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Status of Intrinsic Capacity Decline in China: Prevalence, Associated Factors, and Implications for Clinical Care

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Abstract

Objectives: The WHO proposed intrinsic capacity (IC) as a new model to capture an individual's functions and capacities across lifetime. We aimed to investigate the prevalence of and factors associated with decline in IC (DIC) and examine associations between IC and adverse outcomes in China.

Design: Cross-sectional study.

Setting: Community, China.

Participants: Data were derived from the China Comprehensive Geriatric Assessment Study. IC comprised five domains: locomotion, cognition, vitality, sensory, and psychological domains. Participants were deemed DIC if they had any domain decline(s). Sociodemographic characteristics, chronic diseases, geriatric syndromes, and adverse outcomes were examined. **Results**: Of 5,823 community-dwelling participants aged 60–98 years, 2,506 were DIC (weighted 39.9%): 57.7% in Western, 38.3% in Northern, 33.7% in Northwest, 36.1% in Middle, 16.9% in Eastern, and 19.8% in Northeast China. Participants with decline in locomotion, cognition, vitality, sensory, and psychological domains numbered 1,039 (17.8%), 646 (11.1%), 735 (12.6%), 824 (14.2%), and 713 (12.2%), respectively. Age, northern residence, low education, poor marital status, low income, less exercise, less meat intake, insomnia, memory loss, urinary incontinence, constipation, slowness, chronic obstructive pulmonary disease, and osteoarthritis independently influenced DIC. After adjusting for age, sex, area, district, marriage, education, waist-hip ratio, smoking, alcohol consumption, exercise, income, and chronic diseases, DIC was independently associated with risk of frailty, disability, fall, fracture, and immobility.

Conclusion: DIC prevalence in China is high. IC was significantly associated with adverse outcomes, after adjusting for related variables. Efforts promoting IC to delay functional

dependence should focus on modifiable factors, such as worse social factors, poor lifestyle, chronic diseases, and geriatric syndromes.

Keywords: Intrinsic capacity; Older Adults; Prevalence; Frailty

Article summary

Strengths and limitations of this study

- To the best of our knowledge, this study is the first large nationally representative sample of population-based older people focusing on intrinsic capacity in China.
- Most of the indicators of intrinsic capacity such as locomotion, cognition, and psychological domain were assessed by unified measured performance tests.
- This study provided preliminary understanding of the intrinsic capacity situation in China, which suggests ways to successfully put intrinsic capacity into clinical practice to contribute to complex integrated care strategies for older persons with declined intrinsic capacity.
- The relatively small sample size and cross-sectional design limit generalizability of the results
- We used a composite total score instead of a weighted score, so further statistical approaches should be conducted to compute IC score.

Introduction

The increasing global disability burden associated with rapid population aging causes physical, social, and mental health problems, which challenges the health care system for older people [1]. To cope with the demands of increasing numbers of frail community-dwelling older persons with multiple complex needs, implementing integrated care is necessary to improve their well-being [2]. As such, the World Health Organization (WHO) has developed the Integrated Care for Older People (ICOPE) approach and proposed an innovative public health model for healthy ageing focusing on concepts of intrinsic capacity (IC) and functional ability, with strong recommendations for developing comprehensive approaches such as quality integrated care to maintain IC and functional ability. This highlights the importance of integrated care in improving quality of life in the older population [3,4]. A recent study showed that an integrated health and social care model reduced frailty in community-dwelling older people [5].

IC comprises all the individual's physical and mental capacities [4]. The new IC model has shifted the concept of "healthy ageing" from disease-centered to function-centered paradigms, which opens up opportunities for intervention at an early stage to slow down progression to disability and care-dependency. WHO proposes five components to assess IC: locomotion, cognition, vitality, sensory, and psychological domains [3,4]. Although each component is associated with adverse health events in older people, few studies have focused on the combined components [6,7]. As it reflects biological aging, monitoring IC may provide an innovative method to promote healthy ageing [8]. While evidence about factors associated with decline in IC (DIC) is limited, with increased healthcare utilization, identification of vulnerable populations at risk and further intervention could improve their physical capacity and functional ability [4].

While disease burden affects public health systems and increases expenses, an IC approach might

81 allow a better understanding of an individual's functional trajectories and vulnerabilities to develop strategies for prevention or to delay progression of DIC, even during a catastrophic event as the coronavirus disease [9]. The healthcare system should prioritize strategies targeting chronic diseases in the older population to reduce the disabilities burden [10]. Although the concept of IC has been used in several observational studies [11], no studies have been conducted in China. Therefore, to facilitate the evaluation of integrated primary care approaches for older patients, the present study focuses on (1) the prevalence and factors associated with DIC proposed by the WHO, and (2) the association between IC and frailty, disability, falls, fracture, and immobility in community-dwelling older people in China.

Methods

Participants

Data were obtained from the China Comprehensive Geriatric Assessment Study (CCGAS, 2011–2012), a population-based face-to-face survey of adults aged 60 years or over from rural and urban areas of China. Further details regarding the CCGAS have been reported. Briefly, seven cities (Beijing, Xi'an, Harbin, Chengdu, Chongqing, Changsha, and Shanghai) from seven different provinces were chosen based on well-established cluster, stratification, and random selection statistical sampling techniques; these cities represent six main regions in China (northern, middle, eastern, northwestern, southwestern, and northeastern). A total of 6,867 older adults were included, and 1,040 participants were excluded because of missing data, resulting in 5,823 with complete IC data included in this analysis. All study participants provided informed consent, and the study design was approved by the ethics review board of Xuanwu Hospital Capital Medical University.

Demographics, lifestyles, and diseases

104 A door-to-door survey was conducted by formally trained interviewers using the standard Comprehensive Geriatric Assessment (CGA) instrument. Data gathered included sociodemographic characteristics, anthropometric measurements, health status, personal habits, and mental health. Medical conditions such as self-reported history of chronic disease diagnosed by a doctor and geriatric syndromes were recorded.

109 *IC construct*

110 IC was assessed by the following five domains recommended by WHO [3,12] and available in our cohort.

112 Locomotion was assessed by a short physical performance battery [13]. The balance test comprises three parts: standing unsupported for 10 seconds with the feet together; a semi-tandem stand; and a full-tandem stand. Subjects who were unable to complete each test received a score of 1; otherwise, they were scored 0. The chair-stand test was performed with the subject seated in a chair, with the feet flat on the floor and arms held flat against their side with the elbows at 90°. Subjects who were able to stand five times from the chair received a score of 1, those who partly completed this task scored 0.5, and those who could not do so scored 0. A 20-meter walking test was also conducted; those who were able to walk 20 meters scored 1, those who walked less than 20 meters scored 0.5, and those could not walk scored 0.

121 Cognition was assessed by the Mini-Mental State Examination, with a total score range of 0–30 [14]. The thresholds for participants who were illiterate or who were educated up to elementary school, middle school, and high school or above were 17, 20, and 24, respectively. Participants who scored below the threshold value for their education group were regarded as mildly cognitively impaired (score of 1), and those below 15 were regarded as moderately to severely cognitively impaired (score of 0).

Vitality was assessed by body mass index (BMI), which was calculated by dividing the weight in kilograms by height in meters squared. BMI cutoffs were based on Asian adjustments. BMI above 20kg/m^2 received a score of 2, 18.5–20 kg/m^2 was scored 1, and ≤18.5 kg/m^2 was scored 0.

Sensory domain was assessed by self-reported visual and hearing impairment. Vision capacity was considered intact when the older person did not report "eyesight problems" that interfered with their activities, and they were not identified by the interviewer as being functionally blind. Hearing capacity was considered intact when the older person did not report "hearing problems or deafness" that interfered with their activities, and they were not identified by the interviewer as being profoundly deaf. Participants with both vision and hearing impairments received a score of 0, those with either vision or hearing impairment received a score of 1, and those with both vision and hearing capacities intact scored 2.

Psychological domain was measured by the 30-item Geriatric Depression Scale [15]. Scores from 0 to 10 represent an intact psychological domain (score of 2); scores from 11 to 20 represent mild depression (score of 1); scores from 21 to 60 represent moderate to severe depression (score of 0).

For each of the above five items, participants were scored either 0 (representing severe decline), 1 (representing mild decline), or 2 (representing intact IC). The IC total score ranged from 0–10; higher scores indicated better performance.

Adverse outcomes

Physical function was assessed as activities of daily living (ADL) and instrumental activities of daily living (IADL). The list of activities consisted of 14 items (eating, grooming, dressing, transferring in and out of bed, bathing, walking inside the house, using the toilet, cooking, managing finances, driving or using public transportation, shopping, walking 250 meters, cutting toenails, and climbing stairs), and an individual's performance on each item was classified as independent, partially dependent, or completely dependent. Those with one or more impaired ADL or IADL functions were defined as disabled. The frailty index derived from CGA was measured based on six variables: demographic characteristics, physical health, physical function, living behavior and social function, mental health, and cognitive function [16]. Frailty was defined as a score ≥0.25. We defined fractures as spontaneous fractures over the previous two years. Falls were defined as those that occurred twice in the past year. Immobility was self-reported.

Statistical methods

EpiData was used to establish the database, and input and automatically verify the data. All statistical analyses were performed using SPSS (Chicago, IL, USA, version 11.0). Count data were expressed as percentages. Chi-square tests, t-tests, and one-way analysis of variance were performed. The standard rates calculated using the national standard population composition ratio as at the Sixth National Census (2010). A forward stepwise logistic regression was conducted to explore the association between the factors and DIC or between DIC and adverse outcomes. A P-value of <0.05 was considered statistically significant.

Results

Of the total 5,823 older adults, the average IC score was 9.14±1.304, and 2,506 were DIC, yielding a prevalence of 43.0% (weighted 39.9%). A total of 3,317 (57.0%), 1,512 (26.0%), 636 (10.9%), 271 (4.7%), 75(1.3%), and 12 (0.2%) participants showed decline in 0, 1, 2, 3, 4, and 5 domains, respectively. The prevalence of DIC was higher in women than in men (43.0% vs. 36.7%). The prevalence of DIC among older adults in rural areas was higher, by 1.36 times, than that in urban areas. The prevalence of DIC increased with age, with the highest observed in individuals aged ≥80 y (66.6%) and the lowest among those aged 60–64 y (28.6%) (Table 1). The number of

173 participants with decline in locomotion, cognition, vitality, sensory, and psychological domains was 1,039 (17.8%), 646 (11.1%), 735 (12.6%), 824 (14.2%), and 713 (12.2%), respectively. For each domain, the prevalence was higher in females and those with rural residence, and increased with age, although there was no association between psychological domain and age (Table S1).

177 We observed differences in the prevalence of DIC among the six regions: 57.7% in Western China, 38.3% in Northern China, 33.7% in Northwest China, 36.1% in Middle China, 16.9% in Eastern China, and 19.8% in Northeast China (Figure 1A). The prevalence of DIC was higher in northern than southern regions (46.9% vs 36.7%; Figure 1B). The IC score decreased with increasing age (9.53±0.88, 49.37±1.06, 9.18±1.22, 8.96±1.39, 8.35±1.73; Figure 1D) and was higher in men than women (9.24±1.19 vs 9.06±1.38; Figure 1C).

183 Next, we observed the prevalence of DIC in different regions according to geography, sex, and age. In urban areas, the weighted prevalence of DIC differed across the six regions, with western urban regions showing the highest rates and eastern urban regions showing the lowest rates: 43.1% in Western, 36.1% in Middle, 33.7% in Northwest, 30.7% in Northern, and 19.8% in Northeast, and 11.8% in Eastern China. Older adults living in rural areas included those residing in Beijing and Chengdu, and the prevalence of DIC was higher in Chengdu than Beijing (74.1% vs 47.2%). The prevalence of DIC among the six regions was different when analyzed according to sex and age, with western regions showing the highest rate in both men and women, and in those aged <75 y, and those aged ≥75 y, the eastern regions showing the lowest rates in both men and women, and those aged <75 y, and east-north region showing the lowest rates in those aged ≥75 y (Figure 2).

193 When we compared social-psychological factors, chronic diseases, and geriatric syndromes, a high prevalence of DIC was observed in illiterate participants, those with low income, not married, who did not exercise, with less meat intake and alcohol consumption. Those who had chronic diseases

such as coronary heart disease, stroke, kidney disease, chronic obstructive pulmonary disease, and osteoarthritis, as well as geriatric syndromes had a higher prevalence of DIC, while there was a lower prevalence of DIC in older adults without diabetes (Table S2). The prevalence of DIC among individuals with ≥5 (62.5%) chronic diseases was about two times higher than that among individuals without chronic disease (30.9%).

With DIC as the dependent variable and the above factors as independent variables, forward logistic analysis showed that older age, northern region, low education, poor marital status, low income, less exercise, less meat intake, insomnia, memory decline, urinary incontinence, constipation, slowness, chronic obstructive pulmonary disease, and osteoarthritis, were independent factors influencing DIC in older adults (Table 2).

We further compared the frequency of adverse clinical outcomes between non-DIC and DIC groups. Participants with DIC were much more likely to be frail (22.2% vs 1.2%), disabled (15.0% vs 1.0%), and have falls (7.9% vs 1.8%), fractures (4.7% vs 2.2%), and immobility (20.4% vs 3.4%). Logistic regression showed that, after adjustment for age, sex, area, district, marriage, education, waist-hip ratio, smoking, alcohol consumption, exercise, income, and chronic diseases, DIC was independently associated with risks of frailty (adjusted OR = 19.021), disability (adjusted OR = 8.611), falls (adjusted OR = 3.053), fractures (adjusted OR = 1.656), and immobility (adjusted OR = 4.403) (Table 3).

Discussion

In a nationally representative cross-sectional study, the weighted prevalence of DIC was as high as 39.9% in community-living Chinese adults aged ≥ 60 years, which was about five times higher than the prevalence of frailty in the same population [17]. The frequency of participants with decline in locomotion, cognition, vitality, sensory, and psychological domains was 17.8%, 11.1%, 12.6%, 14.2%, and 12.2%, respectively. The traditional care model for older adults is mostly disease-centered; however, frailty, as an increasingly problematic consequence of population aging, threatens the sustainability of healthcare resources where most people seek healthcare attention only when experiencing symptoms. Furthermore, some studies reported that current integrated care models did not significantly reduce utilization nor consistently reduce mortality [18]. Thus, an IC model may support modernization of current healthcare systems and meet the requirements of each older adult. The ongoing INSPIRE study conducted in Europe will test the implementation and follow up of the ICOPE tool [19].

This study showed the prevalence of DIC participants was higher in northern than southern regions. Furthermore, there were differences in the prevalence of DIC among the six regions, which was consistent with previous studies in which the incidence of frailty [20] and prevalence of disability [21] was more common in the north than the south, indicating the importance of implementing the ICOPE protocol, especially in northern China. We found that IC score decreased with increasing age, while longitudinal studies showed that the effect of age on incidence of ADL dependency was modified by IC [22].

Logistic regression showed that age, region, low education, poor marital status, low income, less exercise, less meat intake, insomnia, memory loss, urinary incontinence, constipation, slowness, chronic obstructive pulmonary disease, and osteoarthritis were independent factors influencing DIC in older adults, which shows the that efforts to develop strategies and health policies to identify and manage modifiable variables are urgently needed. A longitudinal study in New Zealand showed that neighborhood environments and IC interact to affect quality of life in older persons [23]. Since the above associated factors independently affected the persons' IC, multidomain and complex interventions provide a better option for prevention and management of DIC. Accordingly, WHO recommends screening using instruments such as the ICOPE screening tool as the first step at the primary care level [3,4,24].

We showed that after adjusting for sociodemographic variables, age-related factors, and chronic conditions, DIC was independently associated with risk of frailty, disability, falls, fractures, and immobility, which is in line with the finding that IC predicted the incidence of loss of ADLs and IADLs [22], and further indicates the need for worldwide implementation of prevention of DIC. The World Report on Ageing and Health proposes the concept of IC as central for healthy ageing [4]. The term frailty refers to health deficits while IC emphasizes positive aspects and perhaps includes the biological state that underpins the frailty phenotype. Thus, IC may be considered as an evolution of frailty by creating a bridge between geroscience and healthy aging [11]. Furthermore, an IC approach has the benefit of tracing trajectories for progression to adverse clinical outcomes such as frailty and disability, as well as the effectiveness of interventions implemented at the individual level. Thus, an IC model is of great importance in the face of unmet needs.

This study has several limitations. First, the relatively small sample size and cross-sectional design limit generalizability of the results. Further longitudinal studies with a larger sample size are urgently needed. Second, vitality was defined by BMI instead of specific nutritional assessment, which may have affected some of the results, since most of the diabetic patients had a higher BMI, which could explain the lower DIC in participants with diabetes in the study. Third, we used a composite total score instead of a weighted score, so further statistical approaches should be conducted to compute IC score.

To the best of our knowledge, this study is the first large nationally representative sample of population-based older people focusing on IC in China. Second, most of the indicators of IC such as locomotion, cognition, and psychological domain were assessed by unified measured performance tests; thus, response or interviewer bias was avoided. Third, standardized protocols as well as regularly and randomly performed internal quality checks of the data were used to avoid the quality disadvantage of the multi-center design.

The current study provided preliminary understanding of the IC situation in China, which suggests ways to successfully put IC into clinical practice to contribute to complex integrated care strategies for older persons with DIC. This study has the potential to enhance our understanding of the importance and promising future of an IC model of disease and treatment effects in this vulnerable population. Consistent with the WHO recommendations, this study indicates screening and interventions should be provided, especially for vulnerable participants. As such, China has already put the theory-based ICOPE approach into clinical practice and launched a pilot multi-center study called "China Aging, Resilience and Intrinsic Capacity Study (CARICS)" to identify and manage DIC to improve well-being among community-living older adults.

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Author contributions: LM and ZT conceived of the research, reviewed related literature, oversaw analysis and was responsible for final drafting of the paper. JC, FS, LZ and YL contributed to conceptualisation, reviews of related literature and drafting of the paper. All authors reviewed and approved the final manuscript submitted for publication.

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Conflict of interest: None declared.

Patient consent for publication: Not required.

Ethical approval: All study participants provided informed consent, and the study design was approved by the ethics review board of Xuanwu Hospital Capital Medical University.

References

1. Prince MJ, Wu F, Guo Y, et al. The burden of disease in older people and implications for health policy and practice. Lancet. 2015;385(9967):549–62.
2. Stoop A, Lette M, Ambugo EA, et al. Improving Person-Centredness in Integrated Care for Older People: Experiences from Thirteen Integrated Care Sites in Europe. Int J Integr Care [Internet] 2020 [cited 2020 Jul 3];20(2):16. Available from: https://www.ijic.org/article/10.5334/ijic.5427/
3. Integrated Care for Older People: Guidelines on Community-Level Interventions to Manage Declines in Intrinsic Capacity [Internet]. 2017 [cited 2020 Jul 3];Available from: https://pubmed.ncbi.nlm.nih.gov/29608259/
4. World Health Organization. Ageing and health [Internet]. 2018 [cited 2018 Jun 23];Available from: http://www.who.int/news-room/fact-sheets/detail/ageing-and-health
5. Ruby Yu, Cecilia Tong JW. Effect of an integrated care model for pre-frail and frail older people living in community. Age Ageing [Internet] 2020 [cited 2020 Jul 3];Available from: https://academic.oup.com/ageing/article-abstract/doi/10.1093/ageing/afaa087/5848668?redirectedFrom=fulltext
6. Framework Implementation of the INSPIRE ICOPE-CARE Program in Collaboration with the World Health Organization (WHO) in the Occitania Region. J Frailty Aging 2020;1–7.
7. Alexia Charles, Fanny Buckinx, Médéa Locquet, Jean-Yves Reginster, Jean Petermans, Bastien Gruslin OB. Prediction of Adverse Outcomes in Nursing Home Residents According to Intrinsic Capacity Proposed by the World Health Organization | The Journals of Gerontology: Series A | Oxford Academic. J Gerontol A Biol Sci Med Sci [Internet] 2019 [cited 2020 Jun 15];Available from:

https://academic.oup.com/biomedgerontology/advance-article-abstract/doi/10.1093/gerona/glz218/5575908?redirectedFrom=fulltext

8. Cesari M, Araujo de Carvalho I, Amuthavalli Thiyagarajan J, et al. Evidence for the Domains Supporting the Construct of Intrinsic Capacity. Journals Gerontol Ser A [Internet] 2018 [cited 2018 Jun 22];Available from: https://academic.oup.com/biomedgerontology/advance-article/doi/10.1093/gerona/gly011/4834876

9. Nestola T, Orlandini L, Beard JR, Cesari M. Covid-19 and Intrinsic Capacity. J Nutr Heal Aging [Internet] 2020 [cited 2020 Jul 3];1–4. Available from: https://doi.org/10.15585/mmwr.mm6912e2.

10. Zhou M, Wang H, Zeng X, et al. Mortality, morbidity, and risk factors in China and its provinces, 1990–2017: a systematic analysis for the Global Burden of Disease Study 2017. Lancet [Internet] 2019 [cited 2020 Jul 3];394(10204):1145–58. Available from: https://pubmed.ncbi.nlm.nih.gov/31248666/

11. Barreto P de S, Guyonnet S, Ader I, et al. The Inspire Research Initiative: A Program for Geroscience and Healthy Aging Research going from Animal Models to Humans and the Healthcare System. J Frailty Aging [Internet] 2020 [cited 2020 Jun 25];1–8. Available from: https://link.springer.com/article/10.14283/jfa.2020.18

12. WHO | Meeting of the Clinical Consortium on *Healthy Ageing*. WHO 2018;

13. Guralnik JM, Simonsick EM, Ferrucci L, et al. A Short Physical Performance Battery Assessing Lower Extremity Function: Association With Self-Reported Disability and Prediction of Mortality and Nursing Home Admission. J Gerontol [Internet] 1994 [cited 2018 Aug 18];49(2):M85–94. Available from: https://academic.oup.com/geronj/article-

347 lookup/doi/10.1093/geronj/49.2.M85
348 14. Li H, Jia J, Yang Z. Mini-Mental State Examination in Elderly Chinese: A Population-
349 Based Normative Study. J Alzheimers Dis [Internet] 2016 [cited 2018 Nov 16];53(2):487–
350 96. Available from:
351 http://www.medra.org/servlet/aliasResolver?alias=iospress&doi=10.3233/JAD-160119
352 15. Chan ACM. Clinical validation of the Geriatric Depression Scale (GDS): Chinese version.
353 J Aging Health 1996;8(2):238–53.
354 16. Ma L, Zhang L, Tang Z, et al. Use of the frailty index in evaluating the prognosis of older
355 people in Beijing: A cohort study with an 8-year follow-up. Arch Gerontol Geriatr
356 2016;64(3):172–7.
357 17. Ma L, Tang Z, Zhang L, Sun F, Li Y, Chan P. Prevalence of Frailty and Associated Factors
358 in the Community-Dwelling Population of China. J Am Geriatr Soc [Internet] 2018 [cited
359 2018 Apr 15];66(3):559–64. Available from:
360 http://www.ncbi.nlm.nih.gov/pubmed/29168883
361 18. Kasteridis P, Mason A, Street A. Evaluating integrated care for people with complex needs.
362 J Health Serv Res Policy [Internet] 2020 [cited 2020 Jul 3];135581962093187. Available
363 from: http://journals.sagepub.com/doi/10.1177/1355819620931872
364 19. Takeda C, Guyonnet S, Sumi Y, Vellas B, Araujo de Carvalho I. Integrated Care for Older
365 People and the Implementation in the INSPIRE Care Cohort [Internet]. J. Prev. Alzheimer's
366 Dis. 2020 [cited 2020 Jul 3];7(2):70–4. Available from:
367 https://pubmed.ncbi.nlm.nih.gov/32236394/
368 20. Xu W, Li YX, Wu C. Incidence of frailty among community-dwelling older adults: A
369 nationally representative profile in China. BMC Geriatr 2019;19(1).

21. Ma L, Li Z, Tang Z, et al. Prevalence and socio-demographic characteristics of disability in older adults in China: Findings from China Comprehensive Geriatric Assessment Study. Arch Gerontol Geriatr [Internet] 2017;73:199–203. Available from: http://linkinghub.elsevier.com/retrieve/pii/S0167494316302813

22. Whiley L, Sen A, Heaton J, et al. Evidence of altered phosphatidylcholine metabolism in Alzheimer's disease. Neurobiol Aging [Internet] 2014 [cited 2018 Jun 28];35(2):271–8. Available from: http://www.ncbi.nlm.nih.gov/pubmed/24041970

23. Stephens C, Allen J, Keating N, Szabó Á, Alpass F. Neighborhood environments and intrinsic capacity interact to affect the health-related quality of life of older people in New Zealand. Maturitas 2020;139:1–5.

24. WHO | Integrated care for older people (ICOPE): guidance for person-centred assessment and pathways in primary care. WHO [Internet] 2020 [cited 2020 Jul 3];Available from: http://www.who.int/ageing/publications/icope-handbook/en/

Captions for Tables and Figures

Table 1. Prevalence of declines in intrinsic capacity in older adults by sex, area, and age

Table 2. Stepwise forward logistic regression for associated factors with decline in intrinsic capacity

Table 3. Multivariate logistic regression analysis (forward method) for DIC associated with risk of adverse clinical outcomes

Figure 1. The intrinsic capacity in different region, age, and sex groups. (A) The comparison of the weighted prevalence of DIC among the six regions of China (Chi-square test, $p < 0.01$). (B) The comparison of the weighted prevalence of DIC between North China and South China (Chi-square test, $p < 0.01$). (C) The comparison of the intrinsic capacity score among different age groups (One-way ANOVA, $p < 0.01$). (D) The comparison of the intrinsic capacity score between males and females (t-test, $p < 0.01$). Abbreviations: ANOVA, analysis of variance; DIC, decline in intrinsic capacity; IC, intrinsic capacity.

Figure 2. The weighted prevalence of declines in intrinsic capacity in community-dwelling older adults living in the urban area (A1), rural area (A2), male (B1), female (B2), <75 ys (C1) and ≥75 ys (C2). All were analyzed using the Chi-square test, $p < 0.01$.

Table S1. Prevalence of each declined domain in older adults by sex, area, and age

Table S2. The effect of social factors, lifestyle and chronic conditions on DIC

Table 1. Prevalence of declines in intrinsic capacity in older adults by sex, area, and age

	Total	DIC	Weighted	Number of Declined Domains					
		n (%)	(%)	0	1	2	3	4	5
All sample	5823	2506(43.0)	39.9	3317(57.0)	1512(26.0)	636(10.9)	271(4.7)	75(1.3)	12(0.2)
Sex*									
Male	2518	1030(40.9)	36.7	1488(59.1)	652(25.9)	266(10.6)	81(3.2)	27(1.1)	4(0.2)
Female	3305	1476(44.7)	43.0	1829(55.3)	860(26.0)	370(11.3)	190(5.7)	48(1.5)	8(0.2)
Area*									
Urban	3494	1243(35.6)	32.7	2251(64.4)	868(24.8)	275(7.9)	81(2.3)	18(0.5)	1(0)
Rural	2329	1263(54.2)	50.1	1066(45.8)	644(27.7)	361(15.5)	190(8.2)	57(2.4)	11(0.5)
Age (ys)*									
60-64	1471	428(29.1)	28.6	1043(70.9)	309(21.0)	85(5.8)	30(2.0)	4(0.3)	0(0)
65-69	1179	414(35.1)	34.9	765(64.9)	271(23.0)	100(8.5)	34(2.9)	9(0.8)	0(0)
70-74	1165	515(44.2)	43.6	650(55.8)	337(28.9)	116(10.0)	46(3.9)	16(1.4)	0(0)
75-79	1119	562(50.2)	50.3	557(49.8)	325(29.0)	150(13.4)	62(5.5)	20(1.8)	5(0.4)
≥80	889	587(66.0)	66.6	302(34.0)	270(30.4)	185(20.8)	99(11.1)	26(2.9)	7(0.8)

Note: *$P<0.05$; DIC, decline in intrinsic capacity

Table 2. Stepwise forward logistic regression for associated factors with decline in intrinsic capacity

Factors	B	S.E.	Wald	df	Sig	OR	95% CI
Older age	0.647	0.093	48.426	1	<0.001	1.910	1.592-2.291
North region	0.466	0.090	26.993	1	<0.001	1.594	1.337-1.901
Low education	0.890	0.143	38.657	1	<0.001	2.435	1.839-3.223
Poor marital status	0.395	0.105	14.157	1	<0.001	1.485	1.209-1.825
Low income	0.388	0.094	16.974	1	<0.001	1.474	1.226-1.773
Less exercise	0.293	0.099	8.690	1	0.003	1.340	1.103-1.628
Less meat intake	0.260	0.089	8.532	1	0.003	1.296	1.089-1.543
Insomnia	0.453	0.095	22.735	1	<0.001	1.572	1.305-1.894
Urinary incontinence	0.680	0.209	10.605	1	0.001	1.974	1.311-2.973
Constipation	0.408	0.126	10.605	1	0.001	1.504	1.175-1.924
Memory decline	0.714	0.083	73.427	1	<0.001	2.043	1.735-2.405
Slowness	0.407	0.102	15.908	1	<0.001	1.502	1.230-1.835
COPD	0.853	0.215	15.758	1	<0.001	2.347	1.540-3.576
Osteoarthritis	0.534	0.095	31.785	1	<0.001	1.706	1.417-2.054
Constant	-2.028	0.104	379.542	1	<0.001	0.132	

Note: COPD, chronic obstructive pulmonary disease.

The variables not in the equation were sex, living areas, alcohol consumption, coronary heart disease, diabetes, stroke and kidney disease.

Table 3. Multivariate logistic regression analysis (forward method) for DIC associated with risk of adverse clinical outcomes

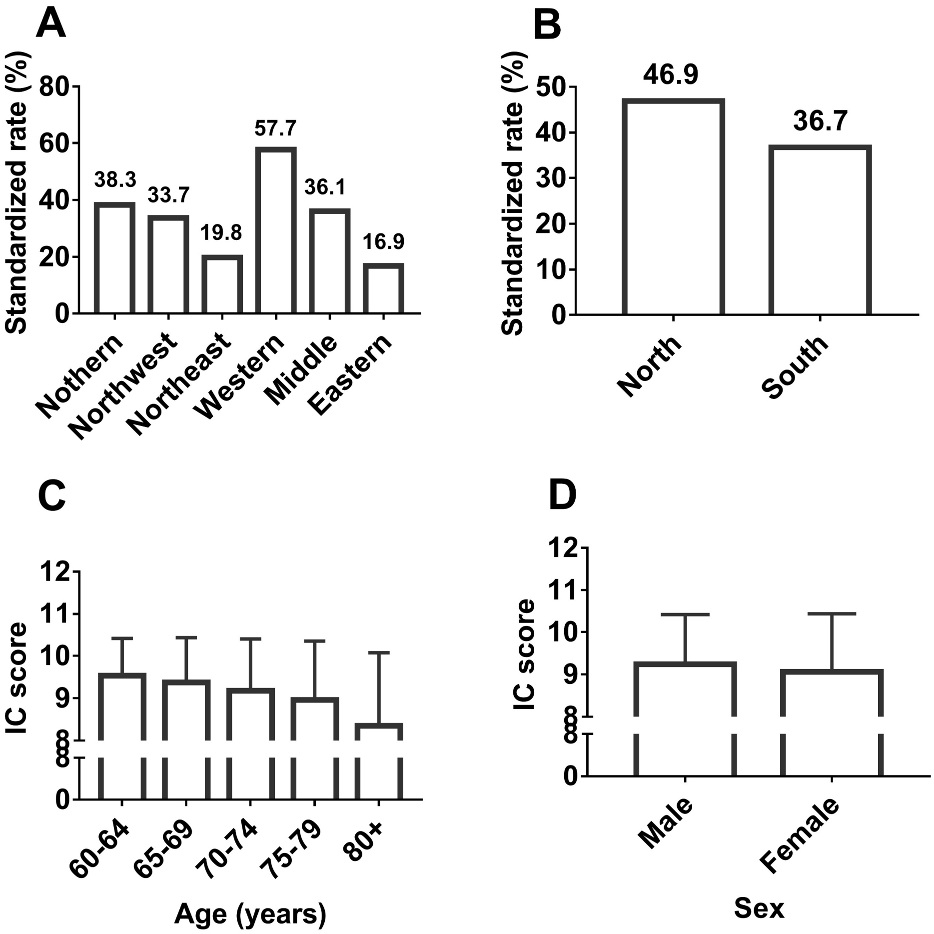
	Model 1			Model 2		
	OR	95% CI	P value	OR	95% CI	P value
Frailty	19.625	14.044-27.423	<0.001	19.021	12.882-28.084	<0.001
Disability	12.628	8.750-18.225	<0.001	8.661	5.925-12.660	<0.001
Fall	3.671	2.699-4.993	<0.001	3.053	2.232-4.177	<0.001
Fracture	1.965	1.448-2.666	<0.001	1.656	1.195-2.295	0.003
Immobility	6.098	4.903-7.584	<0.001	4.403	3.500-5.538	<0.001

Reference: Non-DIC.

Model 1: Adjusted by age, sex, area and district.

Model 2: Fully adjusted Cox proportional hazard analysis. Adjusted by age, sex, area, district, marriage, education, waist hip ratio, smoking, alcohol consuming, exercise, income, and chronic diseases.

Note: DIC, decline in intrinsic capacity.


A
Standardized rate (%)
80
60
40
20
0
38.3
33.7
19.8
57.7
36.1
16.9
Nothern
Northwest
Northeast
Western
Middle
Eastern
B
Standardized rate (%)
50
40
30
20
10
0
46.9
36.7
North
South
C
IC score
12
11
10
9
8
8
0
60-64
65-69
70-74
75-79
80+
Age (years)
D
IC score
12
11
10
9
8
8
0
Male
Female
Sex

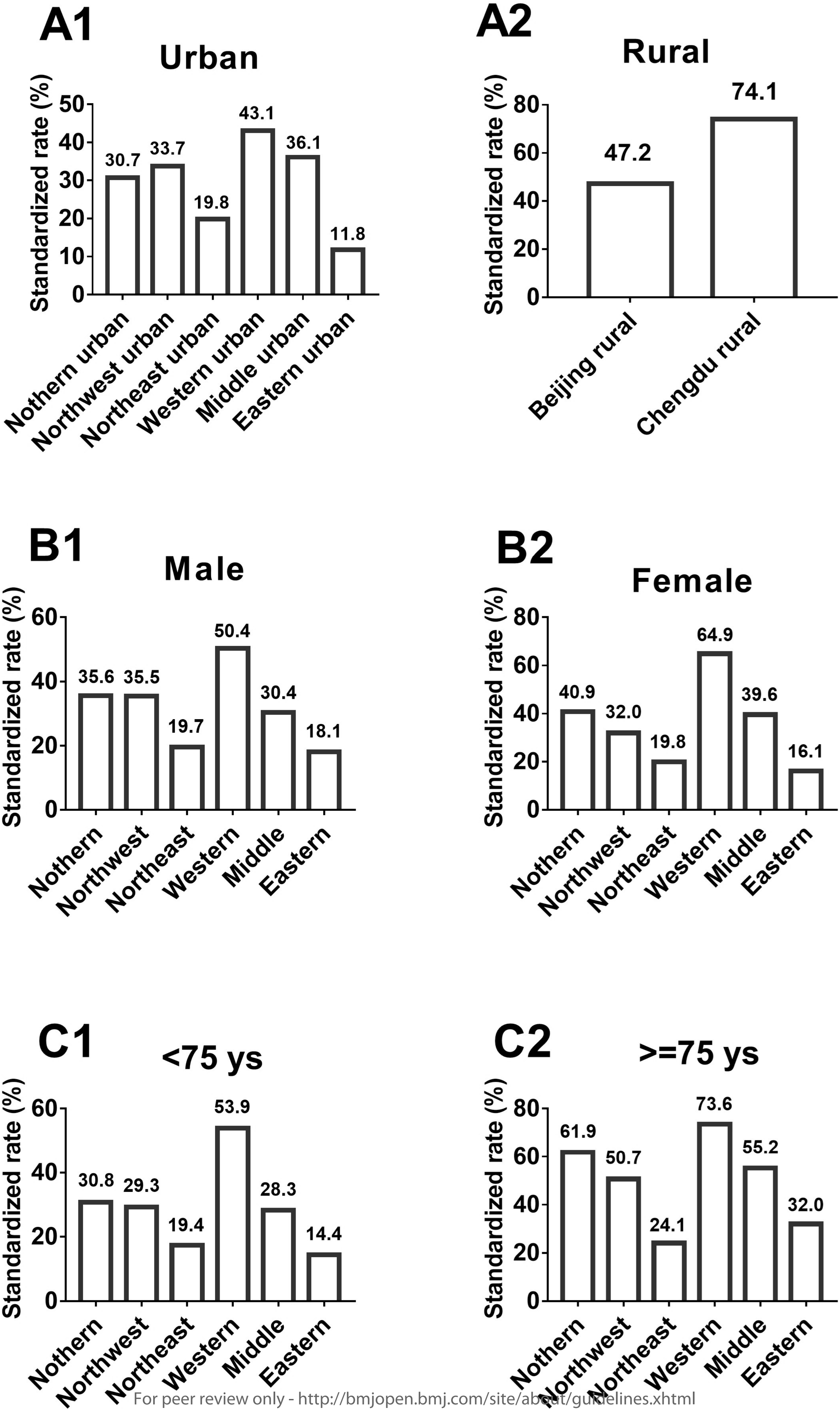

A1
Urban
Standardized rate (%)
0
10
20
30
40
50
30.7
33.7
19.8
43.1
36.1
11.8
Nothern urban
Northwest urban
Northeast urban
Western urban
Middle urban
Eastern urban
A2
Rural
Standardized rate (%)
0
20
40
60
80
47.2
74.1
Beijing rural
Chengdu rural
B1
Male
Standardized rate (%)
0
20
40
60
35.6
35.5
19.7
50.4
30.4
18.1
Nothern
Northwest
Northeast
Western
Middle
Eastern
B2
Female
Standardized rate (%)
0
20
40
60
80
40.9
32.0
19.8
64.9
39.6
16.1
Nothern
Northwest
Northeast
Western
Middle
Eastern
C1
<75 ys
Standardized rate (%)
0
20
40
60
30.8
29.3
19.4
53.9
28.3
14.4
Nothern
Northwest
Northeast
Western
Middle
Eastern
C2
>=75 ys
Standardized rate (%)
0
20
40
60
80
61.9
50.7
24.1
73.6
55.2
32.0
Nothern
Northwest
Northeast
Western
Middle
Eastern

Table S1. Prevalence of each declined domain in older adults by sex, area, and age

	Total	Locomotion	Cognition	Vitality	Sensory	Psychological
All sample	5823	1039(17.8)	646(11.1)	735(12.6)	824(14.2)	713(12.2)
Sex						
Male	2518	372(14.8)*	227(9.0)*	338(13.4)	371(14.7)	247(9.8)*
	3305	667(20.2)	419(12.7)	397(12.0)	453(55.0)	466(14.1)
Female						
Area	3494	481(14.1)*	168(4.8)*	344(9.8)*	417(11.9)*	318(9.1)*
Urban	2329	548(23.5)	478(20.5)	391(16.8)	407(17.5)	395(17.0)
Rural						
Age (ys)	1471	106(7.2)*	72(4.9)*	116(7.9)*	114(7.7)*	177(12.0)
60-64	1179	129(10.9)	90(7.6)	123(10.4)	131(11.1)	136(11.5)
65-69	1165	197(16.9)	123(10.6)	141(12.1)	166(14.2)	144(12.4)
70-74	1119	256(22.9)	158(14.1)	154(13.8)	210(18.8)	138(12.3)
75-79	889	351(39.5)	203(22.8)	201(22.6)	203(22.8)	118(13.3)
≥80						

Note: Data were expressed as n (%); *P<0.05

Table S2. The effect of social factors, lifestyle and chronic conditions on DIC

	Total	DIC, n (%)	Weighted (%)	χ^2	*P*
Social factors					
Education	5823				
Illiterate	1047	724(69.1)	67.7	355.086	<0.001
Not illiterate	4776	1782(37.3)	34.9		
Monthly income	5665				
<2000 Yuan	2658	1408(53.0)	49.6	227.561	<0.001
≥2000 Yuan	3007	996(33.1)	30.0		
Marital status	5818				
Married	4493	1738(38.7)	35.8	151.541	<0.001
Windowed	1325	765(57.7)	56.8		
Lifestyle					
Exercise	5808				
Yes	4594	1779(38.7)	36.1	168.600	<0.001
No	1214	722(59.5)	55.0		
Meat intake	5823				
Usually	3369	1322(39.2)	35.9	46.925	<0.001
Less	2454	1184(48.2)	45.8		
Alcohol consumption	5823				
Yes	4503	600(45.5)	40.7	4.081	0.043
No	5823	1906(42.3)	39.6		
Smoking	1320				
Yes	1658	722(43.5)	38.7	0.241	0.623
No	4165	1784(42.8)	40.5		
Chronic disease					
Hypertension	5823				
Yes	2688	1127(41.9)	39.0	2.505	0.113
No	3135	1379(44.0)	40.7		
CHD	5823				
Yes	1168	559(47.9)	46.0	13.823	<0.001
No	4655	1947(41.8)	38.5		
Diabetes	5823				
Yes	862	344(39.9)	36.6	4.041	0.044
No	4961	2162(43.6)	40.5		
Stroke	5823				
Yes	579	327(56.5)	53.3	47.323	<0.001
No	5244	2179(41.6)	38.5		
Kidney disease	5823				
Yes	259	136(52.5)	50.6	9.907	0.002
No	5564	2370(42.6)	39.4		
COPD	5823				
Yes	205	140(68.3)	66.7	55.288	<0.001
No	5618	2366(42.1)	39.0		
Liver disease	5823				
Yes	253	107(42.3)	40.0	0.062	0.803

No	5570	2399(43.1)	38.7		
Osteoarthritis	5823				
Yes	1597	855(53.5)	51.2	98.993	<0.001
No	4226	1651(39.1)	35.9		
Cancer	5823				
Yes	148	63(42.6)	39.7	0.013	0.909
No	5675	2443(43.0)	39.9		
Geriatric syndrome					
Insomnia	5823				
Yes	1427	830(58.2)	56.5	176.113	<0.001
No	4396	1676(38.1)	34.9		
Memory decline	5823				
Yes	2629	1450(55.2)	52.6	286.447	<0.001
No	3194	1056(33.1)	30.2		
Urinary incontinence	5823				
Yes	257	198(77.0)	76.3	126.654	<0.001
No	5566	2308(41.5)	38.5		
Constipation	5823				
Yes	738	430(59.1)	56.6	87.043	<0.001
No	5095	2076(40.8)	37.8		
Slowness	3306				
Yes	688	367(53.3)	50.2	54.008	<0.001
No	2618	991(37.9)	35.1		

Abbreviations: DIC, decline in intrinsic capacity; ADL, activities of daily living; IADL, instrumental activities of daily living; CHD, coronary heart disease; COPD, chronic obstructive pulmonary disease.

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Cross-sectional Study Examining the Status of Intrinsic Capacity Decline in Community-dwelling Older Adults in China: Prevalence, Associated Factors, and Implications for Clinical Care

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Abstract

Objectives: Intrinsic capacity (IC) was proposed by the World Health Organization as a new concept for capturing an individual's functional capacities across their lifetime. We aimed to investigate the prevalence and factors associated with IC decline and examine associations between IC and adverse outcomes among community-dwelling older adults in China.

Design: Cross-sectional study.

Setting: Community, China.

Participants: Data were derived from the China Comprehensive Geriatric Assessment Study, a population-based nationally representative sample. IC comprises of five domains: locomotion, cognition, vitality, sensory, and psychology. Participants were deemed to have IC decline if they showed a decline in any of the five domains. Sociodemographic characteristics, chronic diseases, geriatric syndromes, and adverse outcomes were also examined.

Results: Of the 5,823 community-dwelling participants aged 60–98 years, 2,506 had IC decline (weighted 39.9%): 57.7% in Western, 38.3% in Northern, 33.7% in Northwest, 36.1% in Middle, 16.9% in Eastern, and 19.8% in Northeast China. The number of participants with decline in the locomotion, cognition, vitality, sensory, and psychological domains were 1,039 (17.8%), 646 (11.1%), 735 (12.6%), 824 (14.2%), and 713 (12.2%), respectively. Age, northern residence, low education, being unmarried, low income, less exercise, less meat intake, insomnia, memory loss, urinary incontinence, constipation, slowness, chronic obstructive pulmonary disease, and osteoarthritis were related to IC decline. After adjusting for age, sex, area, district, marriage, education, waist-hip ratio, smoking, alcohol consumption, exercise, income, and chronic diseases, IC decline was independently associated with risk of frailty, disability, falls, fractures, and immobility.

Conclusion: The prevalence of IC decline in China is high. IC decline was significantly associated with adverse outcomes, after adjustment for related variables. Efforts promoting IC to delay functional dependence should focus on modifiable factors, including negative social factors, poor lifestyle, chronic diseases, and geriatric syndromes.

Keywords: Intrinsic capacity; Older Adults; Prevalence; Frailty; Disability; Aging

Article summary

Strengths and limitations of this study

- This study is the first nationally representative large sample of population-based older people focusing on intrinsic capacity (IC) in China.
- Most of the domains of IC were assessed using unified measured performance tests.
- This study provided a preliminary understanding of the IC status in China, which suggests ways to successfully put IC into clinical practice contributing to the development of integrated care strategies for older persons with IC decline.
- The cross-sectional design of this study limits causality.
- We used a composite total score instead of a weighted score, so further statistical approaches should be conducted to compute the IC score.

Introduction

The increasing global burden of disability associated with the rapid aging of the population has challenged the health care system [1]. To cope with the demands of increasing numbers of frail community-dwelling older persons with multiple complex needs, the implementation of integrated care healthcare model is necessary [2]. The World Health Organization (WHO) has proposed an innovative approach known as the Integrated Care for Older People (ICOPE). This approach centers around the concept of raising intrinsic capacity (IC) and functional ability to achieve healthy aging. Recommendations for the development of comprehensive approaches for the maintenance of IC and functional ability, including quality integrated care, have also been made. Moreover, the importance of integrated care in improving quality of life in the older population has been recently highlighted [3,4], including reducing frailty in community-dwelling older people [5].

According to the WHO ICOPE guidelines, IC comprises an individual's physical and mental capacities at any given time [4]. This novel concept of IC has shifted the notion of "healthy aging" from a disease-centered to a function-centered paradigm, creating opportunities for earlier intervention to delay disability and care-dependency. The WHO proposes five components for the assessment of IC, namely locomotion, cognition, vitality, sensory, and psychology [3,4] Since each component is associated with adverse health events in older people recent studies have focused on these components in combination [6-16]. As so, our in-depth understanding of the trajectory of IC decline may enable us to design ŧ innovative methods for the promotion of healthy aging [17], even during a catastrophic event such as the coronavirus disease [18]. Although the concept of IC has been used in several studies worldwide [12,15,16], no studies have been conducted in China. Therefore, to facilitate the evaluation of integrated care approaches for older patients, this study focuses on (1) the prevalence of IC and the factors associated with IC decline and (2) the associations between IC and geriatric conditions such as frailty, disability, falls, fractures, and immobility in a population-based nationally representative sample of community-dwelling older people in China.

Methods

Participants

Data were obtained from the China Comprehensive Geriatric Assessment Study (CCGAS, 2011–2012), a population-based face-to-face survey of adults aged 60 years or over from rural and urban areas of China. Further details regarding the CCGAS have been reported [19–21]. For the CCGAS, seven cities (Beijing, Xi'an, Harbin, Chengdu, Chongqing, Changsha, and Shanghai) from seven different provinces were chosen based on well-established cluster, stratification, and random selection statistical sampling techniques. These cities represent China's six main regions (northern, middle, eastern, northwestern, southwestern, and northeastern). A total of 6,867 older adults were included in the CCGAS. A total of 5,823 participants with complete IC data were included in our current study and 1,040 were excluded because of missing data. A comparison of included and excluded participants' characteristics is shown in supplementary table S1. All participants provided informed consent and the study design was approved by the ethics review board of Xuanwu Hospital Capital Medical University.

Demographics, lifestyles, and diseases

Data included sociodemographic characteristics, anthropometric measurements, health status, personal habits, and mental health. Medical conditions including a self-reported history of chronic disease diagnosed by a doctor and geriatric syndromes were recorded. Low income was defined as monthly income < 2,000 Yuan, no exercise was defined as exercising for < 3 hours per week, and meat intake was measured by asking participants if they had meat diet ≥ 2 times per week.

IC construct

IC was assessed using the five components recommended by the WHO [3,22] as described below:

1)Locomotion: It was assessed by a short physical performance battery (SPPB) which comprised of various tests [23]. The balance test comprised three parts: standing unsupported for 10 seconds with feet together; a semi-tandem stand; and a full-tandem stand. Participants who were unable to complete each part received a score of 1; otherwise, they were scored 0. The chair-stand test was performed with the participant seated in a chair, with feet flat on the floor and arms held flat against their sides with elbows at 90°. Participants who were able to stand up five times from the chair received a score of 1, those who partially completed this task scored 0.5, and those who could not stand up at all scored 0. A 20-meter walking test was also conducted: those who were able to walk 20 meters scored 1, those who walked less than 20 meters scored 0.5, and those could not walk at all scored 0. The total score range for the SPPB was 0–5.

2) Cognition: It was assessed by the Mini-Mental State Examination (MMSE), with a total score range of 0–30 [24]. The thresholds for participants who were illiterate or who were educated up to elementary school, middle school, and high school or above were 17, 20, and 24, respectively. Participants who scored below the threshold value for their education group were regarded as

mildly cognitively impaired (score of 1), and those who scored below 15 were regarded as moderately to severely cognitively impaired (score of 0).

3) Vitality: It was assessed by body mass index (BMI), which was calculated by dividing weight in kilograms by height in meters squared. BMI cutoffs were based on the Malnutrition Universal Screening Tool (MUST) [25]. A BMI above 20kg/m^2 received a score of 2, 18.5–20 kg/m^2 was scored 1, and $\leqslant$18.5 kg/m^2 was scored 0.

4) Sensory: It was assessed by a self-reported visual and hearing impairment. Vision capacity was considered intact when the participant did not report "eyesight problems" that interfered with their activities and were not identified by the interviewer as being functionally blind. Hearing capacity was considered intact when the participant did not report "hearing problems or deafness" that interfered with their activities, and was not identified by the interviewer as being profoundly deaf. Participants with both visual and hearing impairments received a score of 0, those with either vision or hearing impairment received a score of 1, and those with intact vision and hearing capacities scored 2.

5) Psychology: It was measured by the 30-item Geriatric Depression Scale (GDS-30) with a total score range of 0–30 [26]. Scores from 0 to 10 represent an intact psychological (score of 2), scores from 11 to 20 represent mild depression (score of 1), and scores from 21 to 30 represent moderate to severe depression (score of 0).

For each of the five components, participants were scored either 0 (representing severe decline), 1 (representing mild decline), or 2 (representing intact IC). The total score of IC ranged from 0–10; higher scores indicated better performance.

Adverse outcomes

Physical function was assessed as activities of daily living (ADL) and instrumental activities of daily living (IADL). The list of activities consisted of 14 items (eating, grooming, dressing, transferring in and out of bed, bathing, walking inside the house, using the toilet, cooking, managing finances, driving or using public transportation, shopping, walking 250 meters, cutting toenails, and climbing stairs) and a participant's performance for each item was classified as independent, partially dependent, or completely dependent. Those with one or more impaired ADL or IADL functions were defined as disabled. Frailty was assessed using a frailty index, derived from the standard Comprehensive Geriatric Assessment (CGA) instrument (FI was primarily based on six domains: demographic characteristics, physical health, physical functions, living behavior and social functions, mental health, and cognitive functions) [27]. Frailty was defined by a score of ≥ 0.25 [28]. Fractures were defined as a self-reported history of spontaneous fractures occurring in the past two years and falls were defined as those that occurred twice in the past year. Immobility was self-reported.

Bias

A door-to-door survey was conducted by formally trained interviewers using the CGA to ensure homogeneous reporting. Quality control procedures included regular field supervision and daily review of collected data. EpiData was used to establish the database and input and automatically verify the data.

Study size

The sample size was estimated to measure the prevalence of IC decline in older adults. Assuming an IC decline prevalence of approximately 30% with a precision margin of 2%, the estimated sample size was 2,016. Assuming a 15% refusal or absence, we estimated a sample size adjusted to 2,372.

Statistical methods

All statistical analyses were performed using SPSS (Chicago, IL, USA, version 11.0). Count data were expressed as percentages. Chi-square tests, t-tests, and one-way analysis of variance were performed. Those with a P-value less than 0.05 were included in the multivariable model. The weighted percentages were determined using the national standard population composition ratio based on the Sixth National Census (2010). A forward stepwise logistic regression was conducted to explore the association between the included factors and IC decline or between IC decline and adverse outcomes. A P-value of < 0.05 was considered statistically significant.

Patient and public involvement

Patients and the public were not involved in the planning and design of this study.

Results

Of the total 5,823 older adults, the average IC score was 9.14±1.304, the median (IQR) score was 10(1), and 2,506 had IC decline, yielding a prevalence of 43.0% (weighted 39.9%). A total of 3,317 (57.0%), 1,512 (26.0%), 636 (10.9%), 271 (4.7%), 75(1.3%), and 12 (0.2%) participants showed decline in 0, 1, 2, 3, 4, and 5 domains, respectively. The prevalence of IC decline was higher in women than in men (43.0% vs. 36.7%, P = 0.004). The prevalence of IC decline among older adults in rural areas was higher, by 1.36 times than in urban areas (P < 0.001). The prevalence of IC decline increased with age, with the highest decline observed in individuals aged ≥ 80 years (66.6%) and the lowest in those aged 60–64 years (28.6%; P < 0.001; Table 1). The number of participants with decline in the locomotion, cognition, vitality, sensory, and psychological domains was 1,039 (17.8%), 646 (11.1%), 735 (12.6%), 824 (14.2%), and 713 (12.2%), respectively. For each domain, the prevalence was higher in females and those in rural areas, and increased with age, although there was no association between psychological domain and age (Table S2).

We observed differences in the prevalence of IC decline among the six regions: 57.7% in Western China, 38.3% in Northern China, 33.7% in Northwest China, 36.1% in Middle China, 16.9% in Eastern China, and 19.8% in Northeast China (Figure 1A). The prevalence of IC decline was higher in northern than southern regions (46.9% vs. 36.7%, P < 0.001; Figure 1B). The IC score decreased in older age groups (9.53±0.88 for the 60–64 years age group, 49.37±1.06 for the 65–69 years age group, 9.18±1.22 for the 70–74 years age group, 8.96±1.39 for the 75–79 years age group, 8.35±1.73 for the 80 years and over age group (P < 0.001; Figure 1C) and was higher in men than in women (9.24±1.19 vs. 9.06±1.38, P < 0.001; Figure 1D).

Next, we observed the prevalence of IC decline in different regions according to geography, sex, and age. In urban areas, the weighted prevalence of IC decline differed across the six regions, with

207 western urban regions showing the highest rates and eastern urban regions showing the lowest
208 rates: 43.1% in Western China, 36.1% in Middle China, 33.7% in Northwest China, 30.7% in
209 Northern China, 19.8% in Northeast China, and 11.8% in Eastern China. Older adults living in
210 rural areas included those residing in Beijing and Chengdu, and the prevalence of IC decline was
211 higher in Chengdu than in Beijing (74.1% vs. 47.2%, P < 0.001). The prevalence of IC decline
212 among the six regions was different when analyzed according to sex and age, with western regions
213 showing the highest rate in both genders, in those aged < 75 years, and those aged ≥ 75 years; the
214 eastern regions showing the lowest rates in both genders and those aged < 75 years; and east-north
215 regions showing the lowest rates in those aged ≥ 75 years (P < 0.001; Figure 2).

216 When comparing socio-psychological factors, chronic diseases, and geriatric syndromes, a high
217 prevalence of IC decline was observed in illiterate participants (P < 0.001), those with low income
218 (P < 0.001), who were unmarried (P < 0.001), did not exercise (P < 0.001), consumed less meat
219 diet (P < 0.001), and consumed alcohol (P = 0.043). Those with chronic diseases such as coronary
220 heart disease (P < 0.001), stroke (P < 0.001), kidney disease (P = 0.002), chronic obstructive
221 pulmonary disease (P < 0.001), and osteoarthritis (P < 0.001), as well as geriatric syndromes (P <
222 0.001) had a higher prevalence of IC decline, while there was a lower prevalence in older adults
223 without diabetes (P = 0.044; Table S3). The prevalence of IC decline among individuals with ≥5
224 chronic diseases was approximately two times higher than among individuals without chronic
225 disease (62.5% vs. 30.9%, P < 0.001).

226 With IC decline as the dependent variable and the above factors as independent variables, forward
227 logistic analysis showed that older age (P < 0.001), northern region (P < 0.001), low education (P
228 < 0.001), being unmarried (P < 0.001), low income (P < 0.001), less exercise (P = 0.003), less meat

intake (P = 0.003), insomnia (P < 0.001), memory decline (P < 0.001), urinary incontinence (P = 0.001), constipation (P = 0.001), slowness (P < 0.001), chronic obstructive pulmonary disease (P < 0.001), and osteoarthritis (P < 0.001) were independently associated with IC decline in older adults (Table 2).

We further compared the frequency of adverse clinical outcomes between non-IC decline and IC decline groups. Participants with IC decline were much more likely to be frail (22.2% vs. 1.2%, P < 0.001), disabled (15.0% vs. 1.0%, P < 0.001), and have falls (7.9% vs. 1.8%, P < 0.001), fractures (4.7% vs. 2.2%, P < 0.001), and be immobile (20.4% vs. 3.4%, P < 0.001). Logistic regression showed that, after adjustment for age, sex, area, district, marriage, education, waist-hip ratio, smoking, alcohol consumption, exercise, income, and chronic diseases, IC decline was independently associated with risks of frailty (adjusted OR = 19.021, P < 0.001), disability (adjusted OR = 8.611, P < 0.001), falls (adjusted OR = 3.053, P < 0.001), fractures (adjusted OR = 1.656, P = 0.003), and immobility (adjusted OR = 4.403, P < 0.001; Table 3).

Discussion

In this nationally representative population based cross-sectional study, the weighted prevalence of IC decline was as high as 39.9% in community-living Chinese older adults aged ≥ 60 years, which is approximately five times higher than the prevalence of frailty in the same population [29]. The frequency of participants with a decline in IC domains varied from 11.1% (cognition) to 17.8% (locomotion). These findings highlight the need to focus on functional trajectories rather than the traditional disease-centered approach. However, well-established concepts such as frailty (which is related as an increasingly problematic consequence of population aging), threaten the sustainability of healthcare resources as most people seek healthcare attention only when they are at their worst health state. Furthermore, studies have reported that current integrated care models have not significantly reduced healthcare utilization nor consistently reduced mortality [30]. Thus, healthcare model such as ICOPE with IC as its core of may support the modernization of current healthcare systems and at the same time be more personalized. Results of ongoing ambitious INSPIRE study conducted in Europe which is based on the ICOPE model [31] will have strong implications for the effectiveness of the IC approach.

Our study demonstrated that the prevalence of IC decline among participants was higher in northern than southern regions of China. Furthermore, there were differences in the prevalence of IC decline among the six regions, which was consistent with previous studies in which the incidence of frailty [32] and prevalence of disability [20] was more common in the north than the south, indicating the importance of implementing the ICOPE protocol, especially in northern China. We found that the IC score decreased in older age groups, while longitudinal studies showed that the effect of age on the incidence of ADL dependency was modified by IC [15].

Logistic regression showed that factors such as age, region, low education, unmarried status, low income, less exercise, less meat intake, insomnia, memory loss, urinary incontinence, constipation, slowness, chronic obstructive pulmonary disease, and osteoarthritis were independently associated with IC decline in older adults, demonstrating that efforts to develop strategies and health policies to identify and manage modifiable variables are urgently required. A longitudinal study in New Zealand showed that neighborhood environments and IC interact to affect the quality of life in older persons [33]. Since the above factors are independently associated with an individual's IC, multidomain and complex interventions provide a better option for the prevention and management of IC decline. Accordingly, the WHO recommends screening using instruments such as the ICOPE screening tool as the first step at the primary care level followed by a suitable care plan[3,4,34].

We demonstrated that after adjusting for sociodemographic variables, age-related factors, and chronic conditions, IC decline was independently associated with risk of frailty, disability, falls, fractures, and immobility, which is in line with the finding that IC predicted the incidence of loss of ADLs and IADLs [15], and further indicates that evaluations of IC implementation may be extremely important to avoid further deterioration (which could be a severe frailty state).The term frailty refers to health deficits of an aging individual while IC emphasizes on positive health aspects, therefore, IC may be considered as an evolution of frailty in certain respects [35]. It is also noteworthy that the World Report on Ageing and Health proposes the concept of IC as central for healthy aging [4], thus, the concept of IC could serve as a bridge between geroscience and healthy aging [14]. Furthermore, an IC approach has the benefit of tracing trajectories for progression to adverse clinical outcomes such as frailty and disability, and testing the effectiveness of interventions implemented at the individual level. Thus, an IC model is of great significance for facing the unmet needs of older adults.

This study has several limitations. First, the primary limitation is being unable to establish causality due to the cross-sectional design. Further longitudinal studies with a larger sample size are urgently required. Second, vitality was defined by BMI instead of specific nutritional assessment, which may have affected some of the results. Since most of the diabetic patients in our study had a higher BMI, this could explain the lower IC decline in participants with diabetes. Third, we used a composite total score instead of a weighted score, so further statistical approaches should be conducted to compute IC scores. Fourth, self-reporting for hearing impairment may misestimate hearing loss (although WHO recommends whisper test for assessing hearing loss). Fifth, 1,040 participants who were unable to complete the IC assessment were excluded in this study. The excluded participants who were older and frailer, had more chronic diseases, and lower scores in each domain (Table S1), which may have misestimated the prevalence of IC decline.

To the best of our knowledge, this study is the first nationally representative large sample of population-based older people focusing on IC in China. Most of the components of IC were assessed using unified measured performance tests, thus avoiding response or interviewer bias. Standardized protocols, as well as regularly and randomly performed internal quality checks of the data, were used to avoid the quality disadvantage of the multi-center design.

In conclusion, this study provided a preliminary understanding of the IC status of Chinese older adults. Our results indicate that efforts promoting IC to delay functional dependence should focus on negative social factors, poor lifestyle, chronic diseases, and geriatric syndromes. This study also validated the IC concept in Chinese population. In fact, China has already implemented the ICOPE approach into clinical practice and launched a pilot multi-center study called “China Aging, Resilience and Intrinsic Capacity Study (CARICS)” to identify and manage IC decline to improve well-being among community-living older adults. We hope that this approach of IC will be a fundamental tool towards healthy ageing worldwide.

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References

1. Prince MJ, Wu F, Guo Y, et al. The burden of disease in older people and implications for health policy and practice. Lancet. 2015;385(9967):549–62.

2. Stoop A, Lette M, Ambugo EA, et al. Improving Person-Centredness in Integrated Care for Older People: Experiences from Thirteen Integrated Care Sites in Europe. Int J Integr Care [Internet] 2020 [cited 2020 Jul 3];20(2):16. Available from: https://www.ijic.org/article/10.5334/ijic.5427/

3. Integrated Care for Older People: Guidelines on Community-Level Interventions to Manage Declines in Intrinsic Capacity [Internet]. 2017 [cited 2020 Jul 3];Available from: https://pubmed.ncbi.nlm.nih.gov/29608259/

4. World Health Organization. Ageing and health [Internet]. 2018 [cited 2018 Jun 23];Available from: http://www.who.int/news-room/fact-sheets/detail/ageing-and-health

5. Ruby Yu, Cecilia Tong JW. Effect of an integrated care model for pre-frail and frail older people living in community. Age Ageing [Internet] 2020 [cited 2020 Jul 3];Available from: https://academic.oup.com/ageing/article-abstract/doi/10.1093/ageing/afaa087/5848668?redirectedFrom=fulltext

6. Framework Implementation of the INSPIRE ICOPE-CARE Program in Collaboration with the World Health Organization (WHO) in the Occitania Region. J Frailty Aging 2020;1–7.

7. Alexia Charles, Fanny Buckinx, Médéa Locquet, Jean-Yves Reginster, Jean Petermans, Bastien Gruslin OB. Prediction of Adverse Outcomes in Nursing Home Residents

According to Intrinsic Capacity Proposed by the World Health Organization | The Journals of Gerontology: Series A | Oxford Academic. J Gerontol A Biol Sci Med Sci [Internet] 2019 [cited 2020 Jun 15];Available from: https://academic.oup.com/biomedgerontology/advance-article-abstract/doi/10.1093/gerona/glz218/5575908?redirectedFrom=fulltext

8. Giudici KV, de Souto Barreto P, Guerville F, et al. Associations of C-reactive protein and homocysteine concentrations with the impairment of intrinsic capacity domains over a 5-year follow-up among community-dwelling older adults at risk of cognitive decline (MAPT Study). Exp Gerontol 2019;127.

9. Daskalopoulou C, Chua KC, Koukounari A, Caballero FF, Prince M, Prina AM. Development of a healthy ageing index in Latin American countries - A 10/66 dementia research group population-based study. BMC Med Res Methodol [Internet] 2019 [cited 2020 Nov 30];19(1):226. Available from: https://bmcmedresmethodol.biomedcentral.com/articles/10.1186/s12874-019-0849-y

10. Giudici K V., de Souto Barreto P, Beard J, et al. Effect of long-term omega-3 supplementation and a lifestyle multidomain intervention on intrinsic capacity among community-dwelling older adults: Secondary analysis of a randomized, placebo-controlled trial (MAPT study). Maturitas [Internet] 2020 [cited 2020 Nov 30];141:39–45. Available from: https://pubmed.ncbi.nlm.nih.gov/33036701/

11. Huang CH, Umegaki H, Makino T, et al. Effect of Various Exercises on Intrinsic Capacity in Older Adults With Subjective Cognitive Concerns. J Am Med Dir Assoc [Internet] 2020 [cited 2020 Nov 30];Available from: https://pubmed.ncbi.nlm.nih.gov/32768376/

12. Gutiérrez-Robledo LM, García-Chanes RE, Pérez-Zepeda MU. Allostatic Load as a Biological Substrate to Intrinsic Capacity: A Secondary Analysis of CRELES. J Nutr Heal Aging 2019;23(9):788–95.

13. Ma L, Liu P, Zhang Y, Sha G, Zhang L, Li Y. High Serum Tumor Necrosis Factor Receptor 1 Levels Are Related to Risk of Low Intrinsic Capacity in Elderly Adults. J Nutr Heal Aging [Internet] 2020 [cited 2020 Nov 30];1–3. Available from: http://www.who.int/news-room/fact-

14. Barreto P de S, Guyonnet S, Ader I, et al. The Inspire Research Initiative: A Program for Geroscience and Healthy Aging Research going from Animal Models to Humans and the Healthcare System. J Frailty Aging [Internet] 2020 [cited 2020 Jun 25];1–8. Available from: https://link.springer.com/article/10.14283/jfa.2020.18

15. Beard JR, Jotheeswaran AT, Cesari M, Araujo De Carvalho I. The structure and predictive value of intrinsic capacity in a longitudinal study of ageing. BMJ Open 2019;9(11):e026119.

16. Ramírez-Vélez R, Correa-Bautista JE, García-Hermoso A, Cano CA, Izquierdo M. Reference values for handgrip strength and their association with intrinsic capacity domains among older adults. J Cachexia Sarcopenia Muscle 2019;10(2):278–86.

17. Cesari M, Araujo de Carvalho I, Amuthavalli Thiyagarajan J, et al. Evidence for the Domains Supporting the Construct of Intrinsic Capacity. Journals Gerontol Ser A [Internet] 2018 [cited 2018 Jun 22];Available from: https://academic.oup.com/biomedgerontology/advance-

article/doi/10.1093/gerona/gly011/4834876

18. Nestola T, Orlandini L, Beard JR, Cesari M. Covid-19 and Intrinsic Capacity. J Nutr Heal Aging [Internet] 2020 [cited 2020 Jul 3];1–4. Available from: https://doi.org/10.15585/mmwr.mm6912e2.

19. Ma L, Zhang L, Zhang Y, et al. Cognitive Frailty in China: Results from China Comprehensive Geriatric Assessment Study. Front Med [Internet] 2017 [cited 2017 Oct 18];4:174. Available from: https://www.frontiersin.org/articles/10.3389/fmed.2017.00174/abstract

20. Ma L, Li Z, Tang Z, et al. Prevalence and socio-demographic characteristics of disability in older adults in China: Findings from China Comprehensive Geriatric Assessment Study. Arch Gerontol Geriatr [Internet] 2017;73:199–203. Available from: http://linkinghub.elsevier.com/retrieve/pii/S0167494316302813

21. Ma L, Tang Z, Zhang L, Sun F, Chan P. Prevalence of frailty and associated factors in the community-dwelling population of China. J Am Geriatr Soc 2017;DOI:10.1111/jgs.15214.

22. WHO | Meeting of the Clinical Consortium on *Healthy Ageing*. WHO 2018;

23. Guralnik JM, Simonsick EM, Ferrucci L, et al. A Short Physical Performance Battery Assessing Lower Extremity Function: Association With Self-Reported Disability and Prediction of Mortality and Nursing Home Admission. J Gerontol [Internet] 1994 [cited 2018 Aug 18];49(2):M85–94. Available from: https://academic.oup.com/geronj/article-lookup/doi/10.1093/geronj/49.2.M85

24. Li H, Jia J, Yang Z. Mini-Mental State Examination in Elderly Chinese: A Population-Based Normative Study. J Alzheimers Dis [Internet] 2016 [cited 2018 Nov 16];53(2):487–96. Available from: http://www.medra.org/servlet/aliasResolver?alias=iospress&doi=10.3233/JAD-160119

25. M E. Screening for malnutrition: A multidisciplinary responsibility. Development and Use of the Malnutrition Universal Screening Tool ('MUST') for Adults. Redditch: BAPEN 2003;

26. Chan ACM. Clinical validation of the Geriatric Depression Scale (GDS): Chinese version. J Aging Health 1996;8(2):238–53.

27. Ma L, Zhang L, Tang Z, et al. Use of the frailty index in evaluating the prognosis of older people in Beijing: A cohort study with an 8-year follow-up. Arch Gerontol Geriatr 2016;64(3):172–7.

28. Rockwood K, Andrew M, Mitnitski A. A comparison of two approaches to measuring frailty in elderly people. J Gerontol A Biol Sci Med Sci [Internet] 2007 [cited 2018 Apr 11];62(7):738–43. Available from: http://www.ncbi.nlm.nih.gov/pubmed/17634321

29. Ma L, Tang Z, Zhang L, Sun F, Li Y, Chan P. Prevalence of Frailty and Associated Factors in the Community-Dwelling Population of China. J Am Geriatr Soc [Internet] 2018 [cited 2018 Apr 15];66(3):559–64. Available from: http://www.ncbi.nlm.nih.gov/pubmed/29168883

30. Kasteridis P, Mason A, Street A. Evaluating integrated care for people with complex needs. J Health Serv Res Policy [Internet] 2020 [cited 2020 Jul 3];135581962093187.

Available from: http://journals.sagepub.com/doi/10.1177/1355819620931872

31. Takeda C, Guyonnet S, Sumi Y, Vellas B, Araujo de Carvalho I. Integrated Care for Older People and the Implementation in the INSPIRE Care Cohort [Internet]. J. Prev. Alzheimer's Dis. 2020 [cited 2020 Jul 3];7(2):70–4. Available from: https://pubmed.ncbi.nlm.nih.gov/32236394/

32. Xu W, Li YX, Wu C. Incidence of frailty among community-dwelling older adults: A nationally representative profile in China. BMC Geriatr 2019;19(1).

33. Stephens C, Allen J, Keating N, Szabó Á, Alpass F. Neighborhood environments and intrinsic capacity interact to affect the health-related quality of life of older people in New Zealand. Maturitas 2020;139:1–5.

34. WHO | Integrated care for older people (ICOPE): guidance for person-centred assessment and pathways in primary care. WHO [Internet] 2020 [cited 2020 Jul 3];Available from: http://www.who.int/ageing/publications/icope-handbook/en/

35. Belloni G, Cesari M. Frailty and Intrinsic Capacity: Two Distinct but Related Constructs. Front Med 2019;

Captions for Tables and Figures

Table 1. Prevalence of declines in intrinsic capacity in older adults by sex, area, and age

Table 2. Stepwise forward logistic regression for associated factors with intrinsic capacity decline

Table 3. Multivariate logistic regression analysis (forward method) for intrinsic capacity decline associated with risk of adverse clinical outcomes

Figure 1. Intrinsic capacity in different regions, age, and sex groups. (A) The comparison of the weighted prevalence of IC decline among the six regions of China (Chi-square test, $p < 0.01$). (B) The comparison of the weighted prevalence of IC decline between North China and South China (Chi-square test, $p < 0.01$). (C) The comparison of the intrinsic capacity score among different age groups (One-way ANOVA, $p < 0.01$). (D) The comparison of the intrinsic capacity score between males and females (t-test, $p < 0.01$). Abbreviations: ANOVA, analysis of variance; IC, intrinsic capacity; IC decline, Intrinsic capacity decline.

Figure 2. The weighted prevalence of declines in intrinsic capacity in community-dwelling older adults living in the urban area (A1), rural area (A2), male (B1), female (B2), <75 ys (C1) and ≥75 ys (C2). All were analyzed using the Chi-square test, $p < 0.01$.

Table S1. Comparison of characteristics between included and excluded participants

Table S2. Prevalence of each intrinsic capacity domain declined by sex, area, and age

Table S3. The effect of social factors, lifestyle and chronic conditions on intrinsic capacity decline

Table 1. Prevalence of intrinsic capacity decline in older adults by sex, area, and age

	Total	Intrinsic capacity decline n (%)	Weighted (%)	Number of Declined Domains					
				0	1	2	3	4	5
All sample	5823	2506(43.0)	39.9	3317(57.0)	1512(26.0)	636(10.9)	271(4.7)	75(1.3)	12(0.2)
Sex*									
Male	2518	1030(40.9)	36.7	1488(59.1)	652(25.9)	266(10.6)	81(3.2)	27(1.1)	4(0.2)
Female	3305	1476(44.7)	43.0	1829(55.3)	860(26.0)	370(11.3)	190(5.7)	48(1.5)	8(0.2)
Area*									
Urban	3494	1243(35.6)	32.7	2251(64.4)	868(24.8)	275(7.9)	81(2.3)	18(0.5)	1(0)
Rural	2329	1263(54.2)	50.1	1066(45.8)	644(27.7)	361(15.5)	190(8.2)	57(2.4)	11(0.5)
Age (ys)*									
60-64	1471	428(29.1)	28.6	1043(70.9)	309(21.0)	85(5.8)	30(2.0)	4(0.3)	0(0)
65-69	1179	414(35.1)	34.9	765(64.9)	271(23.0)	100(8.5)	34(2.9)	9(0.8)	0(0)
70-74	1165	515(44.2)	43.6	650(55.8)	337(28.9)	116(10.0)	46(3.9)	16(1.4)	0(0)
75-79	1119	562(50.2)	50.3	557(49.8)	325(29.0)	150(13.4)	62(5.5)	20(1.8)	5(0.4)
≥80	889	587(66.0)	66.6	302(34.0)	270(30.4)	185(20.8)	99(11.1)	26(2.9)	7(0.8)

Note: *P<0.05.

Table 2. Stepwise forward logistic regression for associated factors with intrinsic capacity decline

Factors	B	S.E.	Wald	df	Sig	OR	95% CI
Older age	0.647	0.093	48.426	1	<0.001	1.910	1.592-2.291
North region	0.466	0.090	26.993	1	<0.001	1.594	1.337-1.901
Low education	0.890	0.143	38.657	1	<0.001	2.435	1.839-3.223
Unmarried	0.395	0.105	14.157	1	<0.001	1.485	1.209-1.825
Low income	0.388	0.094	16.974	1	<0.001	1.474	1.226-1.773
Less exercise	0.293	0.099	8.690	1	0.003	1.340	1.103-1.628
Less meat intake	0.260	0.089	8.532	1	0.003	1.296	1.089-1.543
Insomnia	0.453	0.095	22.735	1	<0.001	1.572	1.305-1.894
Urinary incontinence	0.680	0.209	10.605	1	0.001	1.974	1.311-2.973
Constipation	0.408	0.126	10.605	1	0.001	1.504	1.175-1.924
Memory decline	0.714	0.083	73.427	1	<0.001	2.043	1.735-2.405
Slowness	0.407	0.102	15.908	1	<0.001	1.502	1.230-1.835
COPD	0.853	0.215	15.758	1	<0.001	2.347	1.540-3.576
Osteoarthritis	0.534	0.095	31.785	1	<0.001	1.706	1.417-2.054
Constant	-2.028	0.104	379.542	1	<0.001	0.132	

Note: COPD, chronic obstructive pulmonary disease.

The variables not in the equation were sex, living areas, alcohol consumption, coronary heart disease, diabetes, stroke and kidney disease.

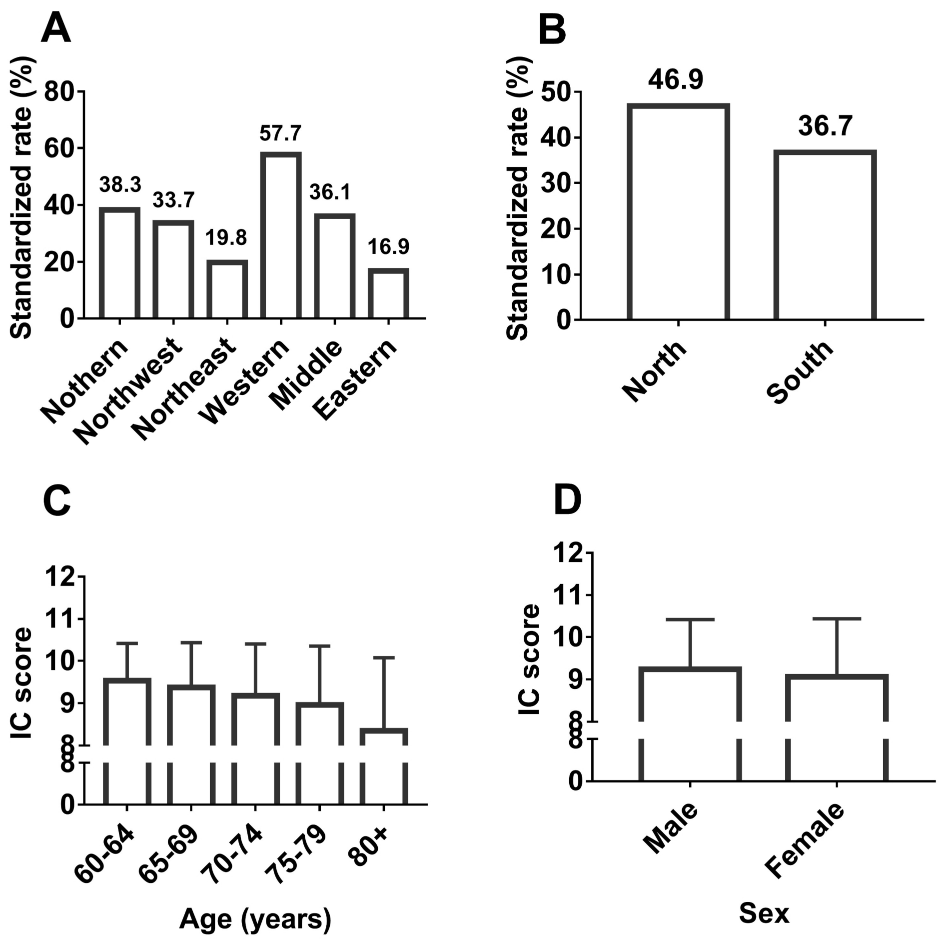
Table 3. Multivariate logistic regression analysis (forward method) for intrinsic capacity decline associated with risk of adverse clinical outcomes

	Model 1			Model 2		
	OR	95% CI	P value	OR	95% CI	P value
Frailty	19.625	14.044-27.423	<0.001	19.021	12.882-28.084	<0.001
Disability	12.628	8.750-18.225	<0.001	8.661	5.925-12.660	<0.001
Fall	3.671	2.699-4.993	<0.001	3.053	2.232-4.177	<0.001
Fracture	1.965	1.448-2.666	<0.001	1.656	1.195-2.295	0.003
Immobility	6.098	4.903-7.584	<0.001	4.403	3.500-5.538	<0.001

Reference: Non-intrinsic capacity decline.

Model 1: Adjusted by age, sex, area and district.

Model 2: Adjusted by age, sex, area, district, marriage, education, waist hip ratio, smoking, alcohol consuming, exercise, income, and chronic diseases.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Standardized rate (%)
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0
46.9
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9
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8
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75-79
80+
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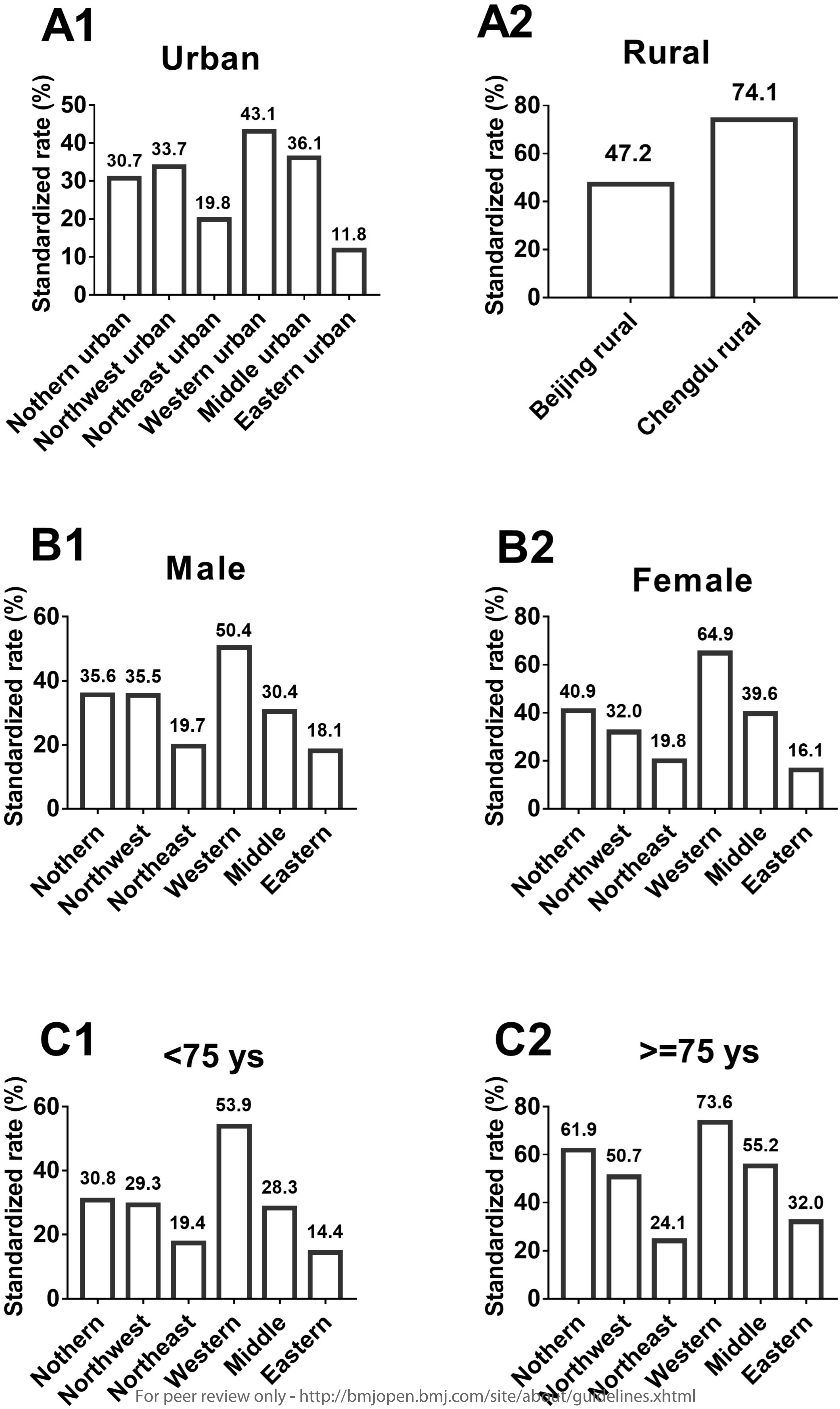
A1
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Northeast urban
Western urban
Middle urban
Eastern urban
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Rural
Standardized rate (%)
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47.2
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Beijing rural
Chengdu rural
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Standardized rate (%)
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Middle
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>=75 ys
Standardized rate (%)
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61.9
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Northwest
Northeast
Western
Middle
Eastern

Table S1. Comparison of characteristics between included and excluded participants

	Included participants	Excluded participants	*P*
Age (ys)	70.86±7.68	72.43±7.37	<0.001
Sex (male) (n, %)	2518(43.2)	450(43.1)	0.934
Education (Illiterate) (n, %)	1047(18.0)	208(20.1)	0.102
Hypertension (n, %)	3835(65.9)	744(71.3)	0.001
CHD (n, %)	1168(20.1)	291(28.0)	<0.001
Diabetes (n, %)	862(14.8)	186(17.9)	0.011
Stroke (n, %)	579(9.9)	139(13.4)	0.001
Kidney disease	259(4.4)	50(4.8)	0.607
COPD	205(3.5)	49(4.7)	0.061
Osteoporosis	1597(27.4)	398(38.8)	<0.001
Immobility	624(10.7)	189(18.2)	<0.001
Frailty index	0.15±0.08	0.20±0.12	<0.001
Locomotion score	1.77±0.53	1.26±0.92	<0.001
Psychological score	1.86±0.38	1.88±0.36	0.122
Cognition score	1.85±0.46	1.85±047	0.913
Vitality score	1.82±0.51	1.88±0.42	<0.001
Sensory score	1.84±0.42	1.76±0.47	<0.001

Abbreviations: CHD, coronary heart disease; COPD, chronic obstructive pulmonary disease.

Table S2. Prevalence of each intrinsic capacity domain declined by sex, area, and age

	Total	Locomotion	Cognition	Vitality	Sensory	Psychology
All sample	5823	1039(17.8)	646(11.1)	735(12.6)	824(14.2)	713(12.2)
Sex						
Male	2518	372(14.8)*	227(9.0)*	338(13.4)	371(14.7)	247(9.8)*
Female	3305	667(20.2)	419(12.7)	397(12.0)	453(55.0)	466(14.1)
Area						
Urban	3494	481(14.1)*	168(4.8)*	344(9.8)*	417(11.9)*	318(9.1)*
Rural	2329	548(23.5)	478(20.5)	391(16.8)	407(17.5)	395(17.0)
Age (ys)						
60-64	1471	106(7.2)*	72(4.9)*	116(7.9)*	114(7.7)*	177(12.0)
65-69	1179	129(10.9)	90(7.6)	123(10.4)	131(11.1)	136(11.5)
70-74	1165	197(16.9)	123(10.6)	141(12.1)	166(14.2)	144(12.4)
75-79	1119	256(22.9)	158(14.1)	154(13.8)	210(18.8)	138(12.3)
≥80	889	351(39.5)	203(22.8)	201(22.6)	203(22.8)	118(13.3)

Note: Data were expressed as n (%); *P<0.05

Table S3. The effect of social factors, lifestyle and chronic conditions on intrinsic capacity decline

	Total	IC decline, n (%)	Weighted (%)	χ^2	*P*
Social factors					
Education	5823				
Illiterate	1047	724(69.1)	67.7	355.086	<0.001
Not illiterate	4776	1782(37.3)	34.9		
Monthly income	5665				
<2000 Yuan	2658	1408(53.0)	49.6	227.561	<0.001
≥2000 Yuan	3007	996(33.1)	30.0		
Marital status	5818				
Married	4493	1738(38.7)	35.8	151.541	<0.001
Unmarried	1325	765(57.7)	56.8		
Lifestyle					
Exercise	5808				
Yes	4594	1779(38.7)	36.1	168.600	<0.001
No	1214	722(59.5)	55.0		
Meat intake	5823				
Usually	3369	1322(39.2)	35.9	46.925	<0.001
Less	2454	1184(48.2)	45.8		
Alcohol consumption	5823				
Yes	4503	600(45.5)	40.7	4.081	0.043
No	5823	1906(42.3)	39.6		
Smoking	1320				
Yes	1658	722(43.5)	38.7	0.241	0.623
No	4165	1784(42.8)	40.5		
Chronic disease					
Hypertension	5823				
Yes	2688	1127(41.9)	39.0	2.505	0.113
No	3135	1379(44.0)	40.7		
CHD	5823				
Yes	1168	559(47.9)	46.0	13.823	<0.001
No	4655	1947(41.8)	38.5		
Diabetes	5823				
Yes	862	344(39.9)	36.6	4.041	0.044
No	4961	2162(43.6)	40.5		
Stroke	5823				
Yes	579	327(56.5)	53.3	47.323	<0.001
No	5244	2179(41.6)	38.5		
Kidney disease	5823				
Yes	259	136(52.5)	50.6	9.907	0.002
No	5564	2370(42.6)	39.4		
COPD	5823				
Yes	205	140(68.3)	66.7	55.288	<0.001
No	5618	2366(42.1)	39.0		

Liver disease	5823				
Yes	253	107(42.3)	40.0	0.062	0.803
No	5570	2399(43.1)	38.7		
Osteoarthritis	5823				
Yes	1597	855(53.5)	51.2	98.993	<0.001
No	4226	1651(39.1)	35.9		
Cancer	5823				
Yes	148	63(42.6)	39.7	0.013	0.909
No	5675	2443(43.0)	39.9		
Geriatric syndrome					
Insomnia	5823				
Yes	1427	830(58.2)	56.5	176.113	<0.001
No	4396	1676(38.1)	34.9		
Memory decline	5823				
Yes	2629	1450(55.2)	52.6	286.447	<0.001
No	3194	1056(33.1)	30.2		
Urinary incontinence	5823				
Yes	257	198(77.0)	76.3	126.654	<0.001
No	5566	2308(41.5)	38.5		
Constipation	5823				
Yes	738	430(59.1)	56.6	87.043	<0.001
No	5095	2076(40.8)	37.8		
Slowness	3306				
Yes	688	367(53.3)	50.2	54.008	<0.001
No	2618	991(37.9)	35.1		

Abbreviations: IC, intrinsic capacity; ADL, activities of daily living; IADL, instrumental activities of daily living; CHD, coronary heart disease; COPD, chronic obstructive pulmonary disease.

STROBE 2007 (v4) Statement—Checklist of items that should be included in reports of *cross-sectional studies*

Section/Topic	Item #	Recommendation	Reported on page #
Title and abstract	1	(*a*) Indicate the study's design with a commonly used term in the title or the abstract	1,2
		(*b*) Provide in the abstract an informative and balanced summary of what was done and what was found	3
Introduction			
Background/rationale	2	Explain the scientific background and rationale for the investigation being reported	5
Objectives	3	State specific objectives, including any prespecified hypotheses	5-6
Methods			
Study design	4	Present key elements of study design early in the paper	6
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection	6
Participants	6	(*a*) Give the eligibility criteria, and the sources and methods of selection of participants	6
Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable	6-8
Data sources/ measurement	8*	For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group	6-8
Bias	9	Describe any efforts to address potential sources of bias	*9*
Study size	10	Explain how the study size was arrived at	9
Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why	10
Statistical methods	12	(*a*) Describe all statistical methods, including those used to control for confounding	10
		(*b*) Describe any methods used to examine subgroups and interactions	10
		(*c*) Explain how missing data were addressed	N/A
		(*d*) If applicable, describe analytical methods taking account of sampling strategy	N/A
		(*e*) Describe any sensitivity analyses	N/A
Results			

Participants	13*	(a) Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed	6
		(b) Give reasons for non-participation at each stage	N/A
		(c) Consider use of a flow diagram	N/A
Descriptive data	14*	(a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders	10
		(b) Indicate number of participants with missing data for each variable of interest	N/A
Outcome data	15*	Report numbers of outcome events or summary measures	12
Main results	16	(*a*) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included	11-12
		(*b*) Report category boundaries when continuous variables were categorized	N/A
		(*c*) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period	N/A
Other analyses	17	Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses	N/A
Discussion			
Key results	18	Summarise key results with reference to study objectives	13
Limitations	19	Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias	15
Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence	15
Generalisability	21	Discuss the generalisability (external validity) of the study results	15
Other information			
Funding	22	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based	17

*Give information separately for cases and controls in case-control studies and, if applicable, for exposed and unexposed groups in cohort and cross-sectional studies.

Note: An Explanation and Elaboration article discusses each checklist item and gives methodological background and published examples of transparent reporting. The STROBE checklist is best used in conjunction with this article (freely available on the Web sites of PLoS Medicine at http://www.plosmedicine.org/, Annals of Internal Medicine at http://www.annals.org/, and Epidemiology at http://www.epidem.com/). Information on the STROBE Initiative is available at www.strobe-statement.org.