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Status and determinants of health promotion among community-dwelling older adults with intrinsic capacity decline: a COM-B model-based path analysis

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Title Page

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Abstract

Background: Older adults with intrinsic capacity decline have low adherence to health promotion interventions, a critical issue since these interventions are key to improving intrinsic capacity. This study aimed to explore the status and determinants of health promotion behaviours among community-dwelling older adults with intrinsic capacity decline, using path analysis guided by the capability, opportunity, motivation and behaviour (COM-B) model, and to inform targeted community health interventions.

Methods: From May to December 2024, 798 older adults with intrinsic capacity decline were included in the final analytical sample via convenience sampling in 18 communities. General information questionnaire, the Integrated Care for Older People (ICOPE) Screening Tool, the Physical Resilience Instrument for Older Adults (PRIFOR), the General Self-efficacy Scale (GSES), the Social Support Rating Scale (SSRS) and the Geriatric Health Promotion (GHP) Scale were used to collect data. R v4.5.2, IBM SPSS v26.0 and AMOS v29.0 were used for descriptive statistics, univariate analysis, correlation, hierarchical regression and structural equation path analysis.

Results: The mean health promotion score of older adults with IC decline in this study was 70.73±7.020 points. Statistically significant differences in GHP were observed among older adults with intrinsic capacity decline by BMI categories, educational levels, smoking history, and regular physical examination status. Social support exerted the largest total effect on health promotion (0.423), physical resilience had a direct effect of 0.304, and general self-efficacy exerted an indirect effect of 0.126 via physical resilience. All path effects were statistically significant, and the internal validation in the subsample with cognitive decline confirmed the stability of the model.

Conclusions: Health promotion among older adults with intrinsic capacity decline needs improvement. Priority should be given to groups with low social support and physical resilience. Targeted interventions addressing these multi-dimensional influencing factors are recommended to enhance geriatric health promotion.

Keywords: older adults, intrinsic capacity decline, health promotion, COM-B model, path analysis

Introduction

China has one of the largest and fastest-growing ageing populations in the world. The phenomenon of "longevity without health" among older adults has become increasingly prominent and poses a pressing social challenge. The World Health Organization (WHO) states that the fundamental approach to fostering healthy ageing is to maintain and improve intrinsic capacity (IC) [1]. IC refers to the aggregate of all physical and mental capabilities, mainly divided into five domains: cognition, vitality, locomotion, psychology and sensory function [2]. IC decline is directly associated with frailty progression [3] and increased risks of disability in instrumental activities of daily living (IADL) and activities of daily living (ADL) [4]. A scoping review reported that the prevalence of IC decline among older adults ranges from 19.23% to 98.00% [5], with this wide variation attributable to differences in study populations, settings, and assessment instruments used across investigations. The substantial prevalence of IC decline consequently contributes to higher rates of disability [6], hospitalisation and mortality among older adults [7–9]. Given these adverse consequences, IC plays a vital role in the process of healthy ageing [10].

The Capability, Opportunity, Motivation-Behaviour (COM-B) model [11] proposes that capability, opportunity and motivation are three essential prerequisites for individual behaviour. Specifically, capability (C) refers to an individual’s inherent ability to perform certain activities or behaviours; opportunity (O) denotes external factors that facilitate or hinder behaviours; motivation (M) represents the intention to engage in a specific behaviour. These three components interact jointly to drive behavioural engagement. The WHO indicates that human behaviour affects health outcomes [12]. Geriatric health promotion (GHP) is a concept oriented toward self-actualisation, encompassing all behaviours and lifestyles adopted to maintain or enhance health, which can effectively reduce health risks and prevent diseases [13]. Insufficient GHP directly exacerbates frailty

[14] and impairs quality of life. Therefore, it is necessary to focus on GHP among older adults with IC decline. The COM-B model is well suited to analysing and interpreting individual behaviours in specific contexts, as it helps comprehensively identify key factors affecting GHP in individuals with IC decline, thereby facilitating health behaviour change [15]. However, despite the established benefits of GHP, older adults with IC decline generally exhibit suboptimal engagement in GHP, and the multifactorial mechanisms underlying such behaviours have not been fully clarified. Moreover, although the COM-B model has been increasingly applied to GHP among older adults, few studies have quantitatively examined, within this framework, the chain pathways through which social support, general self-efficacy, and physical resilience jointly influence GHP among community-dwelling older adults with IC decline.

Within this framework, capability (C) was operationalised as physical resilience, defined as the ability to recover from or adapt to age-related impairments and illnesses [16]; physical resilience reflects the functional reserve required to initiate and sustain health behaviours and is therefore a reasonable indicator of capability. As a predictor of future health and longevity, physical resilience serves as a critical starting point for achieving successful ageing [17, 18]. Motivation (M) was operationalised as general self-efficacy: individuals with higher self-efficacy possess greater confidence and perceived control over performing health behaviours [19]. Opportunity (O) was operationalised as social support, which directly reflects the closeness and quality of social connections and exerts a substantial impact on GHP [20]. On this basis, the research hypotheses of this study are proposed, as presented in Figure 1.

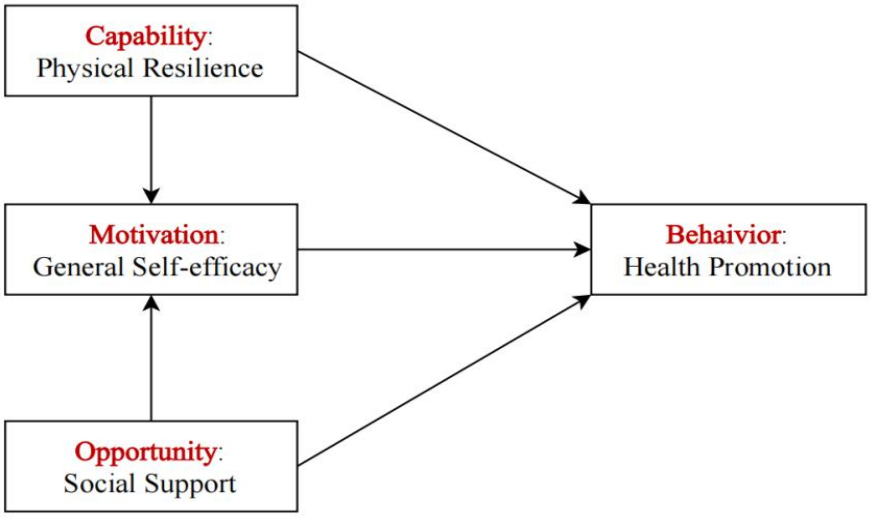

Figure 1 Hypothesised paths based on the COM-B model

Using the COM-B model as a framework, this cross-sectional study examined the status, determinants, and influencing pathways of GHP among community-dwelling older adults with IC decline, focusing on the direct and indirect effects of social support, general self-efficacy and physical resilience. The findings may inform targeted community-based interventions and advance the theoretical framework for improving GHP in this population.

Materials and methods

Study design

We conducted a cross-sectional study to investigate the geriatric health promotion and associated factors among older adults with intrinsic capacity decline. This study used the STROBE statement for cross-sectional studies (Table S1).

Setting and participants

From May to December 2024, participants were recruited from 18 communities in Changsha, Hunan Province, China, using a convenience sampling method. Inclusion criteria: age ≥ 60 years; residing in the community for six months or longer; meeting the criteria for IC decline as defined by the Integrated Care for Older People (ICOPE) Screening Tool; providing voluntary participation and signed informed consent. Exclusion

criteria: diagnosis with severe physical or mental illnesses; presence of consciousness disorders, psychiatric disorders or severe cognitive impairment that precluded cooperation with the questionnaire survey.

The sample size was calculated using the sample size formula for cross-sectional surveys: $N = (U_{1-\alpha/2}\sigma/\delta)^2$ [21]. With a significance level α=0.05 ($U_{1-\alpha/2}$ = 1.96) and an allowable error of δ = 0.9, and based on the mean health promotion score of 75.02 ± 6.04 (σ = 6.04) reported in a previous relevant study [22], the required sample size was estimated as $N = (1.96\times6.04/0.9)^2 \approx 173$. After accounting for an anticipated 20% invalid response rate, the adjusted sample size was $N = 173/(1 - 0.20) \approx 217$. However, as participants needed to be screened for IC decline and structural equation modelling requires a larger sample, questionnaires were distributed to 850 older adults. Of these, 798 older adults with IC decline were included in the final analytical sample, yielding a valid response rate of 93.88%.

Assessment tools and indicators

General information questionnaire

A self-designed questionnaire was used to collect sociodemographic and health-related data. The questionnaire included the following variables: sociodemographic characteristics (gender, age, educational level, marital status, living arrangement, monthly income (CNY), medical insurance and occupation); clinical and health status (BMI category, number of chronic diseases (types), number of medications (types), and duration of chronic diseases (years); and behavioural and psychosocial factors (smoking and drinking history, self-perceived health status, life satisfaction, and regular physical examination).

Integrated care for older people (ICOPE) screening tool

This study utilised the assessment tool from the World Health Organization's Integrated care for older people (ICOPE): guidance for person-centred assessment and pathways in primary care [23]. The ICOPE screening tool evaluates five domains of IC: cognition, vitality, locomotion, psychology and sensory function (hearing and vision). Each domain

is scored as 0 (impaired capacity) or 1 (intact capacity), yielding a total score ranging from 0 to 5, where a higher score indicates better overall IC. In this study, participants with a total score below 5 were classified as having IC decline [24].

Physical resilience instrument for older adults, PRIFOR

The PRIFOR was developed by Hu et al. [25] to assess physical resilience following exposure to health-related stressors. The scale consists of 3 dimensions (positive thinking, coping and lifestyle adjustment, and belief and hope orientation) and 16 items. Responses were rated on a 5-point Likert scale, yielding a total score ranging from 16 to 80, with higher scores indicating greater physical resilience. In the original validation study, the scale demonstrated a Cronbach's α of 0.94 and has shown good validity among older adults from a medical centre in Taiwan [25]. In the current study, the Cronbach's α was 0.756.

General self-efficacy scale, GSES

The GSES was developed by Schwarzer et al. [26] to assess an individual's self-efficacy when facing various difficulties and challenges. The Chinese version of GSES, translated and revised by Wang et al. [27], was used in this study. The scale was unidimensional and consisted of 10 items, each rated on a 4-point Likert scale. The total score ranges from 10 to 40, with higher scores indicating greater general self-efficacy. The scale demonstrated good reliability in the validation study with a Cronbach's α of 0.87, and the Cronbach's α in the current study was 0.868.

Social support rating scale, SSRS

This study used the Social Support Rating Scale (SSRS), originally developed by Xiao [28], to assess the level of social support among older adults. The scale comprises 10 items across three dimensions: objective support (3 items), subjective support (4 items), and support utilisation (3 items). The total score ranges from 12 to 66, with higher scores indicating higher levels of social support. In the original validation study, the scale demonstrated an overall Cronbach's α of 0.896. In the current study, the Cronbach’s α of the scale was 0.765.

Geriatric health promotion scale, GHP

This scale was originally developed by Wang et al. [22] and subsequently cross-culturally adapted and validated by Li et al. [29] to assess health promotion behaviours among community-dwelling older adults. The revised scale consists of 22 items across six dimensions: health habits, healthy diet, health responsibility, physical exercise, social participation and oral health care. Items are rated on a 4-point Likert scale, yielding a total score from 22 to 88, with higher scores indicating better health promotion behaviours. The scale demonstrated good reliability in the original validation study with a Cronbach's α of 0.870, and in the adapted version for community-dwelling older adults with a Cronbach's α of 0.868. In the current study, the Cronbach's α was 0.739.

Data collection

All investigators received standardised training from the research team and used a uniform script to explain the questionnaire completion process to participants. Investigators then completed the questionnaires based on the participants' verbal responses. Questionnaires with straight-lining, obvious response patterns, or missing data were considered invalid and excluded from the analysis.

Data analysis

All statistical analyses were performed using R v4.5.2, IBM SPSS v26.0 and AMOS v29.0. R v4.5.2 was adopted to analyse the current status of intrinsic capacity (IC) and to generate a Pearson correlation heat map. IBM SPSS v26.0 was used for univariate and multivariate analyses. Specifically, for binary variables, the independent samples t-test was applied when data followed a normal distribution with homogeneous variance; otherwise, the Mann-Whitney U test was adopted. For multi-categorical variables, one-way analysis of variance (ANOVA) was used for data conforming to normal distribution and homogeneity of variance, while the Kruskal-Wallis H test was utilised for non-normal or heterogeneous variance data. Variables with statistically significant differences in univariate analysis were included in hierarchical linear regression to quantify the proportion of variance in GHP

explained by the predictors. Finally, statistically significant predictive variables were imported into AMOS v29.0 for path analysis to verify hypothesised influencing paths. Model fit was evaluated using the chi-square/degrees of freedom ratio (χ^2/df), root mean square error of approximation (RMSEA), and multiple incremental fit indices (NFI, GFI, AGFI, TLI, CFI, IFI, RFI). Indirect effects and their 95% confidence intervals (CI) were estimated using bias-corrected bootstrap with 5,000 resamples, and a 95% confidence interval excluding zero was considered statistically significant.

Results

Characteristics of intrinsic capacity and health promotion among older adults

A total of 850 participants were recruited from 18 communities in this study. After excluding 7 questionnaires with substantial missing data and 45 individuals without IC decline, a final sample of 798 older adults with IC decline (798/843 valid questionnaires, 94.66%) was included. The participant screening flow is presented in Figure 2. Among older adults with IC decline, 14 (1.75%) experienced impairment across all five IC dimensions, 50 (6.27%) had declines in four dimensions, 162 (20.30%) in three dimensions, 316 (39.60%) in two dimensions, and 256 (32.08%) in only one dimension. The most common pattern of decline was the concurrent impairment in sensory and cognitive domains (n = 235). Across the five IC dimensions, 656 participants (82.21%) reported sensory impairment (vision or hearing), and 541 (67.79%) exhibited cognitive impairment. Figure 3 illustrates the frequency of different combinations of IC decline reported by the participants. Significant differences in GHP scores were found between participants with and without impairment in the vitality, psychology, cognition and locomotion domains (Table 1).

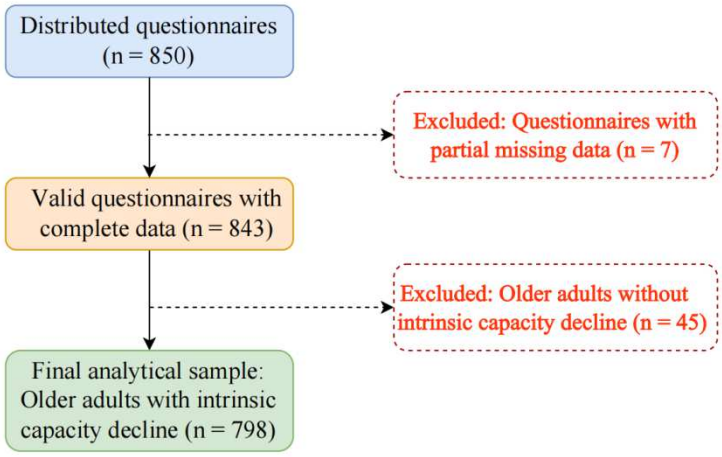

Figure 2 Flowchart of research subject recruitment.

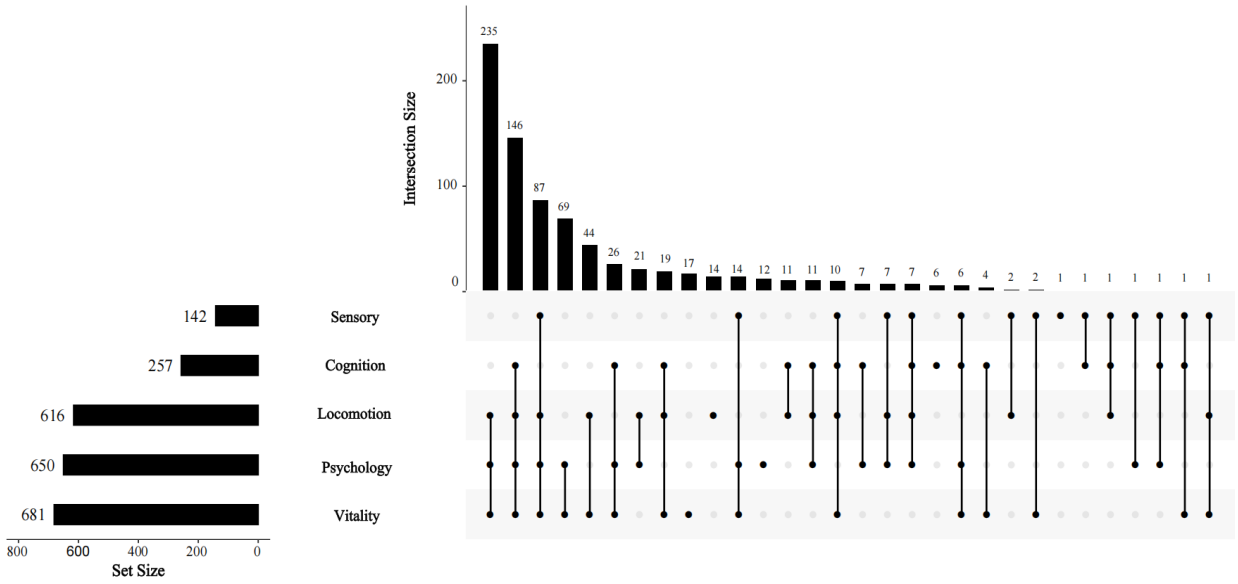

Figure 3 Current status of IC among community-dwelling older adults. The bar chart on the left represents the counts of intact intrinsic capacity dimensions. The bars represent the frequency of each combination, while the dots on the horizontal lines below indicate intact IC dimensions.

Table 1 Analysis on dimensions of IC and characteristics of GHP among community-dwelling older adults (*n* = 798)

Dimensions	**Scores**	**Counts（%）**	**Health Promotion**	**t value**	***P***
-	-	798(100)	70.73±7.020	-	-

Vitality	0	117 (14.66)	68.68±6.762	-3.435	0.001
	1	681 (85.34)	71.08±7.009		
Psychology	0	148 (18.55)	68.72±7.010	-3.900	＜0.001
	1	650 (81.45)	71.19±6.947		
Cognition	0	541 (67.79)	70.28±6.971	-2.627	0.009
	1	257 (32.21)	71.67±7.044		
Sensory	0	656 (82.21)	70.73±7.019	-0.019	0.985
	1	142 (17.79)	70.74±7.054		
Locomotion	0	182 (22.81)	68.12±6.839	-5.822	＜0.001
	1	616 (77.19)	71.50±6.892		

Baseline characteristics and univariate analysis of health promotion among older adults with intrinsic capacity decline

Univariate analysis revealed that 10 variables, including BMI category, marital status, educational level, medical insurance type, occupation, monthly income, smoking history, regular physical examination, self-perceived health status, and life satisfaction showed statistically significant differences in GHP scores. Detailed results are presented in Table 2, which is provided at the end of the manuscript because of its length.

Correlation of continuous independent variables with health promotion among older adults with intrinsic capacity decline

Pearson correlation analysis indicated that among older adults with IC decline, the number of chronic diseases (1.82±1.614 types) and the number of medications (1.72±2.033 types) were negatively correlated with GHP, whereas Physical Resilience (54.45±6.029), General Self-efficacy (29.74±6.086) and Social Support (41.30±6.997) were positively correlated with GHP. However, age (71.31±6.674 years), and the duration of chronic diseases (12.96±13.347 years) showed no significant correlation with GHP (Figure 4).

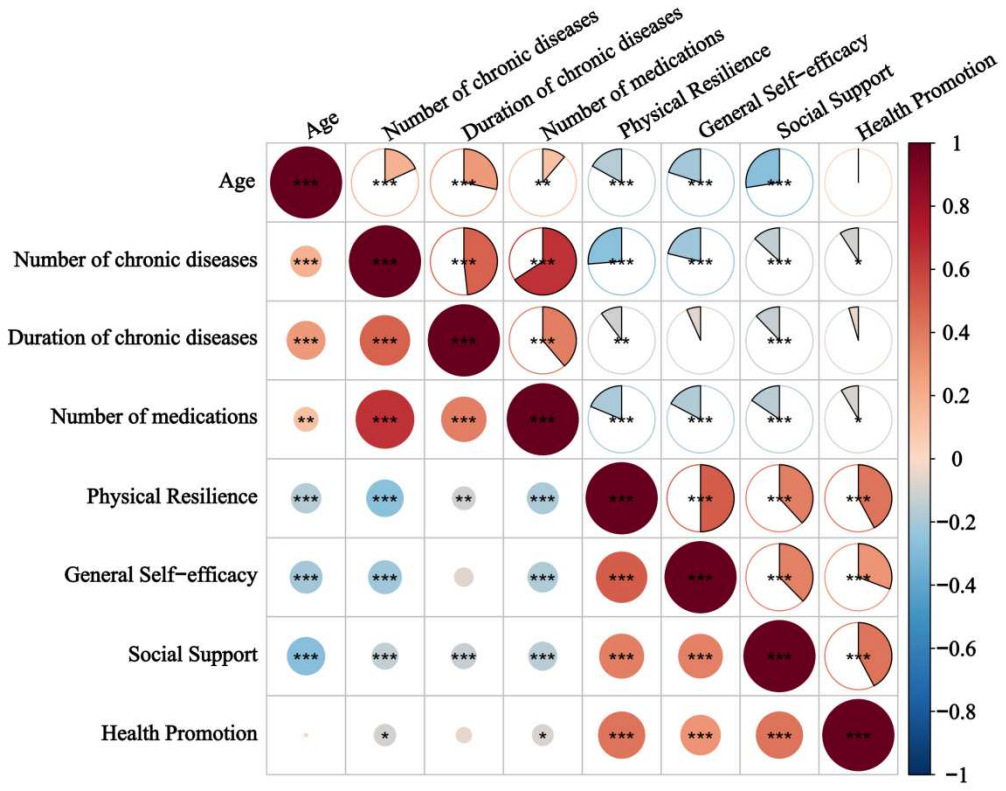

Figure 4 Heat map of correlations between continuous independent variables and GHP. The colour and size of the circles represent the Pearson correlation coefficients between paired variables. Red circles indicate positive correlations, and blue circles indicate negative correlations. Larger and darker circles correspond to stronger correlations. $P<0.001$***; $P<0.01$**; $P<0.05$*

Multilevel linear regression analysis on health promotion among older adults with intrinsic capacity decline

The 15 statistically significant variables identified from the univariate and correlation analyses were incorporated into the linear regression model, with the variable coding scheme presented in Table S2. Further hierarchical regression analysis demonstrated that after controlling for general characteristics, physical resilience, general self-efficacy and social support exerted statistically significant effects on GHP. These variables explained 13.22% of the variance in GHP, indicating a moderate effect size. The detailed results were presented in Table 3, which is provided at the end of the manuscript because of its length. Furthermore, multicollinearity analysis showed that the tolerance of the 15

variables was > 0.2, and all VIF values were < 5, indicating no significant multicollinearity (Table S3).

Construction of structural equation model and results of path analysis

A structural equation model (SEM) was constructed based on the COM-B model, with social support, physical resilience and general self-efficacy set as independent variables and GHP as the dependent variable. Model fitting was performed using AMOS v29.0 software with the maximum likelihood estimation method. The initial model was subsequently modified based on modification indices and theoretical considerations. Specifically, the direct path from general self-efficacy to health promotion was deleted, and the direction of the path between physical resilience and general self-efficacy was reversed (from physical resilience → general self-efficacy to general self-efficacy → physical resilience). Ultimately, a revised model with good fit was obtained in Model A.

To verify the stability of the model, a subsample was selected for re-estimation and validation. Rather than randomly splitting the full sample—which would merely produce two comparable halves and thus provide only a weak test of model stability—we validated the model in a clinically distinct subgroup. As shown in Table 1, four dimensions of IC decline were significantly associated with GHP. Among these, cognitive decline was the most clinically prominent domain; the subsample of participants with cognitive decline (n = 541) satisfied the recommended minimum sample size of 200 for structural equation modelling, ensuring adequate statistical power. Therefore, we selected participants with cognitive capacity decline to construct Model B for validation. Model B achieved acceptable model fit, and all hypothesised paths remained statistically significant, confirming the robustness of the structural pathways identified in Model A. The model results were presented in Tables 4–6 and Figure 5.

Table 4 Model fit indices

Indices	χ^2/df	RMSEA	NFI	GFI	AGFI	TLI	CFI	IFI	RFI
Evaluation	1-5	<0.08	>0.90	>0.90	>0.90	>0.90	>0.90	>0.90	>0.90

criteria									
Model A	2.436	0.042	0.990	0.998	0.985	0.964	0.994	0.994	0.977
Model B	3.090	0.062	0.994	0.997	0.972	0.974	0.996	0.996	0.963

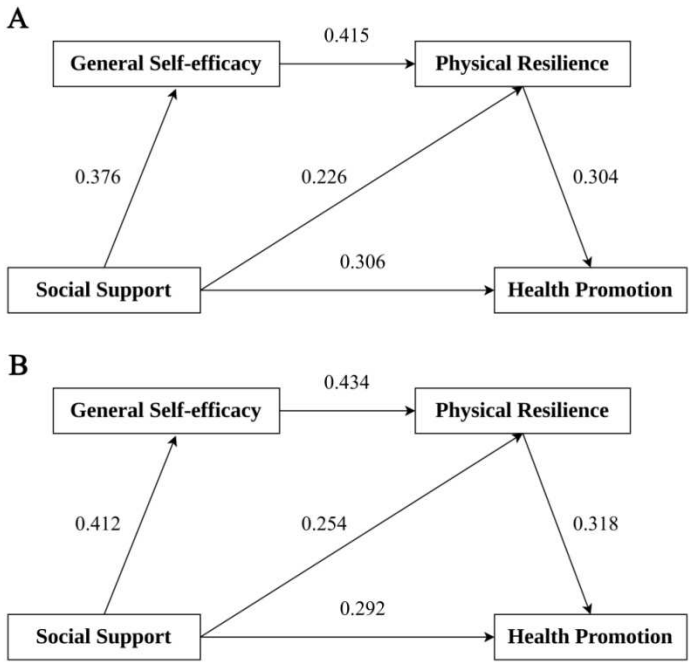

Figure 5 Path analysis model diagram of GHP among community-dwelling older adults with IC decline (Model A, n = 798) and cognitive capacity decline (Model B, n = 541) based on the COM-B model

Table 5 Path coefficients and associated statistics in Model A and Model B

Model pathway		Estimate	*SE*	*95% CI*	*P value*
Model A	③→②	0.376	0.029	(0.312-0.426)	0.009
(n=798)	②→①	0.415	0.038	(0.335-0.492)	0.011
	③→①	0.226	0.040	(0.150-0.310)	0.007
	①→④	0.304	0.038	(0.222-0.378)	0.011
	③→④	0.306	0.034	(0.245-0.375)	0.005
Model B	③→②	0.412	0.036	(0.318-0.467)	0.012
(n=541)	②→①	0.434	0.043	(0.364-0.514)	0.005

③→①	0.254	0.041	(0.165-0.327)	0.016
①→④	0.318	0.052	(0.218-0.414)	0.013
③→④	0.292	0.046	(0.203-0.390)	0.010

Notes: ①Physical Resilience; ②General Self-efficacy; ③Social Support; ④Health Promotion

Table 6 Decomposition of direct, indirect and total effects in Model A and Model B

Antecedent Variables	Effect types	Effect Paths	Model A (n=798)		Model B (n=541)	
			Estimate	*95% CI*	Estimate	*95% CI*
①	Direct effect	①→④	0.304	0.222-0.378	0.318	0.218-0.414
②	Indirect effect	②→①→④	0.126	0.098-0.207	0.138	0.092-0.199
③	Total effect	③→④	0.423	0.368-0.478	0.429	0.357-0.508
	Direct effect	③→④	0.306	0.245-0.375	0.292	0.216-0.422
	Indirect effect	-	0.116	0.085-0.156	0.137	0.083-0.183
		③→①→④	0.069	0.033-0.117	0.081	0.035-0.135
		③→②→①→④	0.047	0.023-0.079	0.057	0.025-0.099

Notes: ①Physical Resilience; ②General Self-efficacy; ③Social Support; ④Health Promotion

Discussion

Current status of intrinsic capacity and health promotion among community-dwelling older adults

The results showed that the mean GHP score among community-dwelling older adults with IC decline in this study was 70.73±7.020, which was higher than that reported in a study focusing on rural older adults (64.01±16.18) [30]. This discrepancy may be attributed to differences in social support, access to health resources, health literacy and information acquisition. The prevalence of IC decline in this study was 94.66%, which is at the upper end of the range reported in previous studies (19.23%–98.00%) [5]. However, this high prevalence should be interpreted with caution, as it may partly reflect selection bias inherent in the convenience sampling method: older adults who were more willing to

participate in community-based surveys may have had greater health concerns or more frequent contact with community health services, potentially inflating the observed prevalence. In addition, the operational definition adopted in this study—classifying participants with a total ICOPE score below 5 as having IC decline—may be more inclusive than the domain-specific screening approaches used in other studies, which could also have contributed to the higher estimate. Therefore, the generalisability of this prevalence estimate to the broader community-dwelling older population is limited, and future studies employing probability-based sampling and standardised IC assessment are warranted to obtain more representative estimates.

Regarding specific IC dimensions, the differences in GHP based on sensory domain status were minimal and not statistically significant. This is likely because sensory capacity impairment was common but mild among the participants, and did not severely interfere with daily life and behaviours. Nevertheless, individuals with higher GHP tended to maintain a favourable status in the vitality, psychological, cognitive and locomotor domains. Adopting healthy behavioural patterns contributes to health maintenance, disease risk reduction and the enhancement of IC [5]. Thus, investigating GHP and its influencing factors can provide a scientific basis for developing targeted intervention strategies for older adults.

Analysis on influencing paths of health promotion among older adults with intrinsic capacity decline

Physical resilience as a direct driver of GHP

Our findings confirm that physical resilience exerts a significant direct positive effect on GHP outcomes among older adults with IC decline. This aligns with emerging evidence that physical resilience enables older adults to better cope with health-related stressors, maintain positive mental states, and preserve quality of life [31–33]. By enhancing functional capacity and adaptive capacity, physical resilience facilitates successful ageing trajectories [34, 35] and directly motivates engagement in health-promoting behaviours.

These findings highlight the importance of regular physical resilience assessments and stratified health management strategies implemented by community health workers, who should integrate targeted health education and guidance to support the adoption of sustainable health promotion behaviours.

General self-efficacy as an indirect driver of GHP via physical resilience

Contrary to previous research demonstrating a direct effect of general self-efficacy on GHP [36], our final model revealed two key findings: first, a significant reversal of the hypothesised pathway between physical resilience and general self-efficacy, with the direct effect flowing from general self-efficacy to physical resilience rather than the originally proposed direction (physical resilience → general self-efficacy); second, general self-efficacy affected GHP indirectly through the mediating role of physical resilience.

Drawing on Bandura's social cognitive theory [37], which posits that self-efficacy beliefs shape activity choices, effort expenditure, and persistence in the face of challenges, we proposed that general self-efficacy served as a foundational psychological resource that enabled older adults to engage in health-enhancing behaviours that built physical resilience. For older adults with IC decline, higher self-efficacy motivates proactive engagement in physical activity, adherence to health-promoting lifestyles, and utilisation of social support systems—all of which contribute to enhanced physical resilience over time [38]. This creates a sequential pathway where self-efficacy operates indirectly through physical resilience to influence GHP: behavioural intention alone is insufficient to drive sustained health-promoting behaviours, but higher self-efficacy enables lifestyle adjustments that enhance physical resilience, which in turn provides the functional capacity and confidence needed to engage in GHP. This may form a positive feedback loop where higher self-efficacy builds physical resilience, which then facilitates greater engagement in health-promoting behaviours, further strengthening both psychological and physical resources. Given that the reversal of the hypothesised pathway was data-driven and identified through post-hoc model modification, these findings should be interpreted with caution, and

longitudinal studies are needed to confirm the direction of causality.

These findings have important implications for community-based interventions targeting older adults with IC decline. Rather than focusing solely on either psychological or physical outcomes, interventions should adopt an integrated approach that simultaneously enhances self-efficacy and physical resilience. Combining belief reinforcement strategies (e.g., mastery experiences, social modelling) with functional training programmes can establish a "psychology-physiology-behaviour" virtuous cycle, effectively improving GHP levels and promoting healthy ageing in this vulnerable population.

Social support as a multidimensional driver of GHP: direct and indirect effects via physical resilience and general self-efficacy

The results of this study indicated that social support was the most influential determinant of GHP among older adults with IC decline. Older adults with higher levels of social support exhibited higher levels of GHP, which is consistent with findings from previous studies [39–41]. The total effect of social support on GHP was statistically significant, comprising both direct and indirect effects. On the one hand, social support had a significant direct positive effect on GHP, suggesting that supportive resources from families and communities can directly motivate individuals to engage in GHP. The underlying mechanism is that older adults with adequate social support are better able to receive care and assistance from their social networks, including family members, friends and healthcare providers. Such support mitigates psychological stress, alleviates anxiety and depression, and fosters a more positive attitude towards disease management [42]. Furthermore, older adults who perceive high levels of social support are more inclined to seek help and advice from their support networks when facing difficulties or setbacks, which in turn promotes their engagement in GHP [43].

On the other hand, social support indirectly affected GHP through two mediating pathways. The first pathway operated through enhancing physical resilience. Hawkley et

al. [44] argued that social support is an integral component of physical resilience and can improve older adults' ability to cope with major life events. Older adults receiving social support tend to adopt positive coping strategies and develop a sense of purpose and meaning in life, thereby exerting a cumulative positive effect on GHP. The second pathway involved serial mediation through general self-efficacy and physical resilience. By providing professional health resources, guidance and institutional guarantees, social support helps older adults manage their health effectively and thereby enhances their self-efficacy [45], while also providing role models of healthy behaviours and positive encouragement [46].

The influence of social support on GHP is multidimensional, with physical resilience and general self-efficacy acting as critical mediators. Accordingly, healthcare providers should encourage older adults with IC decline to strengthen external support through social connections while simultaneously enhancing physical resilience and general self-efficacy. Establishing a comprehensive support system encompassing external support, physical function, and psychological well-being can effectively promote engagement in health promotion behaviours among older adults with IC decline.

General determinants of health promotion

In Model 2, in addition to the hypothesised variables with statistically significant associations, BMI category, educational level, smoking history and regular physical examination also exerted significant effects on GHP. There may be a bidirectional relationship between BMI categories and GHP. On the one hand, a higher BMI or obesity is directly influenced by lifestyle behaviours, such as dietary patterns [47] and physical activity [48]. On the other hand, GHP facilitates effective weight management, thereby mitigating cardiovascular and cerebrovascular risk factors such as hypertension, hyperlipidaemia and hyperglycaemia [49]. Furthermore, these behaviours can improve physical appearance [50] and enhance self-efficacy, which in turn motivates individuals to sustain healthy behaviours over the long term, creating a virtuous cycle. Older adults with

higher educational level were more likely to engage in health-promoting behaviours, consistent with findings from previous research [51]. Older adults with higher education typically possess superior health literacy and a greater ability to access and interpret health information, facilitating the initiation and modification of health behaviours. Smoking history and regular physical examination, as indicators of health-related lifestyles, showed significant associations with GHP. This phenomenon may be explained by the clustering of health behaviours, in which various healthy behaviours co-occur and interact with one another rather than existing in isolation. Further in-depth investigations are required to clarify the underlying mechanisms of these inter-behavioural associations.

Fit and scientific validity of the constructed model

This study constructed an initial hypothesised model based on the COM-B theory, with social support, general self-efficacy, and physical resilience as antecedent factors, to explore the pathways through which these variables influence GHP among community-dwelling older adults with IC decline. After path testing and model modification, the initial theoretical model achieved good fit with the sample data, and was suitable for explaining the mechanism underlying health-promoting behaviours in community-dwelling older adults with IC decline, including those with cognitive decline. Model verification revealed that the path coefficients of social support to general self-efficacy and social support to physical resilience were higher in Model B than in Model A. This finding suggests that social support exerts a stronger effect on enhancing self-efficacy and shaping physical resilience among community-dwelling older adults with cognitive capacity decline. The direct effect of physical resilience on health-promoting behaviours was stable in both groups, indicating that physical resilience acts as a critical mediator linking psychosocial resources to GHP.

Limitations and future perspectives

This study has several limitations. First, the cross-sectional design precludes causal inferences; although the path model was theory-driven, the direction of the associations

among social support, general self-efficacy, physical resilience and GHP should be confirmed in future longitudinal or interventional studies. Second, owing to geographic and resource constraints, participants were recruited from 18 communities in Changsha, Hunan Province, China, using convenience sampling, which may introduce selection bias and restrict the generalisability of the findings to other regions or populations. Third, all data were collected through self-report questionnaires, which may be subject to recall and social desirability biases. Fourth, the final model was derived from post-hoc modifications of the initial hypothesised model, and the validation was performed in a subsample of participants with cognitive decline; although the model demonstrated adequate fit and stability, these exploratory adjustments should be regarded as hypothesis-generating and warrant confirmation in independent samples. Fifth, the Cronbach's α of the GHP scale in this study was 0.739, which is relatively modest but within an acceptable range for scales applied in a new population; nevertheless, the findings should be interpreted with this psychometric consideration in mind. Sixth, other potential influencing factors of GHP, such as depression, cognitive function and other psychological or environmental variables, were not fully included in the model, resulting in incomplete variable coverage. Future research should employ large-scale, longitudinal or interventional designs with probability-based sampling and, where possible, objective measures to comprehensively investigate GHP and the impact of other relevant variables in this population.

Conclusions

In conclusion, health promotion among older adults with IC decline requires further improvement. Social support, general self-efficacy, and physical resilience were identified as key direct or indirect determinants of GHP. Community healthcare teams should therefore implement personalised health management strategies targeting these three factors to promote adherence to health promotion behaviours. However, given the cross-sectional nature of this study, the causal relationships among these determinants and GHP warrant confirmation in future longitudinal or interventional studies.

List of abbreviations

IC	Intrinsic Capacity
GHP	Geriatric Health Promotion
COM-B	The Capability Opportunity Motivation-Behaviour (COM-B) model
VIF	Variance Inflation Factor
SEM	Structural equation modelling
RMSEA	Root Mean Square Error of Approximation
NFI	Normed Fit Index
GFI	Goodness-of-Fit Index
AGFI	Adjusted Goodness-of-Fit Index
TLI	Tucker-Lewis Index
CFI	Comparative Fit Index
IFI	Incremental Fit Index
RFI	Relative Fit Index

Declarations

Ethics approval and consent to participate

This study was approved by the Biomedical Ethics Committee of Hunan Normal University (Ethics Approval Number: 2024-056). All participants provided written informed consent prior to participation. The research protocol was established according to the ethical guidelines of the Declaration of Helsinki.

Consent for publication

Not applicable.

Availability of data and materials

The data are not publicly available due to privacy or ethical restrictions but are available from the corresponding author upon reasonable request.

Competing interests

The authors declare no competing interests.

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Authors' contributions

Sirui Lu: conceptualization, methodology, data analysis and interpretation, writing original draft preparation, writing - review, editing and critical revision of the article. Xing Xie: conceptualization, design, data collection. Qi Yang, Siyi Liu & Yifei Liao: writing - review and editing. Guifei Li: conceptualization, methodology, data interpretation, writing original draft preparation, writing - review, editing and critical revision of the article.

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Table 2 Univariate analysis of baseline characteristics and GHP among community-dwelling older adults with IC decline (*n* = 798)

Variables	**Counts (%)**	**Health Promotion**	***Statistic***	***P***
Gender			-1.733[a]	0.084
Male	408 (51.13)	70.31±7.198		
Female	390 (48.87)	71.17±6.811		
BMI category (kg/m^2)			8.399[d]	0.038
< 18.5	27 (3.38)	70.07±7.043		
18.5–23.9	373 (46.74)	71.42±7.102		
24.0–27.9	322 (40.35)	70.26±7.079		
⩾28.0	76 (9.53)	69.55±6.083		
Marital status			-2.023[a]	0.043
Widowed/Divorced/Separated	156 (19.55)	69.71±6.695		
Married	642 (80.45)	70.98±7.080		
Living arrangement			-1.689[a]	0.092
Living alone	86 (10.78)	69.52±6.856		
Living with others	712 (89.22)	70.88±7.031		
Educational level			59.601[d]	＜0.001
Primary school education or	170 (21.30)	68.76±7.014		

below				
Junior high school	249 (31.20)	69.29±6.897		
Senior high school / technical secondary school	246 (30.83)	71.79±6.952		
College diploma / bachelor's degree or above	133 (16.67)	73.92±5.856		
Medical insurance type			-4.190[b]	＜0.001
Employee Basic Medical Insurance	621 (77.82)	71.32±6.754		
Resident Basic Medical Insurance	177 (22.18)	68.66±7.548		
Occupation			46.162[d]	＜0.001
Unemployed	57 (7.14)	68.88＋8.214		
Physical work	383 (48.00)	69.14＋6.829		
Mental work	358 (44.86)	72.49＋6.585		
Monthly income (CNY)			41.106[d]	＜0.001
≤3000	272 (34.09)	69.19±7.345		
3001–5000	388 (48.62)	70.74±6.728		
>5000	138 (17.29)	73.70±6.206		
Smoking history			-6.087[b]	＜0.001
No	602 (75.44)	71.63±6.670		
Yes	196 (24.56)	67.93±7.345		
Drinking history			-1.774[b]	0.076
No	602 (75.44)	71.07±6.827		
Yes	196 (24.56)	69.65±7.504		
Regular physical examination			-10.703[b]	＜0.001
No	199 (24.94)	66.01±6.993		

Yes	599 (75.06)	72.29±6.295		
Self-perceived health status			10.373[c]	＜0.001
Poor	162 (20.30)	68.75±6.527		
General	210 (26.32)	70.42±6.940		
Good	426 (53.38)	71.62±7.091		
Life satisfaction			53.710[d]	＜0.001
Dissatisfied	39 (4.89)	65.49±6.621		
Neutral	75 (9.40)	66.65±6.839		
Satisfied	684 (81.21)	71.47±6.787		

Notes: a. t value; b. z value; c. F value; d. H value

Table 3 Multilevel linear regression of GHP in community-dwelling older adults with IC decline (n = 798)

Variables	**Model 1**					**Model 2**				
	B	***SE***	***β***	***t***	***P***	***B***	***SE***	***β***	***t***	***P***
Constant	60.672	1.355	-	44.784	＜0.001	39.619	2.100	-	18.866	＜0.001
BMI category (kg/m^2)	-0.691	0.295	-0.070	-2.339	0.020	-0.840	0.266	-0.085	-3.156	0.002
Marital status	1.163	0.537	0.066	2.164	0.031	-0.734	0.531	-0.042	-1.382	0.167
Educational level	1.296	0.255	0.185	5.082	＜0.001	0.709	0.234	0.101	3.036	0.002
Occupation	-0.069	0.368	-0.006	-0.189	0.850	0.063	0.333	0.005	0.188	0.851
Monthly income (CNY)	0.679	0.397	0.067	1.709	0.088	0.447	0.359	0.044	1.248	0.212
Medical insurance	-0.606	0.634	-0.036	-0.956	0.339	-0.270	0.572	-0.016	-0.472	0.637
Smoking history	-3.363	0.494	-0.206	-6.810	＜0.001	-3.081	0.445	-0.189	-6.916	＜0.001

Self-perceived health status	0.707	0.305	0.080	2.319	0.021	0.042	0.282	0.005	0.148	0.883
Number of chronic diseases (types)	-0.178	0.183	-0.041	-0.975	0.330	-0.050	0.165	-0.011	-0.302	0.763
Number of medications (types)	-0.050	0.138	-0.014	-0.360	0.719	0.005	0.124	0.001	0.038	0.970
Regular physical examination	5.526	0.491	0.341	11.256	< 0.001	5.293	0.443	0.326	11.961	< 0.001
Life satisfaction	2.301	0.445	0.165	5.172	< 0.001	0.524	0.428	0.038	1.223	0.222
Physical Resilience			-			0.256	0.041	0.220	6.181	< 0.001
General Self-efficacy			-			0.077	0.037	0.067	2.070	0.039
Social Support			-			0.272	0.033	0.271	8.201	< 0.001
R^2			0.317					0.450		
F			30.412					42.582		
Modified R^2			0.307					0.439		
ΔR^2			0.317					0.132		
ΔF			30.412					62.616		

1

Supplementary Files

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