Effects of rural-to-urban migration on the cognitive aging trajectories of older Chinese adults: results from a prospective cohort analysis

Jinzhao Xie
Sun Yat-Sen University
Jing Liao
Sun Yat-Sen University
Jing Zhang
Sun Yat-Sen University
Jing Gu (gujing5@mail.sysu.edu.cn)
Sun Yat-Sen University

Research article

Keywords: Internal migration, Older adults, Cognitive aging, Cohort analysis

Posted Date: January 8th, 2020

DOI: https://doi.org/10.21203/rs.2.20282/v1

Version of Record: A version of this preprint was published on September 21st, 2020. See the published version at https://doi.org/10.1186/s12877-020-01772-9.

Abstract

Background

Increasingly, rural older Chinese adults are moving to urban to live with their children who have migrated to urban. However, few studies have examined this pattern of migration and its effects on cognitive function. Our aim was to investigate the effects of domestic rural-to-urban migration on the cognitive function trajectories of older Chinese adults, as well as the explanatory factors for these effects.

Methods

The data were drawn from three waves of the China Health and Retirement Longitudinal Study (CHARLS). Migrants were defined as participants who had a rural Hukou status (the household registration system of China) but lived in an urban area throughout the study and follow-up period. Cognitive functions were measured using an adapted Chinese version of the Mini-Mental State Examination. We performed multilevel linear regression models to examine the association of internal migration and cognitive function trajectories.

Results

3,876 Chinese adults aged ≥60 years at baseline were included. Migrants (n = 850) had higher levels of education and reported more interactions with family than their rural non-migrant counterparts. Additionally, female migrants were more likely to participate in leisure activities. All cognitive function scores declined over time, but no significant differences were observed in the rates of cognitive decline between migrants and non-migrants, regardless of sex. Female migrants exhibited significantly better performances in terms of total cognition ($\beta = 0.77$, $P < .001$) and mental status ($\beta = 0.68$, $P < .001$) than female non-migrants, whereas no inter-group difference was observed in memory ($\beta = 0.09$, $P > .05$). No significant differences in cognitive function levels were observed between male migrants and male non-migrants. A series of adjusted models revealed that psychosocial factors such as residence with children, caring grandchildren and participation in leisure activities partly explained the association between migration and cognition in women.

Conclusion

Rural-to-urban migration was positively associated with cognitive function only in women, but did not affect the rate of cognitive decline in either sex. The findings indicate that interventions are warranted to increase the cognitive functions of male migrants and rural, non-migrating older adults.

Background

In China, the estimated number of individuals with cognitive impairment was more than 10.4 million in 2016 [1]. Cognitive impairment is associated with a poor quality of life among older adults, and imposes heavy burdens on families and societies [2]. Moreover, the rapid population aging in China is occurring. However, the health and social care systems are not yet prepared to meet the increasing needs of older patients who have cognitive impairment. On the other hand, the unstable “4-2-1” family structure (four grandparents, two parents, and one child) and the substantial number of working-age adults who migrate from rural to urban

areas for employment has undermined traditional practices of family care [3]. Increasingly, older Chinese adults are moving to remain closer to their migrant children, and many provide care to their grandchildren [4]. This unique trend in migration is associated with significant changes in the living environments and social networks of older Chinese adults, which may have important and not fully understood effects on their health and quality of life [5, 6].

The extent to which migration may affect cognitive aging is unclear [7]. Various aspects may contribute to the effects of migration on the cognition of older adults, including the socioeconomic, physical and psychological statuses, behaviour and environmental factors [8]. Older adults who migrate to cities alongside their adult children may benefit from increased family interactions, such as the receipt of support from, and provision of support to close relatives [8]. Moreover, urban environments provide more opportunities for various leisure activities, which may also contribute to the maintenance of cognitive function [9]. However, some empirical studies found that rural-to-urban elderly migrants adapted poorly to daily life [6], and that migrants were likely to lose their social networks and interactions associated with their places of origin, which may cause depression [10]. However, these changes may have sex differences [11], as women tend participate in family and social activities more than men [12]. Consequently, women may be more likely to experience cognitive benefits or burdens associated with these engagements [13–15].

Most previous studies in this research area have explored the relationship between international migration and cognitive function and have reported conflicting findings, while few have focused on internal migration [7]. In the USA, a retrospective cohort study of 1789 Hispanic-American participants indicated no association between migration and cognitive function [16]. However, a study of 1085 participants in Europe observed poorer cognitive function in non-European migrants than in local citizens [17]. In China, a 12-year longitudinal study indicated that rural-to-urban and rural residents had a more rapid decline in cognitive function than urban residents [18]. However, that study compared rural-to-urban migrants with native urban citizens, rather than their rural non-migrant counterparts, and did not highlight the potential psychosocial risk factors for cognitive decline in the migrant population. A comparison of rural-to-urban migrants with their rural non-migrant counterparts may be more appropriate and might better elucidate the changes in the environment and social network (particularly family interactions and social participation) that are consequential to rural-urban migration and its potential effects on cognition. Despite the increasing phenomenon of internal rural-to-urban elderly migration in China, evidence regarding the potential link between this event and cognitive aging remains lacking. Longitudinal studies are also needed to extend the evidence regarding the long-term effects of migration on cognitive aging trajectories.

This study aimed to investigate the sex-specific effects of internal rural-to-urban migration on cognitive aging trajectories, and to explore the potential contributing psychosocial factors in a nationally representative longitudinal sample of community-dwelling older Chinese adults. We hypothesize that rural-to-urban elderly migrants would exhibit better cognitive function and a slower rate of cognitive decline than their non-migrant rural counterparts. Furthermore, it was hypothesized that these associations would be more evident in women than in men and would be partly attributable to family interaction and social engagement.

Methods

Study Sample

This study used data from three waves of the China Health and Retirement Longitudinal Study (CHARLS 2011–2015), which was designed based on the Health and Retirement Study (HRS) in the USA. CHARLS comprised a nationally representative sample of adults in China aged ≥ 45 years. The CHARLS sample was obtained using four-stage stratified sampling with the probability-proportional-to-size (PPS) technique [19]. A baseline survey that covered 28 provinces, 150 counties/districts and 17,708 respondents from 10,257 households was conducted between June 2011 and March 2012. Two follow-up interviews were conducted in 2013 and 2015. We restricted our sample to 3876 respondents who met the following criteria: (1) age ≥ 60 years at baseline, (2) completion of all three study waves (2011–2015), (3) no history of diseases with potentially strong effects on cognitive function (e.g., cancer, stroke, memory-related disease) at baseline and (4) no change in the Hukou status or residence during 2011–2015.

Measures

Migrants and Non-migrants

We divided our sample into two groups, migrants and non-migrants, based on the Hukou system, which served as a classifier between rural and urban residents in previous studies [20, 21]. The rural-to-urban elderly migrants were defined as older adults (≥ 60 years) with a rural agriculture Hukou status who resided in urban areas during all three study waves (n = 850). Non-migrants were defined as respondents with a rural Hukou status who resided in rural areas during the three study waves (n = 3026).

Cognitive Function

Cognitive function was measured using an adapted Chinese version of the Mini-Mental Status Examination (MMSE), which included similar concepts as those used to measure cognitive function in the U.S. Health and Retirement Study (HRS) [22]. According to previous publications [23–25], we divided cognitive function into two dimensions: episodic memory and mental status. We generated an episodic memory score (range: 0–10) as the average of the immediate and delayed recall scores. The mental status score (range: 0–11) was based on the following three items: figure drawing, serial subtraction of 7 from 100 (up to five times) and the ability to identify the date (month, day, year), day of the week and season. The total cognition score, which incorporated both dimensions, ranged from 0 to 21. A higher score indicated better cognitive function.

Psychosocial Factors

The psychosocial factors comprised family engagement and social attachment. Family engagement was measured by assessing the living arrangement, such as whether the household was coupled, whether the respondent lived with his/her children and whether the respondent had provided any informal care to his/her grandchildren during the past year.

The measure of social attachment was adapted from the definition provided in the English Longitudinal Study of Aging (ELSA). Specifically, social attachment was divided into four domains: civic participation, leisure activities, cultural engagement and social networks. However, we excluded cultural engagement to

accommodate the Chinese social background of the subjects. We defined civic participation as the performance of activities with a community-related organization or of volunteer or charity activities within one month before the interview, and participants who had one of those activities mentioned above was defined as civic participation. Participation in leisure activities was defined as playing mahjong, cards or chess; visiting a community, athletic, social or other type of club or attending an educational or training course within one month before the interview. Participation in a social network was defined as living in a coupled residence or with children, caring for grandchildren or interacting with friends within one month before the interview.

Covariates

Demographic characteristics, socioeconomic status, health and health behaviours were considered covariates in our study. Educational level was classified according to the prior CHARLS study, as well as the distribution of educational attainment among older Chinese adults, as: illiterate; some primary school (not completed); finished primary school; and higher than primary school [26, 27]. The household income was defined as the sum of all annual income at the household level, and was stratified into three levels, low, medium and high, according to the percentiles of respondents in this study. The retirement status was dichotomized as retired or not retired.

The health status was assessed by the number of activities of daily living (ADL) disability, or reported having a chronic disease or depression. ADL was determined by the number of activities during which the participant experienced difficulties (range: 0–6). The chronic disease status was determined from self-reported diagnoses. Depression was measured using the 10-item Center for Epidemiologic Studies Depression Scale (CES-D-10), with a higher score (range: 0–30) indicating more severe depression. According to previous studies, smoking, alcohol consumption and afternoon napping may affect cognitive function in the elderly [8, 22, 28]. Therefore, we considered these three items as health behaviours. Respondents were categorized as non-smokers, light/moderate smokers (< 20 cigarettes per day currently or a history of smoking) or heavy smokers (≥ 20 cigarettes per day, currently). The alcohol consumption categories were non-drinkers, less than once per month and more than once per month. Respondents were further categorized as non-nappers, short nappers (< 30 min), moderate nappers (30–90 min) or extended nappers (> 90 min) [28].

Statistical Methods

The characteristics of the sample are described according to sex and migrant status. Continuous variables are reported as means and standard deviations, while categorical variables are reported as percentages. The t-test was used to compare normally distributed continuous variables, while the chi-square and rank-sum tests were used to compare categorical and ranked variables, respectively.

We examined differences in cognitive function trajectories using a multilevel linear regression with the follow-up wave as the first level (low level), which were coded as 0, 1 or 2 to represent the longitudinal term, and with individuals as the second level (high level). We assumed that individuals would have different baseline levels of cognitive function and different rates of cognitive decline. Therefore, we estimated random coefficient models. First, we detected the difference in cognitive trajectories between migrants and non-migrants and

investigated the presence of a sex-specific difference by establishing a model containing the interacting terms of time, migration status and sex. As we identified a significant interaction between sex and migration status with respect to the total cognition and mental status scores (see Additional file 1: Table S1), we stratified all analyses by sex.

Given the observed difference in cognitive function between female migrants and non-migrants, we constructed a series of adjustment models to explore the possible underlying factors. Model 1 was adjusted for age group and time of follow-up. Model 2 comprised model 1 plus socioeconomic status, while models 3 and 4 included living arrangement and social attachment, respectively. Finally, health status and health behaviours were added to model 5. We used multiple imputation methods to address missing values. We also conducted a sensitivity analysis by running models in which the missing values had not been imputed, and achieved similar results. In all analyses, statistical significance was based on a two-tailed P value < 0.05. All analyses were performed using R software, version 3.4.5.

Results

Baseline characteristics of the overall sample and according to migration status by sex

The total sample comprised 3876 participants (52.2% female, 21.9% migrants), with an average baseline age of 67.5 ± 6.5 years. Of the participants, 43.7% were illiterate, nearly a third had retired, 78.1% lived in a coupled household, nearly half lived with children and 39.9% had cared for grandchildren in the past year. Few reported civic participation (0.9%), less than a fifth had participated in leisure activities during the past one month and 95.2% had a social network. Nearly three quarters of the participants had chronic diseases, and the average depression score was 9.1 ± 6.5. More than half the participants were non-smokers and non-drinkers, and nearly half did not take naps. The average total cognition score was 9.2 ± 3.8.

Notably, migrants accounted for 23.6% (n = 478) of female participants and were more likely than non-migrants to live with a child (58.6% vs 47.5%, $P < 0.001$), care for grandchildren (48.1% vs 34.5%, $P < 0.001$) and participate in leisure activities (16.3% vs 8.6%, $P < 0.001$). Migrants accounted for 20.1% (n = 372) of male participants and were more likely than non-migrants to live with a child (57.8% vs 44.5%, $P < 0.001$) and to care for grandchildren (52.2% vs 39.7%, $P < 0.001$). However, there was no significant difference in participation in leisure activities (20.4% vs 19.1%, $P = 0.598$) between male migrants and male non-migrants.

Although female migrants had better baseline total cognition (8.8 ± 3.8 vs 8.1 ± 3.8, $P = 0.001$) and mental status scores (5.8 ± 3.0 vs 5.2 ± 3.0, $P < 0.001$) than female non-migrants, these differences were not observed among male participants. Moreover, no significant episodic memory inter-group differences were observed. The detailed baseline characteristics are presented in Table 1.

Sex-specific differences in cognitive trajectories between migrants and non-migrants

Table 2 presents the results of the multilevel model analyses of the effect of migration on the cognitive function trajectory. After the age groups were adjusted, the time terms in all models were significantly negative, indicating that all cognitive functions declined with time.

Among women, migrants achieved better total cognition (b = 0.77, P < 0.001) and mental status scores (b = 0.68, P < 0.001) than non-migrants except episodic memory (b = 0.09, P > 0.05). Among men, however, there were no significant differences in all kinds of cognitive function levels between migrants and non-migrants. The interacting terms of migrant and time were not significant in all models, indicating that the differences in the rates of cognitive function decline between migrants and non-migrants were not significant. The sex-specific differences in total cognitive function by migrant status are illustrated in Fig. 1.

Sex-specific contributions of psychosocial risk factors to the association between migration and cognitive function

A series of adjustment models revealed the contributions of psychosocial risk factors to differences in the cognitive function levels between migrants and non-migrants. Regarding total cognition in female participants, after controlling for the various factors included in models 1–5 in a stepwise manner, the estimate of migrant remained positive (model 1: b = 0.78, P < 0.001; model 2: b = 0.47, P < 0.001; model 3: b = 0.48, P < 0.001; model 4: b = 0.41, P < 0.01; model 5: b = 0.31, P < 0.05). The results for Models 4 revealed that living with children (b = -0.31, P < 0.05) was associated with a lower total cognition level, while participation in leisure activities (b = 1.03, P < 0.001) was positively associated with the cognitive function level. In model 4, the estimate of migrant remained positive, although this value decreased from 0.47 in model 2 to 0.41 in model 4, indicating that the psychosocial factors explained 12.8% of the difference in the total cognitive function level between migrants and non-migrants. After all covariates were adjusted in model 5, the effects of living with children and participation in leisure activities remained significant (Table 3).

With regards to the mental status of study participants, among female participants, migrants had better mental status than non-migrants, participation in leisure activities remained significantly associated with a better mental status. Caring for grandchildren was also associated with a better mental status in female participants (see Additional file 1: Table S2). For male participants, the estimate of migrant remained no significant, after controlling for the various factors included in models 1–5 in a stepwise manner. Greater participation in leisure activities was associated with a higher total cognitive level, while living with children was associated with worse cognitive function (detailed results not shown).

Discussion

We observed that rural-to-urban elderly female (but not male) migrants exhibited a better cognition level than their non-migrant counterparts. These differences were evident in the overall level of cognitive function but not the rate of cognitive decline, and were partly explained by variations in psychosocial factors. This work indicated the direction of specific interventions for internal elderly migrants, and revealed the population that require more attention.

In our study, the difference in the rate of cognitive decline between migrants and non-migrants was not significant, and this finding might be explained by the following reasons. First, given the fact the both rural-to-urban migrants and rural non-migrants had rural life experiences, differences in the rates of cognitive decline between rural-to-urban migrants and rural non-migrants were not as significant as those observed between rural and urban residents [18]. Second, the effects of rural-to-urban migration on cognitive function may involve a slow and complex process that might not be detectable in the relatively short four-year follow-up period of CHARLS. According to Cattell's categorization of cognitive abilities, cognition can be divided into two dimensions, namely fluid and crystallized abilities [29]. Some researchers claimed that fluid abilities, such as memory, tend to decline linearly from early adulthood and are more difficult to improve or otherwise change in older adults [30, 31]. This was consistent with our observation that the effect of migration on episodic memory was not significant.

Our results confirmed that more than half of rural-to-urban migrants lived with their adult children, suggesting that the older adults had moved to follow their adult children. And we observed that living with children was associated with a worse cognitive function performance, indicating that some elderly individuals who were disabled or could not perform self-care may have moved to the cities to receive help from their adult children. However, our results also revealed that some older adults may have migrated to provide help (e.g., voluntary care of grandchildren) to their adult children.

Although both female and male migrants were more likely to provide intergenerational care than non-migrants, according our findings, this activity only provided cognitive benefits in terms of the mental status among female migrants. Previous studies claimed that providing voluntary care to grandchildren might have a positive effect on the elderly caregiver's cognitive function by enhancing the caregiver's senses of self-esteem and self-worth and providing a new purpose in later life [32–34]. However, this effect may be somewhat sex-specific and more benefit female caregiver [13, 14]. Our study yielded similar results, this outcome may be partly attributable to traditional social norms in China, where women are typically expected to be responsible for domestic affairs and family life, play a nurturing role and serve as kin-keepers, whereas men are expected to fulfil the role of breadwinner. Accordingly, grandfathers who migrate to urban areas specifically to provide care for grandchildren would deviate from this traditional social norm. Therefore, female rural-to-urban elderly migrants would more easily benefit from caring for grandchildren.

Our findings also suggested other explanations regarding the sex-specific difference in cognitive function between migrants and non-migrants. We observed that female elderly migrants performed better in terms of social attachment than female non-migrants, particularly in leisure activities. This finding was inconsistent with those of previous studies, which reported problem of poor social adaptation and integration faced by migrants [6, 20, 35]. This inconsistency may be related to the selection of the control group, which comprised non-migrant rural elderly in our study, however, local citizens in other studies. Compared with rural areas, urban areas feature a wealth of community activities and facilities for leisure activities [36, 37], which provide migrants with more opportunities for participation. Consequently, rural-to-urban migrants had more opportunities for leisure activities. However, increased participation in leisure activities was only observed in female migrants. This may be explained by following reasons, compared to men, women tend to have more larger and varied social networks and to exchange support with a greater number of members in their

networks [38]. In contrast, men often depend solely on their spouses and may be less likely to participate in social activities in the community [39].

Our study has some limitations that should be acknowledged. First, although we used the Hukou status to classify participants into rural and urban populations, in accordance with the Chinese special background and previous research [37, 40, 41], detailed information about migration, such as the migration time, process and reasons, were not available. Further studies should be conducted based on different reasons for migration. Second, it was difficult to match rural-to-urban migrants with rural non-migrants who shared same residential location information in Hukou. Given the significant development gap between different regions of China, it would be more reasonable to compare populations from the same region. Third, although this analysis covered a four-year period, this might not have been sufficient to enable the development of differences in the rates of cognitive decline. Fourth, rural-to-urban migration was associated with the level of cognitive function performance, but not the rate of cognitive decline. Although possible confounders were adjusted, reverse causation may have existed within those relationships. Further studies are needed to investigate the mechanisms underlying those associations.

Conclusions

In conclusion, our research has advanced the body of knowledge regarding the effects of rural-to-urban migration on the cognitive function trajectories of the elderly. Moreover, we have revealed effects of migration may be amplified by sex-related difference, and discussed psychosocial factors behind this. This study indicated that elderly male migrants and rural non-migrants require more attention, and interventions regarding cognitive reservation of elderly internal migrants should be made based on sex-difference. In addition, our study can serve as a basis for further research exploring the mechanism underlying the relationship between migration and cognitive function in older adults.

Additional File

Additional file 1: Table S1 Differences in Cognitive Trajectories Between Migrants and Non-migrants. **Table S2** Longitudinal Association Between Mental Status and Migrant for Female.

Abbreviations

ADL: Activities of daily living; CES-D-10: the 10-item Center for Epidemiologic Studies Depression Scale; CHARLS: the China Health and Retirement Longitudinal Study; ELSA: the English Longitudinal Study of Aging; HRS: the Health and Retirement Study; MMSE: the Mini-Mental Status Examination; PPS: probability-proportional-to-size

Declarations

Acknowledgements

The data used in this study are from China Health and Retirement Longitudinal Study (CHARLS). The authors are grateful for the permission to use the data here.

Funding

This work was supported by the National Natural Science Foundation of China (71804201), the Natural Science Foundation of Guangdong Province (2018A0303130046, 2017A030310346) and Sun Yat-Sen University Scientific Research Foundation (17ykpy15).

Availability of data and materials

The CHARLS datasets, which analysed during the current study, are publicly available at the National School of Development, Peking University (http://charls.pku.edu.cn/en) and can be obtained after submitting a data use agreement to the CHARLS team.

Authors' contributions

JX and JL contributed equally to this study. Study concept and design: JG, JL, JX. Analysis and interpretation of data: JX, JL, JZ. Preparation of manuscript: JX, JL, JG. All authors read and approved the final manuscript

Ethics approval and consent to participate

The original CHARLS was approved by the ethics review committee of Peking University, and all participants gave written informed consent at the time of participation.

Competing interests

The authors declare that they have no competing interests.

Consent for publication

Not applicable.

References

1. Nichols E, Szoeke CEI, Vollset SE, Abbasi N, Abd-Allah F, Abdela J, et al. Global, regional, and national burden of Alzheimer's disease and other dementias, 1990-2016: a systematic analysis for the Global Burden of Disease Study 2016. Lancet Neurol. 2019;18:88-106.
2. Bolandzadeh N, Kording K, Salowitz N, Davis JC, Hsu L, Chan A, et al. Predicting Cognitive Function from Clinical Measures of Physical Function and Health Status in Older Adults. Plos One. 2015; doi:10.1371/journal.pone.0119075.
3. Fang EF, Scheibye-Knudsen M, Jahn HJ, Li J, Ling L, Guo H, et al. A research agenda for aging in China in the 21st century. Ageing Res Rev. 2015;24:197-205.
4. Liu J. Ageing, migration and familial support in rural China. Geoforum. 2014;51:305-312.

5. Wang Q. Health of the Elderly Migration Population in China: Benefit from Individual and Local Socioeconomic Status? International Journal of Environmental Research and Public Health. 2017; doi:10.3390/ijerph14040370.
6. Ruan Y, Zhu D, Lu J. Social adaptation and adaptation pressure among the "drifting elderly" in China: A qualitative study in Shanghai. Int J Health Plann Manage. 2019; doi:10.1002/hpm.2750.
7. Xu H, Zhang Y, Wu B. Association between migration and cognitive status among middle-aged and older adults: a systematic review. BMC Geriatr. 2017; doi:10.1186/s12877-017-0585-2.
8. Xu H, Vorderstrasse AA, McConnell ES, Dupre ME, Ostbye T, Wu B. Migration and cognitive function: a conceptual framework for Global Health Research. Glob Health Res Policy. 2018;3:34.
9. Wang HX, Xu W, Pei JJ. Leisure activities, cognition and dementia. Biochim Biophys Acta. 2012;1822:482-491.
10. Li Q, Zhou X, Ma S, Jiang M, Li L. The effect of migration on social capital and depression among older adults in China. Soc Psychiatry Psychiatr Epidemiol. 2017;52:1513-1522.
11. Liao J, McMunn A, Mejias ST, Brunner EJ. Gendered trajectories of support from close relationships from middle to late life. Ageing & Society. 2018;38:746-765.
12. Zhang C, Fong VL, Yoshikawa H, Way N, Chen XY, Lu ZH. The Rise of Maternal Grandmother Child Care in Urban Chinese Families. Journal of Marriage and Family. 2019;81:1174-1191.
13. Di Gessa G, Glaser K, Tinker A. The impact of caring for grandchildren on the health of grandparents in Europe: A lifecourse approach. Soc Sci Med. 2016;152:166-175.
14. Hughes ME, Waite LJ, LaPierre TA, Luo Y. All in the family: the impact of caring for grandchildren on grandparents' health. J Gerontol B Psychol Sci Soc Sci. 2007;62:S108-119.
15. Liao J, Scholes S. Association of Social Support and Cognitive Aging Modified by Sex and Relationship Type: A Prospective Investigation in the English Longitudinal Study of Ageing. Am J Epidemiol. 2017;186:787-795.
16. Lawton DM, Gasquoine PG, Weimer AA. Age of dementia diagnosis in community dwelling bilingual and monolingual Hispanic Americans. Cortex; a journal devoted to the study of the nervous system and behavior. 2015;66:141-145.
17. Segers K, Benoit F, Colson C, Kovac V, Nury D, Vanderaspoilden V. Pioneers in migration, pioneering in dementia: first generation immigrants in a European metropolitan memory clinic. Acta neurologica Belgica. 2013;113:435-440.
18. Xu H, Dupre ME, Gu D, Wu B. The impact of residential status on cognitive decline among older adults in China: Results from a longitudinal study. BMC Geriatr. 2017;17:107.
19. Zhao Y, Hu Y, Smith JP, Strauss J, Yang G. Cohort profile: the China Health and Retirement Longitudinal Study (CHARLS). Int J Epidemiol. 2014;43:61-68.
20. Li J, Rose N. Urban social exclusion and mental health of China's rural-urban migrants - A review and call for research. Health Place. 2017;48:20-30.
21. Zheng L, Hu R, Dong Z, Hao Y. Comparing the needs and utilization of health services between urban residents and rural-to-urban migrants in China from 2012 to 2016. BMC Health Serv Res. 2018;18:717.

22. Xiang Y, Zare H, Guan C, Gaskin D. The impact of rural-urban community settings on cognitive decline: results from a nationally-representative sample of seniors in China. BMC Geriatr. 2018;18:323.
23. Zhang L, Yang J, Liao Z, Zhao X, Hu X, Zhu W, et al. Association between Diabetes and Cognitive Function among People over 45 Years Old in China: A Cross-Sectional Study. Int J Environ Res Public Health. 2019; doi:10.3390/ijerph16071294.
24. Lei X, Smith JP, Sun X, Zhao Y. Gender differences in cognition in China and reasons for change over time: Evidence from CHARLS. The Journal of the Economics of Ageing. 2014;4:46-55.
25. Sha T, Cheng W, Yan Y. Prospective associations between pulse pressure and cognitive performance in Chinese middle-aged and older population across a 5-year study period. Alzheimers Res Ther. 2018;10:29.
26. Huang W, Zhou Y. Effects of education on cognition at older ages: evidence from China's Great Famine. Soc Sci Med. 2013;98:54-62.
27. Huang W, Lei X, Ridder G, Strauss J, Zhao Y. Health, Height, Height Shrinkage, and SES at Older Ages: Evidence from China. Am Econ J Appl Econ. 2013;5:86-121.
28. Li J, Cacchione PZ, Hodgson N, Riegel B, Keenan BT, Scharf MT, et al. Afternoon Napping and Cognition in Chinese Older Adults: Findings from the China Health and Retirement Longitudinal Study Baseline Assessment. Journal of the American Geriatrics Society. 2017;65:373-380.
29. Cattell. The measurement of adult intelligence. Psychological Bulletin. 1943;40:153-193.
30. Salthouse TA. Selective review of cognitive aging. Journal of the International Neuropsychological Society : JINS. 2010;16:754-760.
31. Gold DP, Andres D, Etezadi J, Arbuckle T, Schwartzman A, Chaikelson J. Structural equation model of intellectual change and continuity and predictors of intelligence in older men. Psychology and aging. 1995;10:294-303.
32. Ku LJ, Stearns SC, Van Houtven CH, Lee SY, Dilworth-Anderson P, Konrad TR. Impact of caring for grandchildren on the health of grandparents in Taiwan. J Gerontol B Psychol Sci Soc Sci. 2013;68:1009-1021.
33. Xu H. Physical and mental health of Chinese grandparents caring for grandchildren and great-grandparents. Soc Sci Med. 2018; doi:10.1016/j.socscimed.2018.05.047.
34. Luo Y, Pan X, Zhang Z. Productive activities and cognitive decline among older adults in China: Evidence from the China Health and Retirement Longitudinal Study. Social Science & Medicine. 2018; doi:10.1016/j.socscimed.2018.09.052.
35. Lin Y, Zhang Q, Chen W, Shi J, Han S, Song X, et al. Association between Social Integration and Health among Internal Migrants in ZhongShan, China. PLoS One. 2016; doi:10.1371/journal.pone.0148397.
36. Guo Q, Bai X, Feng N. Social participation and depressive symptoms among Chinese older adults: A study on rural-urban differences. J Affect Disord. 2018;239:124-130.
37. Zhu Y, Osterle A. Rural-urban disparities in unmet long-term care needs in China: The role of the hukou status. Soc Sci Med. 2017;191:30-37.
38. Antonucci TC, Akiyama H. An examination of sex differences in social support among older men and women. Sex Roles. 1987;17:737-749.

39. Fuhrer R, Stansfeld SA. How gender affects patterns of social relations and their impact on health: a comparison of one or multiple sources of support from "close persons". Soc Sci Med. 2002;54:811-825.
40. Guo J, Guan L, Fang L, Liu C, Fu M, He H, et al. Depression among Chinese older adults: A perspective from Hukou and health inequities. Journal of Affective Disorders. 2017;223:115-120.
41. Zhang X, Yu B, He T, Wang P. Status and determinants of health services utilization among elderly migrants in China. Global Health Research and Policy. 2018; doi:10.1186/s41256-018-0064-0.

Tables

Table 1 Baseline Characteristics of the Overall Sample and According to Migration Status by Sex

Variables	Total (n = 3876)	Female (n = 2024)		P	Male (n = 1852)		P
		Stayer (n = 1546)	Migrant (n = 478)		Stayer (n = 1480)	Migrant (n = 372)	
Demographic							
Age, mean ± SD	67.5 ± 6.5	67.6 ± 6.6	68.2 ± 7.2	0.061	67.3 ± 6.2	67.1 ± 6.0	0.556
Age group, n (%)				0.193			0.693
<65	1622(41.8)	635(41.1)	191(40.0)		629(42.5)	167(44.9)	
65~70	1190(30.7)	492(31.8)	138(28.9)		450(30.4)	110(29.6)	
>70	1064(27.5)	419(27.1)	149(31.2)		401(27.1)	95(25.5)	
Education level, n (%)				0.032			0.001
Illiterate	1694(43.7)	986(63.8)	270(56.5)		376(25.4)	62(16.7)	
Some primary school	860(22.2)	280(18.1)	100(20.9)		362(24.5)	118(31.7)	
Finished primary school	943(24.3)	222(14.4)	83(17.4)		504(34.1)	134(36)	
Higher than primary school	379(9.8)	58(3.8)	25(5.2)		238(16.1)	58(15.6)	
Retired, n (%)	1173(30.3)	544(35.2)	213(44.6)	<.001	288(19.5)	128(34.4)	<.001
Household annual income, n (%)				<.001			<.001
Low	1098(28.3)	473(30.6)	125(26.2)		429(29.0)	71(19.1)	
Medium	2074(53.5)	821(53.1)	241(50.4)		810(54.7)	202(54.3)	
High	704(18.2)	252(16.3)	112(23.4)		241(16.3)	99(26.6)	
Living arrangement, n (%)							
Coupled household	3026(78.1)	1128(73.0)	327(68.4)	0.061	1238(83.6)	333(89.5)	0.006
Live with children	1889(48.7)	735(47.5)	280(58.6)	<.001	659(44.5)	215(57.8)	<.001
Care grandchildren	1545(39.9)	534(34.5)	230(48.1)	<.001	587(39.7)	194(52.2)	<.001
Social attachment, n (%)							
Civic participation	33(0.9)	11(0.7)	4(0.8)	0.999	14(0.9)	4(1.1)	0.999
Leisure activities	569(14.7)	133(8.6)	78(16.3)	<.001	282(19.1)	76(20.4)	0.598
Social network	3689(95.2)	1464(94.7)	459(96)	0.295	1406(95.0)	360(96.8)	0.188
Health							
ADL, (mean ± SD, 0-6)	0.5 ± 1.1	0.6 ± 1.3	0.5 ± 1.1	0.035	0.4 ± 1.0	0.3 ± 0.7	0.069
Chronic diseases	2757(71.1)	1144(74.0)	348(72.8)	0.646	1018(68.8)	247(66.4)	0.411
Depression, (mean ± SD, 0-30)	9.1 ± 6.5	10.3 ± 6.8	9.0 ± 6.7	<.001	8.2 ± 6.0	7.5 ± 5.7	0.039
Health behaviours							
Smoking, n (%)				0.115			0.477
Non-smoker	2582(66.6)	1457(94.2)	438(91.6)		553(37.4)	134(36.0)	
Light/moderate smokers	601(15.5)	64(4.1)	30(6.3)		411(27.8)	96(25.8)	

Variables	Total (n = 3876)	Female (n = 2024)		P	Male (n = 1852)		P
		Stayer (n = 1546)	Migrant (n = 478)		Stayer (n = 1480)	Migrant (n = 372)	
Heavy smokers	693(17.9)	25(1.6)	10(2.1)		516(34.9)	142(38.2)	
Alcohol consumption, n (%)				0.954			0.183
Non-drinker	2665(68.8)	1349(87.3)	418(87.4)		713(48.2)	185(49.7)	
Less than once per month	239(6.2)	65(4.2)	21(4.4)		115(7.8)	38(10.2)	
More than once per month	972(25.1)	132(8.5)	39(8.2)		652(44.1)	149(40.1)	
Afternoon sleep, n (%)				0.066			0.507
Non-napper	1878(48.5)	876(56.7)	240(50.2)		602(40.7)	160(43.0)	
Short napper	327(8.4)	114(7.4)	35(7.3)		149(10.1)	29(7.8)	
Moderate napper	1111(28.7)	386(25.0)	145(30.3)		467(31.6)	113(30.4)	
Extended napper	560(14.4)	170(11.0)	58(12.1)		262(17.7)	70(18.8)	
Cognition, mean ± SD							
Total cognition (range 0-21)	9.2 ± 3.8	8.1 ± 3.8	8.8 ± 3.8	0.001	10.3 ± 3.7	10.5 ± 3.4	0.274
Mental status (range 0-11)	6.2 ± 3.1	5.2 ± 3.0	5.8 ± 3.0	<.001	7.2 ± 2.9	7.5 ± 2.7	0.086
Episodic memory (range 0-10)	3.0 ± 1.7	2.9 ± 1.7	3.0 ± 1.7	0.651	3.1 ± 1.6	3.0 ± 1.6	0.556

Abbreviations: SD standard deviation, SES socioeconomic status, ADL activity of daily living disability;

Table 2 Sex-specific Differences in Cognitive Trajectories Between Migrants and Non-migrants

	Total cognition	Mental status	Episode Memory
Female			
Fixed effect			
Constant	9.40(0.12)***	6.09(0.10)***	3.34(0.05)***
Time	-0.99(0.05)***	-0.59(0.05)***	-0.40(0.03)***
Migrant	0.77(0.18)***	0.68(0.15)***	0.09(0.08)
Age65~70 (Ref. Age60~)	-0.83(0.16)***	-0.47(0.12)***	-0.39(0.06)***
Age>70 (Ref. Age60~)	-2.68(0.17)***	-1.69(0.13)***	-1.10(0.07)***
Migrant x Time	-0.01(0.11)	-0.03(0.09)	0.03(0.05)
Random effect			
ID	2.27	1.72	0.97
Time	0.26	0.12	0.35
Male			
Fixed effect			
Constant	11.39(0.12)***	7.88(0.09)***	3.54(0.05)***
Time	-0.85(0.05)***	-0.49(0.04)***	-0.36(0.03)***
Migrant	0.16(0.19)	0.25(0.15)	-0.09(0.09)
Age65~70 (Ref. Age60~)	-0.68(0.16 ***	-0.36(0.12)**	-0.35(0.07)***
Age>70 (Ref. Age60~)	-2.52(0.17)***	-1.61(0.13)***	-1.00(0.07)***
Migrant x Time	0.16(0.12)	0.06(0.10)	0.11(0.06)
Random effect			
ID	2.03	1.53	0.83
Time	0.45	0.31	0.27

** $P<0.05$; ** $P<0.01$; *** $P<0.001$;

Table 3 Association Between Total Cognitive Trajectory and Migration for Female

	Model1	Model2	Model3	Model4	Model5
Fixed effect					
constant	9.39(0.12)***	8.08(0.16)***	8.00(0.20) ***	7.72(0.30)***	8.38(0.32)***
Time	-0.99(0.05)***	-0.99(0.05)***	-0.99(0.05) ***	-0.99(0.05)***	-0.99(0.05)***
Migrant (Ref. Non-migrants)	0.78(0.16)***	0.47(0.14)***	0.48(0.14) ***	0.41(0.14)**	0.31(0.14)*
Age65~70 (Ref. Age60~)	-0.83(0.16)***	-0.85(0.14)***	-0.85(0.14) ***	-0.81(0.14)***	-0.78(0.14)***
Age>70 (Ref. Age60~)	-2.68(0.17)***	-1.72(0.16)***	-1.66(0.16) ***	-1.61(0.16)***	-1.61(0.16)***
SES					
Education level (Ref. illiterate)					
Some primary school		2.09(0.15)***	2.09(0.15) ***	2.05(0.15)***	2.03(0.15)***
Finished primary school		3.88(0.17)***	3.88(0.17)***	3.76(0.17)***	3.69(0.17)***
Higher than primary school		5.17(0.30)***	5.14(0.30)***	4.98(0.29)***	4.88(0.29)***
Retired (Ref. no)		-0.09(0.13)	-0.05(0.13)	-0.06(0.13)	-0.03(0.12)
Household annual income (Ref. low)					
Medium		-0.15(0.13)	-0.1(0.14)	-0.12(0.14)	-0.21(0.14)
High		0.26(0.17)	0.41(0.19) *	0.34(0.19)	0.15(0.19)
Living arrangement					
Coupled household			0.15(0.14)	0.14(0.15)	0.08(0.15)
Live with children			-0.36(0.13) **	-0.31(0.13)*	-0.33(0.13)*
Care grandchildren			0.16(0.12)	0.15(0.12)	0.19(0.12)
Social attachment					
Civic participation (Ref.no)				0.65(0.66)	0.57(0.65)
Leisure activities (Ref.no)				1.03(0.19)***	0.87(0.19)***
Social network (Ref.no)				0.22(0.3)	0.26(0.29)
Health					
ADL					-0.13(0.05)**
Chronic diseases (Ref. Non-disease)					-0.04(0.13)
Depression					-0.06(0.01)***
Health behaviours					
Smoking (Ref. Non-smoker)					
Light/moderate smokers					0.30(0.27)
Heavy smokers					0.46(0.43)
Alcohol consumption (Ref. Non-drinker)					

	Model1	Model2	Model3	Model4	Model5
Less than once per month					0.00(0.28)
More than once per month					-0.07(0.21)
Afternoon napping (Ref. Non-napper)					
Short napper					0.67(0.22)**
Moderate napper					0.31(0.13)*
Extended napper					-0.18(0.18)
Random effect					
ID	2.27	1.76	1.76	1.73	1.65
Time	0.25	0.17	0.16	0.17	0.20
AIC	32734	32075	32069	32043	31982

Abbreviations: AIC Akaike Information Criterion, SES socioeconomic status, ADL activity of daily living disability

Model 1: Adjusted for age group and time of follow-up; Model 2: Model 1 + socioeconomic status; Model 3: Model 2 + living arrangement; Model 4: Model3 + social attachment; Model 5: Model 4 + health and health behaviours.

* $P<0.05$; ** $P<0.01$; *** $P<0.001$;

Figures

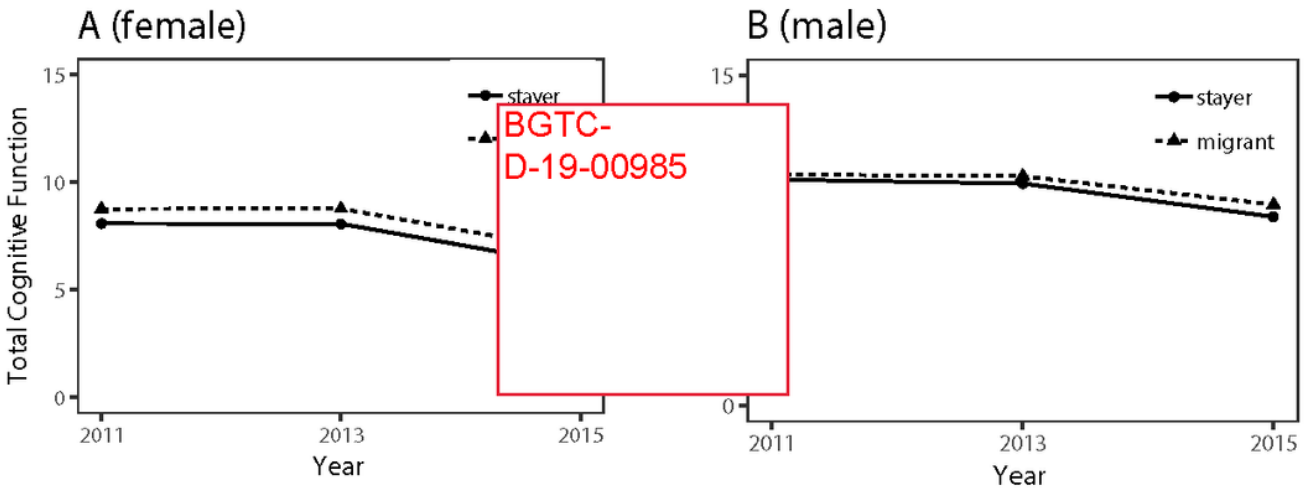

Figure 1

The sex-specific differences in total cognitive function trajectories function by migrant status. Fig. 1(A) Relationship between time (horizontal axis) and total cognitive function (range:0-21; vertical axis) of female according to migrant status. the dotted line and solid line represent migrant and stayer respectively, the dots represent the mean total cognitive function of each fellow-up point. Fig. 1(B) Association between time and total cognitive function of male according to migrant status. Over all the total cognitive function of male was higher than that of female. The cognitive performance of migrants was better than stayers, which was more pronounced in female.

Supplementary Files

This is a list of supplementary files associated with this preprint. Click to download.

- Supplementaryfile.docx