

Sallis, J.F. Frank, L.D. Saelens, B.E. Kraft, M.K. (2004). Active transportation and physical activity: opportunities for collaboration on transportation and public health research. *Transportation Research Part A: Policy and Practice*, 38(4), 249-268. doi: 10.1016/j.tra.2003.11.003

Spittaels, H. Foster, C. Oppert, J.M. Rutter, H. Oja, P. Sjostrom, M. De Bourdeaudhuij, I. (2009). Assessment of environmental correlates of physical activity: development of a European questionnaire. *International Journal of Behavioral Nutrition and Physical Activity*, 6(39), 1-11. doi: 10.1186/1479-5868-6-39

Zook, J.B. Lu, Y. Glanz, K. Zimring, C. (2012). Design and pedestrianism in a Smart Growth development. *Environment and Behavior*, 44(2), 216-234. doi: 10.1177/0013916511402060

ID 1385 | ASSESSING SPATIAL ACCESSIBILITY OF PHYSICAL FITNESS FACILITIES FOR OLDER ADULTS IN WINTER CITY: A CASE STUDY IN HARBIN, CHINA

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1 INTRODUCTION

The spatial distribution of public amenities and the spatial access to them has been a constant focus in geographical research for decades (Smoyer-Tomic et al., 2004). The government of China recognize the significance meaning of public health, the outline of the national fitness programme (2011-2015) (General Administration of Sport of China, 2011) was proposed. During the 5 years from 2011 to 2015, enormous Chinese citizen took participate in daily physical activities, however the quantity of space for physical activities always cannot meet citizen's needs. Accessibility to physical fitness facilities have received a growing attention as a public health concern in China.

There is another fact that the aging has become a more and more serious global society issue, the relevant research has pointed out that China's population of older adults might constitute a larger proportion than youngsters. They estimated that the 60-64yrs group will become the largest portion of population in 2050 and the 60 age and older might be the highest proportion of population in 2100 (Banister et al., 2010, as cited in Zhang et al., 2012). According to the national fitness report of China (General Administration of Sport of China, 2013), the aging group is the prime group who take participate in daily physical activities. Research has shown that adequate physical activities can be beneficial to older adults' health and relevant results have already showed that regular physical activity could reduce hospital admission and the mortality in chronic obstructive pulmonary disease to a certain degree (Garcia-Aymerich et al., 2006). In order to keep both mentally and physically health, it is important for older adults to do daily physical activities properly. For those older adults who live in winter cities, long and extreme cold temperature poses a major barrier to participate in daily physical activities. Poor accessibility to physical fitness facilities may lead to the decrease of frequency for older adults in winter cities. Considering this situation, the accessibility to physical fitness facilities may play an important role to keep good health of older adults in winter cities in both developing country and developed country.

Zhou et al. (2008) summarized that "spatial accessibility is a vital index in the relevant research on healthcare (Wang & Luo, 2005), job access (Wang, 2001; Wang & Monor, 2003), transport (Pooler, 1995), location analysis (Ying et al., 2006) and so on". However, there is a limitation on research related to spatial disparities by taking older adults as subjects in winter cities.

2 DATA AND METHODS

In this research, Nangang district of Harbin was taken as an object to assess the accessibility of physical fitness facilities for older adults who took part in daily physical activities. Nangang district is the most representative area of Harbin and Harbin is a typical winter city of China.

2.1 DATA

According to the equation of the two-step floating catchment area method, the data collecting was divided into 3 parts including the supply, the demand and the measurement of travel distance (Song et al., 2013). In this research, the supply part was represented by the area with physical fitness facilities, while the older adults who have the biggest potential to take part in daily physical activity stood for the demand part. The travel distance measurement was implemented by Network Analyst of GIS 10.1 from the participant's home of older adults to the physical fitness facilities.

2.1.1 THE SUPPLY: PHYSICAL FITNESS FACILITIES

A total number of 551 areas with physical fitness facilities in Harbin has been investigated by the Harbin administration of Sport. In this investigation, Harbin administration of Sport has showed the statistic with details, they provided the most accurate and comprehensive source of the specific numbers of area with physical fitness facilities and their location in every subdistrict in 2015. In Nangang district which was the main object of this research, there were 278 areas with physical fitness facilities in this district, it can be seen that physical fitness facilities are clustered in the Nangang District (Figure 1). To well understand spatial distribution of physical fitness facilities for older adults in Nangang district of Harbin, currently each area with physical fitness facilities was geocoded in GIS 10.1. Nearest subdistrict index was calculated and density of physical fitness facilities was mapped by the implementation of kernel density estimation (Figure 5). Results of these analysis are reported below.

2.1.2 THE DEMAND: POTENTIAL OLDER ADULTS WHO TOOK PARTICIPATE IN PA IN WINTER

The study focuses on the Nangang district of Harbin which is the most important district in Harbin, the area is 116km² with the total population of 1.27 million inhabitants. Important government agencies, organizations, CBD are gathering in Nangang district. It is also the district with the longest history in Harbin. Nangang district was divided into 18 subdistrict (Figure 2). There are no more data for a smaller scale because subdistrict is the minimum research unit for demographic data, subdistrict was taken as the research unit in this study. Based on the data from the Sixth Population Census of China (the most recent census), the population of age over 60 is 235280 with the percentage of 18.54% and the population of age over 65 is 156520 with the percentage of 12.33%. Considering the definition of aging society by UNESCO, the issue of aging society becomes increasingly pressing.

To obtain more details about the demand, self-administrated questionnaires were applied in order to acquire basic information of older adults doing daily physical activity in the winter of winter cities in detail. 400 participants with 272 valid questionnaires were accomplished online. According to the result of self-administrated questionnaire, young elderly whose age in 60-69 has the biggest potential to take part in the daily physical activity in winter among the older adults, with the percentage of 68.75%. In this research, young elderly (age in 60-69) was taken as the object for this research to represent the older adults group. The density of older adults who took part in daily activity in each catchment area varies differently (Figure 7).

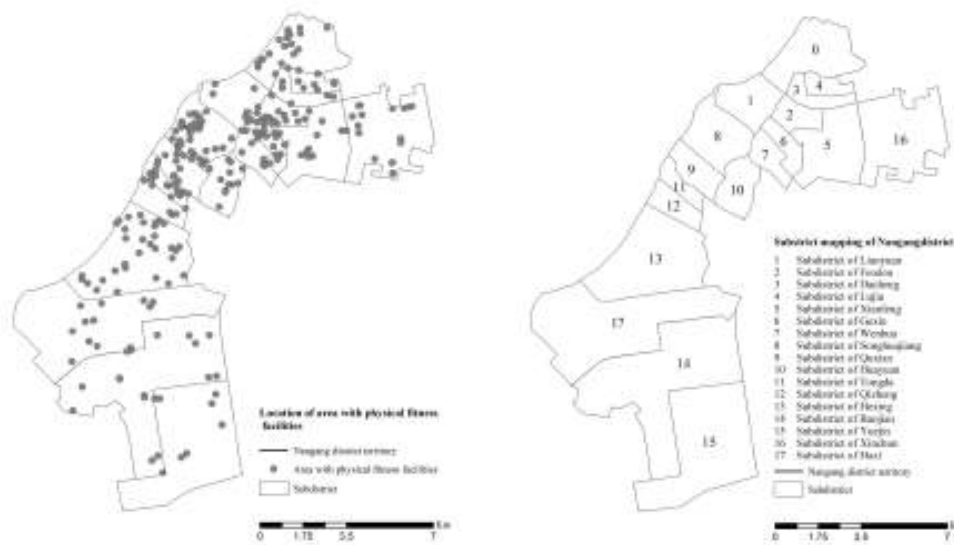


Figure 1 - Location of area with physical fitness facilities Figure 2 - Subdistricts of Nangang

2.1.3 MEASURING TRAVEL DISTANCE

One of the most important parameters in spatial accessibility is the measuring of distance between the supply and the demand locations(Ngui & Vanasse, 2012). Measures including counting the number of facilities contained within census tract (Luo, 2004) to computing the number of facilities inside a given Euclidean or travel-time distance of demand location(Apparicio et al., 2008; Lovett et al., 2002) has already been implemented in GIS. In this research, based on the function of Network analyst of Geological Information System (GIS), Origination Destination was applied to measure the shortest travel distance(Radke & Mu, 2000) considering the scale of data resource. By using this analyst, the travel distance is measured based on the road system of city which can provide more accurate distance from participants' home to areas with physical fitness facilities. The road system of Nangang district is download by the Baidu Map form the internet (Baidu Map is the most accurate internet map of China). According to the results of questionnaires, since older adults mostly prefer walking time less than 15minutes, 3 thresholds of travel distance(time) were selected based on the walking speed of young elderly with 83.7m/min (Bohannon, 1997), which were distance of 5-minute, 10-minute and 15-minute walking distance.

2.2 METHODS

In this research, self-administrated questionnaire and two-step floating catchment area method were both implemented in order to assess the spatial accessibility of areas with physical fitness facilities.

2.2.1 SELF- ADMINISTRATED QUESTIONNAIRE

This self-administrated questionnaire was accomplished online from 2016.12.7 to 2017.1.17, there were a total accumulation of 400 questionnaires to 272 valid samples were collected with the 68% effective rate. Self-administrated questionnaire was generally used in health and health services' investigation(Bowling, n.d.,2001). Self-administrated questionnaire was applied in this research because self-administrated questionnaire could get more subjective responses than interview or other method of questionnaire in order to avoid exaggerated positive results in research of health-related questions like quality of life, engaging in behaviours and activities and so on(Presser & Stinson, 1998; Tourangeau et al., 1997; Vuillemin et al., 2000; Weinberger et al., 1996). In addition, doing selfadministrated questionnaire online can provide a more convenient access for interviewees to accomplish the questionnaire at any location in any time. In this research, self- administrated questionnaires were accomplished with the purpose of finding which group of older adults have the biggest potential of joining in daily physical activities and what characters of PA behaviors they have in the winter of the winter city. Since this study was focused on the

older adults of winter city, all interviewees were chosen in areas with physical fitness facilities of Nangang district randomly with the age over 60. Questions in the questionnaire were focused on acquiring basic information like where and when they chose to do daily PA, what is the average frequency and the time span of daily PA. The maximum length of time span from home to an area with physical fitness facilities by specific mode of transportation which is one of the most important parameters of the 2SFCA method was also collected. In addition, the disparity of PA behaviors' seasonal characters, especially in summer and winter was considered.

2.2.2 TWO-STEP FLOATING CATCHMENT AREA METHOD

The spatial distribution of public amenities within cities and the access to these amenities have been a central focus in much geographical research (Smoyer-Tomic, 2004). Assessing the spatial accessibility is vital to the allocation of public infrastructure. The government generally take spatial accessibility as one of the prime principles of public service distribution. Quantitative measures of evaluating spatial accessibility has been applied, including buffer zone method, minimum distance method, travel cost method(TCM). In this study, 2SFCA method was implemented because it need to take both the supply and the demand into consideration. In this research, 18 subdistrict was taken as the research object combining with the population of older adults who have the biggest potential to be participants of daily PA.

The first step, searching all population of locations k (demand location k) for each area with physical fitness facilities j within the threshold of travel time d0 from the catchment area j (area with physical fitness facilities j). Summing up R j which is the supply-to-demand ratio within this catchment area(Radke & Mu, 2000):

$$R_j = \frac{S_j}{\sum_{k \in \{dk | j \leq d_0\}} D_k}$$

For the next step, searching each area with physical fitness facilities j (supply locations j) for each demand location i within the threshold of travel time form location i and summing up the supply-todemand ratio R j at those locations to obtain the accessibility A0 1 at demand location i (Radke & Mu, 2000) :

$$A_i^F = \sum_{\{dl | j \leq d_0\}} R_j = \sum_{j \in \{dl | j \leq d_0\}} \frac{S_j}{\sum_{k \in \{dk | j \leq d_0\}} D_k}$$

3 RESULTS

According to the data collected by the Harbin administration of Sport and the field research by us, in this research, the physical fitness facilities of Nangang not only include facilities for people doing sports, but also areas providing space for local citizen doing daily physical activities. In order to optimize the research, all physical fitness facilities are divided in to 3 modes' space based on their opening degree of locations which including: 1) space in neighborhood; 2) space in public space; 3) space in campus. The distribution of three modes of physical fitness facilities is shown in the figure 3.

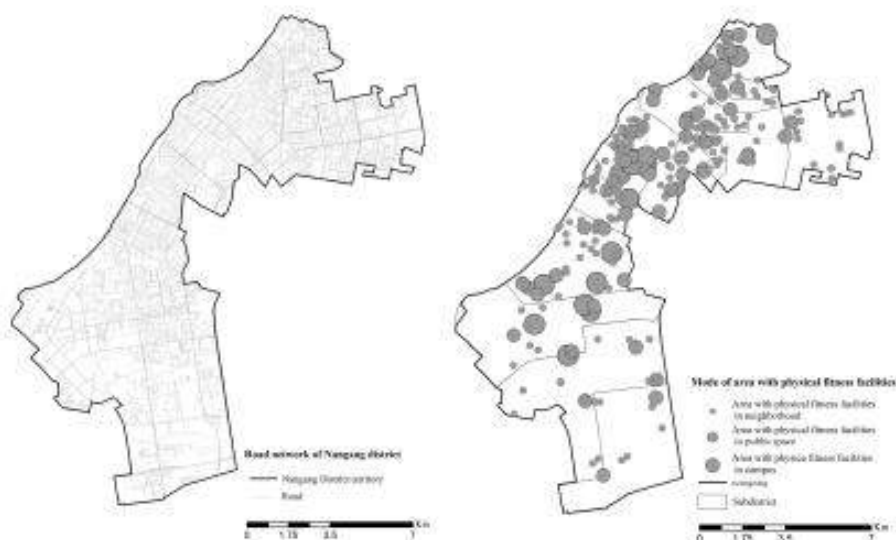


Figure 3 - Road network of Nangang district Figure 4 – Mode of area with physical fitness facilities

3.1 RESULTS OF SELF-ADMINISTRATED QUESTIONNAIRE

6 results were found from the self-administrated report on the physical activity behavior in winter of younger older adults in winter cities: 1) older adults whose age was between 60-69 had the largest proportion of people who insist doing daily PA, which means young elderly was the group of older adults who has the biggest potential to take participate in daily PA; 2) most older adults keep doing PA in winter although winter cities' temperature in winter is extremely low, with a 24-hour average in January of only -18.4°C (-1.1°F) (Harbin Municipal Government, 2011); 3) the frequency of doing PA in winter is lower than that in summer, although young elderly insists on doing PA in winter, 23% respondents have a lower frequency in doing PA in winter than summer; 4) the time span of doing PA one time in winter is shorter than that in summer, within a percentage of 9% respondents spent less time on doing PA in winter than that in summer; 5) older adults have a tendency to choose a nearer place to do PA especially in winter, statistic showed that 6% older adults prefer a homenearer place to do PA, while the distance from home to area with physical fitness facilities seem not so much important in summer than that in winter; 6) for older adults, 15-min walking distance from home to area with physical fitness facilities are the maximum length of time that can be tolerated which has the largest proportion of respondents.

3.2 RESULTS OF ACCESSIBILITY SCORE BY IMPLEMENTED 2SFCA METHOD

By computing and evaluating the spatial accessibility index at the time of walking in 5 minutes, 10minutes, 15minutes. Our results show that significant difference of accessibility exists in each subdistrict. Within 5 minutes, the spatial accessibility score range from 0 to 0.067. Within the time of 10 minutes, the score of spatial accessibility ranges from 0 to 0.308. When walking-time increasing into 15 minutes, the accessibility score ranges from 0.018 to 0.713. Accessibility scores were calculated to show that evident spatial disparities exist in the research area (Figure 5).

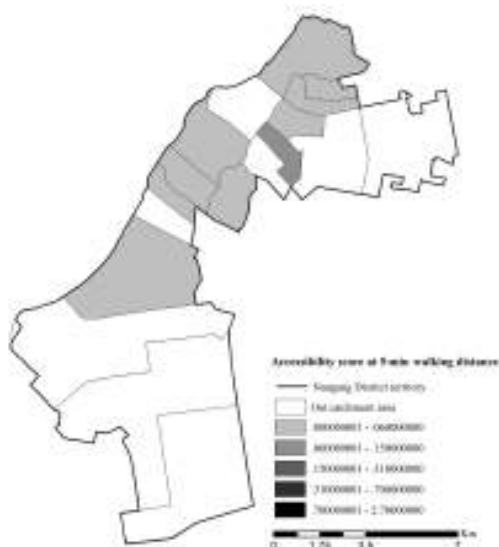


Figure 5-1-Accessibility score at 5-min

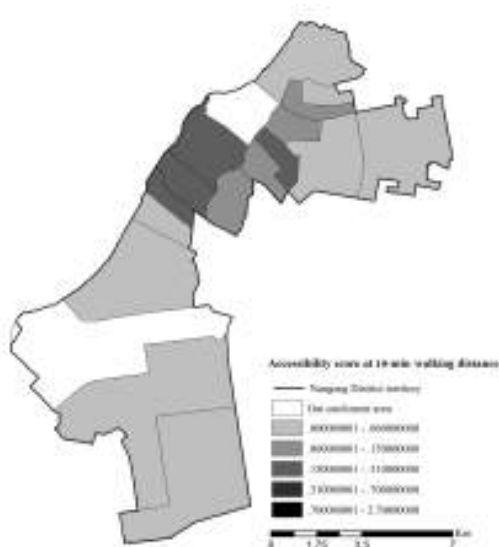


Figure5-2- Accessibility score at 10-min

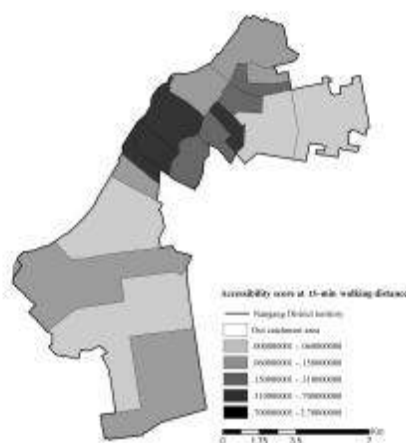


Figure 5-3- Accessibility score at 15-min

Figure 5 - Accessibility distribution within the threshold of 5-min, 10-min, 15-min

4 DISCUSSIONS

Based on the result of self-administrated report, 15-min walking distance is the maximum length of time for older adults walking from home to area with physical fitness facilities in winter in Harbin. In this research, 5-min, 10min, 15min were taken as the threshold and 2SFCA Mode was applied to assess the spatial accessibility of an area with physical fitness facilities. The accessibility score was defined in 5 levels which were “lower”, within the score range from .00 to .06, “low”, within the score range from .06 to .15, “moderate”, within the score range from .15 to .31, “high”, within the score range from .31 to .7, “higher”, within the score range from .7 to 2.7. Three facts were discovered in the research.

4.1 THE ACCESSIBILITY SCORE WAS LOW IN GENERAL IN THE WALKING TIME OF 5 MINUTES

Results in the figure 5 showed that spatial accessibility disparity vary greatly. Within the threshold of 5-min walking time, the accessibility of an area with physical fitness facilities in Harbin is low in general. There was 8 out of 18 subdistricts was at the out of catchment area with the accessibility score of 0. 1 of 18 subdistricts had an accessibility level of “low”, the other 9 subdistricts had an accessibility score of level of “lower”. As the growing of threshold, the accessibility score grows as whole. The area without catchment

has decreased into 2 subdistricts and the accessibility score of level “moderate” has increase into 4 subdistricts. There is no out of catchment area when the threshold increasing into 15 minutes. One subdistrict has an accessibility level of “higher”, 7 subdistricts has an accessibility level of “high”, 2 subdistricts has an accessibility level of “moderate”, only 2 subdistricts is left with the accessibility level of “lower”. According to the self-administrated, the maximum length of time from home to area with physical fitness facilities to do daily PA is 30min. From the Table 1, the growing tendency is evident that all accessibility score grow within the threshold grows from 5minutes to 30minutes. Even though the spatial accessibility score grows with the threshold, considering the situation that older adults prefer to choose a nearer place to do daily physical fitness facilities in winter, the spatial accessibility for older adults is still quite low. There is a fact that the allocation of amenities is irrational.

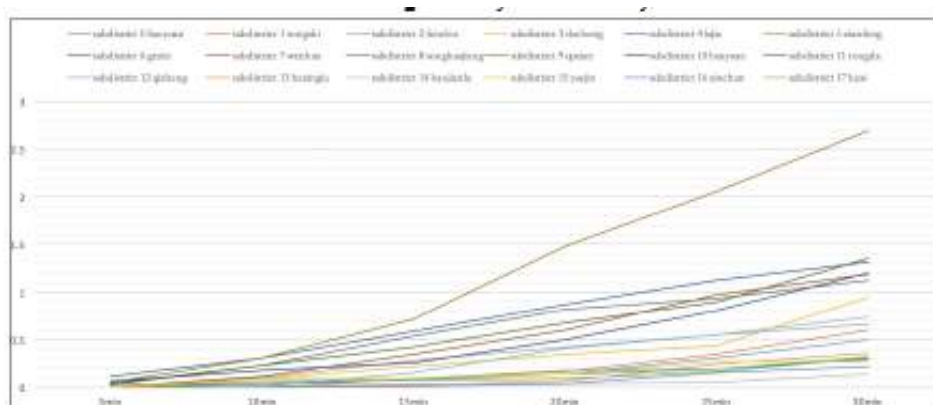


Table 1 - Growing tendency of accessibility score

4.2 THE CITY CENTER HAS HIGHER SPATIAL ACCESSIBILITY OF PHYSICAL FITNESS FACILITIES THAN OTHER DISTRICTS

From the Figure 5, it is clearly that the allocation of areas with physical fitness facilities was not even. The center of the city has the higher accessibility of physical fitness facilities than other districts. There is a tendency that the accessibility of an area with physical fitness facilities decreased from center to two sides gradually.

In Figure 5-3, 4 subdistricts have a higher level of spatial accessibility was shown and all these 4 subdistricts are in the center of city. It is obvious that city center has higher accessibility of transportation and higher density of road network, which make older adults get easier access to the city center to take participate into daily physical activities than other parts of city. Another fact is that most city events and activities happens in the city center since there are more amenities in city center than other parts of the city, which make daily physical fitness activities happens much easier and make city center has a higher density of physical fitness facilities than other part of the city (Figure 6). Considering the equation of 2SFCA method, 3 factors can affect the results which are population, location demand and the measurement of travel distance (time). The matching of population supply and the location demand is more rational in these 4 subdistricts. Comparing with Figure7, these 5 subdistricts who have higher spatial accessibility all have a moderate number of older adults' population.

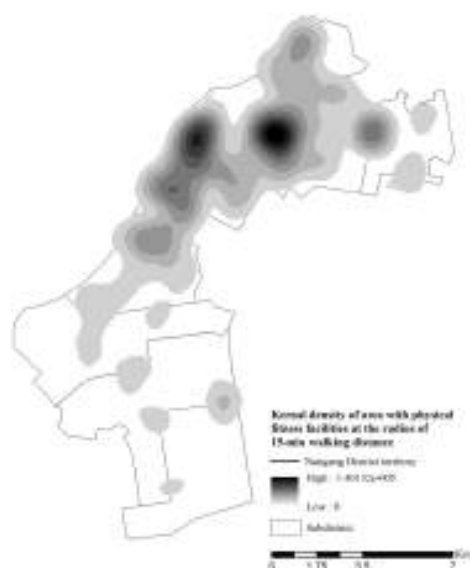


Figure 6 - Kernel density of area with physical fitness facilities

4.3 MISMATCHING BETWEEN THE PHYSICAL FITNESS FACILITIES ACCESSIBILITY AND THE POPULATION OF OLDER ADULTS

Based on population data from the Sixth Population Census and by Arc GIS 10.1, the density of young elderly (60-69) was showed in Figure 7. The cluster range from shallow to dark means the density from low to high. In order to optimized the research process, we divided the density into 5 levels, which are “lower”, “low”, “moderate”, “high”, “higher”.

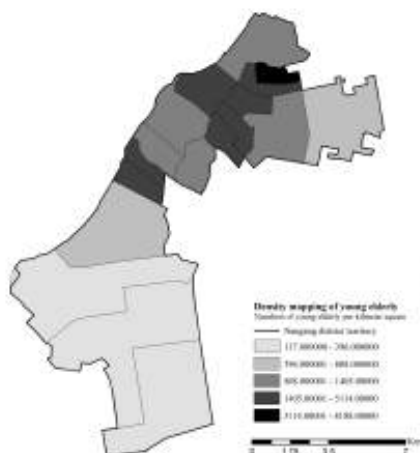


Figure 7 - Density map of young elderly

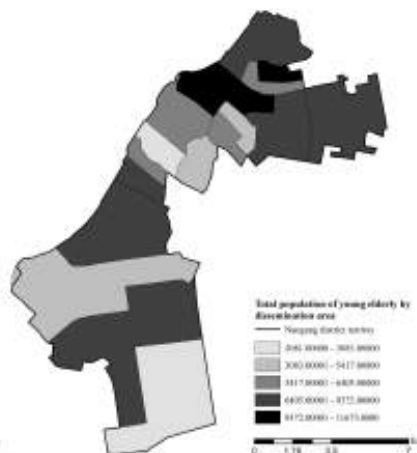


Figure 8 - total population of young elderly

Comparing the density map (Figure 7) of young elderly with the accessibility assessment within the index of 15 minutes (Figure 5-3), the subdistrict that has the highest density of young elderly does not have the highest level of spatial accessibility. The other 4 subdistricts who have the better level of spatial accessibility all have a moderate density of young elderly. On the other hand, those subdistricts with lower accessibility always within a lower density of young elderly. This mismatching phenomenon exists in 17 of 18 subdistricts with a percentage of 94.5%.

From the view of the total amount of young elderly population, the mismatching between the total population of young elderly with spatial accessibility is more evident (Figure 8). The accessibility score for 3 subdistricts with highest quantities of young elderly were in the level of moderate and low. 6 subdistricts have better quantities of young elderly have a spatial accessibility at a level low and level lower. At the same time, those subdistricts with higher accessibility of physical fitness facilities all within a moderate or low quantities of young elderly. That’s also prove the mismatching phenomenon between accessibility and population, which means the uneven spatial distribution of amenities exists in Nangang district of Harbin.

5 CONCLUSIONS

Access to physical fitness facilities will continue to be the focus of attention among those contentious issues in developing countries in the next decades. It is necessary to implement methodological methods of analysis in order to determine where is the proper location for areas with physical fitness facilities and other facilities or amenities, aiding in planning of amenities allocation in a more rational way. Our research has implemented the application of the 2SFCA method in order to demonstrated the phenomenon of the uneven distribution of areas with physical fitness facilities in Nangang district of Harbin by three facts from the results of the assessment, which including the spatial accessibility in each subdistricts vary greatly from each other, city center has a better accessibility of physical fitness facilities than other parts of city and the mismatching phenomenon exist between the accessibility of physical fitness facilities and the older adults’ population of each subdistricts. However, although 2SFCA method was testified that it can estimate the areas with accessibility of physical fitness facilities, more optimized method could be used to have more precise estimation on spatial accessibility in a more detailed resource. More detailed results could be discovered if there was more detailed data of the supply and the demand at the same time. Although it has limitation, this research is also a good example in the integration of GIS approached to the assessment of city amenities spatial accessibility. nsity map of young elderly Figure 8 - total population of young elderly

6 ACKNOWLEDGEMENT

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BIBLIOGRAPHIC REFERENCES

- Apparicio, P., Abdelmajid, M., Riva, M., & Shearmur, R. (2008). Comparing alternative approaches to measuring the geographical accessibility of urban health services: Distance types and aggregation-error issues. *International Journal of Health Geographics*, 7, 7. <https://doi.org/10.1186/1476-072X-7-7>
- Bloom, D. E., Canning, D., & Rosenberg, L. (2011). Program on the Global demographic change and economic growth in South Asia, (67).
- Bowling, A. (n.d.). *Methods in Health*.
- Garcia-Aymerich, J., Lange, P., Benet, M., Schnohr, P., & Antó, J. M. (2006). Regular physical activity reduces hospital admission and mortality in chronic obstructive pulmonary disease: a population based cohort study. *Thorax*, 61(9), 772–8. <https://doi.org/10.1136/thx.2006.060145>
- General Administration of Sport of China. (2011, 2 24). The nationwide body-building plan (2011-2015). Retrieved from General Administration of Sport of China: <http://www.sport.gov.cn/n16/n1077/n1467/n1808585/1808663.html>
- General Administration of Sport of China. (2013, 7 30). Physical activity and physical condition investigation of people age between 20-69. Retrieved from General Administration of Sport of China: <http://www.sport.gov.cn/n16/n1107/n1788/4428310.html>
- Harbin Municipal Government. (2011, 7 14). Climatological Summary. Retrieved from Harbin Government: http://www.harbin.gov.cn/english/Harbin_Overview/Climatological_Summary.html
- Lovett, A., Haynes, R., Sunnerberg, G., & Gate, S. (2002). Car travel time and accessibility by bus to GP services: a study using patient registers and GIS. *Social Science and Medicine*, 55, 97–111.
- Luo, W. (2004). Using a GIS-based floating catchment method to assess areas with shortage of physicians. *Health and Place*, 10(1), 1–11. [https://doi.org/10.1016/S1353-8292\(02\)00067-9](https://doi.org/10.1016/S1353-8292(02)00067-9)
- Ngamini Ngui, A., & Vanasse, A. (2012). Assessing spatial accessibility to mental health facilities in an urban environment. *Spatial and Spatio-Temporal Epidemiology*, 3(3), 195–203. <https://doi.org/10.1016/j.sste.2011.11.001>
- Pooler, J. A. (1995). The use of spatial separation in the measurement of transportation accessibility. *Transportation Research Part A*, 29(6), 421–427. [https://doi.org/10.1016/0965-8564\(95\)00013-E](https://doi.org/10.1016/0965-8564(95)00013-E)
- Presser, S., & Stinson, L. (1998). Data collection mode and social desirability bias in self-reported religious attendance. *American Sociological Review*, 63(1), 137–145. Retrieved from https://scholar.google.se/citations?view_op=view_citation&continue=/scholar%3Fhl%3Dsv%26start%3D230%26as_sdt%3D0,5%26scilib%3D1&citilm=1&citation_for_view=9BHthLMAAAJ:YIPif8NxbYC&hl=sv&oi=p
- Radke, J., & Mu, L. (2000). Spatial decompositions, modeling and mapping service regions to predict access to social programs. *Geographic Information Sciences*, 6(2), 105–112. <https://doi.org/10.1080/10824000009480538>
- Smoyer-Tomic, K. E., Hewko, J. N., & Hodgson, M. J. (2004). Spatial accessibility and equity of playgrounds in Edmonton, Canada. *Canadian Geographer*, 48(3), 287–302. <https://doi.org/10.1111/j.0008-3658.2004.00061.x>
- Song, P., Zhu, Y., Mao, X., Li, Q., & An, L. (2013). Assessing spatial accessibility to maternity units in Shenzhen, China. *PLoS ONE*, 8(7). <https://doi.org/10.1371/journal.pone.0070227>
- Tourangeau, Roger; Rasinski Kenneth, Jobe, Jared B.; Smith, Tom W.; Pratt, W. F. (1997). Tourangeau R 1997.asp. *Journal of Official Statistics*, 13(4), 341–365.
- Vuillemin, a, Oppert, J. M., Guillemin, F., Essermeant, L., Fontvieille, a M., Galan, P., ... Hercberg, S. (2000). Self-administered questionnaire compared with interview to assess past-year physical activity. *Medicine and Science in Sports and Exercise*, 32(July), 1119–1124. <https://doi.org/10.1097/00005768-200006000-00013>
- Wang, F. (2001). Explaining intraurban variations of commuting by job proximity and workers' characteristics. *Environment and Planning B: Planning and Design*, 28(2), 169–182. <https://doi.org/10.1068/b2710>

Wang, F., & Luo, W. (2005). Assessing spatial and nonspatial factors for healthcare access: Towards an integrated approach to defining health professional shortage areas. *Health and Place*, 11(2), 13–146. <https://doi.org/10.1016/j.healthplace.2004.02.003>

Wang, F., & Monor, W. (2003). Where the jobs are: Employment access and crime patterns in Cleveland. *Annals of the Association of American Geographers*, 92(3), 433–450. Retrieved from <http://search.ebscohost.com/login.aspx?direct=true&db=cja&AN=CJA0370040001446s&site=ehost-live&scope=site>

Weinberger, M., Oddone, E. Z., Samsa, G. P., & Landsman, P. B. (1996). Are health-related quality-of-life measures affected by the mode of administration? *Journal of Clinical Epidemiology*, 49(2), 135–140. [https://doi.org/10.1016/0895-4356\(95\)00556-0](https://doi.org/10.1016/0895-4356(95)00556-0)

Ying, ZHANG;Zheng, WANG;Wei, ZHOU; Xiao, LIU; Dan, Y. (2006). Research and Application of Weber Facility Location. *ACTA GEOGRAPHICA SINICA*, 61(10), 1057–1064.

Zhang, N. J., Guo, M., & Zheng, X. (2012). China: Awakening giant developing solutions to population aging. *Gerontologist*, 52(5), 589–596. <https://doi.org/10.1093/geront/gns105>

Zhou, K., Wu, J., Xiong, Y., Xu, Z., & Shi, L. (2008). Modeling the spatial resource allocation based on justice principle. *Geoinformatics 2008 and Joint Conference on GIS and Built Environment: The Built Environment and Its Dynamics*, 7144, 71442K–9. <https://doi.org/10.1117/12.812841>

ID 1460 | RELATIONSHIPS BETWEEN HEALTH STATUS AND SOCIOECONOMIC AND HEALTH SERVICES INDICATORS DURING THE FINANCIAL CRISIS

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ABSTRACT: The literature has highlighted the association between social and economic determinants and physical and mental health. Several studies have stated that the positive correlation between socioeconomic status and health is different between countries and welfare states in Europe. On the other, the current financial crisis might have modified this relationship. Due to all the above, the aims of this research are to analyse the relationships between self-perceived health status and socioeconomic variables in Europe at NUTS 2 level (European regional statistical unit) focusing on the influence of the spatial factor during the financial crisis. Taking into account the focus on spatial effects, the analysis includes the continental regions and the closest ones, removing from the analysis the remote and far regions in order to assess the geographic influence. Moreover, in order to consider spatial relationships between regions, this research combines simple linear, spatial lag, spatial error and geographically weighted regressions. The analysis has related to the health status with macroeconomic indicators (income of households by inhabitant, GDP per capita in PPS and unemployment rate), social indicators (tertiary education rate and at-risk-of-poverty rate), and health indicators (crude death rate, hospital beds rate, life expectancy and medical doctor rate) during 2008-2014. Four models for each year have been designed using classical and spatial regression methods. The models show that self-perceived health is explained significantly by unemployment, risk of poverty, tertiary education and medical doctor rates for 2008, 2010 and 2014. In addition, life expectancy, hospital beds and death rates show collinearity worsening the models. Finally, the results support the objective of the research: the regression models improve when the geographical location and distance between analysis units are considered. Missing data and the lack of other interesting socioeconomic variables at regional level together with the ecological fallacy are the main limitations of this study. The results support the existence of contextual effects among European regions that varies the association between socioeconomic measures and health status throughout the time. The findings also points out the relevance of social context in explaining the differences in individuals' states of health. Thus, the spatial analysis have stated that the macroeconomic