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Mobility impairment, social engagement, and life satisfaction among the older population in China: a structural equation modeling analysis

Linna Li[1] · Becky P. Y. Loo[1]

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Abstract
Purpose Revealing the relationship between mobility impairment and life satisfaction can help to propose effective interventions to secure mobility and life satisfaction. However, the relationship remains unclear and lacks quantitative evidence in China. This study therefore assesses the association of mobility impairment, social engagement, and life satisfaction among the older population in China.
Methods Based on the sample of China Health and Retirement Longitudinal Survey database in 2013, a structural equation modeling is established. The sample size is 4245 with 55.9% with mobility impairment.
Results The model shows that the length of suffering from disability is significantly related to mobility impairment ($\beta = 0.058$, $p < 0.001$). Mobility impairment is inversely related to social engagement ($\beta = -0.300$, $p < 0.001$) and life satisfaction ($\beta = -0.311$, $p < 0.001$). Social engagement is positively related to life satisfaction ($\beta = 0.211$, $p < 0.001$). Moreover, the relationships have some differences for the seniors with different sociodemographic characteristics and living in different residential areas.
Conclusions As seniors get older, they tend to have more severe mobility impairment and participate less in social activities. Those with higher mobility impairment are more likely to report lower life satisfaction partly because they usually participate less in social activities. Different strategies are suggested to be adopted to improve the life satisfaction of the older population from the aspects of promoting mobility and social engagement, including improving the design of transport facilitates, providing assistive facilities for the seniors with severe mobility impairment, promoting the accessibility of community leisure and healthcare services, and constructing more community senior activity centers.

Keywords Mobility · Social engagement · Life satisfaction · Aging · China · Structural equation modeling

Introduction

Population aging has become a worldwide phenomenon due to the decreasing mortality and declining fertility. According to the United Nations [27], the global share of the population aged 60 years and over has increased from 9.2% in 1990 to 11.7% in 2013. This demographic change poses several challenges to the society, such as healthcare, social insurance, public pensions, and general provision of products and services. Transport is also an important dimension that needs transition for the aging society. It is generally believed that increasing age is accompanied by mobility impairment due to the physical disability of the older population, which may restrict their social participation and further contribute to the quality of life reduction [15, 30]. As mobility is an integral part of functioning, which is one of the domains of quality of life, there are numerous studies about mobility impairment and quality of life for the seniors [3–5, 8, 18]. However, most of these studies are in the context of the developed countries, such as the UK [2, 32], Canada [23], and Australia [24]. In contrast, the developing countries that have great different seniors' travel behavior and provision of accessibility facilities from the developed countries [12] lack extensive related research. Accordingly,

✉ Linna Li
lilinna@connect.hku.hk

[1] Department of Geography, The University of Hong Kong, Pokfulam Road, Hong Kong, China

whether the relationship between mobility impairment and quality of life in the developing countries is different from the developed countries has been unknown. Indeed, revealing such relationship in the developing countries can help to propose effective interventions to secure mobility and quality of life for the seniors [19] and also be beneficial for assessing the efficacy of strategies that promote mobility in aging society [15].

In China, the growth rate of older population is more rapid than the developed countries [17]. Proportion of population aged over 65 years was only 5.6% in 1990, but increased to 9.7% in 2013 [16] and is projected to reach 30% by 2050 [25]. As the population ages, the mobility of the older population in China has received much attention. Most existing studies focus on the travel behavior [10, 12, 31, 33] and find that the travel behavior of Chinese seniors was significantly different from that of the seniors in the developed countries. For instance, Chinese seniors tend to choose walking and public transport modes to travel, while most seniors in the developed countries rely on motor cars [12, 33]. Also, there are many cultural factors in China that some seniors choose to live with their adult children and grandchildren, who tend to make fewer trips and travel shorter distances than other seniors that live alone [10]. Meanwhile, abundant studies focus on the quality of life for Chinese seniors and try to figure out the influencing factors, including physical exercise [11], social engagement [21], living arrangement [26], economic stress [29]. However, mobility impairment as an important factor of physical function and its relationship with quality of life lack investigation in China. Thus, analysis about the relationship between mobility impairment and quality of life for the seniors is needed in the Chinese context. Furthermore, it is worth noting that China is a huge country with various cultures and socioeconomic factors in different geographic regions and between the urban and rural areas, and it is also necessary to figure out the regional differences of this relationship. Based on these disparities, different strategies can be adopted in different regions.

This study tries to understand the current situation of mobility impairment among the seniors in China and the impact of mobility impairment on their social engagement and quality of life in different geographic regions and residential areas (living in urban or rural areas). Generally, social engagement refers to making social and emotional connections with people and the community [20], including participating in social activities, investing in social operation, interacting with social members and sharing their social resources of education, culture, religion, and politics [6, 21]. Quality of life is defined as "individuals' perception of their position in life in the context of the culture and value systems in which they live and in relation to their goals, expectations, standards, and concerns" [28]. It has wide range covering dimensions of life satisfaction, social support, physical health, and relationship. In this study, life satisfaction is selected to analyze as a vital component of quality of life. This investigation begins with a stratification of mobility impairment by different sociodemographic characteristics of the seniors, including gender, age, marital status, and community type that depends on the urban or rural location of the community. It is followed by analyzing the association between different levels of mobility impairment, frequency of social engagement, and the extent of life satisfaction for the seniors. Then, the effect of mobility impairment on social engagement and life satisfaction is explored by establishing a structural equation modeling (SEM). Furthermore, the possible different effects for the seniors with different genders, ages, marital status, residential areas, and geographic regions are analyzed by multiple group analysis. The final part provides some policy implications and discussion.

Methods

Sample

This research is based on the data collected in the China Health and Retirement Longitudinal Survey (CHARLS) in 2013 [7], which followed the first survey that was conducted in 2011. Since the gap between these two wave surveys was only 2 years, this study does not make a time series analysis. The 2013 wave survey covered a national sample of Chinese residents aged 45 years and above, obtained by stratified random sampling. A total of 17,500 individuals in 150 counties or districts from 28 provinces of China were interviewed. All procedures performed in CHARLS involving human participants were in accordance with the ethical standards of Biomedical Ethics Committee of Peking University. Informed consent was obtained from all individual participants. Using a structured questionnaire with several main sections, information about their demographic and family characteristics, health status, insurance, pension, income, and housing was collected. In this paper, the seniors aged 65 years and above were selected from the database, and several indictors to measure mobility impairment, social engagement, and life satisfaction were extracted, respectively. There are a total of 4245 cases usable for analysis after dropping out all the cases with missing values.

Measurement instruments

Mobility impairment

Mobility impairment refers to the decreased capabilities of independent physical movement throughout the communities

[13]. Since the movement requires physical capabilities such as walking, climbing stairs, and standing, the severity of mobility impairment can be measured using indicators about functional limitations. The CHARLS database had nine questions about the capabilities of physical actions for the seniors, including running, walking, climbing stairs, bending, reaching, and lifting objects, while no questions about travel behavior, such as taking buses and metros or driving cars were available. Two of them were related to the ability of moving around communities: (1) whether the senior has any difficulty walking 1 km; and (2) whether the senior has any difficulty climbing several flights of stairs. In this survey, the respondents were asked to report the difficulty level by "No, I don't have any difficulty," "I have difficulty but can still do it," "Yes, I have difficulty and need help," or "I cannot do it" in the last 3 months. Meanwhile, the participants were asked about the use of mobility auxiliaries, including walking stick, travel device, manual, and electric wheelchair. In sum, questions about the ability to walk and climb stairs and use of mobility auxiliaries were combined to measure different levels of mobility impairment. As shown in Table 1, the seniors had major mobility impairment if they cannot either walk or climb stairs, or need the use of wheelchair; they had moderate mobility impairment if they "have difficulty and need help" with either, or need the use of travel device; they had minor impairment if they "have difficulty but can still do" either, or need the use of walking stick. The severity of mobility impairment was scored on a scale of 1–4 (1 = None; 2 = Minor; 3 = Moderate; 4 = Major). Moreover, the variable indicating disability in the database, i.e., length of suffering from physical disability (if the senior has no physical disability, it is defined as 0), was chosen as a moderating factor of mobility impairment.

Social engagement

Social engagement includes different dimensions of activities that the seniors participate in their daily life, such as learning, voluntary services, community social activities, and exercises [6]. In the CHARLS database, the participants were firstly asked whether they had some sorts of activities. If the answer was "yes," they were further asked about frequency of activity. If the answer was "no," the frequency was defined as "none." In this study, the frequency of participating different activities can be captured to measure social engagement. The activities surveyed include: (1) interact with friends; (2) play Ma-jong, play chess, play cards, or go to community club; (3) provide help to family, friends, or neighbors who do not live together; (4) go to a sport, social, or other kind of club; (5) take part in a community-related organization; (6) do voluntary or charity work; (7) care for a sick or disabled adult who does not live together and who did not pay for help; (8) attend an educational or training course; (9) stock investment; (10) use the Internet; and (11) other activity. Thus, for each activity, four choices were given to the respondents, i.e., "almost daily," "almost every week," and "not regularly," "none" in the last month, measured by scores "3," "2," "1," "0," respectively. With factor analysis, four categories of social engagement were extracted: leisure activities, helping activities, organization activities, and media activities. Table 2 shows the activities included in the four categories of social engagement. For each category, a composite score was calculated by averaging the scores for the relevant activities.

Life satisfaction

Life satisfaction, as a dimension of psychological well-being, is defined to be an evaluation of life in general [9]. The CHARLS database provided one question about "How satisfied are you with your life-as-a-whole?" and ten questions about depression symptoms, all of which were included in the analysis to help understanding life satisfaction of the seniors. The levels of satisfied with life-as-a-whole included "not at all satisfied," "not very satisfied," "somewhat satisfied," "very satisfied," and "completely satisfied," which were scored on a scale of 1–5. The levels of depression symptoms included "rarely," "seldom," "occasionally," and "always," which were scored on a scale of 1–4. The scores for indicators about negative feelings of depression symptoms, such as "I was bothered by things that don't usually bother me" and "I had trouble keeping my mind on what I was doing," were reversed in order to be compared with other indicators. The Cronbach's alpha of all these indicators was 0.76, and the reliability was acceptable. Thus, overall life satisfaction was measured by summing up the scores for all the relevant indicators listed in Table 3, and a higher score denoted a higher life satisfaction.

Table 1 Definition of four levels of mobility impairment

Mobility impairment level	Climbing stairs/walking 1 km	Auxiliary
None	Don't have any difficulty with both	None
Minor	Have difficulty but can still do either	Walking stick
Moderate	Have difficulty and need help with either	Travel device
Major	Cannot do either	Wheelchair

Table 2 Categories of social engagement and activities

Social engagement	Activities
Leisure activities	Interact with friends
	Play Ma-jong, play chess, play cards, or go to community club
	Go to a sport, social, or other kind of club
Helping activities	Provide help to family, friends, or neighbors who do not live together
	Care for a sick or disabled adult who does not live together and who did not pay for help
	Other activity
Organization activities	Take part in a community-related organization
	Do voluntary or charity work
	Attend an educational or training course
Media activities	Stock investment
	Use the Internet

Table 3 Indicators of life satisfaction

Indicators of life satisfaction
How satisfied are you with your life-as-a-whole?
I was bothered by things that don't usually bother me
I had trouble keeping my mind on what I was doing
I felt depressed
I felt everything I did was an effort
I felt fearful
My sleep was restless
I felt lonely
I could not get going
I felt hopeful about the future
I was happy

Data analysis

First of all, the prevalence and distribution of levels of mobility impairment will be analyzed and compared by different demographic characteristics of the seniors, including the gender, age, marital status, and community types (based on the urban or rural location of the community). Then, SEM will be applied to explore the effect of mobility impairment on social engagement and life satisfaction. SEM is a powerful multivariate technique that can be used to estimate the relationship among multiple independent and dependent variables based on multiple techniques, such as regression analysis and factor analysis. It can show path diagram that indicates the complex direct relationship among independent and dependent variables and the indirect effect of independent variable(s) on dependent variable(s) through one or more intervening or mediating variables. The present analysis follows the two-step procedures of the approach proposed by Anderson and Gerbing [1]. Firstly, confirmatory factor analysis is used to develop measurement modals that measure the latent variables by corresponding indicators. In this study, the latent variable includes social engagement. Then, the relationships among the variables of interest are measured by a structural model. The structural model is estimated using generalized least squares (GLS) technique instead of maximum likelihood (ML), because the data violate the assumption of multivariate normality and the sample size is large. However, as all variables are nominal/categorical variables, it is difficult to build more complex nonlinear models. Then, the theoretical model will be tested and revised until a theoretically meaningful and statistically acceptable model is achieved. Usually, Chi-square statistic is used to assess the model fit, which is the difference between the sample covariance matrix and the fitted covariance matrix of the model. It should be nonsignificant, and the relative Chi-square should be less than 2.0. However, it is sensitive to the sample size and large sample size may lead to a significant Chi-square. Thus, other criteria of variable measures have also been adopted, including root-mean-square error of approximation (RMSEA) less than or equal to 0.1, standardized root-mean-square residual (SRMR) less than or equal to 0.08, and goodness-of-fit index (GFI) greater than or equal to 0.9. The final fit model will present the estimates and significant levels of correlation and regression parameters, which suggest the relationship between mobility impairment, social engagement, and life satisfaction. Furthermore, multiple group analysis of SEM will be applied to different groups of the seniors and identify whether there are any differences between the relationships for the seniors with different sociodemographic characteristics and living in different geographic regions or residential areas.

Results

The prevalence of mobility impairment of Chinese seniors

Table 4 shows the distribution of mobility impairment by different sociodemographic characteristics of Chinese seniors. About 24.4% of the seniors above 65 years old reported major mobility impairment. It means that they could not walk 1 km or climb several flights of stairs or needed to use wheelchair to facilitate movement. Meanwhile, climbing several flights of stairs seems to be more difficult than walking 1 km for the seniors (Fig. 1). It also finds out that more females reported mobility impairment than males, for all different levels of mobility impairment. Meanwhile, there are significant differences in mobility impairment across different age categories. The mobility impairment was much severer for the "old seniors" (74 years old and above) than for the "young seniors" (65–74 years old) in terms of self-reported mobility impairment. Moreover, when the factor of age was not controlled, the divorced, widowed, separated seniors reported more mobility impairment than the married or cohabiting people, and people living in the rural communities had more mobility impairment than their compeers in the urban community.

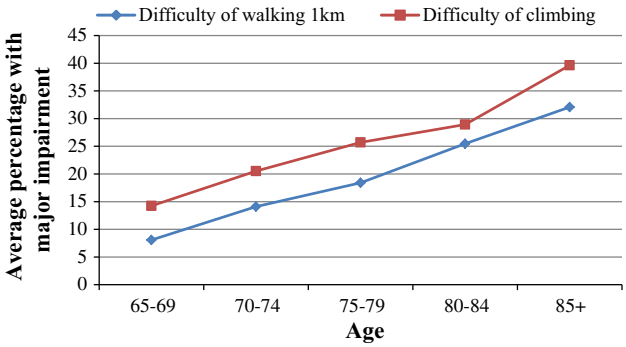

Fig. 1 Average percentage of the seniors with major impairment of climbing and walking 1 km

Structural equation modeling

The means and standard deviations (SDs) of each measure, as well as their correlations are presented in Table 5. The Pearson correlation coefficient matrix suggests that age is positively correlated with mobility impairment and inversely correlated with two categories of activities including helping and media activities. Mobility impairment is inversely correlated with all indicators of social engagement and life satisfaction. Length of suffering from disability is positively correlated with mobility impairment and inversely correlated with life satisfaction. Frequencies

Table 4 Level of mobility impairment by different demographic characteristics

Characteristics	Count	Level of mobility impairment (%)			
		None	Minor	Moderate	Major
Overall	4245	44.1	27.9	3.6	24.4
Gender					
Males	2244	52.3	26.1	2.7	18.9
Females	2001	34.8	30.0	4.7	30.5
Age group					
65–74	3082	48.1	28.4	3.4	20.1
75–84	1057	34.6	26.9	4.2	34.3
85 and above	106	22.6	24.5	3.8	49.1
Marital status					
Single, never married	35	54.3	20.0	2.9	22.9
Married/cohabiting	3225	45.9	28.1	3.6	22.4
Divorced, widowed, separated	985	37.8	27.5	3.9	30.9
Community type					
City	712	50.7	31.6	1.8	15.9
Combined urban–rural areas	126	40.5	26.2	4.8	28.6
Town center areas	491	46.8	28.5	3.3	21.4
Combined town–township areas	326	40.5	28.8	4.9	25.8
Other special district	37	40.5	40.5	2.7	16.2
Township center areas	157	41.4	31.2	4.5	22.9
Village	2396	42.4	26.3	4.0	27.3

of all four kinds of activities are correlated with life satisfaction, with the correlation coefficients of leisure activities largest, followed by organization, helping and media activities. In sum, the results suggest that in China, aging is accompanied by more severe mobility impairment due to some physiological changes. Meanwhile, mobility impairment is correlated with less social engagement and lower life satisfaction.

Based on the correlation analysis, the pathway of the relationship between mobility impairment, social engagement, and life satisfaction is further revealed by SEM. Figure 2 shows the final model with standardized path coefficients. Since age is a control variable, it will be analyzed in the multiple group analysis instead of as an independent variable in the model. Indexes of model fitness suggest that the model provides a good fit to the observed data: The Chi-square value is not significant ($\chi^2 = 15.30$, $df = 10$, $p = 0.122$), the relative Chi-square is less than 2.0 ($\chi^2/df = 1.53$), RMSEA is less than 0.1 (RMSEA = 0.011), SRMR is less than 0.08 (SRMR = 0.012), and GFI is greater than 0.95 (GFI = 0.999). Table 6 further shows the total effects of the independent variables on the dependent variables. It indicates that length of suffering from disability is significantly related to mobility impairment ($\beta = 0.058$, $p < 0.001$). Mobility impairment is significantly inversely related to social engagement ($\beta = -0.300$, $p < 0.001$) and life satisfaction ($\beta = -0.311$, $p < 0.001$). Social engagement is significantly positively related to life satisfaction ($\beta = 0.211$, $p < 0.001$). Based on these results, the mediation effect of social engagement is further assessed by testing the indirect effect using the bias-corrected bootstrap confidence intervals [22]. It suggests that the indirect effects of mobility impairment on life satisfaction through social engagement are significant at the 0.001 level, with a 95% bias-corrected CI for the standardized regression weights of (−0.097, −0.043). Accordingly, mobility impairment exerts direct effects on both social engagement and life satisfaction, and it has indirect effect on life satisfaction via social engagement. In conclusion, the seniors who have more severe mobility impairment are more likely to participate less in activities and report lower life satisfaction.

Multiple group analysis of structural equation modeling

In order to identify whether relationship between mobility impairment, social engagement, and life satisfaction differs by different sociodemographic characteristics of Chinese seniors, multiple group SEM analysis was conducted across different groups of the seniors. They were stratified into subgroups according to their gender, age, marital status, residential areas, and geographic regions, respectively. In the analysis, two types of models were tested, including the unconstrained model and constrained model with equal structural weights. If there is no significant difference between these two models, the results of unconstrained model are reported to compare the multiple groups. If there is a significant difference, the model with a better fit based on the value of RMSEA is used for the comparison. By comparing the critical ratios for differences between parameters, the differences of path coefficients can be identified between different groups in terms of gender, age, marital status, residential areas, and geographic regions, respectively. Tables 7 and 8 present the path coefficients of multiple group analysis. For subgroups with different gender and marital status, there is no significantly different association relationship among mobility impairment, social engagement, and life satisfaction. For subgroups with different age, the association between mobility impairment and social engagement is significantly larger for the "old

Table 5 Correlation coefficients, means, and standard deviations of measured variables

Measure	Age	MI	LD	S1	S2	S3	S4	LS
Age	1							
Mobility impairment (MI)	0.211**	1						
Length of suffering from disability (LD)	0.002	0.059**	1					
Leisure activities (S1)	0.002	−0.148**	−0.029	1				
Helping activities (S2)	−0.076**	−0.067**	0.005	0.095**	1			
Organization activities (S3)	−0.017	−0.058**	−0.006	0.128**	0.147**	1		
Media activities (S4)	−0.046**	−0.066**	−0.022	0.060**	0.089**	0.085**	1	
Life satisfaction (LS)	0.024	−0.311**	−0.055**	0.146**	0.048**	0.069**	0.042**	1
Mean	71.54	2.08	1.69	0.49	0.06	0.02	0.03	35.13
SD	5.51	1.20	8.33	0.60	0.20	0.12	0.22	6.09

*, **, *** Represents a significance level of $p < 0.05$; $p < 0.01$; $p < 0.001$, respectively

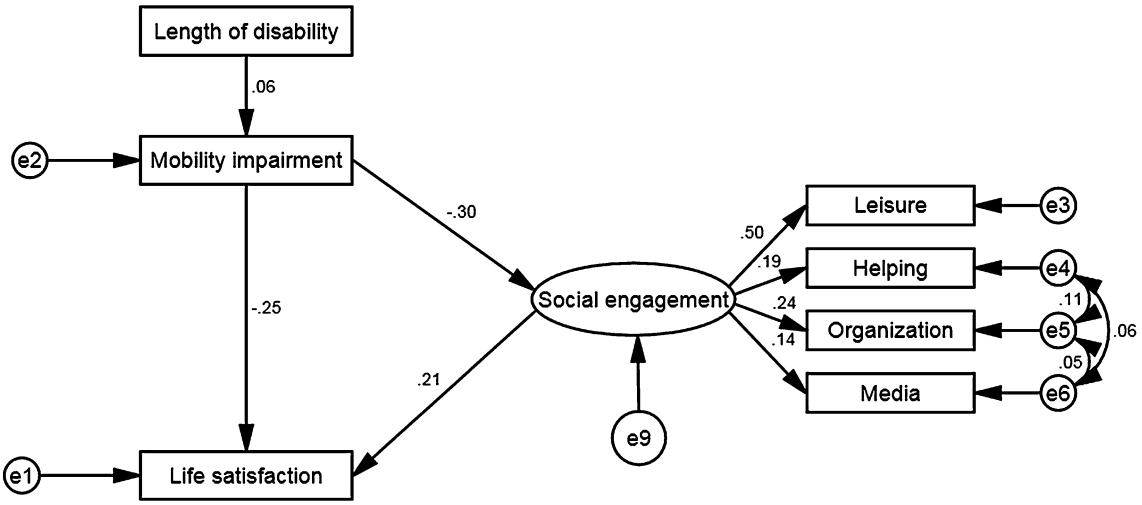

Fig. 2 Structural equation model of the standardized paths among mobility impairment, social engagement, and life satisfaction

Table 6 Standardized total effects between mobility impairment, social engagement, and life satisfaction

Dependent variables	Length of suffering from disability	Mobility impairment	Social engagement
Mobility impairment	0.058	–	–
Social engagement	−0.018	−0.300	–
Leisure activities (S1)	−0.009	−0.150	0.500
Helping activities (S2)	−0.003	−0.058	0.193
Organization activities (S3)	−0.004	−0.073	0.243
Media activities (S4)	−0.002	−0.042	0.139
Life satisfaction	−0.018	−0.311	0.211

The results are based on the path analysis of structural equation modeling, and the numbers indicate the total standardized regression weights of direct and indirect effects

seniors" (aged 75 and above) than the "young seniors" (aged 65–74) ($p < 0.05$). It means that mobility impairment is likely to exert larger effect on social engagement for "old seniors" ($\beta = -0.425$, $p < 0.001$) than for "young seniors" ($\beta = -0.244$, $p < 0.001$). For the subgroups living in urban or rural residence, there is also significantly different association between mobility impairment and social engagement ($p < 0.01$). The association is larger for urban residence ($\beta = -0.326$, $p < 0.001$) than for rural residence ($\beta = -0.306$, $p < 0.001$). It means that mobility impairment is related to much more reduction in social engagement for the seniors living in the urban area than the ones living in rural areas. Thus, the provision of kinds of facilities to facilitate the mobility of seniors in the urban areas of China is very important. In different geographic regions of China, the relationship among mobility impairment, social engagement, and life satisfaction has no significant difference (Table 8). Thus, for both the seniors living in the more developed provinces of the eastern China and the seniors living in the less developed provinces of the central and eastern China, they are likely to report less social engagement and lower life satisfaction when they have more severe mobility impairment.

Discussion and conclusion

This study found that mobility impairment was directly related to social engagement and life satisfaction and indirectly related to life satisfaction via social engagement for the older population in China. It is similar with the findings of previous studies in the developed countries. Numerous studies have found that mobility impairment was associated with perceived quality of life [4, 5, 8, 23, 32] in the UK, Canada, and Australia. Meanwhile, evidences in these countries also suggest that mobility impairment was associated with fewer social contacts [18] and social isolation [24]. However, only a few of them have revealed the role of social engagement in the relationship between mobility impairment and quality of life [3, 18]. The model and path analysis of this study

Table 7 Path coefficients results of multiple group analysis by different sociodemographic characteristics

By gender	Male		Female		z score
	Estimate	p	Estimate	p	
Length of disability → Mobility impairment	0.076	***	0.073	0.001	1.048
Mobility impairment → Social engagement	−0.309	***	−0.304	***	−1.155
Mobility impairment → Life satisfaction	−0.243	***	−0.216	***	0.269
Social engagement → Life satisfaction	0.24	***	0.202	***	−0.846
By age	Age (65–74)		Age (75 and above)		z score
	Estimate	p	Estimate	p	
Length of disability → Mobility impairment	0.066	***	0.055	0.062	−0.032
Mobility impairment → Social engagement	−0.244	***	−0.425	***	−2.39*
Mobility impairment → Life satisfaction	−0.267	***	−0.248	***	1.343
Social engagement → Life satisfaction	0.215	***	0.199	0.043	−0.343
By marital status	Married/cohabiting		Single/divorced		z score
	Estimate	p	Estimate	p	
Length of disability → Mobility impairment	0.058	***	0.056	0.074	−0.169
Mobility impairment → Social engagement	−0.312	***	−0.283	***	0.927
Mobility impairment → Life satisfaction	−0.236	***	−0.245	***	−0.344
Social engagement → Life satisfaction	0.224	***	0.21	0.017	0.151
By residential areas	Urban		Rural		z score
	Estimate	p	Estimate	p	
Length of disability → Mobility impairment	0.08	0.001	0.045	0.024	−1.393
Mobility impairment → Social engagement	−0.326	***	−0.306	***	4.32**
Mobility impairment → Life satisfaction	−0.262	***	−0.233	***	0.49
Social engagement → Life satisfaction	0.197	***	0.196	0.015	1.378

For the model by gender, age, and marital status, results of unconstrained model presented because the difference with constrained model not statistically significant at 0.05 level. For the model by residential areas, results of unconstrained model presented because they are statistically different from the constrained model and have better model fit (RMSEA 0.008 for the former and 0.018 for the latter). In addition, estimate refers to the standard regression weights

*** Represents a significance level of $p < 0.001$; ** represents a significance level of $p < 0.01$; * represents a significance level of $p < 0.05$

Table 8 Path coefficients results of multiple group analysis by different geographic regions

By geographic regions	Eastern region (E)		Central region (C)		Western region (W)		z score		
	Estimate	p	Estimate	p	Estimate	p	E–C	E–W	C–W
Length of disability → Mobility impairment	0.095	***	0.045	0.093	0.048	0.071	−1.619	−2.103*	−0.31
Mobility impairment → Social engagement	−0.287	***	−0.321	***	−0.341	***	0.061	−1.518	−1.521
Mobility impairment → Life satisfaction	−0.25	***	−0.248	***	−0.257	***	−0.312	−1.11	−0.783
Social engagement → Life satisfaction	0.178	0.011	0.184	0.007	0.263	***	0.417	0.881	0.401

For the model by geographic regions, results of unconstrained model presented because the difference with constrained model not statistically significant at 0.05 level. In addition, estimate refers to the standard regression weights

*** Represents a significance level of $p < 0.001$; ** represents a significance level of $p < 0.01$; * represents a significance level of $p < 0.05$

suggested that social engagement was crucial to the link between mobility impairment and life satisfaction. However, it is worth noting that our analysis was based on cross-sectional data, which cannot adequately test the reciprocal paths and specify the direction of causal flow between these variables. Thus, analysis based on

longitudinal data is needed in the future. Nevertheless, based on the association between these variables, the present study provided some implications for improving life satisfaction of the seniors in China. Since China is a huge country with great regional disparity and urban–rural differences, this study further explored the relationship differentiated by different sociodemographic characteristics of the seniors and different residential areas and geographic regions they live. It was found that in urban areas of China, the seniors with mobility impairment were more likely to report less social engagement than their compeers living in the rural areas. It was probably because the built environment in the urban areas were more unfriendly for the movement for the seniors with mobility impairment. Thus, the provision of kinds of facilities to facilitate the mobility of seniors in the urban areas of China is especially important.

Based on the findings, it is important not only to reduce mobility impairment but also to provide the opportunities of social engagement and access to infrastructures and services for the seniors with mobility impairment. Kinds of strategies can be adopted to achieve this [15], such as improving the design of transport facilitates, providing assistive facilities for the seniors with severe mobility impairment, promoting the accessibility of community leisure and healthcare services, and constructing more community senior activity centers. Currently, there have been some strategies for the older population in China, most of which focus on transport subsidy. The public transport fare reduction is prevalent in China, especially in the provincial capitals or the big cities. For the seniors aged 65 years, most have privileges when using public transport such as buses and metros. This policy is beneficial for the seniors usually with none or minor mobility impairment. However, for the seniors with moderate or major mobility impairment, other strategies such as improving the "inclusive design" of transport facilities may be more important. For instance, the provision of handicapped facilities is necessary for the seniors. Based on the database of CHARLS, 38.8% of the seniors lived in multistory building and 24.0% of the seniors lived above second floor. For those seniors living above second floor, 94.0% of their housing did not have elevator, which could be an obstacle for the seniors to go out of home. Also, since most housing in China did not have handicapped facilities, 76.3% of the seniors needed to climb stairs to get to the main entrance of the household's flat, and 8.7% of them even needed to climb more than 25 steps. Indeed, climbing several flights of stairs seems to be more difficult than walking 1 km for the seniors, which highlights the requirement of escalators and handicapped facilities for the movement of the seniors. Therefore, improving the design of facilities for the seniors in both housing and public places is important for China in the future. Meanwhile, the provision of assistive facilities for the seniors with severe mobility impairment in China is still not prevalent currently, and it is necessary for the community and public transport to provide these facilities to help the seniors travel. Furthermore, it is also important to improve the accessibility of the seniors and to improve the physical ability of the seniors. According to the CHARLS database, only 38.4% of the seniors went to medical facilities within 5 km, 59.4% of the seniors went to medical facilities within 10 km, while 29.5% of the seniors went to medical facilities more than 20 km far away from their home. Thus, the accessibility of healthcare still needs improvement in China to prepare for the aging society in the future [14].

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Compliance with ethical standards

Conflict of interest The authors declare that they have no conflict of interest.

Ethical approval The authors declare that ethics approval is not required for this study since it uses secondary data source. Details of the ethical and sampling procedures of the data source are provided in the methodology section of the paper.

Informed consent Informed consent was obtained from all individual participants included in the study.

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