical Activity Preference in a Sample (N = 2,427), Urban (n = 1,528) and Rural (n = 899) Residents

	Physical Activity Preference in 2004		
	Sample	Urban	Rural
Time of Physical Activity in 2004	0.202***	0.201***	0.111***
Time of Physical Activity in 2011	0.126***	0.111***	0.032

*** $p < 0.001$

Table 6 shows the multivariate logistic regressions assessing the association between leisure time physical activity behavior in 2011 and preference in 2004 after adjusting for age, sex, ethnicity, marital status, community types, region of residence, education, employment status, annual household income, smoking status, alcohol consumption, current health status (self-report), health insurance coverage, and BMI. Leisure time physical activity preference in 2004 was a significant predictor of actual behavior in the whole sample (OR = 1.05, 95% CI = 1.01-1.09) and urban sample (OR = 1.06, 95% CI = 1.01-1.10), but not among rural residents (OR = 1.04, 95% CI = 0.92-1.17). Age was also significantly associated with higher probability of physical activity behavior in the whole sample (OR = 1.01, 95% CI = 1.00-1.03) and urban sample (OR = 1.02, 95% CI = 1.00-1.03). Married rural residents were significantly related to lower probability of physical activity (OR = 0.12, 95% CI = 0.03-0.53) comparing to never married counterparts. In the whole sample, village (OR = 0.30, 95% CI = 0.20-0.47) and town residents (OR = 0.69, 95% CI = 0.49-0.99) had a lower probability of physical activity. Participants in the whole sample and urban sample with higher education levels tended to be more actively involved in physical activity during leisure time. Specifically, as compared to illiterate participants, those who had primary school (OR = 1.92, 95% CI = 1.14-3.25 in the whole sample; OR = 1.81, 95% CI = 1.02-3.22 in urban residents), middle school (OR = 2.53, 95% CI = 1.51-4.23 in the whole sample; OR = 2.46, 95% CI = 1.41-4.30 in urban residents), and high school or above (OR = 3.72, 95% CI = 2.22-6.22 in the whole sample; OR = 3.25, 95% CI = 1.86-5.68 in urban residents) as their

highest education level had an elevated probability of physical activity. The associations were diminished in rural residents except that those who had high school or above education had a higher probability of physical activity (OR = 9.33, 95% CI = 2.20-39.55). Notably, participants covered by health insurance were more likely to report physical activity (OR = 1.77, 95% CI = 1.35-2.33 in the whole sample; OR = 1.53, 95% CI = 1.14-2.06 among urban residents; OR = 4.07, 95% CI = 1.92-8.60 for rural participants).

Table 6. Multivariate Logistic Regression on Leisure Time Activity Behavior among Sample (N = 2,427), Urban (n = 1,528) and Rural (n = 899) Residents

Variables	**Whole Sample (N = 2,427)**	**Urban Residents (n = 1,528)**	**Rural Residents (n = 899)**
	Odds Ratio (95% CI)	**Odds Ratio (95% CI)**	**Odds Ratio (95% CI)**
		Leisure time physical activity preference	
Prefer activity in 2004	1.05** (1.01-1.09)	1.06** (1.01-1.10)	1.04 (0.92-1.17)
		Demographics	
Age	1.01** (1.00–1.03)	1.02** (1.00–1.03)	1.01 (0.97–1.05)
Sex			
Male	1 [Reference]	1 [Reference]	1 [Reference]
Female	1.23 (0.87–1.75)	1.25 (0.86–1.83)	1.37 (0.47–3.99)
Ethnicity			
Han	1 [Reference]	1 [Reference]	1 [Reference]
Others	1.26 (0.81–1.96)	1.18 (0.71–1.95)	1.87 (0.66–5.30)
Marital status			
Never married	1 [Reference]	1 [Reference]	1 [Reference]
Married	0.67 (0.37–1.24)	0.86 (0.43–1.69)	0.12*** (0.03–0.53)
Divorced	0.40 (0.08–2.13)	0.62 (0.11–3.50)	0.00 (0.00–0.00)
Widowed	0.64 (0.22–1.85)	0.73 (0.23–2.28)	0.22 (0.01–7.53)
Community types			
Urban	1 [Reference]	-	-
Suburban	1.38* (0.99–1.92)	-	-
Town	0.69** (0.49–0.99)	-	-
Village	0.30*** (0.20–0.47)	-	-
Region of residence			
North	1 [Reference]	1 [Reference]	1 [Reference]
South	1.22 (0.94–1.58)	1.29* (0.97–1.70)	0.90 (0.43–1.88)
		Socioeconomic status	
Employment			
Unemployed	1 [Reference]	1 [Reference]	1 [Reference]
Employed	0.89 (0.64–1.25)	0.93 (0.65–1.33)	0.83 (0.24–2.93)

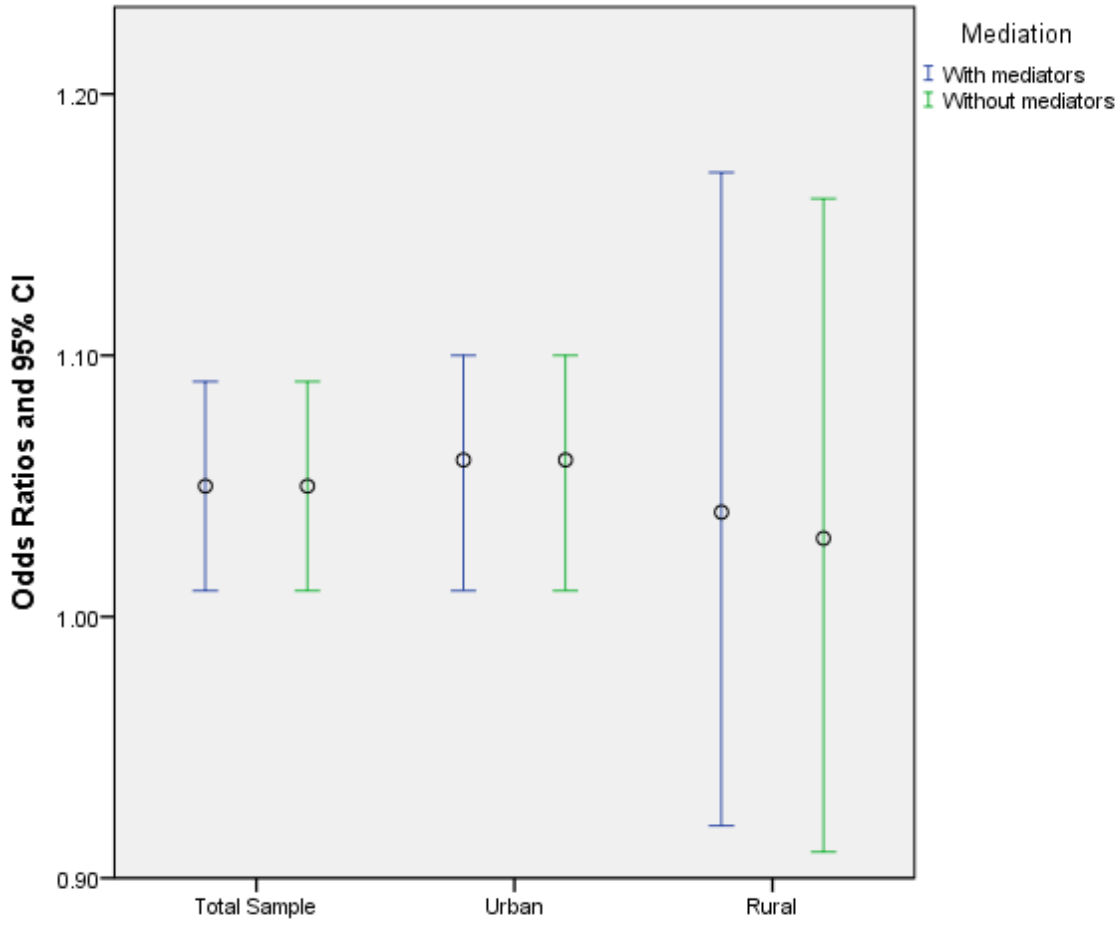
Variables	Whole Sample (N = 2,427)	Urban Residents (n = 1,528)	Rural Residents (n = 899)
	Odds Ratio (95% CI)	Odds Ratio (95% CI)	Odds Ratio (95% CI)
Annual household income (Yuan)			
0-8000	1 [Reference]	1 [Reference]	1 [Reference]
8001-15000	1.05 (0.67–1.65)	1.04 (0.62–1.74)	1.11 (0.42–2.94)
15001-25000	1.04 (0.67–1.63)	1.11 (0.67–1.84)	0.61 (0.20–1.91)
Over 25000	1.40 (0.92–2.14)	1.49* (0.93–2.39)	1.24 (0.45–3.43)
Education			
Illiterate	1 [Reference]	1 [Reference]	1 [Reference]
Primary school	1.92** (1.14–3.25)	1.81** (1.02–3.22)	3.00 (0.72–12.52)
Middle school	2.53*** (1.51–4.23)	2.46*** (1.41–4.30)	2.38 (0.54–10.56)
High school or above	3.72*** (2.22–6.22)	3.25*** (1.86–5.68)	9.33*** (2.20–39.55)
Health behavior			
Smoking status			
Nonsmoker	1 [Reference]	1 [Reference]	1 [Reference]
Smoker	0.84 (0.60–1.19)	0.89 (0.62–1.29)	0.55 (0.20–1.48)
Alcohol consumption			
No drinking	1 [Reference]	1 [Reference]	1 [Reference]
Drinking	1.16 (0.86–1.58)	1.21 (0.87–1.67)	0.83 (0.29–2.38)
Health-related variables			
BMI categories			
Underweight	1 [Reference]	1 [Reference]	1 [Reference]
Normal weight	1.26 (0.57–2.78)	1.19 (0.50–2.82)	1.95 (0.20–19.11)
Overweight	1.41 (0.63–3.15)	1.41 (0.59–3.38)	1.20 (0.12–12.47)
Obese	1.31 (0.55–3.11)	1.29 (0.51–3.30)	0.85 (0.57–12.83)
Current health status (self-report)			
Very good	1 [Reference]	1 [Reference]	1 [Reference]
Good	1.48** (1.02–2.15)	1.49* (0.99–2.24)	1.28 (0.47–3.51)
Bad	1.10 (0.73–1.66)	1.01 (0.65–1.58)	1.63 (0.58–4.77)
Very bad	0.61 (0.29–1.30)	0.61 (0.27–1.37)	0.62 (0.06–5.97)
Health insurance coverage			
No	1 [Reference]	1 [Reference]	1 [Reference]
Yes	1.77*** (1.35–2.33)	1.53*** (1.14–2.06)	4.07*** (1.92–8.60)

Abbreviations: CI, confidence interval; BMI, Body Mass Index; —, not applicable.
* $p < .10$.

** $p < .05$.
*** $p < .01$.

Figure 5 shows the mediation effects of BMI and current health status (self-report). After removing BMI and current health status from multivariate models, odds ratios and 95% CI of physical activity among the whole sample, urban residents, and rural residents did not dramatically change.

Figure 5. Comparison of odds ratios and 95% CI of leisure time physical activity with and without mediators



Discussion

This study examined the association between leisure time physical activity preference and behavior among adults, who participated in the China Health & Nutrition Survey in 2004 and 2011. Overall, leisure time physical activity was not commonly practiced in the sample, which is consistent with previous studies (S. W. Ng et al., 2009; Sallis et al., 1999). In addition, the results reveal that physical activity preference was a significant predictor of physical activity behavior, which supports the original hypothesis, but only among the whole sample, urban residents, and not in rural participants.

Preferring leisure time physical activity was strongly and positively correlated with performing leisure time physical activity. This is not surprising in light of existing research on the causal relationship between food preference and food intake, between sedentary activity preference and sedentary activity behavior (Drewnowski & Hann, 1999; Duffy et al., 2007; Harvey-Berino et al., 1997; Ricketts, 1997; Salmon et al., 2003; Temple, 2007). Specifically, existing studies show predicting value of food preference on actual food intake, and causal relationships between sedentary activity preference and lower physical activity level. This study confirms that measuring participants' preference on leisure time physical activity provides evidence on their actual activity level.

The urban-rural difference was observed in the study. Firstly, leisure time physical activity was substantially higher among urban residents than their rural counterparts, and urban participants were more likely to prefer leisure time physical activity. This could be explained by previous research (A. Bauman et al., 2011; Du et al., 2002; Yang et al., 2008), which shows that urban adults were more physically active than their rural counterparts, while rural residents were more and more involved in TV watching. In addition, the significant association between leisure time physical activity preference and leisure time physical activity behavior was found in urban residents, but not in rural participants. A possible explanation could be that the urban residents had more access to facilities and more spaces for physical activity than those in the rural areas (Loucaides, Chedzoy, & Bennett, 2004; Sheu-jen, Wen-chi, Patricia, & Jackson, 2010). Therefore, it would not be surprising to see that rural residents who prefer leisure time physical activity might find it impractical to do exercise, thus lead to lower physical activity level. Alternatively, rural residents were busy with farming work, and this made them have little leisure time for physical activities. Both of them could result in an observation of diminished association in rural residents.

This study has several limitations. First, the data contained no qualitative data on leisure time physical activity such as the purpose of performing physical activity, perceived usefulness of physical activity, how physical activity impacts other health behaviors, and so forth. Thus, one cannot disentangle why and how physical activity preference predicts physical activity behavior. Furthermore, the use of self-report data

can potentially introduce recall bias especially for variables based on participants' long-term memory such as duration of physical activity (Hassan, 2006). Additionally, the questions asking about leisure time physical activity preference and behavior were based on different types of activity, which may hide the association, especially among rural residents, in whom the significant correlation was not found. Finally, this study was based on a sample in China, where cultural norms and patterns of physical activity maybe unique to the Chinese context, which limits the generalizability of the findings to other countries.

Despite these limitations, this population-based study is unique in establishing the causal relationship between leisure time physical activity preference and behavior. To the best of our knowledge, this is the first scientific attempt to examine the predictive value of preference on leisure time physical activity. Furthermore, the study used longitudinal data which allows inferring causality.

Applications:

The major finding of this study: leisure time physical activity preference of Chinese adults is the significant predictor of reported physical activity behavior, has implications for health promotion interventions. Specializing in changing people's preference on leisure time physical activity through comprehensive health promotion interventions, like community involvement in modeling healthful physical activity is more likely to have a positive impact than direct and simple education on knowledge. In

addition, the findings regarding urban and rural difference may suggest future interventions to be tailored according to intervention settings. Specifically, health interventions in rural areas may also pay more attention to increase residents' access to physical activity facilities and invest more on infrastructure development, besides the preference education.

Chapter 2: Is leisure time physical activity an independent risk factor for the development of hypertension? An urban-rural comparison

Methods

Research Aim:

To study the effect of leisure time physical activity behavior on the incidence of hypertension, and the difference between urban and rural areas.

Research Approach:

Since previous studies conducted in other countries suggested that physical activity may independently decrease the risk of developing obesity and even hypertension (Howard et al., 2014; G. Hu et al., 2004; G. Ma et al., 2008), it is hypothesized that leisure time physical activity behavior is a significant protector against developing hypertension among Chinese participants, after adjusting for possible confounding variables. Proportional hazards regressions were conducted to test if the leisure time physical activity behavior in 2004 can predict incidents of hypertension between 2004 and 2011. Stratified analysis was conducted in urban and rural residents.

Measurements:

Leisure time physical activity behavior:

Participants had been asked if they participate in the following activities: Martial arts (Kung Fu, etc.), Gymnastics, dancing, acrobatic, Track and field (running, etc.), swimming, Soccer, basketball, tennis, Badminton, volleyball, Other (ping pong, Tai Chi, etc.). If they answered "yes" to any of those activities, their responses would be coded as 1, otherwise 0.

Hypertension:

"Has a doctor ever told you that you suffer from high blood pressure?" was asked to identify if the participants have any doctor-diagnosed hypertension. Then, participants further indicated how many years they have had hypertension if they answered "yes" to the question mentioned above. Those who have had hypertension over seven years in 2011 were excluded from the study because their hypertension was diagnosed before the study period (from 2004 to 2011). Previous studies have shown the validity of self-reported physician-diagnosed chronic diseases (Kehoe, Wu, Leske, & Chylack, 1994).

Potential confounding variables:

Potential confounding variables were measured in 3 constructs: sociodemographic variables, health behaviors, and health-related variables. Sociodemographic variables include age, sex, ethnicity, marital status, community types (urban vs. suburban vs. town vs. village), region of residence (north vs. south), education, employment status, and annual household income (Chinese Yuan Renminbi - RMB: ￥; Yuan-US Dollar exchange rate was 6.4588 Yuan per U.S dollar in 2010; annual household income was grouped into four levels according to quartiles: 0-8000, 8001-15000, 15001-25000, and over 25000). Region of residence was divided into north and south based on Huai River policy, since 5.5 years of disparity in terms of life expectancy between north and south China had been observed in previous study (Y. Chen, Ebenstein, Greenstone, & Li, 2013). Health behaviors were indicated by smoking status and alcohol consumption. Health-related variables included current health status (self-report), health insurance coverage, and Body Mass Index (BMI). A unique BMI criterion was applied recognizing that Chinese have different body shapes and skeletons compared to westerners as a growing number of studies reveals that Chinese and several populations from other Asian Pacific countries have an increased risk for obesity-related chronic diseases or conditions at a lower BMI than Caucasians (Bassett & Organization, 2000; Bei-Fan & the Cooperative Meta-analysis Group of Working Gro, 2002; Deurenberg-Yap & Deurenberg, 2003; Misra, 2003; Nishida, 2004; Zhou, Kessler, &

Su, 2016). It also has been argued that the WHO BMI cut points are developed primarily based on data from Western populations (Wang et al., 2007). The Chinese BMI cut points were developed based on data collected in 239,972 Chinese adults in the 1990s. In this criterion, underweight is <18.50, normal weight is 18.50-23.99, overweight is 24.00-27.99, obesity is 28.00 and over ("Criteria of weight for adults," 2013).

Statistical Analysis:

A univariate analysis was conducted to depict the distribution of all explanatory and control variables. The Chi-square (χ^2) tests were used for assessing the association between categorical variables leisure time physical activity behavior (two categories: yes and no) and development of hypertension (two categories: yes and no).

The association between leisure time physical activity behavior and incidence of hypertension was further assessed by proportional hazards regressions adjusting for age, sex, ethnicity, marital status, community types, region of residence, education, employment status, annual household income, smoking status, alcohol consumption, current health status (self-report), health insurance coverage, and BMI. Proportional hazards regression is one of frequently used survival analysis, which takes into consideration the time of events occurring (Aalabaf-Sabaghi, 2010). Proportional hazards regression was conducted because it allows us to analyze the effect of time of each incidence of hypertension occurring. In addition, to explore potential urban-rural differences, analyses were conducted separately for urban residents and rural residents.

To test for possible mediation through BMI and current health status (self-report), models were run with and without these mediating variables. Hazards ratios and 95% confidence intervals (95% CIs) were reported. The association was considered to be statistically significant if the 2-sided p value is less than 0.05. All analyses were performed using the SPSS for Windows, version 21.0 ("SPSS," 2012).

Results

Table 7 shows descriptive statistics for all outcome variables and covariates among the whole sample, urban residents, and rural residents. Overall, incidence of hypertension was not low (12.6%), and it was more prevalent among urban residents (13.9%) than their rural counterparts (10.7%) in rural areas. Participants did not actively participate in leisure time physical activity in 2004 (14.9%); urban residents were substantially more likely than rural citizens to report physical activity behavior (20.7% vs. 5.9%). In terms of ethnic composition, Han dominated the sample (almost 90% of respondents were Han ethnicity across different community groups), which is consistent with the national ethnic distribution in China. Unemployment rate was substantially higher in urban residents than rural participants (26.9% vs. 8.9%). Annual household income was generally higher among urban people. Specifically, there were more urban residents in 15001-25000 (23.2% vs. 22.6%) and over 25000 (39.1% vs. 19.6%) income categories, and less urban participants in 0-8000 (15.4% vs. 28.4%) and 8001-15000 (22.3% vs. 29.3%) categories. Education level was low in the sample. Specifically, less than one

third (30.5%) of the sample received a high school or above education. The disparity between urban and rural residents was substantial. Forty point one percent (40.1%) of urban residents reported high school of above education, as compared to only 15.5% among rural residents. Nearly 40% (38.9%) of the whole sample was from rural area (village), while 61.1% of them was from urban areas (including urban, suburban, and town). Urban residents were less likely to be smokers (32.6% vs. 34.5%), and more likely to drink alcohol (36.1% vs. 32.8%) than their rural counterparts. Urban residents also tended to have higher Body Mass Index (BMI). Specifically, they were less likely to be underweight (3.4% vs. 5.2%) and have normal weight (51.3% vs. 59.0%), and more likely to be overweight (35.8% vs. 29.2%) and obese (9.5% vs. 6.6%). They (urban residents) were more likely to be covered by health insurance than rural people (42.6% vs. 21.8%).

Table 7. Variables in Analysis of Leisure Time Physical Activity Behavior and Incidence of Hypertension in the Sample (N = 2,213), Urban (n = 1,367) and Rural (n = 846) Residents

	Whole Sample		**Urban Residents**		**Rural Residents**	
Variables	Number	Mean or Percentage (SD)	Number	Mean or Percentage (SD)	Number	Mean or Percentage (SD)
Dependent variable (2011)						
Hypertension						
No	2123	87.4	1278	86.1	845	89.3
Yes	307	12.6	206	13.9	101	10.7
Independent variables (2004)						
Leisure time activity behavior						
Leisure time activity						
No	2052	85.1	1168	79.3	884	94.1
Yes	360	14.9	305	20.7	55	5.9
Demographics						
Age	2412	39.62 (12.51)	1487	41.25 (13.06)	948	37.07 (11.15)
Sex						
Male	1156	47.5	697	46.9	459	48.4
Female	1279	52.5	790	53.1	489	51.6
Ethnicity						
Han	2192	90.0	1369	92.1	823	86.8
Others	243	10.0	118	7.9	125	13.2
Marital status						
Never married	107	4.4	71	4.8	36	3.8
Married	2257	93.1	1367	92.4	890	94.3
Divorced	14	0.6	10	0.7	4	0.4
Widowed	46	1.9	32	2.2	14	1.5

	Whole Sample		Urban Residents		Rural Residents	
Variables	Number	Mean or Percentage (SD)	Number	Variables	Number	Mean or Percentage (SD)
Community types						
Urban	425	17.5	425	28.6	-	-
Suburban	578	23.7	578	38.9	-	-
Town	484	19.9	484	32.5	-	-
Village	948	38.9	-	-	948	100.0
Region of residence						
North	1149	47.2	657	44.2	492	51.9
South	1286	52.8	830	55.8	456	48.1
Socioeconomic status						
Employment						
Unemployed	484	19.9	400	26.9	84	8.9
Employed	1948	80.1	1085	73.0	863	91.1
Annual household income (Yuan)						
0-8000	492	20.5	227	15.4	265	28.4
8001-15000	602	25.0	329	22.3	273	29.3
15001-25000	552	23.0	341	23.2	211	22.6
Over 25000	759	31.6	576	39.1	183	19.6
Education						
Illiterate	410	16.9	200	13.5	210	22.2
Primary school	551	22.7	258	17.4	293	30.9
Middle school	726	29.9	429	29.0	297	31.4
High school or above	740	30.5	593	40.1	147	15.5
Health behavior						
Smoking status						
Nonsmoker	1622	66.7	1002	67.4	620	65.5
Smoker	810	33.3	484	32.6	326	34.5

	Whole Sample		Urban Residents		Rural Residents	
Variables	Number	Mean or Percentage (SD)	Number	Variables	Number	Mean or Percentage (SD)
Alcohol consumption						
No drinking	1587	65.2	950	63.9	637	67.2
Drinking	848	34.8	537	36.1	311	32.8
Health-related variables						
BMI categories						
Underweight	94	4.1	48	3.4	46	5.2
Normal weight	1248	54.2	728	51.3	520	59.0
Overweight	766	33.3	509	35.8	257	29.2
Obese	193	8.4	135	9.5	58	6.6
Current health status (self-report)						
Very good	411	16.9	227	15.3	184	19.5
Good	1118	46.0	710	47.8	408	43.1
Bad	778	32.0	478	32.2	300	31.7
Very bad	124	5.1	70	4.7	54	5.7
Health insurance coverage						
No	1590	65.6	849	57.1	741	78.2
Yes	835	34.4	629	42.6	206	21.8

Abbreviation: SD, standard deviation; —, not applicable.

Table 8 shows the bivariate associations between leisure time physical activity behavior in 2004 and incidence of hypertension in 2011. Physical activity behavior was marginally significantly related to incidence of hypertension among the whole sample ($\chi^2 = 2.064$, $p < 0.10$) and significantly associated with incidence of hypertension among urban residents ($\chi^2 = 3.734$, $p < 0.05$), but the relationship was not significant in rural residents. Among the whole sample, 13.0% of those did not perform physical activity had been diagnosed as hypertension, while only 10.3% of those had physical activity was hypertensive. The discrepancy was more substantial in urban residents (14.8% vs. 10.5%). Although the pattern was observed in rural residents (10.7% vs. 9.1%), the difference was not huge and the association between leisure time physical activity and incidence of hypertension was not significant ($p > 0.10$).

Table 8. Bivariate Associations between Leisure Time Physical Activity Behavior in 2004 and Incidence of Hypertension between 2004 and 2011 among Sample (N = 2,213), Urban (n = 1,367) and Rural (n = 846) Residents

			Incidence of Hypertension between 2004 and 2011 (cases and row percentages)			χ^2
			No	Yes	Total	
Leisure time physical Activity in 2004	**Whole Sample**	No	1781 (87.0%)	267 (13.0%)	2048 (100.0%)	2.064*
		Yes	322 (89.7%)	37 (10.3%)	359 (100.0%)	
		Total	2103 (87.4%)	304 (12.6%)	2407 (100.0%)	
	Urban Residents	No	993 (85.2%)	173 (14.8%)	1166 (100.0%)	3.734**
		Yes	272 (89.5%)	32 (10.5%)	304 (100.0%)	
		Total	1265 (86.1%)	205 (13.9%)	1470 (100.0%)	
	Rural Residents	No	788 (89.3%)	94 (10.7%)	882 (100.0%)	0.134
		Yes	50 (90.9%)	5 (9.1%)	55 (100.0%)	
		Total	838 (89.4%)	99 (10.6%)	937 (100.0%)	

* $p < .10$.

** $p < .05$.

*** $p < .01$.

Table 9 shows the proportional hazards models assessing the association between incidence of hypertension in 2011 and leisure time physical activity behavior in 2004 after adjusting for age, sex, ethnicity, marital status, community types, region of residence, education, employment status, annual household income, smoking status, alcohol consumption, current health status (self-report), health insurance coverage, and BMI. Leisure time physical activity behavior was a significant protector from incidence of hypertension in the whole sample (HR = 0.60, 95% CI = 0.41-0.87) and urban sample (HR = 0.57, 95% CI = 0.38-0.87), but not among rural residents (HR = 0.91, 95% CI = 0.36-2.33). Specifically, the hypertension hazard was reduced by 40% (1-0.60) in the whole sample and 43% (1-0.57) in the urban residents for those who performed physical activity versus those who did not during leisure time. Age was also significantly associated with higher probability of hazard of hypertension in the whole sample (HR = 1.03, 95% CI = 1.02-1.04), urban sample (HR = 1.03, 95% CI = 1.01-1.04), and rural residents (HR = 1.04, 95% CI = 1.02-1.07). Hazard of hypertension for married urban residents were 7.54 times that of never married urban participants (HR = 7.54, 95% CI = 1.04-54.50). In the whole sample and rural sample, south residents had higher hazard of hypertension (HR = 1.36, 95% CI = 1.06-1.74 and HR = 1.51, 95% CI = 0.97-2.33 respectively) comparing to north residents. Notably, participants with higher BMI tend to have higher a hypertension hazard. Specifically, the hypertension hazard for those who were overweight were 5.52 (95% CI = 2.02-15.10) times in the whole sample, 5.34 (95% CI = 1.30-22.03) times in urban residents, and 6.40 (95% CI = 1.51-27.19) times in rural

people that of underweight participants. Those number were 5.70 (95% CI = 2.01-16.13), 5.73 (95% CI = 1.35-24.44), and 7.25 (95% CI = 1.54-34.26) in the whole sample, urban sample, and rural sample respectively when comparing the hazard of obese participants to that of underweight people.

Table 9. Hazards Ratios for Hypertension Based on Multivariate Regressions among Sample (N = 2,213), Urban (n = 1,367) and Rural (n = 846) Residents

	Whole Sample (N = 2,213)	**Urban Residents (n = 1,367)**	**Rural Residents (n = 846)**
Variables	**Hazards Ratio (95% CI)**	**Hazards Ratio (95% CI)**	**Hazards Ratio (95% CI)**
Events	**286**	**194**	**92**
	Leisure time physical activity behavior		
Leisure time activity in 2004	0.60*** (0.41-0.87)	0.57*** (0.38-0.87)	0.91 (0.36-2.33)
	Demographics		
Age	1.03*** (1.02–1.04)	1.03*** (1.01–1.04)	1.04*** (1.02–1.07)
Sex			
Male	1 [Reference]	1 [Reference]	1 [Reference]
Female	1.00 (0.71–1.40)	1.04 (0.68–1.60)	0.93 (0.51–1.70)
Ethnicity			
Han	1 [Reference]	1 [Reference]	1 [Reference]
Others	0.74 (0.46–1.19)	0.89 (0.49–1.62)	0.62 (0.28–1.36)
Marital status			
Never married	1 [Reference]	1 [Reference]	1 [Reference]
Married	2.10 (0.77–5.75)	7.54** (1.04–54.50)	0.48 (0.14–1.68)
Divorced	0.00 (0.00–0.00)	0.00 (0.00–0.00)	0.00 (0.00–0.00)
Widowed	1.20 (0.32–4.52)	4.81 (0.54–43.08)	0.13 (0.01–1.63)
Community types			
Urban	1 [Reference]	-	-
Suburban	0.97 (0.68–1.38)	-	-
Town	0.70* (0.48–1.03)	-	-
Village	0.73 (0.50–1.07)	-	-
Region of residence			
North	1 [Reference]	1 [Reference]	1 [Reference]
South	1.36** (1.06–1.74)	1.24 (0.91–1.67)	1.51* (0.97–2.33)
	Socioeconomic status		
Employment			
Unemployed	1 [Reference]	1 [Reference]	1 [Reference]
Employed	1.26 (0.91–1.76)	1.18 (0.82–1.72)	1.15 (0.50–2.61)

Variables	Whole Sample (N = 2,213)	Urban Residents (n = 1,367)	Rural Residents (n = 846)
	Hazards Ratio (95% CI)	Hazards Ratio (95% CI)	Hazards Ratio (95% CI)
Events	**286**	**194**	**92**
Annual household income (Yuan)			
0-8000	1 [Reference]	1 [Reference]	1 [Reference]
8001-15000	0.87 (0.62–1.22)	0.65* (0.42–1.02)	1.31 (0.77–2.23)
15001-25000	0.72* (0.49–1.04)	0.65* (0.41–1.03)	0.77 (0.39–1.51)
Over 25000	0.84 (0.59–1.18)	0.74 (0.48–1.14)	1.05 (0.56–1.97)
Education			
Illiterate	1 [Reference]	1 [Reference]	1 [Reference]
Primary school	1.02 (0.73–1.45)	1.02 (0.66–1.60)	1.07 (0.61–1.88)
Middle school	0.79 (0.54–1.16)	0.75 (0.47–1.21)	0.81 (0.42–1.55)
High school or above	0.69* (0.46–1.04)	0.63* (0.39–1.04)	0.80 (0.36–1.76)
Health behavior			
Smoking status			
Nonsmoker	1 [Reference]	1 [Reference]	1 [Reference]
Smoker	1.01 (0.74–1.39)	1.21 (0.81–1.80)	0.73 (0.42–1.27)
Alcohol consumption			
No drinking	1 [Reference]	1 [Reference]	1 [Reference]
Drinking	1.15 (0.85–1.56)	1.08 (0.75–1.56)	1.16 (0.68–1.99)
Health-related variables			
BMI categories			
Underweight	1 [Reference]	1 [Reference]	1 [Reference]
Normal weight	2.42* (0.89–6.63)	2.60 (0.63–10.78)	2.48 (0.59–10.49)
Overweight	5.52*** (2.02–15.10)	5.34** (1.30–22.03)	6.40** (1.51–27.19)
Obese	5.70*** (2.01–16.13)	5.73** (1.35–24.44)	7.25** (1.54–34.26)
Current health status (self-report)			
Very good	1 [Reference]	1 [Reference]	1 [Reference]
Good	0.98 (0.69–1.41)	0.92 (0.60–1.42)	1.04 (0.54–2.00)
Bad	1.02 (0.70–1.49)	0.87 (0.55–1.38)	1.29 (0.65–2.53)
Very bad	1.14 (0.65–1.99)	0.73 (0.34–1.57)	2.20* (0.93–5.21)
Health insurance coverage			
No	1 [Reference]	1 [Reference]	1 [Reference]
Yes	1.19 (0.91–1.55)	1.15 (0.83–1.59)	1.39 (0.87–2.23)

Abbreviations: CI, confidence interval; BMI, Body Mass Index; —, not applicable.

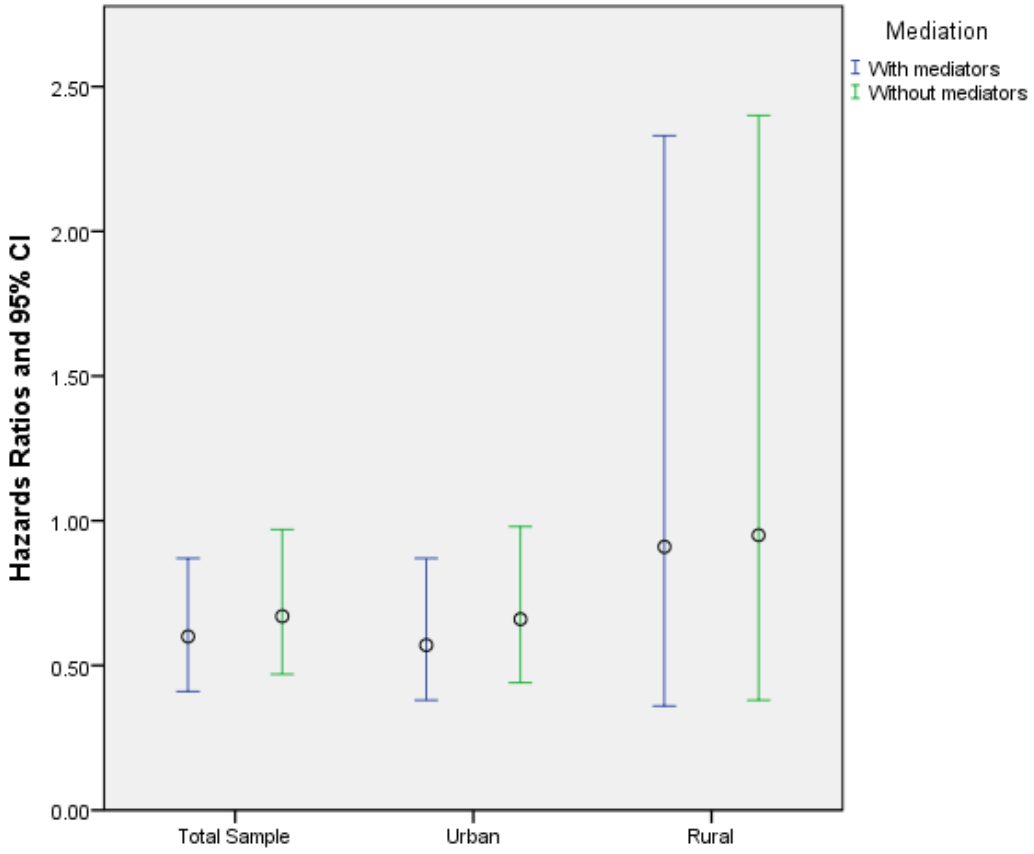
* $p < .10$.

** $p < .05$.

*** $p < .01$.

Figure 6 shows the mediation effects of BMI and current health status (self-report). After removing BMI and current health status from multivariate models, hazard ratios and 95% CI of leisure time physical activity on hypertension among the whole sample, urban residents, and rural residents increased, although very slightly.

Figure 6. Comparison of hazards ratios and 95% CI of incidence of hypertension with and without mediators



Discussion

This study explored the association between leisure time physical activity behavior and incidence of hypertension among adults, who participated in the China Health & Nutrition Survey in 2004 and 2011. Overall, incidence rate of hypertension over the past 7 years in the sample was high (12.6%), in consideration of the prevalence of hypertension in Chinese adults was only 26.6% in 2008 (Gao et al., 2013; Wu et al., 2008). Again, leisure time physical activity was not commonly practiced in the sample (14.9%), which is consistent with previous studies (S. W. Ng et al., 2009; Sallis et al., 1999). In addition, the results reveal that leisure time physical activity behavior was a significant protector from developing hypertension, which supports the original hypothesis, but only among the whole sample, urban residents, and not in rural participants,.

Performing physical activity during leisure time was strongly and negatively associated with incidence of hypertension. Specifically, people who were physically active is associated with 40% (43% in urban residents) less risk of hypertension when compared with who were not, independent of age, sex, ethnicity, marital status, community types, region of residence, education, employment status, annual household income, smoking status, alcohol consumption, current health status (self-report), health insurance coverage, and BMI, which is supported by previous studies (Howard et al., 2014; G. Hu et al., 2004; G. Ma et al., 2008). Although the pathway from lack of physical

activity to hypertension is still unclear (Howard et al., 2014), confirming the causal relationship is essential, especially among Chinese population who is experiencing a significant transition in terms of physical activity level and hypertension prevalence.

Again, the urban-rural difference was substantial in the study. Firstly, leisure time physical activity was significantly higher among urban residents than their rural counterparts. As mentioned in Chapter 1, the reason could be the urban residents had more access to facilities more spaces for physical activity than those in the rural areas (Loucaides, Chedzoy, & Bennett, 2004; Sheu-jen, Wen-chi, Patricia, & Jackson, 2010).

In addition, the incidence of hypertension was also higher in urban sample. Possibly, the difference is because that chronic diseases, such as hypertension, diabetes remained highly undiagnosed, and the rate of undiagnosed hypertension was higher in rural residents as compared to their urban counterparts (Hou, 2008; Wu et al., 2008; Y. Zhao, Hu, Smith, Strauss, & Yang, 2012). Alternatively, this may be due to unadjusted mediating effects (e.g. diet, occupational physical activity). Specifically, rural residents tend to have a healthier diet and be involved in more vigorous occupational physical activity (Abu-Omar & Rütten, 2008; Holtermann, Hansen, Burr, Søgaard, & Sjøgaard, 2012; D. Su et al., 2015). In terms of diet, natural foods sources that high in fruits, vegetables, and grains and low in fat are more available and affordable in developing countries like China (Drewnowski, 2000); processed foods that are commonly high in fat, salt and refined sugar are usually more expensive in the country (Kim, Symons, & Popkin, 2004). Furthermore, since the market system had been introduced to China,

people with higher socioeconomic status are more exposed to a western lifestyle to make them adopt some of its unhealthy diet (Guo et al., 2000). Taking into account the income difference between urban and rural residents, it is reasonable to observe that fat intake and daily intake of animal foods were higher in urban Chinese. Therefore, urban residents had worse diet pattern. Additionally, occupation of urban adults shifted from vigorous activity pattern to light activity pattern; in rural residents, even though their farming activities decreased due to the use of machinery, they held multiple jobs and spent more intensive effort than urban residents (Ding et al., 2011; Du et al., 2002). The energy expenditure from occupational physical activity has decreased more rapidly in urban residents than in rural adults (Monda et al., 2008). Healthier diet and more vigorous occupational physical activity in rural residents may have diminished the hazard effect of low leisure time physical activity level on development of hypertension. Therefore, the anticipated higher incidence of hypertension among rural residents was not present.

Furthermore, the significant association between leisure time physical activity behavior and incidence of hypertension was found in urban residents, but not in rural participants. A possible explanation could be the same: healthier diet and more vigorous occupational physical activity among rural residents diminished the association. Therefore, it would not be surprising to see that association between leisure time physical activity and incidence of hypertension was diminished in rural sample, and incidence of hypertension was lower in rural areas regardless of the lower leisure time

physical activity level, possibly due to the protecting effects of diet and occupational physical activity in rural participants.

This study has several limitations. First, the data contained no qualitative data on leisure time physical activity such as the purpose of performing physical activity, perceived usefulness of physical activity, how physical activity impacts other health behaviors, and so forth. Thus, one cannot disentangle why and how physical activity behavior impacts incidence of hypertension. Furthermore, the use of self-report data can potentially introduce recall bias especially for variables based on participants' long-term memory such as diagnosed hypertension or duration of physical activity (Hassan, 2006). Additionally, several important covariates (such as diet or occupational physical activity) were not included in the models due to the availability of data. In addition, the measurement of leisure time physical activity behavior is simply based on yes or no, so no dose-response relationship would be observed. Finally, this study was based on a sample in China, where cultural norms and patterns of physical activity may be unique to the Chinese context, which limits the generalizability of the findings to other countries.

Despite these limitations, this population-based study is unique in establishing the causal relationship between leisure time physical activity behavior and incidence of hypertension. This study used longitudinal data which allows for inferring causality. Furthermore, it is important in capturing the urban-rural disparities in leisure time physical activity as well as incidence of hypertension.

Applications:

The major finding of this study: leisure time physical activity behavior in Chinese adults is the significant protector from reported incidence of hypertension, has implications for health promotion interventions. Community health interventions focusing on decreasing prevalence of hypertension may find promoting leisure time physical activity very useful. In addition, the finding regarding urban and rural disparities may imply that future interventions can be tailored according to intervention settings. Since urban residents may have worse diet and occupational physical activity pattern, it would be wise to educate healthy diet and occupational physical activity pattern, in addition to leisure time physical activity among urban people.

Chapter 3: How are changes in leisure time physical activity preference related to the development of hypertension? Exploring the urban-rural gap

Methods

Research Aim:

To examine the association between changes in leisure time physical activity preference and incidence of hypertension between 2004 and 2011, and the association difference between urban and rural areas.

Research Approach:

Since previous research revealed that preferences for physical activity and psychological variables explain significant physical activity changes among children (Sallis et al., 1999), and studies proved that changes in physical activity are significantly related to heart disease and all-cause mortality(Paffenbarger Jr et al., 1993; Wannamethee et al., 1998; Young et al., 1993), it is hypothesized that there are significant relationships between changes in leisure time physical activity preference and development of hypertension among adults, after adjusting for possible confounding variables. Chi-square and multivariate logistic regressions were conducted to test if changes in leisure time physical activity preference are related to the development of

hypertension among adults. Stratified analysis was conducted in urban and rural residents.

Measurements:

Changes in leisure time physical activity preference:

In both 2004 and 2011, respondents' leisure time physical activity preference was calculated and had a score range of 3 to 15 as mentioned in Chapter 1. Then, their preference score in 2011 was compared to that in 2004. Those who had a negative score of changes in leisure time physical activity preference between 2004 and 2011 were regarded as "reduced physical activity preference", and those who had a positive score between 2004 and 2011 were treated as "increased physical activity preference". Apparently, those who did not change their physical activity preference between 2004 and 2011 had a score "0" and were labeled as "no change". Therefore, there are three categories for changes in leisure time physical activity preference: no change, reduced physical activity preference, and increased physical activity preference.

Hypertension:

"Has a doctor ever told you that you suffer from high blood pressure?" was asked to identify if the participants have any doctor-diagnosed hypertension. Then, participants further indicated how many years they have had hypertension if they answered "yes" to the question mentioned above. Those who have had hypertension

over seven years in 2011 were excluded from the study because their hypertension was diagnosed before the study period (from 2004 to 2011). Previous studies have shown the validity of self-reported physician-diagnosed chronic diseases (Kehoe, Wu, Leske, & Chylack, 1994).

Potential confounding variables:

Potential confounding variables were measured in 3 constructs: sociodemographic variables, health behaviors, and health-related variables. Sociodemographic variables include age, sex, ethnicity, marital status, community types (urban vs. suburban vs. town vs. village), region of residence (north vs. south), education, employment status, and annual household income (Chinese Yuan Renminbi - RMB: ¥; Yuan-US Dollar exchange rate was 6.4588 Yuan per U.S dollar in 2010; annual household income was grouped into four levels according to quartiles: 0-8000, 8001-15000, 15001-25000, and over 25000). Region of residence was divided into north and south based on Huai River policy, since 5.5 years of disparity in terms of life expectancy between north and south China had been observed in previous study (Y. Chen, Ebenstein, Greenstone, & Li, 2013). Health behaviors were indicated by smoking status, alcohol consumption, and baseline physical activity behavior. Health-related variables included current health status (self-report), health insurance coverage, and Body Mass Index (BMI). A unique BMI criterion was applied recognizing that Chinese have different body shapes and skeletons compared to westerners as a growing number of

studies reveals that Chinese and several populations from other Asian Pacific countries have an increased risk for obesity-related chronic diseases or conditions at a lower BMI than Caucasians (Bassett & Organization, 2000; Bei-Fan & the Cooperative Meta-analysis Group of Working Gro, 2002; Deurenberg-Yap & Deurenberg, 2003; Misra, 2003; Nishida, 2004; Zhou, Kessler, & Su, 2016). It also has been argued that the WHO BMI cut points are developed primarily based on data from Western populations (Wang et al., 2007). The Chinese BMI cut points were developed based on data collected in 239,972 Chinese adults in the 1990s. In this criterion, underweight is <18.50, normal weight is 18.50-23.99, overweight is 24.00-27.99, obesity is 28.00 and over ("Criteria of weight for adults," 2013).

Statistical Analysis:

A univariate analysis was conducted to depict the distribution of all explanatory and control variables. The Chi- square (χ^2) tests were used for assessing the associations between changes in leisure time physical activity preference (three categories: no change, reduced physical activity preference, and increased physical activity preference) and development of hypertension (two categories: yes and no).

Those associations were further assessed by multivariate logistic regressions adjusting for age, sex, ethnicity, marital status, community types, region of residence, education, employment status, annual household income, smoking status, alcohol consumption, baseline physical activity behavior, current health status (self-report), health insurance coverage, and BMI. In addition, to explore potential urban and rural

differences, analyses were conducted separately for urban residents and rural residents. To test for possible mediation through BMI and current health status (self-report), models were run with and without these mediating variables. Odds ratios (ORs) and 95% confidence intervals (95% CIs) were reported. The association was considered to be statistically significant if the 2-sided p value is less than 0.05. All analyses were performed using the SPSS for Windows, version 21.0 ("SPSS," 2012).

Results

Table 10 shows descriptive statistics for all outcome variables and covariates among the whole sample, urban residents, and rural residents. Overall, incidence of hypertension was not low (12.6%), and it was more prevalent among urban residents (13.9%) than their rural counterparts (10.7%). Majority of the sample (66.7% in the whole sample, 65.7% among urban residents, and 68.2% in rural people) increased their preference on leisure time physical activity from 2004 to 2011, while there were still some participants (23.3% in the whole sample, 25.7% in the urban residents, and 19.5% in rural residents) reduced their preference. Urban participants tend to reduce preference more than their rural counterparts (25.7% vs. 19.5%), and increase preference less than rural residents (65.7% vs. 68.2%). In terms of ethnic composition, Han dominated the sample (almost 90% of respondents were Han ethnicity across different community groups), which is consistent with the national ethnic distribution in China. Most of the sample was employed (80.1%), while the unemployment rate was higher in

urban areas (26.9% vs. 8.9%). Annual household income was generally higher among urban people. Specifically, there were more urban residents in 15001-25000 (23.2% vs. 22.6%) and over 25000 (39.1% vs. 19.6%) income categories, and less urban participants in 0-8000 (15.4% vs. 28.4%) and 8001-15000 (22.3% vs. 29.3%) income categories. The sample had a relatively low education level. Specifically, less than one third (30.5%) of the sample received a high school of above education. The disparity between urban and rural residents was substantial. Forty point one percent of urban residents reported high school of above education, as compared to only 15.5% among rural residents. Over one third (38.9%) of the whole sample was from rural area (village), while 61.1% of them was from urban areas (including urban, suburban, and town). Urban residents were less likely to be smokers (32.6% vs. 34.5%), and more likely to drink alcohol (36.1% vs. 32.8%) than their rural counterparts. Urban residents also tended to have higher Body Mass Index (BMI). Specifically, they were less likely to be underweight (3.4% vs. 5.2%) and have normal weight (51.3% vs. 59.0%), and more likely to be overweight (35.8% vs. 29.2%) and obese (9.5% vs. 6.6%). They (urban residents) were substantially more likely to be covered by health insurance than rural people (42.6% vs. 21.8%).

Table 10. Variables in Analysis of Changes in Leisure Time Physical Activity Preference and Incidence of Hypertension in the Sample (N = 2,189), Urban (n = 1,346) and Rural (n = 843) Residents

	Whole Sample		**Urban Residents**		**Rural Residents**	
Variables	Number	Mean or Percentage (SD)	Number	Mean or Percentage (SD)	Number	Mean or Percentage (SD)
Dependent variable (2011)						
Hypertension						
No	2123	87.4	1278	86.1	845	89.3
Yes	307	12.6	206	13.9	101	10.7
Variable of Interest						
Changes in leisure time activity preference between 2004 and 2011						
No change	241	10.0	125	8.5	116	12.3
Reduced	561	23.3	377	25.7	184	19.5
Increased	1605	66.7	963	65.7	642	68.2
Covariates (2004)						
Demographics						
Age	2412	39.62 (12.51)	1487	41.25 (13.06)	948	37.07 (11.15)
Sex						
Male	1156	47.5	697	46.9	459	48.4
Female	1279	52.5	790	53.1	489	51.6
Ethnicity						
Han	2192	90.0	1369	92.1	823	86.8
Others	243	10.0	118	7.9	125	13.2
Marital status						
Never married	107	4.4	71	4.8	36	3.8
Married	2257	93.1	1367	92.4	890	94.3
Divorced	14	0.6	10	0.7	4	0.4
Widowed	46	1.9	32	2.2	14	1.5

	Whole Sample		Urban Residents		Rural Residents	
Variables	Number	Mean or Percentage (SD)	Number	Variables	Number	Mean or Percentage (SD)
Community types						
Urban	425	17.5	425	28.6	-	-
Suburban	578	23.7	578	38.9	-	-
Town	484	19.9	484	32.5	-	-
Village	948	38.9	-	-	948	100.0
Region of residence						
North	1149	47.2	657	44.2	492	51.9
South	1286	52.8	830	55.8	456	48.1
Socioeconomic status						
Employment						
Unemployed	484	19.9	400	26.9	84	8.9
Employed	1948	80.1	1085	73.0	863	91.1
Annual household income (Yuan)						
0-8000	492	20.5	227	15.4	265	28.4
8001-15000	602	25.0	329	22.3	273	29.3
15001-25000	552	23.0	341	23.2	211	22.6
Over 25000	759	31.6	576	39.1	183	19.6
Education						
Illiterate	410	16.9	200	13.5	210	22.2
Primary school	551	22.7	258	17.4	293	30.9
Middle school	726	29.9	429	29.0	297	31.4
High school or above	740	30.5	593	40.1	147	15.5
Health behavior						
Smoking status						
Nonsmoker	1622	66.7	1002	67.4	620	65.5
Smoker	810	33.3	484	32.6	326	34.5

	Whole Sample		Urban Residents		Rural Residents	
Variables	Number	Mean or Percentage (SD)	Number	Variables	Number	Mean or Percentage (SD)
Alcohol consumption						
No drinking	1587	65.2	950	63.9	637	67.2
Drinking	848	34.8	537	36.1	311	32.8
Baseline physical activity						
No	2052	85.1	1168	79.3	884	94.1
Yes	360	14.9	305	20.7	55	5.9
Health-related variables						
BMI categories						
Underweight	94	4.1	48	3.4	46	5.2
Normal weight	1248	54.2	728	51.3	520	59.0
Overweight	766	33.3	509	35.8	257	29.2
Obese	193	8.4	135	9.5	58	6.6
Current health status (self-report)						
Very good	411	16.9	227	15.3	184	19.5
Good	1118	46.0	710	47.8	408	43.1
Bad	778	32.0	478	32.2	300	31.7
Very bad	124	5.1	70	4.7	54	5.7
Health insurance coverage						
No	1590	65.6	849	57.1	741	78.2
Yes	835	34.4	629	42.6	206	21.8

Abbreviation: SD, standard deviation; —, not applicable.

Table 11 shows the bivariate associations between changes in leisure time physical activity preference and incidence of hypertension between 2004 and 2011. Changes in leisure time physical activity preference were marginally significantly related to incidence of hypertension among the entire sample ($\chi^2 = 6.006$, $p < 0.10$) and significantly associated with incidence of hypertension among rural residents ($\chi^2 = 8.545$, $p < 0.05$), but the relationship was not significant in urban residents. Among the whole sample, 14.8% of those negatively changed physical activity preference had been diagnosed as hypertension, while only 9.5% of those maintained physical activity preference was hypertensive. The discrepancy was more substantial in urban residents (14.3% vs. 8.0%), but narrower among rural participants (15.8% vs. 11.2%).

Table 11. Bivariate Associations Between Changes in Leisure Time Physical Activity Preference between 2004 and 2011 and Incidence of Hypertension Among Sample (N = 2,189), Urban (n = 1,346) and Rural (n = 843) Residents

			Incidence of Hypertension in 2014 (cases and row percentages)			χ^2
			No	Yes	Total	
Changes in leisure time physical activity preference between 2004 and 2011	**Whole Sample**	No change	218 (90.5%)	23 (9.5%)	241 (100.0%)	6.006*
		Reduced	478 (85.2%)	83 (14.8%)	561 (100.0%)	
		Increased	1418 (88.6%)	183 (11.4%)	1601 (100.0%)	
		Total	2114 (88.0%)	289 (12.0%)	2403 (100.0%)	
	Urban Residents	No change	115 (92.0%)	10 (8.0%)	125 (100.0%)	3.412
		Reduced	323 (85.7%)	54 (14.3%)	377 (100.0%)	
		Increased	831 (86.6%)	129 (13.4%)	960 (100.0%)	
		Total	1269 (86.8%)	193 (13.2%)	1462 (100.0%)	
	Rural Residents	No change	103 (88.8%)	13 (11.2%)	116 (100.0%)	8.545**
		Reduced	155 (84.2%)	29 (15.8%)	184 (100.0%)	
		Increased	587 (91.6%)	54 (8.4%)	641 (100.0%)	
		Total	838 (89.4%)	99 (10.6%)	937 (100.0%)	

* $p < .10$.

** $p < .05$.

*** $p < .01$.

Table 12 show the multivariate logistic regressions assessing the association between changes in leisure time physical activity preference and incidence of hypertension between 2004 and 2011, after adjusting for age, sex, ethnicity, marital status, community types, region of residence, education, employment status, annual household income, smoking status, alcohol consumption, baseline physical activity behavior, current health status (self-report), health insurance coverage, and BMI. Changes in leisure time physical activity preference were significantly associated incidence of hypertension in the whole sample and urban sample, but not among rural residents. Specifically, those who became less prefer physical activity during leisure time were more likely to develop hypertension comparing to those without changes (OR = 1.92, 95% CI = 1.13-3.28 in the whole sample and OR = 2.19, 95% CI = 1.04-4.60 among urban residents). Age was also significantly associated with higher probability of hypertension in the whole sample (OR = 1.03, 95% CI = 1.02-1.05), urban sample (OR = 1.03, 95% CI = 1.01-1.05), and rural participants (OR = 1.05, 95% CI = 1.02-1.08). Married urban residents were significantly related to higher probability of hypertension (OR = 7.68, 95% CI = 1.02-57.88) comparing to never married counterparts. In the whole sample, town residents (OR = 0.68, 95% CI = 0.43-1.05) and village residents (OR = 0.69, 95% CI = 0.45-1.06) had a lower probability of develop hypertension. Among the whole sample and rural residents, those who were from south part of China were more likely to be diagnosed as hypertensive comparing to north counterparts (OR = 1.50, 95% CI = 1.13-1.99 and OR = 1.72, 95% CI = 1.04-2.84 respectively). In urban residents, those who had

higher annual household income were associated with lower probability of developing hypertension. Specifically, the odds of those whose annual household income was between 8001 and 15000 were 0.56 (95% CI = 0.33-0.95) times that of who had lower annual household income (0-8000); the numbers were 0.59 (95% CI = 0.34-1.01) for those who were in 15001-25000 income category. As compared to illiterate participants, those who had high school or above as their highest education level had a lower probability of develop hypertension (OR = 0.57, 95% CI = 0.36-0.91 for the whole sample and OR = 0.53, 95% CI = 0.30-0.95 for the urban residents). Those who were physically active in 2004 were less likely to develop hypertension in the next 7 years (OR = 0.48, 95% CI = 0.31-0.74 in the whole sample and OR = 0.47, 95% CI = 0.29-0.75 in urban residents). Notably, participants with higher BMI tend to have higher odds of developing hypertension. Specifically, odds for those who were overweight were 6.14 (95% CI = 2.15-17.47) times that of those were underweight in the whole sample, 5.98 (95% CI = 1.37-26.06) times in urban residents, and 6.54 (95% CI = 1.43-30.02) times in rural people. Those number were 6.31 (95% CI = 2.11-18.90), 6.16 (95% CI = 1.34-28.30), and 8.69 (95% CI = 1.66-45.49) in the whole sample, urban sample, and rural sample respectively when comparing odds of developing hypertension in obese participants to that of underweight people.

Table 12. The Odds ratios of Changes in Leisure Time Physical Activity Preference between 2004 and 2011 on incidence of hypertension for Multivariate Logistic Regressions among Sample (N = 2,189), Urban (n = 1,346) and Rural (n = 843) Residents

	Whole Sample (N = 2,189)	**Urban Residents (n = 1,346)**	**Rural Residents (n = 843)**
Variables	**Odds Ratio (95% CI)**	**Odds Ratio (95% CI)**	**Odds Ratio (95% CI)**
	Variable of Interest		
Changes in leisure time physical activity preference			
No change	1 [Reference]	1 [Reference]	1 [Reference]
Reduced	1.92** (1.13-3.28)	2.19** (1.04-4.60)	2.16* (0.95-4.92)
Increased	1.19 (0.72-1.96)	1.69 (0.84-3.43)	0.78 (0.37-1.65)
	Demographics		
Age	1.03*** (1.02–1.05)	1.03*** (1.01–1.05)	1.05*** (1.02–1.08)
Sex			
Male	1 [Reference]	1 [Reference]	1 [Reference]
Female	0.95 (0.65–1.41)	0.97 (0.59–1.58)	0.93 (0.47–1.84)
Ethnicity			
Han	1 [Reference]	1 [Reference]	1 [Reference]
Others	0.66 (0.39–1.12)	0.75 (0.37–1.52)	0.58 (0.24–1.38)
Marital status			
Never married	1 [Reference]	1 [Reference]	1 [Reference]
Married	2.02 (0.70–5.81)	7.68** (1.02–57.88)	0.40 (0.10–1.64)
Divorced	0.00 (0.00–0.00)	0.00 (0.00–0.00)	0.00 (0.00–0.00)
Widowed	0.90 (0.21–3.91)	3.85 (0.38–39.43)	0.08* (0.01–1.30)

	Whole Sample (N = 2,189)	Urban Residents (n = 1,346)	Rural Residents (n = 843)
Variables	**Odds Ratio (95% CI)**	**Odds Ratio (95% CI)**	**Odds Ratio (95% CI)**
Community types			
Urban	1 [Reference]	-	-
Suburban	0.90 (0.60–1.36)	-	-
Town	0.68* (0.43–1.05)	-	-
Village	0.69* (0.45–1.06)	-	-
Region of residence			
North	1 [Reference]	1 [Reference]	1 [Reference]
South	1.50*** (1.13–1.99)	1.34 (0.94–1.92)	1.72** (1.04–2.84)
Socioeconomic status			
Employment			
Unemployed	1 [Reference]	1 [Reference]	1 [Reference]
Employed	1.28 (0.87–1.87)	1.24 (0.81–1.92)	1.13 (0.46–2.80)
Annual household income (Yuan)			
0-8000	1 [Reference]	1 [Reference]	1 [Reference]
8001-15000	0.84 (0.57–1.24)	0.56** (0.33–0.95)	1.44 (0.78–2.65)
15001-25000	0.68* (0.45–1.04)	0.59* (0.34–1.01)	0.76 (0.35–1.63)
Over 25000	0.85 (0.57–1.26)	0.70 (0.42–1.16)	1.11 (0.55–2.27)
Education			
Illiterate	1 [Reference]	1 [Reference]	1 [Reference]
Primary school	1.01 (0.68–1.50)	1.06 (0.62–1.80)	1.05 (0.55–2.03)
Middle school	0.75 (0.49–1.16)	0.71 (0.41–1.24)	0.85 (0.41–1.77)
High school or above	0.57** (0.36–0.91)	0.53** (0.30–0.95)	0.73 (0.29–1.81)

	Whole Sample (N = 2,189)	Urban Residents (n = 1,346)	Rural Residents (n = 843)
Variables	**Odds Ratio (95% CI)**	**Odds Ratio (95% CI)**	**Odds Ratio (95% CI)**
	Health behavior		
Smoking status			
Nonsmoker	1 [Reference]	1 [Reference]	1 [Reference]
Smoker	1.03 (0.72–1.49)	1.20 (0.75–1.91)	0.74 (0.39–1.39)
Alcohol consumption			
No drinking	1 [Reference]	1 [Reference]	1 [Reference]
Drinking	1.14 (0.81–1.60)	1.08 (0.71–1.65)	1.08 (0.59–2.00)
Baseline physical activity			
No	1 [Reference]	1 [Reference]	1 [Reference]
Yes	0.48*** (0.31–0.74)	0.47*** (0.29–0.75)	0.78 (0.27–2.23)
	Health-related variables		
BMI categories			
Underweight	1 [Reference]	1 [Reference]	1 [Reference]
Normal weight	2.30 (0.81–6.53)	2.46 (0.56–10.75)	2.16 (0.48–9.78)
Overweight	6.14***(2.15–17.47)	5.98** (1.37–26.06)	6.54** (1.43–30.02)
Obese	6.31***(2.11–18.90)	6.16** (1.34–28.30)	8.69** (1.66–45.49)
Current health status (self-report)			
Very good	1 [Reference]	1 [Reference]	1 [Reference]
Good	0.96 (0.65–1.43)	0.85 (0.52–1.39)	1.12 (0.54–2.32)
Bad	1.04 (0.68–1.58)	0.83 (0.49–1.40)	1.49 (0.70–3.17)
Very bad	1.25 (0.66–2.38)	0.66 (0.27–1.62)	3.14** (1.15–8.63)
Health insurance coverage			
No	1 [Reference]	1 [Reference]	1 [Reference]
Yes	1.21 (0.89–1.65)	1.15 (0.78–1.67)	1.54 (0.90–2.64)

Abbreviations: CI, confidence interval; BMI, Body Mass Index; —, not applicable.

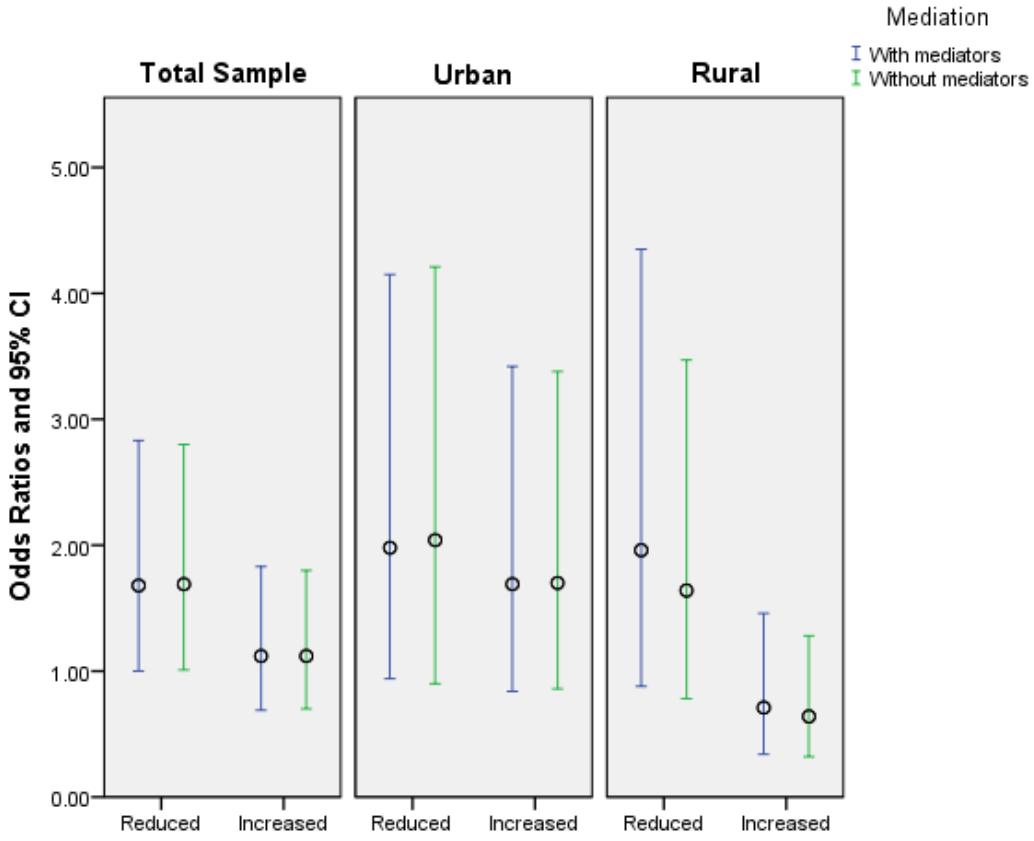
* $p < .10$.

** $p < .05$.

*** $p < .01$.

Figure 7 shows the mediation effects of BMI and current health status (self-report). After removing BMI and current health status from multivariate models, odds ratios and 95% CI of changes in leisure time physical activity preference (both reduced and increased physical activity preference) among the whole sample, urban residents, and rural residents did not substantially change. The exception is that among rural residents, odds ratio of reducing physical activity preference versus no changes was decreased and 95% CI was narrower after removing BMI and current health status.

Figure 7. Comparison of odds ratios and 95% CI with and without mediators



Discussion

This study assessed the association between changes in leisure time physical activity preference and incidence of hypertension among adults, who participated in the China Health & Nutrition Survey in 2004 and 2011. Overall, incidence rate of hypertension over the past 7 years in the sample was considerably high (12.6%), taking into consideration that the prevalence of hypertension in Chinese adults was only 26.6% in 2008 (Gao et al., 2013; Wu et al., 2008). The majority of the population changed their preference on leisure time physical activity; among them, most participants had their preference increased. In addition, the results reveal that reduced leisure time physical activity preference was significantly associated with incidence of hypertension among the whole sample and urban residents, but not in rural participants ($p > 0.05$).

Changes in leisure time physical activity preference was significantly associated with incidence of hypertension in rural areas, but not in urban residents using Chi-square test. Nevertheless, this pattern was reversed in multivariate logistic regressions, in which association was significant in urban areas as opposed to rural residents. One possible explanation is that the multivariate logistic regressions was investigating the reduced physical activity preference group comparing to no change group, or increased group comparing to no change group, while Chi-square test was used to determine whether there is a significant difference between the expected frequencies and the observed frequencies in all three categories of changes in leisure time physical activity

preference (Hair, Black, Babin, Anderson, & Tatham, 2006; Koch & Bhapkar, 2006; Mantel, 1963). In other words, the discrepancy could be due to the nature of statistical methods that have been applied, not the "true" difference.

Incidence of hypertension was strongly and positively associated with reduced physical activity preference, but not the increased physical activity preference. Possibly, people increased their physical activity preference, but this did not necessarily lead to their elevated physical activity level. So it is not surprising to see that incidence of hypertension was not significantly correlated to increased physical activity preference. Alternatively, if increased physical activity preference had elevated physical activity level, elevated physical activity did not necessarily resulted in lower probability of incidence of hypertension. Specifically, Chinese population was adopting an unhealthier diet pattern than before (Drewnowski, 2000; Guo et al., 2000; Kim et al., 2004), and they were shifting from vigorous occupational activity pattern to light occupational activity pattern (Ding et al., 2011; Du et al., 2002; Monda et al., 2008). Therefore, those factors may diminish the association between increased leisure time physical activity preference and incidence of hypertension.

Significant urban rural difference was observed in the study again. Firstly, changes in leisure time physical activity preference were less preferred in urban residents. Specifically, urban residents were less likely to increase, but more likely to reduce their physical activity preference, as compare to their rural counterparts. This may be consistent with changes in physical activity in Chinese residents, since study

reveals that urban population becomes less physical active while rural residents are increasing leisure time physical activity (Muntner et al., 2005). This may be partially supported by previous research (B. Su, Shen, & Zhou, 2006), which shows that public community recreational facilities in urban China remained poorly managed and received little for maintenance and updating.

Secondly, the incidence rate of hypertension was higher in urban residents, as opposed to rural people. This is consistent with findings from existing literatures (Hou, 2008; Wu et al., 2008). Possibly, the difference is because that chronic diseases, such as hypertension, diabetes remained highly undiagnosed, and the rate of undiagnosed hypertension was higher in rural residents as compared to their urban counterparts (Hou, 2008; Wu et al., 2008; Y. Zhao, Hu, Smith, Strauss, & Yang, 2012). Alternatively, rural residents may have healthier diet pattern and more active occupational physical activity level (Ding et al., 2011; Drewnowski, 2000; Du et al., 2002; Guo et al., 2000; Kim et al., 2004; Monda et al., 2008).

Last but not least, the relationship between reduced physical activity preference and incidence of hypertension was found significant among urban residents, but not in rural participants. Before explaining the urban-rural difference, it is wise to infer the causal relationship between leisure time physical activity preference and incidence of hypertension. Since leisure time physical activity preference was not significant protector from development of hypertension, neither in the whole sample, nor in urban and rural residents (see Table B in Appendix), and there is relationship between reduced

physical activity preference and incidence of hypertension, patients might have reduced their preference on leisure time physical activity after they were diagnosed with hypertension. The relationship between reduced physical activity preference and incidence of hypertension was not significant among rural residents, possibly because that the Chinese government has implemented the "Sports for All" program to expand relevant facilities and infrastructure, especially in rural areas (J. Chen, 1997), which could make rural patients with hypertension be less likely to reduce the preference. Alternatively, previous studies shows that rural residents "are in a very collective society and nobody exercises alone" (Ding et al., 2011). So the strong effect of social modelling among rural residents might have diminished the effect.

This study has several limitations. First, the data contained no qualitative data on changes in leisure time physical activity preference such as the reasons of changing physical activity preference, perceived barriers of changing preference, how changing physical activity preference impacts other health behaviors, and so forth. Thus, one cannot disentangle why and how changes in leisure time physical activity preference impacts incidence of hypertension. Furthermore, the use of self-report data can potentially introduce recall bias especially for variables based on participants' long-term memory such as diagnosed hypertension (Hassan, 2006). Additionally, several important covariates (such as diet or occupational physical activity) were not included in the models due to the unavailability of data. Finally, this study was based on a sample

in China, where cultural norms and patterns of physical activity may be unique to the Chinese context, which limits the generalizability of the findings to other countries.

Despite these limitations, this study is the first one to explore the association between changes in leisure time physical activity preference and incidence of hypertension using a large population-based study data.

Applications:

The conclusion that patients who were diagnosed with hypertension might lose/drop interest on leisure time physical activity and reduce their leisure time physical activity preference suggests that relevant health promotion interventions may focus on this group of people. For instance, health promotion interventions focusing on hypertension control may work with physicians, to show more encouragement and support to maintain or even increase patients' leisure time physical activity preference as well as help them engage in daily low intensity physical activities, after they are diagnosed with hypertension. In addition, the finding regarding urban and rural disparities may imply that future interventions may be tailored according to intervention settings. Specifically, special attention may be given to urban residents, as their leisure time physical activity preference maybe less preferably changing. Besides leisure time physical activity, diet and occupational physical activity need to be well-educated among urban residents. Health promotion interventions among rural residents

may find social modelling very helpful in maintaining their leisure time physical activity preference.

Conclusion

Summary

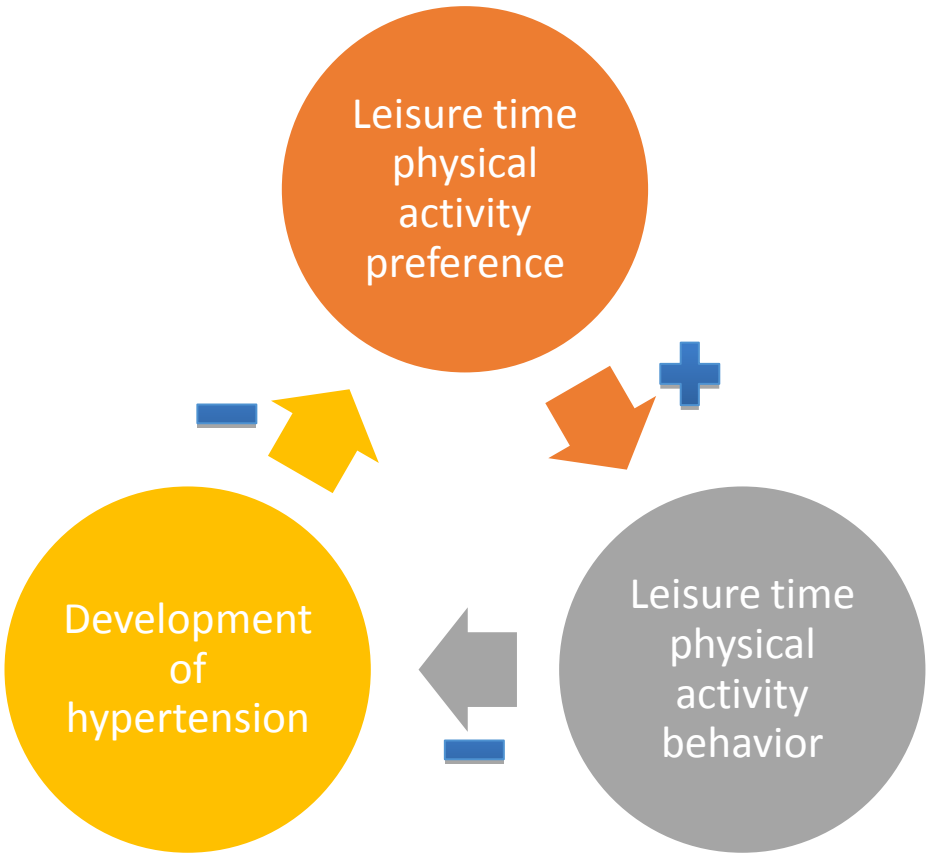
This dissertation examined the association between leisure time physical activity preference and behavior, the relationship between leisure time physical activity behavior and incidence of hypertension, as well as the correlation between changes in leisure time physical activity preference and incidence of hypertension among adults, who participated in the China Health & Nutrition Survey in 2004 and 2011. Overall, the results show that leisure time physical activity preference was a significant predictor of actual behavior, leisure time physical activity behavior was a significant protector from developing hypertension, and reduced leisure time physical activity preference was significantly associated with incidence of hypertension. All the three overarching findings were observed among the whole sample, urban residents, but not in rural participants.

Taken together, the three studies inform how the three variables leisure time physical activity preference, leisure time physical activity behavior, and incidence of hypertension are correlated with each other. Based on the first two studies, one can infer that leisure time physical activity preference leads to leisure time physical activity behavior, and leisure time physical activity behavior results in lower incidence of hypertension. Since reduced leisure time physical activity preference was associated

with incidence of hypertension, and leisure time physical activity preference was not significant protector from developing hypertension (see Table B in Appendix), the inference that having hypertension causes lower leisure time physical activity preference could be made.

Therefore, Figure 8 is presented below. In the figure, leisure time physical activity preference positively predicts behavior; leisure time physical activity behavior negatively causes development of hypertension; and development of hypertension negatively leads to changes in leisure time physical activity preference.

Figure 8. Relationships among leisure time physical activity preference, leisure time physical activity behavior, and development of hypertension



All three studies also explored urban-rural disparities. The relationships in Figure 8 were consistently only significant in the whole sample and urban residents, but not among rural participants. Taking into account the low prevalence of leisure time physical activity behavior among rural residents (partly because of their limited knowledge, access to excise facilities), relationships among the three variables might not be established yet in this group. Future studies may be conducted to support or reject such hypothesis. Furthermore, future health interventions may be tailored based on intervention settings.

Significance

The dissertation determined the associations between leisure time physical activity behavior and (changes in) leisure time physical activity preference, and incidence of hypertension in subjects who participated in China Health & Nutrition Survey (CHNS) from 2004 to 2011, and thus provided the evidence base that can guide future studies on effects of leisure time physical activity preference and behavior on hypertension. The primary results show that leisure time physical activity preference was significantly associated with actual behavior, and leisure time physical activity behavior and changes in leisure time physical activity preference were associated with the incidence of hypertension. Therefore, future studies can use this knowledge to

research more about the effects of leisure time physical activity (preference) on hypertension, obesity and other chronic diseases.

Research evidence shows that the prevalence of overweight, obesity and cardiovascular diseases (heart disease and hypertension) in China have dramatically increased during the last several decades. At the same time, physical activity level among Chinese populations has declined significantly. Because studies in other countries revealed that there are relationships between physical activity and overweight, obesity, and hypertension, exploring the leisure time physical activity and chronic diseases appears to be necessary, especially among the Chinese population who is experiencing a significant transition in terms of physical activity level and hypertension prevalence. Thus, the contribution is particularly significant because it provides a necessary part of the knowledge base needed for further research and even interventions. In addition, no studies have examined the direct relationship between preference for leisure time physical activity and physical activity behavior in adults. This study, therefore, helped understand the rationale behind the pathway to leisure time physical activity behavior by investigating the causal relationship between leisure time physical activity preference and behavior. Since the central hypothesis that leisure time physical activity preference was positively associated with actual behavior, and leisure time physical activity behavior and changes in leisure time physical activity preference were negatively associated incidence of hypertension is supported, it is expected that more

and more researchers become interested in the area, and interventions could be formulated accordingly.

Furthermore, the study used a longitudinal data from 2004 to 2011 in China to establish the causal relationships among the leisure time physical activity preference, leisure time physical activity behavior, and incidence of hypertension. This is highly significant because: (1) exposures such as leisure time physical activity behavior was recorded at the beginning of study period which can alleviate recall bias; (2) the timing of disease (hypertension) onset was tracked so that the effect of time of each incidence of hypertension occurring can be analyzed; (3) the changes in leisure time physical activity preference were measured at the individual level (due to the use of longitudinal data) which provide the opportunity to observe individual patterns of change (Fitzmaurice, Davidian, Verbeke, & Molenberghs, 2008).

In addition, the research investigating the urban-rural disparities provided the opportunity to add to the extant body of literature on differences between urban and rural residents in leisure time physical activity and incidence of hypertension and reinforce justifications for community-specific physical activity education, especially in China, where is dramatically experiencing rapid urbanization. Specifically, all the three overarching findings (associations among leisure time physical activity preference, leisure time physical activity behavior, and incidence of hypertension) were observed among the whole sample, urban residents, but not in rural participants. This is significant since it may warrant more leisure time physical activity interventions among

urban residents, whose occupational physical activity is relatively low comparing to their rural counterparts. In addition, it informs the importance of improving rural residents' leisure time physical activity behavior by changing their leisure time physical activity preference and increasing their access to relevant facilities. To summarize, leisure time physical activity is significant for both urban and rural people, but for different reasons: 1. although leisure time physical activity is more prevalent among urban residents, it is more vitally important to maintain or increase it in this group considering their low occupational physical activity level; 2. since research found that occupational physical activity is declining among rural residents, finding alternatives such as leisure time physical activity is essential in this group.

Innovation

Previous studies found that food preference is a simpler and more accurate indicator of food intake than people's diet behaviors, in consideration of that food intake may incur recall bias. Studies on sedentary activity preference indicated that preference for sedentary activity was a significant predictor of lower physical activity level. Nevertheless, no one has examined the direct relationship between leisure time physical activity preference and leisure time physical activity behavior. Therefore, this study is the first one to explore the area.

Furthermore, studies on the effect of leisure time physical activity behavior on the incidence of hypertension are scant among the Chinese population, so the study added to the extant body of literature.

Besides, exploring the effects of changes in leisure time physical activity preference on the incidence of hypertension added to the current evidence on the relationship between leisure time physical activity preference and hypertension.

Last but not least, the three proposed studies complemented each other to constitute a coherent body of empirical evidence. Specifically, the study results show that leisure time physical activity preference was not a good predictor of the development of hypertension, so examining the relationship between changes in leisure time physical activity preference and incidence of hypertension enabled to infer the development of hypertension was predictive of leisure time physical activity preference. In addition, since the association between leisure time physical activity preference and leisure time physical activity behavior, the relationship between leisure time physical activity behavior and incidence of hypertension were investigated in the project, the rationale of interrelationships among the three variables (leisure time physical activity preference, leisure time physical activity behavior, and incidence of hypertension) were explained as well.

Limitations

Although this dissertation is significant and innovative, there are several limitations. First, the data was purely quantitative, contained no qualitative data on leisure time physical activity preference as well as leisure time physical activity behavior such as the reasons of changing preference, purpose of performing physical activity, perceived usefulness of physical activity, how physical activity impacts other health behaviors, and so forth. Thus, one cannot disentangle why and how (changes in) leisure time physical activity preference and leisure time physical activity behavior impact development of hypertension. Furthermore, the use of self-report data can potentially introduce recall bias especially for variables based on participants' long-term memory such as diagnosed hypertension as well as time devoted in physical activity (Hassan, 2006). Additionally, several important covariates (such as diet or occupational physical activity) were not included in the dissertation due to the unavailability of data. Finally, this study was based on a sample in China, where cultural norms and patterns of physical activity may be unique to the Chinese context, which limits the generalizability of the findings to other countries.

Applications

The dissertation concludes that leisure time physical activity preference, leisure time physical activity behavior, and incidence of hypertension are closely related to each

other. Specifically, leisure time physical activity preference positively predicts leisure time physical activity behavior; leisure time physical activity behavior negatively causes development of hypertension; and development of hypertension negatively leads to changes in leisure time physical activity preference. Therefore, future health promotion interventions in China focusing on hypertension prevention and control may pay more attention to the leisure time physical activity. Not only educate people with knowledge, also make attempts to positively change their preference on physical activity, which would increase the prevalence of leisure time physical activity. Additionally, such health promotion programs may also work on maintaining or increasing one's leisure time physical activity preference if he/she is diagnosed with hypertension. The dissertation also found urban rural disparities exist in all relationships. Specifically, all correlations are significant in urban residents, but not in rural areas. This observation has a practical significance since future health promotion interventions may be tailored according to intervention settings. Interventions in rural areas may increase the availability of and people's access to leisure time exercise facilities as well as adopt social modelling while changing their preference. Programs in urban residents, however, probably may pay more attention to improve their diet as well as develop physical activity in working places.

Future plans

The dissertation is not perfect, so several improvements have been planned in the near future. First of all, the interaction term of Urban*Rural will be added into the multivariate logistic regressions and proportional hazards regressions in the whole sample to test if relationships were different among urban residents and rural residents. In addition, the possible mediating effect of leisure time physical activity behavior on the relationship between leisure time physical activity preference and development of hypertension will be assessed to see if complete or partial mediation exists. Last but not least, comparison of all covariates between urban and rural sample will be carried out to improve the understanding of urban and rural disparities.

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Appendix

Table A. Comparison of samples with and without those did not express physical activity preference

	Sample without those did not express leisure time physical activity preference		Sample with those did not express leisure time physical activity preference	
Variables	Number	Mean or Percentage (SD)	Number	Mean or Percentage (SD)
Demographics				
Age	2645	40.49 (12.84)	5685	39.06 (12.25)
Sex				
Male	1253	47.4	2551	44.9
Female	1392	52.6	3134	55.1
Ethnicity				
Han	2391	90.4	4983	87.7
Others	254	9.6	702	12.3
Marital status				
Never married	108	4.1	265	4.7
Married	2448	93.0	5237	92.5
Divorced	16	0.6	30	0.5
Widowed	60	2.3	130	2.3
Community types				
Urban	482	18.2	608	10.7
Suburban	640	24.2	1099	19.3
Town	526	19.9	843	14.8
Village	997	37.7	3135	55.1
Region of residence				
North	1268	47.9	2489	43.8
South	1377	52.1	3196	56.2
Socioeconomic status				
Employment				
Unemployed	570	21.6	872	15.4
Employed	2072	78.4	4807	84.6
Annual household income (Yuan)				
0-8000	520	19.9	1371	24.1
8001-15000	643	24.6	1517	26.9
15001-25000	601	23.0	1294	23.0
Over 25000	850	32.5	1449	25.7

	Sample without those did not express leisure time physical activity preference		Sample without those did not express leisure time physical activity preference	
Variables	Number	Mean or Percentage (SD)	Number	Mean or Percentage (SD)
Education				
Illiterate	464	17.6	1298	22.9
Primary school	593	22.5	1511	26.6
Middle school	781	29.6	1709	30.1
High school or above	799	30.3	1154	20.3
Health behavior				
Smoking status				
Nonsmoker	1781	67.4	3850	67.8
Smoker	861	32.6	1827	32.2
Alcohol consumption				
No drinking	1726	65.3	3850	67.7
Drinking	919	34.7	1835	32.3
Health-related variables				
BMI categories				
Underweight	96	3.8	289	5.4
Normal weight	1313	52.4	3044	56.8
Overweight	855	34.1	1571	29.3
Obese	241	9.6	458	8.5
Current health status (self-report)				
Very good	433	16.4	728	12.8
Good	1185	44.9	2581	45.5
Bad	872	33.0	1981	35.0
Very bad	151	5.7	378	6.7
Health insurance coverage				
No	1699	64.5	4233	74.9
Yes	936	35.5	1420	25.1

Abbreviation: SD, standard deviation; —, not applicable.

Table B. Proportional Hazards Model Hazards Ratios for Multivariate Regressions among Sample (N = 2,435), Urban (n = 1,487) and Rural (n = 938) Residents

	Whole Sample (N = 2,435)	**Urban Residents (n = 1,487)**	**Rural Residents (n = 948)**
Variables	**Hazards Ratio (95% CI)**	**Hazards Ratio (95% CI)**	**Hazards Ratio (95% CI)**
Events	**287**	**194**	**93**
	Leisure time physical activity preference		
Prefer activity in 2004	1.03 (0.99-1.07)	1.00 (0.96-1.05)	1.02 (0.98-1.18)
	Demographics		
Age	1.03*** (1.02–1.04)	1.02*** (1.01–1.04)	1.05*** (1.02–1.07)
Sex			
Male	1 [Reference]	1 [Reference]	1 [Reference]
Female	0.98 (0.70–1.38)	1.02 (0.67–1.57)	0.99 (0.54–1.81)
Ethnicity			
Han	1 [Reference]	1 [Reference]	1 [Reference]
Others	0.75 (0.47–1.20)	0.93 (0.51–1.69)	0.62 (0.28–1.36)
Marital status			
Never married	1 [Reference]	1 [Reference]	1 [Reference]
Married	2.19 (0.80–5.97)	7.89** (1.09–57.05)	0.49 (0.14–1.70)
Divorced	0.00 (0.00–0.00)	0.00 (0.00–0.00)	0.00 (0.00–0.00)
Widowed	1.08 (0.28–4.24)	4.11 (0.44–38.33)	0.13 (0.01–1.63)
Community types			
Urban	1 [Reference]	-	-
Suburban	0.97 (0.68–1.38)	-	-
Town	0.70* (0.48–1.03)	-	-
Village	0.79 (0.54–1.15)	-	-
Region of residence			
North	1 [Reference]	1 [Reference]	1 [Reference]
South	1.32** (1.03–1.68)	1.16 (0.85–1.57)	1.55* (1.00–2.39)
	Socioeconomic status		
Employment			
Unemployed	1 [Reference]	1 [Reference]	1 [Reference]
Employed	1.27 (0.91–1.77)	1.18 (0.81–1.71)	1.26 (0.55–2.89)

	Whole Sample (N = 2,435)	Urban Residents (n = 1,487)	Rural Residents (n = 948)
Variables	**Hazards Ratio (95% CI)**	**Hazards Ratio (95% CI)**	**Hazards Ratio (95% CI)**
Events	**287**	**194**	**93**
Annual household income (Yuan)			
0-8000	1 [Reference]	1 [Reference]	1 [Reference]
8001-15000	0.84 (0.60–1.18)	0.60** (0.38–0.94)	1.30 (0.77–2.20)
15001-25000	0.70* (0.48–1.01)	0.62** (0.39–0.98)	0.77 (0.39–1.52)
Over 25000	0.79 (0.56–1.12)	0.68* (0.44–1.04)	1.09 (0.58–2.05)
Education			
Illiterate	1 [Reference]	1 [Reference]	1 [Reference]
Primary school	1.02 (0.72–1.44)	1.04 (0.66–1.63)	1.04 (0.59–1.83)
Middle school	0.79 (0.54–1.15)	0.75 (0.46–1.21)	0.81 (0.42–1.55)
High school or above	0.65** (0.43–0.99)	0.61* (0.37–1.01)	0.77 (0.35–1.67)
Health behavior			
Smoking status			
Nonsmoker	1 [Reference]	1 [Reference]	1 [Reference]
Smoker	1.02 (0.74–1.39)	1.22 (0.82–1.82)	0.74 (0.43–1.28)
Alcohol consumption			
No drinking	1 [Reference]	1 [Reference]	1 [Reference]
Drinking	1.11 (0.82–1.49)	1.03 (0.71–1.48)	1.15 (0.67–1.97)
Health-related variables			
BMI categories			
Underweight	1 [Reference]	1 [Reference]	1 [Reference]
Normal weight	2.40* (0.88–6.57)	2.62 (0.63–10.82)	2.29 (0.54–9.70)
Overweight	5.29*** (1.93–14.46)	5.34** (1.30–22.03)	5.74** (1.35–24.44)
Obese	5.57*** (1.97–15.77)	5.73** (1.35–24.39)	7.03** (1.49–33.18)
Current health status (self-report)			
Very good	1 [Reference]	1 [Reference]	1 [Reference]
Good	1.01 (0.71–1.45)	0.93 (0.60–1.42)	1.13 (0.59–2.19)
Bad	1.08 (0.74–1.57)	0.90 (0.57–1.43)	1.38 (0.70–2.71)
Very bad	1.27 (0.73–2.22)	0.79 (0.37–1.71)	2.51** (1.05–6.01)
Health insurance coverage			
No	1 [Reference]	1 [Reference]	1 [Reference]
Yes	1.16 (0.89–1.52)	1.13 (0.82–1.57)	1.37 (0.85–2.19)

Abbreviations: CI, confidence interval; BMI, Body Mass Index; —, not applicable.

* $p < .10$.

** $p < .05$.

*** $p < .01$.