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Original Research

Intrinsic capacity impairments are associated with increased risk of incident dementia among community-dwelling older adults: Results from a 9-year follow-up of a nationwide cohort in Taiwan

Chia-Lin Li [a,*], Fiona F. Stanaway [b], Yu-Hsuan Tsai [a]

[a] Department of Health Care Management, College of Management, Chang Gung University, Taoyuan City, 333323, Taiwan
[b] Faculty of Medicine and Health, School of Public Health, University of Sydney, New South Wales, 2006, Australia

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ABSTRACT

Objectives: The main aim of this study was to examine whether screening for intrinsic capacity (IC) impairments could identify those at increased risk of incidence of dementia among community-dwelling older adults.
Design: Nine-year longitudinal study.
Settings and participants: A total of 2308 community-dwelling persons aged 65 years or older who participated in the National Health Interview Survey (NHIS) in Taiwan, 2013.
Measurements: IC impairments were measured using the questionnaire from NHIS based on six domains of cognition, vitality, locomotion, vision, hearing, and psychological. The incidence of dementia was confirmed by the computerized data files of the Taiwan National Health Insurance claims database.
Results: In this study, a total of 358 persons developed incident dementia during the 9-year follow-up, giving a cumulative incidence rate of 15.5% (358/2308). Overall, 28.4% of participants had one IC domain impairment, 29.4% of participants had two or more domains impairment. Compared to those participants with no IC impairment, participants with one IC domain impairment had no increased risk of incident dementia (adjusted SHR=1.17; 95% CI=0.89–1.54), but increased risk was observed in participants with impairments in two or more domains (adjusted SHR=1.54; 95% CI=1.18–2.01).
Conclusions: Our results highlight the high prevalence of participants with impairments in two or more IC domains and its independent association with increased risk of incident dementia among community-dwelling older adults. Further investigation is needed to explore whether such individuals could benefit from interventions to reduce risk of dementia.

1. Introduction

The incidence of dementia is increasing in Taiwan [1], and in many other populations globally [2]. Given the growing burden of dementia and its associated health care costs, it is important to develop effective and comprehensive strategies for preventing dementia. There is increasing evidence supporting the important concept of intrinsic capacity (IC) as a measure of functional status in the aging process that can help identify people at risk for care dependency. IC was introduced by the World Health Organization and is comprised of the six domains of cognition, vitality, locomotion, vision, hearing, and psychological [3,4]. Past research has consistently shown that people with impaired IC have an increased risk of adverse outcomes such as frailty, disability, and mortality [5–9]. However, few studies have explored whether impaired IC is associated with an increased risk of incident dementia.

In addition, there is still a lack of consensus on how best to measure IC, resulting in differences in included domains and analysis methods among different studies. Sun et al. analyzed data from the UK Biobank using a composite score based on four IC domains (vitality, sensory, psychological, and locomotion), to investigate the relationship between the IC deficit score and incident dementia [10]. They found that a higher IC deficit score was associated with an increased risk of developing dementia.

González-Bautista et al. used latent transition analysis of baseline IC based on 6 domains (locomotion, nutrition, vision, hearing, cognition and psychological) to group older adults into four typologies, namely

* Corresponding author.
E-mail address: clli@mail.cgu.edu.tw (C.-L. Li).

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"high IC", "low deterioration with impaired locomotion", "high deterioration without cognitive impairment" and "high deterioration with cognitive impairment" [9]. They found that those with low and high levels of deterioration had a significantly higher risk of adverse outcomes including dementia than their high IC counterparts.

Impairment in at least one IC domain is reportedly common in older adults [9,11,12]. However, the epidemiology of impairments in multiple IC domains among older people has yet to be characterized. Furthermore, the aggregate effect of these impaired IC domains on incident dementia in the older adult population has not been investigated. A better understanding of whether older people with impairments in multiple IC domains have an increased risk of incident dementia would assist health care providers to identify older adults at risk of incident dementia who may benefit the most from early intervention.

In view of these considerations, we analyzed data from a 9-year prospective study of a national sample of community-dwelling older adults in Taiwan. We used the questionnaire from the National Health Interview Survey (NHIS) to measure impairments in IC in the six domains of cognition, vitality, locomotion, vision, hearing, and psychological. The main aim of the present study was to explore whether screening community-dwelling older adults for IC impairments could identify those at increased risk of incident dementia. We hypothesized that participants with impairments in two or more IC domains would have a significantly increased risk of incident dementia. We also aimed to describe the distribution of impairments in two or more IC domains among older adults and associated factors.

2. Methods

2.1. Study population

This was a population-based cohort of community-dwelling persons aged 65 years or older, who participated in the 2013 NHIS in Taiwan. The sample design of the 2013 NHIS has been detailed previously [13,14]. The original sample comprised 2941 participants aged 65 years or older. Of these, 184 were excluded due to pre-existing dementia or Parkinson's disease diagnosis or having died in 2013, and 449 were excluded due to missing data for intrinsic capacity domains. This resulted in 2308 eligible participants who were followed until their date of dementia diagnosis, death, or the end of the study period (31 December 2022). Deaths were confirmed by the computerized database of the National Register of Deaths. Dataset linkage and statistical analyses were performed at the Data Science Center of the Ministry of Health and Welfare. This study was approved by the relevant institutional review board.

2.2. Measures

2.2.1. Assessment of incident dementia

Incident dementia was determined by the computerized data files of the Taiwan National Health Insurance (NHI) claims database from 2014 to 2022. The types of dementia included Alzheimer's disease, vascular dementia, and unspecified dementia. Incident dementia was defined according to the International Classification of Disease, Ninth Edition, Clinical Modification codes 290.0, 290.1, 290.2, 290.3, 290.4, 294.1, 331.0, 331.1, and 331.2 and the Tenth Edition, Clinical Modification codes F00, F01, F02, F03, and G30 in the NHI claims database. If the diagnosis codes occurred at least three times in outpatient visits or at least once in an inpatient setting, participants were considered to have incident dementia. The date of the first dementia claim was defined as the date of dementia diagnosis. This definition was adopted from past studies using the NHI claims database in Taiwan [14,15].

2.2.2. Assessment of IC impairments and baseline characteristics

In this study, six IC domains were assessed: cognition, vitality, locomotion, vision, hearing, and psychological. For each domain, the presence of an impairment was based on the following criteria.

Impairment in cognition was assessed by the Mini-Mental State Examination (MMSE) [16] which has been validated in the Chinese population [17]. Participants with a Mini-Mental State Examination (MMSE) score < 18 for those who were illiterate and had no schooling, a MMSE score < 21 for those with 1–6 years of education, or a MMSE score < 25 for those with 7 or more years of education were considered to have impairment in the cognition domain [16,17].

Impairment in vitality was assessed by two questions "do you have poor appetite often or most of the time in the previous week?" and "do you have any difficulties in lifting or carrying 4.5 kg?". Participants who had poor appetite often or most of the time in the previous week and reported difficulties lifting or carrying 4.5 kg were considered to have impairment in the vitality domain [7].

Impairment in locomotion was assessed by two questions "do you have any difficulty walking 400 m alone and without aids?" and "do you have any difficulty climbing 10 steps alone and without aids?". Participants who reported difficulties or reported being completely unable for either question were considered to have limited mobility, i.e., impairment in the locomotion domain [18].

Impairment in vision was assessed by using a question "do you have any difficulty seeing things clearly (even with glasses)". Participants who reported difficulties or were unable to see (even with glasses) were considered to have impaired vision, i.e., impairment in the visual domain [19,20].

Impairment in hearing was assessed by using a question "do you have any difficulty hearing things clearly (even with a hearing aid)". Those who reported difficulties or were unable to hear (even with a hearing aid) were considered to have impaired hearing, i.e., impairment in the hearing domain [20,21].

The 10 item version of the Center for Epidemiologic Studies Depression Scale (CES-D), which has well established validity and reliability [22,23], was used to assess depressive symptoms. Participants with a score between 10 and 30 were considered to have depressive symptoms [22,23], i.e., impairment in the psychological domain [24].

Demographic characteristics such as age, sex, years of education, marital status (married or living with partner; yes/no), and smoking status (current or former smoker; yes/no) were obtained from the questionnaires. Other factors associated with incident dementia, including a history of hypertension, diabetes, stroke, and heart disease were also obtained from the questionnaires. For each disease, participants were asked whether the diagnosis had been confirmed by a medical professional.

2.3. Statistical analyses

We used the Pearson's chi-square test to examine baseline characteristics associated with multiple impaired IC domains. Since death can preclude the subsequent onset of dementia, it is considered a competing risk rather than a simple censoring event. Therefore, we used the Fine–Gray subdistribution hazards model to evaluate the association between IC impairments and incident dementia [25,26]. All models were adjusted for age, sex, education, marital status, smoking status (current or former smoker), hypertension, diabetes, stroke, and heart disease. Adjusted subdistribution hazard ratios (SHRs) and 95% confidence intervals (CIs) for incident dementia were estimated. All analyses were conducted using SAS statistical software, version 9.4 (SAS Institute, Inc., Cary, NC, USA).

3. Results

Table 1 shows the baseline characteristics of older adults with multiple impaired IC domains. Age, sex, education, marital status, and a history of hypertension, diabetes, stroke, and heart disease were all significantly associated with the presence of multiple impaired IC domains.

Table 1
Baseline characteristics of the study participants by number of impaired intrinsic capacity domains.

		Number of impaired intrinsic capacity domains			P-value[a]
	Overall (N = 2308)	0 (N = 975)	1 (N = 655)	2+ (N = 678)	
	N (%)				
Age (%)					<0.0001
65–74 years	1370 (59.4)	712 (73.0)	397 (60.6)	261 (38.5)	
75+ years	938 (40.6)	263 (27.0)	258 (39.4)	417 (61.5)	
Sex (% female)	1216 (52.7)	456 (46.8)	332 (50.7)	428 (63.1)	<0.0001
Education (%)					<0.0001
0 years	660 (28.6)	176 (18.1)	188 (28.7)	296 (43.7)	
1–6 years	1014 (43.9)	472 (48.4)	284 (43.4)	258 (38.1)	
7+ years	634 (27.5)	327 (33.5)	183 (27.9)	124 (18.3)	
Marital status (% married or living with partner)	1487 (64.4)	726 (74.5)	405 (61.8)	356 (52.5)	<0.0001
Current or former smoker (% yes)	571 (24.9)	260 (26.8)	161 (24.7)	150 (22.3)	0.1147
Hypertension (% yes)	1212 (53.0)	449 (46.4)	335 (51.7)	428 (63.6)	<0.0001
Diabetes (% yes)	491 (21.3)	167 (17.2)	144 (22.0)	180 (26.7)	<0.0001
Stroke (% yes)	128 (5.6)	29 (3.0)	30 (4.6)	69 (10.2)	<0.0001
Heart (% yes)	430 (18.8)	121 (12.5)	115 (17.7)	194 (28.8)	<0.0001

[a] Categorical variables were compared using Pearson's chi-square test.

Table 2 shows the prevalence of IC impairment for each domain and its frequency of co-occurrence with other impaired domains. The prevalence of IC impairment for each domain was: cognition 24.8%, vitality 2.7%, locomotion 31.1%, vision 23.0%, hearing 13.3%, and psychological 12.9%, respectively. Among participants with impaired cognition, 64.7% had at least one other impaired domain, 38.5% had at least two other impaired domains, and 17.8% had at least three other impaired domains.

Table 3 shows the adjusted SHR and 95% CIs for incident dementia. In subdistribution models, after adjustment for age, sex, education, marital status, smoking status, hypertension, diabetes, stroke, and heart disease, compared to those participants with no IC impairment, participants with impairments in two or more domains had an increased risk of incident dementia (adjusted SHR=1.54; 95% CI=1.18–2.01).

Table 4 shows the sensitivity analysis removing the cognition domain from IC impairments. In fully adjusted subdistribution models, after removal of the cognition domain, compared to those participants with no IC impairment, participants with impairments in two or more domains had an increased risk of incident dementia (adjusted SHR=1.36; 95% CI=1.03–1.79).

Table 5 shows the sensitivity analysis excluding incident dementia that occurred during the first 2 years of follow-up. In fully adjusted subdistribution models for this analysis, participants with impairments in two or more domains had an increased risk of incident dementia compared to participants with no IC impairment (adjusted SHR=1.63; 95% CI=1.23–2.17).

Table 2
Prevalence of intrinsic capacity impairment for each domain and co-occurrence with other impaired domains.

		Prevalence of co-occurring other impaired domain in respondents with index domain (% impairment)		
Index domain	N (%)	1+	2+	3+
Cognition (% impairment)	572 (24.8)	370 (64.7)	220 (38.5)	102 (17.8)
Vitality (% impairment)	62 (2.7)	62 (100.0)	55 (88.7)	36 (58.1)
Locomotion (% impairment)	718 (31.1)	539 (75.1)	295 (41.1)	130 (18.1)
Vision (% impairment)	530 (23.0)	385 (72.6)	229 (43.2)	115 (21.7)
Hearing (% impairment)	308 (13.3)	230 (74.7)	137 (44.5)	72 (23.4)
Psychological (% impairment)	298 (12.9)	247 (82.9)	177 (59.4)	103 (34.6)

Table 3
Adjusted subdistribution hazard ratios and 95% confidence intervals for 9-year incidence of dementia in the study cohort (N = 2308).

	N	Dementia	Adjusted SHR[a]	95% CI	P-value
Number of impaired IC domains					
0	975	114	Ref		
1	655	95	1.17	(0.89–1.54)	0.2679
2+	678	149	1.54	(1.18–2.01)	0.0015

[a]Adjusted for age, sex, education, marital status, current or former smoker, hypertension, diabetes, stroke, and heart disease.
SHR: Subdistribution hazard ratio; CI: Confidence interval.

Table 4
Sensitivity analysis for removing the cognition domain from IC impairments. Adjusted subdistribution hazard ratios and 95% confidence intervals for 9-year incidence of dementia in the study cohort (N = 2308).

	N	Dementia	Adjusted SHR[a]	95% CI	P-value
Number of impaired IC domains					
0	1177	147	Ref		
1	603	96	1.16	(0.88–1.51)	0.2897
2+	528	115	1.36	(1.03–1.79)	0.0289

[a]Adjusted for age, sex, education, marital status, current or former smoker, hypertension, diabetes, stroke, and heart disease.
SHR: Subdistribution hazard ratio; CI: Confidence interval.

Table 5
Sensitivity analysis for excluding incident dementia that occurred during the first 2 years of follow-up. Adjusted subdistribution hazard ratios and 95% confidence intervals for 9-year incidence of dementia in the study cohort (N = 2269).

	N	Dementia	Adjusted SHR[a]	95% CI	P-value
Number of impaired IC domains					
0	960	99	Ref		
1	644	84	1.21	(0.90–1.63)	0.2022
2+	665	136	1.63	(1.23–2.17)	0.0006

[a]Adjusted for age, sex, education, marital status, current or former smoker, hypertension, diabetes, stroke, and heart disease.
SHR: Subdistribution hazard ratio; CI: Confidence interval.

4. Discussion

Our study found that as many as 29.4% of community-dwelling older adults had impairment in two or more IC domains. Our results confirm our hypothesis that participants with impairment in two or more IC domains have a significantly increased risk of incident dementia and that screening for IC impairments can identify community-dwelling older adults at risk of dementia. Further studies are required to examine whether the early identification of impaired IC followed by interventions to reduce impairments can reduce dementia risk.

The major strength of our study is that we investigated the prevalence of IC impairments in a population-based national sample of older adults. We found that 57.8% of participants had at least one IC domain impairment in line with previous studies where the prevalence has ranged between 43% and 94% [9]. We found that age, sex, education, marital status, and a history of hypertension, diabetes, stroke, and heart disease were all associated with impairment in multiple IC domains. These findings are similar to those found in research on IC impairments in older community-dwellers in Japan and Taiwan [24]. Moreover, most previous research agrees that these attributes are associated with increased risk of incident dementia [27]. After adjustment for these factors, we found that participants with one IC domain impairment did not have an increased risk of incident dementia, but participants with two or more IC domains impairment had a significantly increased risk of incident dementia (adjusted SHR=1.54; 95% CI=1.18–2.01).

Previous studies support associations between impaired IC domains such as cognitive impairment, grip strength, walking pace, vision or hearing impairment, or depressive symptoms and incident dementia [28–32]. Our findings add to the understanding of the association of impaired IC with increased risk of dementia by demonstrating that community dwelling older adults with impairment in two or more IC domains have a higher risk of dementia compared to those without IC impairment. However, our results show that the magnitude of the association between multiple impaired IC domains and increased risk of incident dementia was mild. Moreover, we failed to show a graded association between the number of impaired IC domains and risk of dementia. There are a number of potential pathways through which IC impairments could result in incident dementia. Previous studies have shown that impairments in the sensory (hearing and vision) domain may reflect deficiencies in the quality of input received by the impaired cognitive domain, leading to more severe cognitive impairments [33, 34]. Older adults with co-occurring depressed mood and impaired cognition are less likely to exercise and have a healthy diet [35], which are associated with an increased risk of dementia [27]. González-Bautista and colleagues showed that each additional IC domain impairment was associated with increased risk of incident frailty [5]. Previous studies have shown that frailty is associated with a higher risk of developing dementia [36,37]. These observations provide possible explanations for the mechanisms behind our findings of association between multiple impaired IC domains and increased risk of dementia.

It is notable that for each of the impaired IC domains, the prevalence of having at least one other impaired domain exceeded 60%, and having two or more other impaired domains exceeded 35% (Table 2). These results indicate that all IC domains are closely interrelated with each other. We did not analyze the association between specific combination of domains with incident dementia since no specific combination of domains reflects an individual's overall health status.

Before recommending screening using the IC, further investigation is needed to explore the underlying cause of incident dementia in participants with multiple impaired IC domains and whether such individuals could benefit from interventions to reduce dementia risk among community-dwelling older adults. Further research is also needed to compare the predictive power of IC screening and other dementia screening tools.

There are limitations that should be noted. As this study was an observational study, there are limitations on the causal interpretation of our study findings. Consider our assessment of IC impairments including cognition, the domain most closely linked to dementia. We conducted a sensitivity analysis removing the cognition domain from IC impairments to examine the impact of this on our findings, we found that the association between multiple impaired IC domains and increased risk of incident dementia remained unchanged (Table 4). It is possible that the presence of early symptoms of underlying neurodegenerative diseases are leading to both IC impairments and increased risk of dementia. We conducted a sensitivity analysis excluding incident dementia that occurred during the first 2 years of follow-up to examine the impact of early symptoms of underlying neurodegenerative diseases on our findings. However, we found that the association between multiple impaired IC domains and increased risk of incident dementia remained unchanged (Table 5). Although the initial sample of 2941 is a nationally representative sample of adults aged 65 years or older, our analytic sample could be biased due to the included participants being limited to those who had complete data for the assessments of IC impairments. The comparison of characteristics between respondents who were included (N = 2308) and excluded due to incomplete data (N = 449) from this study suggests that our sample could be biased toward individuals of younger age, with a higher education level, who are likely to be married or living with a partner, and with better health (Supplementary Table 1). Therefore, we may have underestimated both the prevalence of IC impairments and rates of incident dementia. Additionally, the association between multiple impaired IC domains and incident dementia may be underestimated. Thus, some care should be taken when generalizing our results to the whole population. Most previous studies used only single attribute criteria (such as nutritional status, energy, neuromuscular function, or metabolism) to evaluate impairment in the vitality domain. In our study, vitality was assessed by a combination of nutritional status (self-reported appetite loss) and neuromuscular function (self-reported difficulties lifting or carrying 4.5 kg). This more stringent definition may have resulted in a lower prevalence of impairment in vitality domain in our study and may have reduced the comparability of our findings with other similar studies. In this study, apart from cognition which was assessed by the MMSE score, assessments of other IC domains were based on self-report. There is potential bias from the self-reporting of IC impairments, and potential misclassification due to inaccurate recall. Finally, we did not have data on APOE4-carrier status to be controlled for in the models and as a result this may have confounded our results.

We consider our results important because of their practical implications. It is notable that 50.9% of our participants with impaired IC reported multiple impaired IC domains. These observations indicate that a substantial proportion of community-dwelling older adults may be faced with the simultaneous management of multiple impaired IC domains and need more help. These findings have important implications for health care planning and resource allocation to support improved IC in community-dwelling older adults. Previous studies have indicated that the early identification of IC impairments by self-reported questionnaire followed by community-based intervention activities may result in improved IC [18]. Further investigation is needed to explore whether people with multiple impaired IC domains could benefit from interventions such as community-based intervention activities to prevent dementia.

5. Conclusions

In summary, our results indicate that a substantial proportion of older adults reported two or more impaired IC domains. Our results suggest that the presence of multiple impaired IC domains is a marker for increased risk of incident dementia among community dwelling older adults. Further studies are needed to examine whether the early identification of those with impaired IC domains followed by targeted interventions aimed at reducing IC impairments can reduce dementia risk among community-dwelling older adults.

Ethical approval

This study was approved by the Research Ethics Committee of National Taiwan University (NTU-REC No.: 202412EM033).

Declaration of generative AI and AI-assisted technologies in the writing process

The authors did not use generative AI or AI-assisted technologies in the preparation of this manuscript.

Data statement

The data generated and analyzed during the current study are unavailable publicly to access or unsuitable to post, because our research data are stored in the Data Science Center of the Ministry of Health and Welfare, and to protect the participants' privacy, the Data Science Center of the Ministry of Health and Welfare aims to limit the storage of data externally. For more information, see: https://dep.mohw.gov.tw/DOS/cp-5283-63826-113.html.

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CRediT authorship contribution statement

Chia-Lin Li: Writing – review & editing, Writing – original draft, Methodology, Funding acquisition, Formal analysis, Data curation, Conceptualization. **Fiona F. Stanaway:** Writing – review & editing, Methodology, Conceptualization. **Yu-Hsuan Tsai:** Writing – review & editing, Formal analysis, Data curation, Conceptualization.

Declaration of competing interests

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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Supplementary materials

Supplementary material associated with this article can be found, in the online version, at doi:10.1016/j.tjfa.2026.100220.

References

[1] Huang ST, Loh CH, Lin CH, Hsiao FY, Chen LK. Trends in dementia incidence and mortality, and dynamic changes in comorbidity and healthcare utilization from 2004 to 2017: a Taiwan national cohort study. Arch Gerontol Geriatr 2024;121:105330. https://doi.org/10.1016/j.archger.2024.105330.

[2] Perera G, Pedersen L, Ansel D, Alexander M, Arrighi HM, Avillach P, Foskett N, Gini R, Gordon MF, Gungabissoon U, Mayer MA, Novak G, Rijnbeek P, Trifirò G, van der Lei J, Visser PJ, Stewart R. Dementia prevalence and incidence in a federation of European Electronic Health Record databases: the European Medical Informatics Framework resource. Alzheimers Dement 2018;14(2):130–9. https://doi.org/10.1016/j.jalz.2017.06.2270.

[3] WHO World Report on Ageing and Health. Accessed September 22, 2025, who.int/publications/i/item/9789241565042; 2015.

[4] WHO Integrated Care for Older People (ICOPE). Guidance for person-centred assessment and pathways in primary care. Accessed September 22, 2025, iris.who.int/handle/10665/326843; 2019.

[5] González-Bautista E, de Souto Barreto P, Andrieu S, Rolland Y, Vellas B, MAPT/DSA group (members are listed under 'Contributors'). Screening for intrinsic capacity impairments as markers of increased risk of frailty and disability in the context of integrated care for older people: secondary analysis of MAPT. Maturitas 2021;150:1–6. https://doi.org/10.1016/j.maturitas.2021.05.011.

[6] Locquet M, Sanchez-Rodriguez D, Bruyère O, Geerinck A, Lengelé L, Reginster JY, Beaudart C. Intrinsic capacity defined using four domains and mortality risk: a 5-year follow-up of the SarcoPhAge cohort. J Nutr Health Aging 2022;26(1):23–9. https://doi.org/10.1007/s12603-021-1702-7.

[7] Yu R, Lai D, Leung G, Woo J. Trajectories of intrinsic capacity: determinants and associations with disability. J Nutr Health Aging 2023;27(3):174–81. https://doi.org/10.1007/s12603-023-1881-5.

[8] Meng LC, Chuang HM, Lu WH, Lee WJ, Liang CK, Loh CH, Hsiao FY, Chen LK. Multi-trajectories of intrinsic capacity decline and their impact on age-related outcomes: a 20-year national longitudinal cohort study. Aging Dis 2023 Nov 21. https://doi.org/10.14336/AD.2023.1115-1.

[9] González-Bautista E, Llibre-Guerra JJ, Sosa AL, Acosta I, Andrieu S, Acosta D, Llibre-Rodríguez JJ, Prina M. Exploring the natural history of intrinsic capacity impairments: longitudinal patterns in the 10/66 study. Age Ageing 2023;52(7):afad137. https://doi.org/10.1093/ageing/afad137.

[10] Sun M, He Q, Sun N, Han Q, Wang Y, Zhao H, Li G, Ma Z, Feng Z, Li T, Yang L, Shen Y. Intrinsic capacity, polygenic risk score, APOE genotype, and risk of dementia: a prospective cohort study based on the UK biobank. Neurology 2024;102(12):e209452. https://doi.org/10.1212/WNL.0000000000209452.

[11] Tavassoli N, de Souto Barreto P, Berbon C, Mathieu C, de Kerimel J, Lafont C, Takeda C, Carrie I, Piau A, Jouffrey T, Andrieu S, Nourhashemi F, Beard JR, Soto Martin ME, Vellas B. Implementation of the WHO integrated care for older people (ICOPE) programme in clinical practice: a prospective study. Lancet Healthy Longev 2022;3(6):e394–404. https://doi.org/10.1016/S2666-7568(22)00097-6.

[12] González-Bautista E, de Souto Barreto P, Virecoulon Giudici K, Andrieu S, Rolland Y, Vellas B. Frequency of conditions associated with declines in intrinsic capacity according to a screening tool in the context of integrated care for older people. J Frailty Aging 2021;10(2):94–102. https://doi.org/10.14283/jfa.2020.42.

[13] Li CL, Chang HY, Stanaway FF. Combined effects of frailty status and cognitive impairment on health-related quality of life among community dwelling older adults. Arch Gerontol Geriatr 2020;87:103999. https://doi.org/10.1016/j.archger.2019.103999.

[14] Li CL, Chang HY, Shyu YL, Stanaway FF. Relative role of physical frailty and poor cognitive performance in progression to dementia. J Am Med Dir Assoc 2021;22:1558–9. https://doi.org/10.1016/j.jamda.2021.02.022.

[15] Li CL, Chang HY, Tsai YH. Sarcopenia screened with SARC-F and subjective memory complaints are independently associated with increased risk of incident dementia among cognitively unimpaired older adults. J Nutr Health Aging 2023;27(11):940–5. https://doi.org/10.1007/s12603-023-2006-x.

[16] Folstein MF, Folstein SE, McHugh PR. Mini-mental state. A practical method for grading the cognitive state of patients for the clinician. J Psychiatr Res 1975;12:189–98. https://doi.org/10.1016/0022-3956(75)90026-6.

[17] Katzman R, Zhang MY, Ouang-Ya-Qu, Wang ZY, Liu WT, Yu E, Wong SC, Salmon DP, Grant I. A chinese version of the Mini-Mental State Examination; impact of illiteracy in a Shanghai dementia survey. J Clin Epidemiol 1988;41(10):971–8. https://doi.org/10.1016/0895-4356(88)90034-0.

[18] Yu R, Lai D, Leung G, Tam LY, Cheng C, Kong S, Tong C, Cheung B, Woo J. Moving towards the ICOPE approach: evaluation of community-based intervention activities on improving intrinsic capacity. J Nutr Health Aging 2023;27(11):1028–37. https://doi.org/10.1007/s12603-023-2003-0.

[19] Liljas AEM, Carvalho LA, Papachristou E, De Oliveira C, Wannamethee SG, Ramsay SE, Walters KR. Self-reported vision impairment and incident prefrailty and frailty in english community-dwelling older adults: findings from a 4-year follow-up study. J Epidemiol Community Health 2017;71(11):1053–8. https://doi.org/10.1136/jech-2017-209207.

[20] Aliberti MJR, Bertola L, Szlejf C, Oliveira D, Piovezan RD, Cesari M, de Andrade FB, Lima-Costa MF, Perracini MR, Ferri CP, Suemoto CK. Validating intrinsic capacity to measure healthy aging in an upper middle-income country: findings from the ELSI-Brazil. Lancet Reg Health Am 2022;12:100284. https://doi.org/10.1016/j.lana.2022.100284.

[21] Liljas AEM, Carvalho LA, Papachristou E, Oliveira C, Wannamethee SG, Ramsay SE, Walters K. Self-reported hearing impairment and incident frailty in English community-dwelling older adults: a 4-year follow-up study. J Am Geriatr Soc 2017;65(5):958–65. https://doi.org/10.1111/jgs.14687.

[22] Radloff L. The CES-D Scale: A self-report depression scale for research in the general population. Appl Psychol Meas 1977;1:385–401. https://doi.org/10.1177/014662167700100306.

[23] Andresen EM, Malmgren JA, Carter WB, Patrick DL. Screening for depression in well older adults: evaluation of a short form of the CES-D (Center for Epidemiologic Studies Depression Scale). Am J Prev Med 1994;10:77–84.

[24] Zhang S, Peng LN, Otsuka R, Liang CK, Nishita Y, Arai H, Chen LK. Comparative analysis of intrinsic capacity impairments, determinants, and clinical consequences in older community-dwellers in Japan and Taiwan: longitudinal studies showing shared traits and distinct presentations. J Nutr Health Aging 2023;27(11):1038–46. https://doi.org/10.1007/s12603-023-2020-z.

[25] Fine JP, Gray RJ. A proportional hazards model for the subdistribution of a competing risk. J Am Stat Assoc 1999;94:496. https://doi.org/10.2307/2670170.

[26] Putter H, Fiocco M, Geskus RB. Tutorial in biostatistics: competing risks and multi state models. Stat Med 2007;26:2389–430. https://doi.org/10.1002/sim.2712.
[27] Livingston G, Huntley J, Liu KY, Costafreda SG, Selbæk G, Alladi S, Ames D, Banerjee S, Burns A, Brayne C, Fox NC, Ferri CP, Gitlin LN, Howard R, Kales HC, Kivimäki M, Larson EB, Nakasujja N, Rockwood K, Samus Q, Shirai K, Singh-Manoux A, Schneider LS, Walsh S, Yao Y, Sommerlad A, Mukadam N. Dementia prevention, intervention, and care: 2024 report of the Lancet standing Commission. Lancet. 2024;404(10452):572–628. https://doi.org/10.1016/S0140-6736(24)01296-0.
[28] Yan Y, Xiang H, Wang M, Wei J, Fan H, Du Y, Tao Y, Dou Y, Ma Y, Yang X, Ma X. Effects of depression and cognitive impairment on increased risks of incident dementia: a prospective study from three elderly cohorts. Transl Psychiatry 2024;14(1):427. https://doi.org/10.1038/s41398-024-03125-1.
[29] Kuo K, Zhang YR, Chen SD, He XY, Huang SY, Wu BS, Deng YT, Yang L, Ou YN, Guo Y, Zhang RQ, Zhang Y, Tan L, Dong Q, Cheng W, Yu JT. Associations of grip strength, walking pace, and the risk of incident dementia: a prospective cohort study of 340212 participants. Alzheimers Dement 2023;19(4):1415–27. https://doi.org/10.1002/alz.12793.
[30] Almidani L, Mihailovic A, Varadaraj V, Swenor BK, Ramulu PY. Longitudinal changes in visual acuity and contrast sensitivity and incident dementia. Am J Ophthalmol 2024;266:227–34. https://doi.org/10.1016/j.ajo.2024.06.001.
[31] Davies HR, Cadar D, Herbert A, Orrell M, Steptoe A. Hearing impairment and incident dementia: findings from the English Longitudinal Study of Ageing. J Am Geriatr Soc 2017;65(9):2074–81. https://doi.org/10.1111/jgs.14986.
[32] Ezzati A, Katz MJ, Derby CA, Zimmerman ME, Lipton RB. Depressive symptoms predict incident dementia in a community sample of older adults: results from the Einstein Aging Study. J Geriatr Psychiatry Neurol 2019;32:97–103. https://doi.org/10.1177/0891988718824036.
[33] Maharani A, Dawes P, Nazroo J, Tampubolon G, Pendleton N. Sense-Cog WP1 group. Visual and hearing impairments are associated with cognitive decline in older people. Age Ageing 2018;47(4):575–81. https://doi.org/10.1093/ageing/afy061.
[34] Albers MW, Gilmore GC, Kaye J, Murphy C, Wingfield A, Bennett DA, Boxer AL, Buchman AS, Cruickshanks KJ, Devanand DP, Duffy CJ, Gall CM, Gates GA, Granholm AC, Hensch T, Holtzer R, Hyman BT, Lin FR, McKee AC, Morris JC, Petersen RC, Silbert LC, Struble RG, Trojanowski JQ, Verghese J, Wilson DA, Xu S, Zhang LI. At the interface of sensory and motor dysfunctions and Alzheimer's disease. Alzheimers Dement 2015;11(1):70–98. https://doi.org/10.1016/j.jalz.2014.04.514.
[35] Li CL, Chiu YC, Bai YB, Lin JD, Stanaway F, Chang HY. The co-occurrence of depressive symptoms and cognitive impairment and its relationship with self-care behaviors among community dwelling older adults with diabetes. Diabetes Res Clin Pract 2017;129:73–8. https://doi.org/10.1016/j.diabres.2017.03.025.
[36] Gray SL, Anderson ML, Hubbard RA, LaCroix A, Crane PK, McCormick W, Bowen JD, McCurry SM, Larson EB. Frailty and incident dementia. J Gerontol A Biol Sci Med Sci 2013;68(9):1083–90. https://doi.org/10.1093/gerona/glt013.
[37] Rogers NT, Steptoe A, Cadar D. Frailty is an independent predictor of incident dementia: evidence from the English Longitudinal Study of Ageing. Sci Rep 2017;7(1):15746. https://doi.org/10.1038/s41598-017-16104-y.