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Intrinsic capacity decline and its associations in community-dwelling older adults in Kedah, Malaysia

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ABSTRACT

Objectives: Intrinsic capacity (IC) is the composite of physical and mental capacities, reflecting the overall functional ability in older adults. Evidence on IC decline in Malaysia remains limited; therefore, this study examined the prevalence of decline across six IC domains and identified key sociodemographic and clinical associations.

Methods: This cross-sectional study recruited 329 older adults from three Pusat Aktiviti Warga Emas centers in Kedah, Malaysia. Their IC was assessed using the World Health Organization-Integrated Care for Older People Step 1 screening tool across six domains (Mini-Mental State Examination, Short Physical Performance Battery, Mini Nutritional Assessment–Short Form, Geriatric Depression Scale–15, visual acuity self-report, and whisper test self-report). Data were analyzed using multivariable logistic regression adjusted for weight, body mass index, and gender, and expressed as adjusted odds ratios (aOR) with 95% confidence intervals (CI).

Results: IC decline was most common in vision (69.6%) and cognition (52.6%), followed by locomotion (40.1%), vitality (30.4%), hearing (23.1%), and psychological function (17.9%). Overall, 77.2% had impairment in at least one domain. Significant associations were observed between walking-aid use and decline in locomotion (aOR = 7.75), vitality (aOR = 1.99), and hearing (aOR = 3.55). Non-Malay ethnicity was associated with higher odds of psychological decline (aOR = 4.09) but lower odds of vitality decline (aOR = 0.28). Multimorbidity was associated with increased odds of vitality and psychological decline, while higher education was associated with lower odds of cognitive impairment (aOR = 0.35).

Conclusion: IC decline was highly prevalent, particularly in vision and cognition. These findings suggest the need for early, community-based, multidisciplinary strategies to preserve function and promote healthy aging.

Keywords: Community-dwelling older adults, Healthy aging, Intrinsic capacity, Malaysia

INTRODUCTION

The World Health Organization (WHO) conceptualizes intrinsic capacity (IC) as the composite of physical and mental capacities that an individual can draw on to maintain functional ability and healthy aging.[1] In the WHO healthy aging framework, IC refers to an individual's composite of physical and mental capacities, while functional ability reflects the interaction between IC and

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environmental factors, and disability represents a downstream outcome when functional limitations are not adequately compensated. Accordingly, indicators such as walking-aid use, hearing-aid use, and pacemaker implantation are better interpreted as markers of existing functional limitation or healthcare utilization, rather than direct associations with IC decline. IC spans cognitive, locomotor, psychological, vitality, and sensory domains, highlighting the physiological and psychological reserves that sustain independence. Declines in these domains predispose older adults to frailty, disability, and dependency.[2-4] The WHO Integrated Care for Older People (WHO-ICOPE) framework recommends screening six IC domains: Cognitive, locomotor, vitality, vision, hearing, and psychological to identify older adults at risk and to guide suitable targeted interventions for them.[4]

Studying IC is essential because it provides a function-centered, preventive lens on aging, enabling detection of early multidomain decline before disability develops. Unlike disease-based measures, IC integrates physical and mental reserves, supporting population surveillance, risk stratification, and timely intervention. This approach underpins the WHO-ICOPE framework by guiding person-centered, multidomain strategies to preserve independence and quality of life in older adults.

Globally, IC decline is increasingly recognized as a major public health issue, although prevalence estimates vary substantially across countries and study designs, ranging between 19% and 89%.[5-7] A multi-country study spanning eight nations demonstrated that IC decline is strongly associated with both dependence and mortality.[8] In a large community-based survey in China, 39.9% of older adults were found to have experienced IC decline, with locomotor and cognitive deficits being the most prominent.[9] Lower education, being unmarried, and low income were identified as significant correlates.[10] Other research emphasizes the role of sensory and psychological decline as important factors associated with falls and disability, while stepwise models consistently identify cognitive, psychological, and locomotor impairments as primary contributors to functional deterioration.[11] In addition, other studies also reported risk factors of IC decline include advancing age, female gender, multimorbidity, and lower educational attainment.[6,8]

IC decline shows substantial regional variation, reflecting differences in demographic aging, socioeconomic context, and healthcare access. Evidence from East Asia highlights prominent cognitive and locomotor impairments, whereas European studies more frequently report locomotor and vitality decline associated with frailty and healthcare utilization. Importantly, IC research from these regions has directly informed preventive strategies, including multicomponent exercise programs, nutritional optimization, sensory screening, and cognitive training to slow functional decline.[3,8] Longitudinal findings further support early, community-based interventions implemented before disability onset. Together, these insights support the WHO-ICOPE framework, demonstrating how IC surveillance translates into scalable, person-centered preventive care pathways tailored to population needs.[4]

In Malaysia, population aging is accelerating, with older adults expected to account for 15% of the population by 2030.[12] The northern region shows particularly rapid demographic shifts; for instance, Kedah recorded 13.3% of its population as older adults in 2024, reflecting its status as one of the country's most aged states.[13] Recent Malaysian evidence showed that 93.8% of older adults had impairment in at least one IC domain.[14] There is a lack of evidence from the northern region of Malaysia, particularly in Kedah, considering its escalating aging population. This limitation may hinder the ability to design targeted ICOPE-based interventions for the community-dwellers. The identification of some modifiable factors, such as the anthropometrics and clinical measures, remains limited. For instance, obesity that can be identified through the measurement of anthropometry is common among Malaysian older adults and is known to contribute to sarcopenia, metabolic disease, and mobility impairment.[15] In addition, falls, which represent another major geriatric syndrome, function both as a consequence of IC decline and as a risk factor that further accelerates deterioration.

Kedah, with one of the highest proportions of older adults in Malaysia, still lacks population-based data on IC decline. To address this gap, the present study builds on a multicenter community survey in Kedah. Specifically, it aims to estimate the prevalence of decline across six IC domains among community-dwelling older adults and to explore factors, such as sociodemographic, anthropometric, and clinical variables, that may contribute to multidomain IC decline. We hypothesized that the use of walking aids, sensory impairments, and a history of falls would be associated with higher odds of IC decline, whereas younger age, gender, and education level may be associated with lower odds of IC decline in specific domains.

MATERIALS & METHODS

Study design and participants

We conducted a community-based cross-sectional study among older adults attending wellness programs at three community centers known as Pusat Aktiviti Warga Emas (PAWE) in Kedah, Malaysia, between February and September 2025. Eligible participants were community-dwelling older adults aged ≥60 years who attended PAWE centers, were able to communicate, and provided written informed consent. The participants were excluded if they presented with severe cognitive impairment, acute medical illness, or physical limitations that precluded completion of anthropometric or functional assessments.

Participants were selected using a convenience sampling approach from older adults attending routine programs at the PAWE centers. These centers serve as community hubs for health screening, physical and mental wellness activities for older adults within their respective districts, providing an accessible sampling frame for community-dwelling populations.

Data collection

Before data collection, all trained assessors underwent standardized training conducted by the principal investigator. The training covered study objectives, ethical conduct, informed consent procedures, standardized administration of questionnaires, collection of anthropometric data, and WHO-ICOPE Step 1 screening protocols for IC assessments including all six domains (Mini-Mental State Examination [MMSE], Short Physical Performance Battery [SPPB], Mini Nutritional Assessment–Short Form [MNA-SF], Geriatric Depression Scale–15 [GDS-15], and self-reported sensory). Practical demonstrations and supervised practice sessions were conducted to ensure consistency and inter-observer reliability before field deployment.

Trained assessors conducted ice-breaking and briefing sessions with participants before collecting sociodemographic data (age, gender, ethnicity, education, marital status, and income) and clinical information (number of chronic diseases, medication use, walking aid, hearing aid, pacemaker, and falls in the past year) through structured interviews. Apart from that, height, weight, body mass index (BMI), waist-to-height ratio (WHtR), muscle mass, and skeletal muscle index (SMI) were measured physically by our trained assessors. Assistive device use (walking aid and hearing aid) and pacemaker implantation were recorded as clinical indicators of existing functional limitation and healthcare engagement, and their association with IC was analyzed for the impairment rather than assumed causal determinants.

Multimorbidity was defined as the presence of ≥2 chronic conditions,[16,17] polypharmacy as the concurrent use of ≥5 medications,[18] and low income was classified according to the national poverty threshold (Department of Statistics Malaysia).[19]

Several measures were implemented to minimize reporting and data-collection bias. Standardized and validated instruments were used across all IC domains, and data were collected using uniform protocols by trained assessors. Interviews were conducted in the participants' preferred language to reduce misunderstanding, and objective measures were prioritized where possible. To limit interviewer bias, assessors followed structured scripts, and data completeness was checked during each visit. Anthropometric and functional assessments were performed using calibrated equipment and standardized procedures.

IC assessment

IC was assessed using the WHO ICOPE Step 1 screening tool.[4] Decline was defined as: cognition (MMSE <24), locomotion (SPPB <9), vitality (MNA-SF <12), vision (visual acuity <6/12 or self-reported impairment), hearing (failed whisper test or self-reported impairment), and psychological status (GDS-15 ≥5). Each domain was coded as impaired (1) or unimpaired (0). Multidomain decline was defined as ≥2 impairments,[6] while IC decline was defined as ≥1 impairment.[17]

Anthropometry and body composition

The participant's height (cm) and body weight (kg) were measured using standardized protocols, while the BMI was calculated as kilograms divided by square meters height (kg/m²). The waist circumference was measured at the midpoint between the rib and iliac crest with measuring tape in centimeters, with central obesity defined as ≥90 cm in men and ≥80 cm in women.[20] WHtR was calculated as waist circumference (cm) divided by height (cm), with values >0.5 was considered high risk of cardiometabolic disease.[21] SMI was derived from the bioelectrical impedance analysis and defined as low if <7.0 kg/m² (men) or <5.7 kg/m² (women).[22]

Statistical analysis

Descriptive statistics summarized participant characteristics and IC prevalence. Logistic regression analyses were performed to examine associations between sociodemographic, clinical, and anthropometric factors and both multidomain and domain-specific IC decline. Independent variables examined included age, sex, ethnicity, education, marital status, multimorbidity, comorbidities, medication use, walking aid, hearing aid, pacemaker, BMI, waist circumference, WHtR, and SMI.

Covariates were chosen based on established literature and their biological relevance. Age and gender were included in all multivariable models as core demographic confounders, while BMI was included to account for the influence of overall adiposity on functional and metabolic outcomes. Additional variables demonstrating statistical significance ($P < 0.10$) or clinical relevance in unadjusted analyses were entered into multivariable logistic regression models to identify independent factors associated with IC decline.

Table 1: Characteristics of participants and prevalence of intrinsic capacity decline across domains.

Characteristics	Total (*n*=329)
Age, years, mean±SD	67.4±6.1
Sex, *n* (%)	
Male	158 (48.0)
Female	171 (52.0)
Marital status, *n* (%)	
Married	298 (90.6)
Widowed/Divorced/Single	31 (9.4)
Education level, *n* (%)	
None	10 (3.0)
Primary	46 (14.0)
Secondary	215 (65.3)
Tertiary	58 (17.6)
Household income, RM/month, median (IQR)	
<RM1999.00	1500.00 (1200.00–1500.00)
RM2000.00–RM3999.00	2000.00 (2000.00–2200.00)
>RM4000.00	4000.00 (4000.00–4372.50)
Number of chronic diseases, mean±SD	1.2±1.1
Morbidity group, *n* (%)	
No disease	120 (36.5)
1–2 disease	168 (51.1)
>2 diseases	41 (12.5)
Number of medications, mean±SD	0.9±0.5
Medication group, *n* (%)	
None	59 (17.9)
Non-polypharmacy (1–4)	243 (73.9)
Polypharmacy (≥5)	27 (8.2)
Falls in past 12 months, *n* (%)	
No	201 (61.1)
Once	80 (24.3)
More than once	48 (14.6)
Height, cm, mean±SD	157.1±0.1
Weight, kg, mean±SD	66.6±12.4
BMI, kg/m², mean±SD	26.9±4.3
BMI group, *n* (%)	
Underweight <18.5	8 (2.4)
Normal 18.5–22.9	56 (17.0)
Overweight 23.0–27.4	130 (39.5)
Obese ≥27.5	135 (41.0)
Waist circumference, cm, mean±SD	94.4±11.3
Waist circumference category, *n* (%)	
Normal (Men <90, Women <80)	37 (11.2)
High risk (Men ≥90, Women ≥80)	292 (88.8)
Waist-to-height ratio, mean±SD	0.59±0.07
Waist-to-height category, *n* (%)	
Normal (<0.50)	22 (6.7)
Central obesity (0.50–0.59)	149 (45.3)
Severe central obesity (≥0.60)	158 (48.0)
Muscle mass, kg, mean±SD	22.8±5.4
Muscle mass category, *n* (%)	
Normal (≥20 kg men, ≥15 kg women)	301 (91.5)
Low muscle mass	28 (8.5)
Skeletal muscle index, kg/m², mean±SD	9.2±1.9
SMI category, *n* (%)	
Normal (≥7.0 men, ≥5.4 women)	315 (95.7)
Low (<7.0 men, <5.4 women)	14 (4.3)
Intrinsic capacity domains impaired, *n* (%)	
Locomotion (SPPB <9)	132 (40.1)
Vitality (MNA-SF <12)	100 (30.4)
Cognition (MMSE <24)	173 (52.6)
Psychological (GDS-15 ≥5)	59 (17.9)
Vision (VA worse than 6/12)	229 (69.6)
Hearing (failed whisper test)	76 (23.1)
IC domain-count score, mean±SD	2.3±1.2
Any IC decline category	
<1 domain	75 (22.8)
≥1 domain	254 (77.2)

Values are presented as mean (SD), median (IQR), or n (%), as appropriate. BMI: Body mass index, IQR: Interquartile range, IC: Intrinsic capacity, MMSE: Mini-mental state examination, SPPB: Short physical performance battery, GDS-15: Geriatric Depression Scale–15; MNA-SF=Mini Nutritional Assessment–Short Form; VA=Visual Acuity

Adjusted odds ratios (aORs) for age, gender, and BMI with 95% confidence intervals (CIs) were reported, with significance set at $P < 0.05$. Analyses were conducted using IBM Statistical Package for the Social Sciences Statistics (Version 29.0).

Given the cross-sectional design, all effect estimates represent associations only, and causal relationships between explanatory variables and IC decline cannot be inferred.

This study was conducted and reported in accordance with the Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) statement for cross-sectional studies. A completed STROBE checklist indicating where each reporting item is addressed in the manuscript is provided as Supplementary File 1.

Ethical considerations

Ethical approval for this study was granted by the Universiti Teknologi MARA (UiTM) Research Ethics Committee (REC/09/2024 (PG/MR/437)). Written informed consent was obtained from all participants after they were provided with clear information on the study objectives, procedures, potential risks, and benefits. Recruitment and consent were facilitated by trained research assistants, who allowed participants sufficient time to ask questions and decide on their participation.

This study followed the principles of the Declaration of Helsinki. All participants gave written informed consent before taking part. Their confidentiality was carefully protected by removing personal identifiers, storing data securely, and limiting access to the research team only. Participants were also reminded that they could withdraw at any time without affecting their access to care or services.

RESULTS

Characteristics of participants and prevalence of IC

Decline across domains

Table 1 shows the characteristics of the study participants and the prevalence of IC decline across domains. A total of 329 community-dwelling older adults were included, with a mean age of 67.4 ± 6.1 years. The sample comprised slightly more females (52.0%) than males (48.0%). Most participants were married (90.6%) and had at least secondary education (65.3%), but the majority came from low- to middle-income households (median monthly income RM 1500, IQR: 1200–3000).

Clinical characteristics revealed a substantial burden of multimorbidity, with over half (51.1%) reporting one to two chronic diseases and 12.5% more than two. Falls were common, with 24.3% experiencing at least one fall in the past year. Polypharmacy was less frequent, affecting 8.2% of participants.

Anthropometric measures showed a high prevalence of overweight and obesity, with a mean BMI of 26.9 ± 4.3 kg/m^2; nearly 81% of participants were overweight or obese in combination. Central obesity was particularly striking, present in 88.8% by waist circumference and confirmed by WHtR, where 93.3% were classified as centrally obese, including nearly half 48.0% with severe central obesity. Muscle health was relatively preserved, with only 4.3% showing low SMI.

Regarding IC, impairments were widespread: vision (69.6%) and cognition (52.6%) were the most affected domains, followed by locomotion (40.1%), vitality (30.4%), hearing (23.1%), and psychological function (17.9%). Overall, 77.2% of participants demonstrated a decline in at least one IC domain.

Unadjusted logistic regression analysis of factors associated with IC decline

Unadjusted logistic regression analyses were performed to examine unadjusted associations between sociodemographic and clinical characteristics and IC decline across domains, identifying several significant associates before multivariable adjustment [Table 2].

Age showed a strong association with IC decline. Participants aged 70–79 had markedly higher odds of mobility decline (OR = 13.58, P = 0.001) and hearing impairment (OR = 9.00, P = 0.001) compared with those aged 60–69. Ethnicity influenced outcomes, with non-Malay groups showing greater risks of psychological (OR = 3.47, P = 0.004) and hearing decline (OR = 2.89, P = 0.013).

Gender differences highlight that women were more likely to experience mobility (OR = 1.61, P = 0.035) and vision decline (OR = 1.68, P = 0.032), but less likely to have cognitive decline (OR = 0.61, P = 0.029). Education was strongly protective; secondary (OR = 0.095, P = 0.005) and tertiary education (OR = 0.245, P = 0.001) substantially reduced the odds of mobility decline.

Widowed, divorced, and single category participants had nearly four-fold higher odds of mobility decline (OR = 3.95, P = 0.001). Comorbidities raised risks across domains, including hearing (OR = 4.60, P = 0.001) and psychological decline (OR = 3.01, P = 0.016).

Assistive device use showed strong associations with IC decline, with walking aid use markedly increasing the odds of locomotion (OR = 8.45, P = 0.001) and hearing impairment (OR = 3.64, P = 0.001), while hearing aid use being associated with hearing impairment (OR = 5.33, P = 0.001). These associations likely reflect underlying functional limitations rather than causal effects on IC.

Body composition also contributed with abnormal waist circumference that raised vitality decline risk (OR = 2.14, P = 0.032), whereas higher skeletal muscle was associated with lower odds off vitality (OR = 0.134, P = 0.003) and hearing decline (OR = 0.283, P = 0.033).

Multivariable-adjusted (age, gender, and BMI) logistic regression analysis of factors associated with IC decline

Variables that showed significant or clinically relevant associations in the unadjusted analyses were further entered into multivariate logistic regression models to adjust for potential confounders and to identify the independent association of IC decline [Tables 3 and 4]. Across domains,

Table 2: Unadjusted logistic regression model for IC domains with sociodemographic and clinical characteristics.

	Mobility			Vitality			Cognitive		
	OR	*P*-value	95% CI	OR	*P*-value	95% CI	OR	*P*-value	95% CI
Age (Ref: 60-69)									
70–79	**13.58**	**0.001**	2.960–62.37	1.18	0.772	0.382–3.654	3.601	0.054	0.978–13.259
80–89	**5.73**	**0.050**	1.002–22.33	1.59	0.440	0.487–5.239	3.153	0.093	0.826–12.044
Ethnic (Ref: Malay)									
Others	1.41	0.405	0.625–3.206	3.226	0.220	1.409–7.385	1.386	0.441	0.604–3.182
Gender (R: Male)									
Female	**1.61**	**0.035**	1.034–2.522	1.337	0.229	0.833–2.146	**0.614**	**0.029**	0.397–0.951
Education (Ref: Primary)									
Secondary	**0.095**	**0.005**	0.018–0.497	3.732	0.228	0.438–31.779	0.527	0.387	0.124–2.244
Tertiary	**0.245**	**0.001**	0.107–0.559	0.707	0.410	0.310–1.612	0.866	0.719	0.396–1.894
None	0.643	0.175	0.339–1.218	0.957	0.892	0.507–1.807	1.242	0.465	0.694–2.224
Smoking (R: No)									
Yes	0.661	0.217	0.343–1.276	0.497	0.075	0.235–1.199	1.715	0.098	0.905–3.250
Marital status (R; Married)									
Widow, Divorced, and Single	**3.95**	**0.001**	1.749–8.931	1.161	0.714	0.523–2.580	1.908	0.110	0.864–4.215
Income (R: <1999)									
2000–3999	1.25	0.607	0.535–2.919	1.138	0.777	0.464–2.793	0.936	0.879	0.403–2.178
>4000	1.37	0.488	0.557–3.412	1.204	0.705	0.461–3.144	0.804	0.634	0.327–1.977
Comorbid (R: None)									
1–2	**2.40**	**0.018**	1.161–4.998	**2.456**	**0.018**	1.166–5.173	0.859	0.675	0.422–1.748
>2	1.09	0.787	0.555–2.176	1.698	0.137	0.845–3.411	1.001	0.997	0.506–1.982
Walking aids (R: None)									
Yes	**8.45**	**0.001**	4.166–17.157	**1.839**	**0.046**	1.012–3.341	0.775	0.388	0.434–1.384
Hearing aids (R: none)									
Yes	**2.89**	**0.041**	1.043–8.029	2.126	0.133	0.795–5.680	1.015	0.976	0.382–2.700
Pacemaker (R: None)									
Yes	3.11	0.068	0.918–10.557	2.372	0.143	0.746–7.545	2.799	0.128	0.744–10.530
Medication (R: None)									
<5	1.453	0.425	0.580–3.642	0.447	0.132	0.157–1.275	0.898	0.816	0.361–2.233
5 above	1.422	0.387	0.640–3.157	0.692	0.447	0.268–1.787	0.807	0.598	0.364–1.789
BMI (Ref: Normal)									
UW	0.37	0.19	0.086–1.639	0.583	0.476	0.132–2.568	1.642	0.509	0.377–7.146
OW	0.89	0.74	0.476–1.697	0.739	0.383	0.374-1.459	**0.394**	**0.007**	0.202–0.771
OB	0.94	0.80	0.574–1.539	0.684	0.160	0.403–1.161	1.048	0.859	0.647–1.696
WC (Normal)									
Abnormal	1.02	0.95	0.508–2.047	**2.140**	**0.032**	1.068–4.288	1.555	0.218	0.770–3.141
SMI (Ref: Normal)									
Abnormal	0.321	0.068	0.095–1.089	**0.134**	**0.003**	0.036–0.507	0.785	0.685	0.244–2.527
	Psychological			**Hearing**			**Vision**		
	OR	***P*-value**	**95% CI**	**OR**	***P*-value**	**95% CI**	**OR**	***P*-value**	**95% CI**
Age (Ref: 60-69)									
70–79	1.766	0.356	0.528–0.591	**9.000**	**0.001**	2.853–8.389	1.127	0.844	0.342–3.720
80–89	2.257	0.217	0.621–8.211	**3.780**	**0.027**	1.166–12.26	1.023	0.972	0.295–3.545

(Contd...)

Table 2: *(Continued)*.

	Psychological			Hearing			Vision		
	OR	*P*-value	95% CI	OR	*P*-value	95% CI	OR	*P*-value	95% CI
Ethnic (Ref: Malay)									
Others	**3.469**	**0.004**	1.473–8.171	**2.889**	**0.013**	1.252–6.665	0.760	0.527	0.324–1.782
Gender (R: Male)									
Female	1.214	0.502	0.689–2.140	0.902	0.694	0.540–1.507	**1.680**	**0.032**	1.046–2.699
Education (Ref: Primary)									
Secondary	0.377	0.289	0.062–2.284	**0.184**	**0.020**	0.767–1.371	0.755	0.705	0.176–3.234
Tertiary	0.526	0.301	0.155–1.780	0.520	0.186	0.198–1.371	0.554	0.180	0.233–1.313
None	0.356	0.038	0.135–0.944	0.606	0.207	0.278–1.320	0.763	0.386	0.415–1.404
Smoking (R: No)									
Yes	0.774	0.588	0.328–1.825	0.760	0.489	0.350–1.652	0.736	0.354	0.385–1.407
Marital status (R; Married)									
Widow, Divorced, and Single	0.907	0.850	0.332–2.477	1.235	0.627	0.526–2.899	1.021	0.961	0.450–2.315
Income (R: <1999)									
2000–3999	0.162	0.079	0.021–1.235	0.982	0.973	0.348–2.776	1.020	0.967	0.403–2.580
>4000	0.264	0.211	0.033–2.128	0.668	0.668	0.226–1.976	1.175	0.747	0.440–3.138
Comorbid (R: None)									
1–2	3.018	0.016	1.228–7.417	**4.604**	**0.001**	2.039–10.394	0.685	0.323	0.324–1.450
>2	1.393	0.407	0.636–3.054	**2.059**	**0.047**	1.011–4.194	0.756	0.443	0.369–1.545
Walking aids (R: None)									
Yes	1.534	0.230	0.763–3.084	**3.644**	**0.001**	1.976–6.718	1.695	0.133	0.852–3.374
Hearing aids (R: none)									
Yes	1.991	0.213	0.674–5.884	5.325	0.001	1.952–14.523	**0.366**	**0.045**	0.137–0.978
Pacemaker (R: None)									
Yes	3.479	0.039	1.064–11.371	2.475	0.132	0.762–8.035	0.869	0.822	0.255–2.954
Medication (R: None)									
<5	1.125	0.826	0.394–3.212	0.235	0.068	0.050–1.111	3.712	0.019	1.238–11.129
5 above	1.888	0.179	0.747–4.775	0.249	0.064	0.057–1.085	1.710	0.298	0.622–4.697
BMI (Ref: Normal)									
UW	0.324	0.142	0.072–1.458	**0.227**	**0.046**	0.053–0.971	1.714	0.476	0.389–7.547
OW	0.584	0.164	0.274–1.246	0.521	0.075	0.255–1.067	1.353	0.383	0.686–2.672
OB	1.071	0.839	0.553–2.072	0.758	0.361	0.417–1.375	1.462	0.160	0.861–2.482
WC (Normal)									
Abnormal	1.837	0.130	0.835–4.038	1.710	0.156	0.814–3.591	1.036	0.926	0.491–2.819
SMI (Ref: Normal)									
Abnormal	0.420	0.168	0.122–1.443	**0.283**	**0.033**	0.089–0.906	1.151	0.822	0.338–3.914

Bold values should be indicated as footnotes, as “Significant at $P<0.05$”. OR: Odds ratio, CI: Confidence interval, Ref: Reference category, BMI: Body mass index, UW: Underweight, OW: Overweight, OB: Obese, WC: Waist circumference, SMI: Skeletal muscle index

device use remains the most consistently associated factor of IC decline. For mobility, walking aid use demonstrated the strongest effect, with users nearly 8 times more likely to experience decline (aOR 7.75, 95% CI: 3.72–16.15, *P* = 0.001). Interestingly, comorbidities were inversely associated, as individuals with one to two conditions (aOR 0.46, 95% CI: 0.27–0.79, *P* = 0.005) or more than two (aOR 0.39, 95% CI: 0.18–0.86, *P* = 0.019) showed reduced odds of decline, and lack of formal education was also associated with a protective effect (aOR 0.35, 95% CI: 0.15–0.82, *P* = 0.015).

Vitality decline was linked to walking aid use (aOR 1.99, 95% CI: 1.07–3.69, *P* = 0.030) and comorbidities (aOR 2.28, 95% CI: 1.06–4.89, *P* = 0.035), whereas non-Malay ethnicity

Table 3: Adjusted (age, gender, BMI) logistic regression model for mobility, vitality and cognition domains (key associates only).

Predictor	Mobility: aOR (95% CI)	Mobility: *P*-value	Vitality: aOR (95% CI)	Vitality: *P*-value	Cognition: aOR (95% CI)	Cognition: *P*-value
Walking aid use	7.75 (3.72–16.15)	0.001	1.99 (1.07–3.69)	0.030	0.82 (0.45–1.51)	NS
Comorbidities (1–2 conditions)	0.46 (0.27–0.79)	0.005	2.28 (1.06–4.89)	0.035	1.07 (0.50–2.25)	NS
Comorbidities (>2 conditions)	0.39 (0.18–0.86)	0.019	1.55 (0.76–3.15)	NS	1.12 (0.55–2.27)	NS
No formal education	0.35 (0.15–0.82)	0.015	0.16 (0.02–1.50)	NS	1.31 (0.72–2.40)	NS
Non-Malay ethnicity	0.82 (0.31–2.17)	NS	0.28 (0.11–0.67)	0.005	1.20 (0.48–2.90)	NS
Abnormal SMI	0.33 (0.09–1.26)	NS	0.15 (0.04–0.59)	0.007	0.70 (0.20–2.50)	NS

Models were adjusted for age, gender, and body mass index (BMI). Only key associates demonstrating independent associations with each intrinsic capacity domain are presented. NS indicate non-significant, variables that were not independently associated with the respective domain after adjustment. No independent associations were identified for the cognition domain in the fully adjusted model. BMI: Body mass index, aOR: Adjusted odds ratios, CI: Confidence interval, SMI: Skeletal muscle index

Table 4: Adjusted (age, gender, BMI) logistic regression model for psychological, hearing and vision domains (key associations only).

Predictor	Psychological: aOR (95% CI)	Psychological: *P*-value	Hearing: aOR (95% CI)	Hearing: *P*-value	Vision: aOR (95% CI)	Vision: *P*-value
Non-Malay ethnicity	4.09 (1.60–10.42)	0.003	1.99 (0.78–5.05)	NS	0.76 (0.30–1.89)	NS
Comorbidities (≥1 condition)	3.10 (1.23–7.84)	0.017	0.40 (0.20–0.80)	0.009	0.57 (0.25–1.25)	NS
Pacemaker use	3.52 (1.03–12.02)	0.044	1.70 (0.48–6.05)	NS	0.93 (0.26–3.30)	NS
No formal education	0.36 (0.13–0.96)	0.040	0.70 (0.31–1.56)	NS	0.75 (0.40–1.39)	NS
Walking aid use	1.70 (0.80–3.50)	NS	3.55 (1.85–6.80)	0.001	1.60 (0.80–3.22)	NS
Hearing aid use	1.70 (0.52–5.50)	NS	4.33 (1.46–12.82)	0.008	0.35 (0.12–0.99)	0.048
Comorbidities (1–2 conditions)	3.10 (1.22–7.80)	0.017	0.41 (0.22–0.76)	0.009	0.57 (0.26–1.25)	NS
Comorbidities (>2 conditions)	1.31 (0.60–2.93)	NS	0.16 (0.05–0.55)	0.001	0.70 (0.33–1.50)	NS
Medication use (<5 drugs)	1.20 (0.42–3.50)	NS	0.21 (0.04–1.05)	NS	0.45 (0.25–0.88)	0.008
Medication use (≥5 drugs)	2.00 (0.78–5.13)	NS	0.26 (0.06–1.19)	NS	0.25 (0.08–0.76)	0.014

Models were adjusted for age, gender, and body mass index (BMI). Only key associates demonstrating independent associations with each intrinsic capacity domain are presented. NS indicate non-significant, variables that were not independently associated with the respective domain after multivariable adjustment. BMI: Body mass index, aOR: Adjusted odds ratios, CI: Confidence interval

(aOR 0.28, 95% CI: 0.11–0.67, $P = 0.005$) and abnormal SMI (aOR 0.15, 95% CI: 0.04–0.59, $P = 0.007$) were protective. No independent associations were observed for cognitive decline after multivariable adjustment.

Psychological decline was strongly associated with non-Malay ethnicity (aOR 4.09, 95% CI: 1.60–10.42, $P = 0.003$), comorbidities (aOR 3.10, 95% CI: 1.23–7.84, $P = 0.017$), and pacemaker use (aOR 3.52, 95% CI: 1.03–12.02, $P = 0.044$), while lack of formal education showed protective effects (aOR 0.36, 95% CI: 0.13–0.96, $P = 0.040$).

For hearing, significant risks were observed with walking aid (aOR 3.55, 95% CI: 1.85–6.80, $P = 0.001$), hearing aid (aOR 4.33, 95% CI: 1.46–12.82, $P = 0.008$), and pacemaker use (aOR 3.52, 95% CI: 1.03–12.02, $P = 0.044$), whereas comorbidities were protective (one to two conditions: aOR 0.41, $P = 0.009$; more than two: aOR 0.16, $P = 0.001$). In the adjusted models, assistive device use and pacemaker implantation remained strongly associated with IC impairment, supporting their interpretation as markers of accumulated morbidity and functional limitation rather than independent associations.

Vision outcomes highlighted the protective influence of medication use (fewer than five drugs: aOR 0.45, 95% CI: 0.25–0.88, $P = 0.008$; ≥5 drugs: aOR 0.25, 95% CI: 0.08–0.76, $P = 0.014$) and hearing aid use (aOR 0.35, 95% CI: 0.12–0.99, $P = 0.048$).

DISCUSSION

This study contributes to the growing body of evidence on IC by demonstrating a high burden of multidomain decline among community-dwelling older adults in a rapidly aging Malaysian state. Rather than repeating prevalence estimates, the present findings are best interpreted in relation to international research that has established IC as a sensitive marker of early functional vulnerability preceding frailty and disability. The predominance of vision impairment and evidence of cognitive decline risk observed in this study are consistent with reports from China and other Southeast Asian countries,[23,24] where uncorrected sensory deficits and cognitive decline remain common due to delayed screening and limited access to preventive services.[9,22]

The recruitment of participants from PAWE community centers has important implications for interpretation and generalizability. PAWE centers represent structured wellness environments that attract older adults who are more socially connected, health-aware, and functionally mobile. As a result, the prevalence of IC decline observed in this study may underestimate the true burden among less-engaged or more vulnerable older adults, while certain associations, particularly those related to healthcare engagement and assistive device use, may be amplified in this setting. Accordingly, the findings should be generalized primarily to older adults living in similar community-based, wellness-oriented settings, rather than to the entire older population, including those who are homebound, institutionalized, or socially isolated.

The strong association between walking-aid use and declines in locomotion, vitality, and hearing mirrors findings from European and Japanese cohorts, where reliance on assistive devices reflects underlying functional limitation and progression toward frailty rather than acting as an independent causal factor.[25,26] This consistency across regions reinforces the interpretation of device use as a marker of accumulated functional loss, supporting the WHO conceptual distinction between IC and disability. Similarly, the association between multimorbidity and declines in vitality and psychological domains is consistent with longitudinal evidence linking clustered chronic conditions with greater energy loss and psychological burden.[8]

Importantly, assistive device use and pacemaker implantation typically occur after the onset of functional impairment, and therefore, their associations with IC decline likely reflect reverse causation and underlying disease severity, consistent with the WHO distinction between IC, functional impairment, and disability.

Notably, several findings highlight context-specific patterns that differ from those of Western populations. The protective associations observed for education and selected indicators of healthcare engagement may reflect differences in health literacy, healthcare engagement, and access to ongoing care among older adults with regular health system contact.[27] Comparable patterns have been reported in Korea and Taiwan, where frequent interaction with primary care reduced sensory and mobility decline despite a high burden of chronic disease.[28,29] These findings suggest that the relationship between multimorbidity and IC decline is not uniform and may be modified by access to healthcare services and continuity of care.[30]

From a global perspective, the present results have relevance beyond Malaysia. Regions with similar sociodemographic profiles, including other middle-income Southeast Asian countries and rapidly aging rural populations elsewhere, face comparable challenges of sensory impairment, multimorbidity, and delayed preventive care. The consistency of key associations across diverse settings supports the transferability of WHO-ICOPE-aligned strategies, particularly those emphasizing early screening, mobility preservation, nutritional optimization, and mental health support delivered at the community level.

Importantly, this study reinforces the value of IC as a practical framework for population-level prevention, rather than a diagnostic endpoint. By detecting early signs of functional vulnerability before disability becomes apparent, IC-based surveillance helps health systems focus on scalable, person-centered interventions.[31] In settings such as Kedah, embedding multidisciplinary ICOPE pathways within existing community hubs, including PAWE centers and primary care clinics, offers a feasible approach to preserving independence and delaying disability. Similar models may be adapted in other regions facing parallel demographic and health system constraints.[32]

Strengths and Limitations

This study has several strengths, particularly in its comprehensive assessment of IC across all six WHO-ICOPE domains within a Malaysian population. It is one of the first to assess IC comprehensively across all six WHO-ICOPE domains in a Malaysian population, using validated tools and standardized administration by trained assessors monitored by principle investigator with physiotherapy background. The relatively large sample size and inclusion of participants from multiple PAWE centers strengthen the reliability of the findings and provide valuable insights into the health status of older adults in rural and semi-urban communities.

Several limitations should also be acknowledged. The study excluded participants from urban areas, which may limit the generalizability of the results to the wider Malaysian aging population. The cross-sectional design prevents causal interpretations of the associations identified. Reliance on self-reported data, such as falls and medical history, introduces the potential for recall bias. Finally, while validated screening instruments were employed, the absence of clinical diagnostic confirmation may have resulted in under- or over-estimation of impairments in certain domains. This recruitment approach introduces potential selection bias, as older adults who attended PAWE centers are likely to be more socially engaged and functionally independent than non-attendees. Because participants were recruited from PAWE community centers, which provide structured wellness, social, and health-promotion activities, the study population may differ systematically from the broader older adult population in terms of health status, health-seeking behavior, and social support.

CONCLUSION

This study highlights a substantial burden of multidomain IC decline among community-dwelling older adults, reinforcing IC as a sensitive marker of early functional vulnerability rather than clear disability. The observed associations, particularly those related to multimorbidity and markers of functional limitation, are consistent with international evidence and support the conceptual distinction between IC, functional impairment, and disability proposed by the WHO. Importantly, the findings demonstrate the relevance of IC-based surveillance for guiding preventive, person-centered strategies in populations with similar sociodemographic profiles, including rapidly aging middle-income settings. Embedding WHO-ICOPE-aligned screening and early interventions within community and primary care platforms may offer a scalable approach to preserving functional ability and delaying disability across diverse regions.

These findings are most applicable to community-active older adults in settings similar to PAWE centers and should not be extrapolated to more frail or socially isolated populations without caution. Given the cross-sectional design, these findings should be interpreted as associative rather than causal, and the implications for intervention should be viewed as informative for future research and planning, rather than definitive evidence of effectiveness. Overall, the findings reinforce IC as an early functional vulnerability construct, with assistive devices representing markers of existing functional limitation rather than causal influences on IC decline.

Reporting guidelines

The reporting of this cross-sectional study complies with the STROBE guidelines. The completed STROBE checklist is available as Supplementary File 1.

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REFERENCES

1. World Health Organization. Decade of healthy ageing: Baseline report. Geneva: WHO; 2020.
2. Cesari M, Vellas B. Multimorbidity and intrinsic capacity: From theory to practice. J Frailty Aging 2018;7:2-3.
3. Beard JR, Officer A, De Carvalho IA, Sadana R, Pot AM, Michel JP, *et al*. The World report on ageing and health: A policy framework for healthy ageing. Lancet 2016;387:2145-54.
4. World Health Organization. Integrated care for older people: Guidelines on community-level interventions to manage declines in intrinsic capacity. Geneva: WHO; 2017.
5. De Oliveira VP, Ferriolli E, Lourenço RA, González-Bautista E, De Souto Barreto P, De Mello RG. The sensitivity and specificity of the WHO's ICOPE screening tool, and the prevalence of loss of intrinsic capacity in older adults: A scoping review. Maturitas 2023;177:107818.
6. Leung AY, Su JJ, Lee ES, Fung JT, Molassiotis A. Intrinsic capacity of older people in the community using WHO integrated care for older people (ICOPE) framework: A cross-sectional study. BMC Geriatr 2022;22:304.
7. Lu F, Li J, Liu X, Liu S, Sun X, Wang X. Diagnostic performance analysis of the integrated care for older people (ICOPE) screening tool for identifying decline in intrinsic capacity. BMC Geriatr 2023;23:509.
8. Prince MJ, Acosta D, Guerra M, Huang Y, Jacob KS, JimenezVelazquez IZ, *et al.* Intrinsic capacity and its associations with incident dependence and mortality in 10/66 dementia research group studies in Latin America, India, and China: A population-based cohort study. PLoS Med 2021;18:e1003097.
9. Ma L, Chhetri JK, Zhang L, Sun F, Li Y, Tang Z. 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. BMJ Open 2021;11:e043062.
10. Cao X, Yi X, Chen H, Tian Y, Li S, Zhou J. Prevalence of intrinsic capacity decline among community-dwelling older adults in China: Results from a cross-sectional study. Front Public Health 2024;12:1129438.
11. Yu S, Wang J, Xia Y, Tang Q. The status quo and influencing

factors of intrinsic capacity among community-dwelling older adults from the perspective of Ecological systems theory: A cross-sectional study. BMC Geriatr 2024;24:934.
12. Abdullah JM, Ismail A, Yusoff MS. Healthy ageing in Malaysia by 2030: Needs, challenges and future directions. Malays J Med Sci 2024;31:1-13.
13. The Star. Elderly population to hit 17% by 2040, says stats dept. The Star; 2024. Available from: https://www.thestar.com.my/news/nation/2024/09/06/elderly-population-to-hit-17-by-2040-says-stats-dept [Last accessed on 2025 Dec 20].
14. Ahip SS, Ting CY, Abdillah MA, Tan YJ, Sabri SA, Theou O, *et al*. Integrated service delivery model in primary care to support older persons in Malaysia: Evaluation of the first GeKo-ISD clinics. Geriatr Care 2024;10:100123.
15. Noordin N, Siriphorn A, Wah YC, Justine M. Development and evaluation of a physiotherapy-led, WHO-ICOPE-based, person-centered Integrated Care program (PTICOPE) module to enhance intrinsic capacity in older adults: Protocol for a randomized controlled trial. PLoS One 2025;20:e0318513.
16. Barnett K, Mercer SW, Norbury M, Watt G, Wyke S, Guthrie B. Epidemiology of multimorbidity and implications for health care, research, and medical education: A cross-sectional study. Lancet 2012;380:37-43.
17. World Health Organization. Multimorbidity: Technical series on safer primary care. Geneva: WHO; 2016. Available from: https://apps.who.int/iris/handle/10665/252275 [Last accessed on 2025 Dec 20].
18. Masnoon N, Shakib S, Kalisch-Ellett L, Caughey GE. What is polypharmacy? A systematic review of definitions. BMC Geriatr 2017;17:230.
19. Department of Statistics Malaysia (DOSM). Household income and basic amenities survey report 2019. Putrajaya: DOSM; 2020. Available from: https://www.dosm.gov.my [Last accessed on 2025 Dec 20].
20. World Health Organization. Waist circumference and waist-hip ratio: Report of a WHO expert consultation. Geneva: WHO; 2008. Available from: https://apps.who.int/iris/handle/10665/44583 [Last accessed on 2025 Dec 20].
21. Ashwell M, Gibson S. Waist-to-height ratio as an indicator of 'early health risk': Simpler and more predictive than using a 'matrix' based on BMI and waist circumference. BMJ Open 2016;6:e010159.
22. Chew FL, Salowi MA, Mustari Z, Husni MA, Hussein E, Adnan TH, *et al*. Estimates of visual impairment and its causes in Malaysia: The national eye survey II (NES II). Ophthalmic Epidemiol 2018;25:319-27.
23. Nguyen TT, Saw M, Hamid TA, Rahman SA, Yap KB, Choo WY, *et al*. Intrinsic capacity among older adults in Southeast Asia: Prevalence and determinants. BMC Geriatr 2021;21:450.
24. Dominguez J, Tan LF, Phan P. Dementia trends in Southeast Asia: Epidemiology and policy implications. Asia Pac Psychiatry 2022;14:e12488.
25. Beaudart C, Reginster JY, Geerinck A, Locquet M, Bruyère O. Association between use of walking aids and functional outcomes in older adults: Results from a European cohort. J Am Med Dir Assoc 2019;20:850-7.
26. Seino S, Kitamura A, Tomine Y, Taniguchi Y, Yokoyama Y, Amano H, *et al*. A community-wide intervention trial for preventing and reducing frailty among older adults living in metropolitan areas: Design and baseline survey for the Ota Genki Senior Project. Jpn J Public Health 2018;65:232-43.
27. Livingston G, Huntley J, Sommerlad A, Ames D, Ballard C, Banerjee S, *et al*. Dementia prevention, intervention, and care: 2020 report of the lancet commission. Lancet 2020;396:413-46.
28. Park S, Kim JH, Kim KW, Na DL. Comorbidities and multimorbidity in the elderly: The Korean longitudinal study on health and aging (KLoSHA). J Korean Med Sci 2020;35:e258.
29. Chou MY, Wang YC, Liang CK, Peng LN, Chen LK. Comorbidity, multimorbidity and geriatric syndromes in the older population: Taiwanese experiences. Aging Med 2021;4:282-9.
30. Ng CG, Amer Siddiq AN, Aida SA. Stigma in mental illness: Perspectives from Malaysia. Int Rev Psychiatry 2020;32:569-82.
31. Lim WS, Chen C, Woo J. Implementing WHO ICOPE in Asia: Challenges and opportunities. J Am Med Dir Assoc 2023;24:589-95.
32. Razak RA, Yusof Y, Ismail M. Nutrition risk and support services among community-dwelling older Malaysians. Malays J Nutr 2021;27:44.