

# Memory predicted self-care maintenance in patients with heart failure among cognitive functions: Results from a structural equation model

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## Research Article

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# Abstract

**Background:** To explain the direction of specific cognitive function training that could prevent potential self-care deficits, the cognitive domain that affects self-care behaviours in patients with heart failure (HF) should be identified. This study aimed to confirm the relationship between major potential variables affecting self-care maintenance behaviours of patients with HF. The study also aimed to determine which cognitive domain predicts self-care maintenance among patients with HF.

**Methods:** This descriptive study involved a secondary analysis using data of 201 patients with HF from two observational studies in three Korean hospitals. The structural equation model using AMOS version 24.0 was constructed to assess the relationships among the variables. The Seoul Neuropsychological Screening Battery was used to assess global cognition, immediate/delayed memory, and executive function, and the Self-Care of Heart Failure Index v.6.2. was used for self-care confidence and maintenance.

**Results:** Self-care maintenance was affected by memory function with a significant direct effect ( $\beta=.43$ ,  $p=.006$ ), as well as self-care confidence ( $\beta=.70$ ,  $p<.001$ ). Memory function and global function indirectly affected self-care maintenance through self-care confidence ( $\beta=-.37$ ,  $p=.002$ ;  $\beta=.14$ ,  $p=.030$ ). Depressive symptoms also had an indirect effect through self-care confidence on self-care maintenance ( $\beta=-.21$ ,  $p=.005$ ).

**Conclusion:** This study confirmed the need for periodic simple screening of the memory function and training to raise it in patients with HF, enhancing their self-care behaviours. It also suggests that supportive intervention is needed to enhance self-confidence as a mediator.

## Background

Self-care for patients with heart failure (HF) is a multidimensional process involving maintenance and management behaviours. Self-care maintenance requires a patient's participation to maintain one's physiological stability, while self-care management requires a patient's decision-making for monitoring and managing symptoms accordingly as they occur [1]. Adequate self-care in patients with HF has been shown to be associated with better health outcomes, such as fewer clinical adverse events and symptom response behaviours [2], fewer rehospitalisation [3, 4], and better quality of life [4]. Thus, to reduce major adverse events for patients with HF, it is essential to regularly assess their level of self-care and identify factors that influence it.

One of the important individual barriers to self-care behaviours was poor cognitive function which was prevalent in approximately 40% patients with HF who had a substantial impairment [5]. Further, systematic reviews reported that cognitive impairment is a common complication of HF and HF diagnosis increased the odds of cognitive impairment more than 2.6 times, compared to non-HF controls [5, 6]. Poor outcomes associated with cognitive impairment have been well-documented, particularly its impairment directly associated with poor self-care behaviours in patients with HF [7, 8]. Thus, screening for cognitive impairment was critical to prevent potential self-care deficits in patients with HF [6, 9, 10]. Among the cognitive domains, memory impairment [11] and slower psychomotor speed [12] each had a predictive

value for poorer self-care behaviours. While, in one study that used the structural equation modelling, short-term memory directly affected self-care maintenance [13], thereby suggesting that additional studies must be conducted on the cognitive domains of patients with HF in other countries. Self-care confidence and depressive symptoms were also often reported with reference to self-care. Self-care confidence is a critically important factor that consistently influenced the effectiveness of self-care maintenance [1]. Self-care confidence totally mediated the relationships between cognition function and self-care behaviours [13] and the relationships between knowledge, health literacy, social support, and self-care behaviours in patients with HF [8]. Adverse impacts associated with depressive symptoms are well-documented, such as high morbidity and/or mortality [3, 10, 13] and poor quality of life [10]. These negative influences on self-care were also reported in patients with HF and those with depressive symptoms were more likely to have lower levels of self-care behaviours [3].

Despite a large body of empirical evidence influencing factors for self-care of patients with HF [7], particular domains of concern in cognitive function associated with self-care maintenance are still lacking. In addition, results related to cognitive domains that affected self-care were inconsistent across previous studies. Short-term memory [13] and psychomotor speed [12] were found to be factors influencing self-care maintenance in Western countries. However, in the study of Koreans with comparatively low levels of self-care, none of the three domains of cognitive function were related to self-care maintenance [14]. Therefore, it is necessary to examine the specific cognitive domain that predicts self-care maintenance for Koreans through a structural relationship that can simultaneously identify direct and indirect effects with the major influencing factors, namely, depressive symptoms and self-care confidence. In addition, this study aims to determine whether there are differences in cognitive function factors affecting self-care maintenance in the elderly and adult groups, respectively.

## Methods

### Study design

In this cross-sectional descriptive study, data for this secondary analysis were obtained from two observational studies conducted on patients with HF.

### Setting and Participants

Each of the two parent studies was approved by research ethics, and written consent was obtained from all HF patients. Among the patients enrolled in the two studies, data from patients with HF who met the subject selection criteria for this study were used for the analysis. Patients with HF were recruited from three cardiology outpatient departments of university-affiliated hospitals located in a metropolitan city and two provinces in South Korea. Patients with HF who visited the outpatient clinic for treatment and had not received self-care training or intervention were potential subjects of this study. Specifically, patients were eligible to participate in this study if they were thirty years of age or older with an HF diagnosis of three months or more, and they were able to understand and follow the study protocol instructions. Exclusion criteria for the study subjects were those who were diagnosed with chronic diseases involving clinical depression and cognitive impairment, such as dementia, stroke, or terminal cancers.

The minimum number of patients that are required for a structural equation model analysis, using the maximum likelihood method for parameter estimation, is more than 10 times the observation variables that is 200 samples [15]. Based on this, 10 times the 16 observational variables, or 160 patients, were required. Thus, the data from 201 subjects was sufficient for analysis in this case.

## Measurement Tools

### Cognitive function

The Seoul Neuropsychological Screening Battery-II was used to measure cognitive function in the domains of global cognition (Korean Mini-Mental Status Examination [K-MMSE]), memory function (Seoul Verbal Learning Test [SVLT]), and executive function (Controlled Oral Word Association [COWA]) [16]. Based on the professional manual guideline, the scores of each domain were calculated [16]. For global cognition, the Korean Mini-Mental Status Examination (K-MMSE) was used. It consisted of thirty items and the possible score ranges were 0–30, with higher scores indicating better cognitive function. In the K-MMSE total score, the cut-off point of 23 and less was used to determine the severity of cognitive impairment [16]. The K-MMSE has been validated for the assessment of cognitive function in patients with dementia and is widely used as a reliable tool in Korea [17].

To measure immediate and delayed recalls, the SVLT was used. After a list of up to 12 words were first spoken, subjects were asked to recall the list of words regardless of the order, then two more recall sessions were followed consecutively for immediate recall and one more session for the delayed recall 20 minutes later. Possible scores were 0–36 for immediate recall and 0–12 for delayed recall, with higher scores indicating better memory. To measure the executive memory function of words, the COWA test was used with function with verbal fluency. All subjects were asked to generate words beginning with a letter given in sixty seconds. This was repeated for three letters and the score was calculated as the sum of the three tests, and validity was verified for the elderly [18]. Higher scores indicated better executive function [18].

### Depressive symptoms

Depressive symptoms were measured with the validated Korean version of the Patient Health Questionnaire (PHQ-9) [19]. It consists of nine items on a 4-point Likert scale (0–3), with possible scores ranging from 0 to 27 points and five or more points indicating a depressive disorder [19]. Higher scores indicated more severe depressive symptoms. For structural equation modelling, an exploratory factor analysis was performed and classified into three sub-areas. The reliability and validity of this instrument have been supported in Korean patients with HF [20]. Cronbach's alpha in this study was .85.

### Self-care confidence and Self-care maintenance

The Confidence and Maintenance Subscales of the Self-Care of Heart Failure Index v.6. were used to assess self-care confidence and maintenance [21]. It consisted of ten items for self-care maintenance and six items for self-care confidence. Each item was constructed originally on a four-point Likert scale, and each subscale score was transformed to a 0-100-point scale. Higher scores indicated better self-care confidence and maintenance. Exploratory factor analysis for the structural equation modelling showed that the

confidence subscale was classified into two sub-areas and the maintenance was classified into four sub-areas. The reliability and validity of the Korean version were supported [22] and Cronbach's alphas in this study were .83 for the confidence subscale and .82 for the maintenance subscale.

## Data collection

This study complied with the Declaration of Helsinki, and approval from the institutional review board of the university was obtained. The data collection period for primary research was from September 2017 to April 2018. Data were collected from three university-affiliated hospitals in Seoul and two provinces in Korea with cooperation from the cardiology department of each hospital. Before data collection, the first author of the study and a trained research nurse of each hospital received an informed consent from each participant after explaining the purpose and protocol of the study in face-to-face interviews. It was also explained to the patients that they were free to withdraw at any time during the interview.

## Data analysis

We conducted analyses using SPSS ver. 23.0 and AMOS ver. 24.0 to verify descriptive statistics of the study parameters and to determine the model fit with structural equation modelling. The reliability of the instrument was validated by Cronbach's alpha. Pearson's correlation coefficient was used to confirm the correlation between the continuous measured variables. The exploratory factor analysis of the instrument was analysed using principal component analysis by Varimax rotation and a confirmatory factor analysis was performed to determine the model fit. To estimate the parameters of the model analysis, the model was first estimated using the maximum likelihood method, and then the predictive model was estimated. Structural equation modelling was performed to calculate the direct and indirect path coefficients between the factors. The model's goodness of fit was determined using  $\chi^2$ , goodness of fit index (GFI), comparative fit index (CFI), Tucker-Lewis index (TLI), root mean square error of approximation (RMSEA), and standardised root mean square residual (SRMR). We used the bootstrapping method to test the statistical significance of indirect effects and total effects of the modified model on the endogenous variables (number of bootstrap samples = 1,000).

## Results

### General characteristics of the subjects and descriptive statistics of variables

The mean age of the patients was  $62.5 \pm 11.4$  years, and 63.2% were men. The mean duration of the HF was  $37.40 \pm 40.90$  months and the mean number of rehospitalisation was  $1.42 \pm 1.54$  times. Of the patients, 41.8% had a left ventricular ejection fraction rate of less than 40%, and 43.3% accounted for less than the New York Heart Association (NYHA) Class II (Table 1). The descriptive statistics of cognitive domains, depressive symptoms, self-care confidence and self-care maintenance are shown in Table 2. In the K-MMSE total score, mild cognitive impairment ranging from 20 to 23 points was found in 8.9% ( $n=18$ ), and moderate cognitive impairment of 19 points or less was found in 5.9% ( $n=12$ ). Depressive disorder with a PHQ-9 total score of 6 or more was found in 32.3% ( $n=65$ ) of the study subjects. The basic assumption of the multivariate analysis for the normal distribution of all measured variables of the hypothetical model were verified as the absolute value of Skewness (0.01-2.81) was less than 3 and the absolute value of

Kurtosis (0.13-9.52) was less than 10 [23]. There were significant differences in all cognitive function sub-domains in the adults and the elderly group over 65 years old, but there was no difference in self-care confidence and maintenance between the two groups (Table 2).

### **Correlations among variables and validity of latent variables**

The convergent validity of the latent variables was satisfied in that the construct reliability (CR) was higher than .70 and the average variance extracted (AVE) was higher than .50, and it was confirmed that the observational variables were highly related to the latent variables [23]. As a result of the discriminant validity test, it was confirmed that the AVE values of the potential variables were larger than the square of the correlation coefficient ( $R^2$ ) among the latent variables. As a result of the correlation analysis between variables, global cognition showed a negative correlation with depressive symptoms and self-care maintenance, but it was not significantly related with self-care confidence. Immediate recall memory showed a negative correlation with depressive symptoms and self-care confidence. Delayed recall memory also negatively correlates with depressive symptoms and self-care confidence. Executive function also showed a negative correlation with depressive symptoms. Depressive symptoms showed a negative correlation with self-care confidence and self-care maintenance. Self-care confidence showed a statistically significant positive correlation with self-care maintenance (Table 3).

### **Regression analysis of factors affecting self-care maintenance according to age group**

Multivariate regression analysis was performed to identify factors influencing self-care maintenance in adults and the elderly group over 65, respectively. In the adult group, age, delayed memory function, and self-care confidence were significant predictors (Adjusted  $R^2=.14$ ,  $F=3.23$ ,  $p=.004$ ). In the elderly group, only self-care confidence was a significant predictor (Adjusted  $R^2=.29$ ,  $F=6.95$ ,  $p < .001$ ) (Table 4).

### **Standardised direct, indirect, and total effects of the model**

The linear regression analysis showed that the tolerance was .68 to .89, and that the variance inflation factor (VIF) was 1.86–2.72, a result of less than 10, thereby indicating that there was no multi-collinearity. This study measured  $\chi^2=95.28$  ( $df=66$ ,  $p=.011$ ),  $GFI=.94$ ,  $TLI=.94$ ,  $CFI=.96$ ,  $RMSEA=.05$  (.02-.07), and  $SRMR=.05$ , thereby indicating a good level of fitness. The fitness index of the confirmatory factor analysis showed that the fit index was  $\chi^2=87.85$  ( $df=56$ ,  $p=.004$ ),  $GFI=.94$ ,  $TLI=.93$ ,  $CFI=.95$ ,  $RMSEA=.06$  (.04-.08), and  $SRMR=.06$ , thus indicating a good level of fitness [23]. Age and duration of HF were included in the model as adjusted measured variables.

Memory function including immediate and delayed recall had a direct effect on self-care maintenance ( $\beta = .43$ ,  $p = .006$ ) and an indirect effect through self-care confidence on self-care maintenance ( $\beta = -.37$ ,  $p = .002$ ). Self-care confidence also had a direct effect on self-care maintenance with a significant total effect ( $\beta = .70$ ,  $p < .001$ ). Global cognition ( $\beta = .14$ ,  $p = .030$ ) and depressive symptoms ( $\beta = -.21$ ,  $p = .005$ ) showed indirect effects through self-care confidence on self-care maintenance. Memory function, depressive symptoms, and self-care confidence explained 50% of self-care maintenance ( $R^2 = .53$ ). For self-care confidence, global function had a positive direct effect ( $\beta = .20$ ,  $p = .043$ ). However, memory function ( $\beta =$

-.53,  $p < .001$ ) and depressive symptoms ( $\beta = -.30$ ,  $p = .002$ ) showed negative direct effects on self-care confidence (Table 5). The parameter estimates are shown in Figure 1.

## Discussion

The main findings of this study confirmed the structural relationship between cognitive function domains, depressive symptoms, and self-care confidence, all of which were found to be important factors in maintaining self-care behaviours in patients with chronic HF. Among the cognitive domains, the memory function had a significant direct effect on self-care maintenance, and this memory function, as well as the global cognition had an indirect effect on the self-care maintenance through the mediation of self-care confidence. Depressive symptoms also had an indirect effect through self-care confidence on self-care maintenance.

Specifically, memory function including immediate and delayed recalls showed a positive direct effect on self-care maintenance, and it had an indirect effect through self-care confidence on self-care maintenance in this study. Considering that there is a difference in cognitive function with increasing age, the factors affecting self-care maintenance were confirmed by regression analysis by dividing them into adult and elderly groups. In the cognitive function domain, delayed memory function was confirmed to be a predictor in adult patients under the age of 65, so it is necessary to regularly monitor memory function in middle-aged HF patients and to check the degree of self-care in the low memory group. These findings are consistent with the results of a structural equation modelling study in that memory among cognitive domains had a direct effect on self-care maintenance in patients with HF [13]. In addition, the findings were supported by a previous multiple regression analysis study wherein memory impairment was associated with poorer adherence to self-care maintenance in older patients with HF [11]. A systematic review and meta-analysis study also supported the finding that the recall testing was the most effective way to detect mild cognitive impairment [24].

However, the finding of this study differs from a previous study for regression analysis that found psychomotor speed to be the only cognitive dimension significantly associated with self-care behaviours [12]. In addition, global cognition as measured by the K-MMSE in this study was found to be a factor with an indirect effect on self-care maintenance. This finding is consistent with a previous study of Italian patients with HF that reported on global cognition indirectly influencing self-care behaviours only through self-care confidence [25]. The results of the current and prior studies recommend cognitive functional performance should be considered for enhanced self-care maintenance, particularly global cognition, memory, or psychomotor speed.

Self-care confidence had the greatest direct effect on self-care maintenance in this study, and it was also found to be a mediator in the relationships between global and memory function and self-care maintenance. This result is similar to results of past studies in which self-care confidence was a critical factor influencing self-care behaviours [8] and mediated the relationship between cognitive function and self-care behaviours [13]. However, a longitudinal study reported that self-care behaviours in daily life, such as poor medication compliance, are not easily improved [26] and require special intervention for patients

with HF with low self-care. Interventions can include the development of the patients' behavioural skills for self-care [27] and social support for increased self-care confidence [28, 29]. Therefore, self-care confidence must be increased by providing counselling and education from healthcare professionals to patients, especially for those with low cognitive function, and by assessing their self-confidence as early as possible after the initial HF diagnosis.

As for self-care confidence, global cognition had a positive direct effect, whereas memory function had a negative direct effect on self-care confidence in this study. This result is not consistent with a previous study in which the relationship between self-care confidence and cognitive function was positively associated [28]. One reason for the dissimilar results may be that the level of self-care confidence of Korean patients is low, compared to those of patients with HF in other country [13]. The majority of subjects in this study showed self-care maintenance and self-care confidence levels below the cut-off point of 70 [21], with average scores of self-care confidence and maintenance being 50.4 and 53.9 points, respectively. These are significantly lower than the average scores of 75.8 and 66.8 points in the U.S. study [13], despite the subjects having the same average age of 62 years. Possible reasons for having a low score and an inverse relationship with the cognitive score may be the result of differences among the items included in the measurement tool. The items in the self-care confidence tool included evaluating their symptoms, alleviating those symptoms, and evaluating the effectiveness of the treatment. In Korea, most patients remain dependent on their physicians and obey their treatment instructions; therefore, their confidence in practicing self-assessment of the effects of symptoms and medication in daily life is predictably low. This suggests that Korean patients with HF lack active attention to treatment and their symptoms.

Further, depressive symptoms showed a negative direct effect on self-care confidence with the significance of total effect, and they also affected self-care maintenance indirectly through self-care confidence in the current study. These findings are consistent with a literature review wherein depressive symptom was identified as a factor that negatively affected self-care behaviours [1]. This also supports a study that patients with HF with depressive symptoms were more likely to have lower levels of self-care and higher rehospitalisation rates [7]. According to another literature review, the prevalence of depression reportedly ranged from 24–68% in Korean patients with HF [30]. Further, patients with HF with a combination of depressive symptoms and physical frailty had 3.5 times higher risk of cognitive impairments compared to those without those factors [31]. One randomised experimental study reported that cognitive behavioural therapy was effective in lowering depression [32]. Therefore, it is necessary to increase confidence in self-management through counselling and education for depressed patients with HF.

## **Limitation of the study**

First, a small sample size was a major limitation of this study, requiring the validation of our results in a larger sample. Second, the study subjects were recruited with convenient sampling from three hospitals in Korea, and the results of the self-report questionnaire were limited to a generalisation of all chronic patients with HF. Third, many patients with HF have common comorbid conditions, such as diabetes mellitus and hypertension that could affect cognitive function, while was not, controlled in this study. In addition, although statistically corrected, latent variables according to age and HF duration were not considered,

which is a limitation of this study. Further, the sources of the cognitive function in patients with HF were secondary data obtained from previous research projects conducted for different research purposes. Thus, some data may not fit in the same for this secondary analysis, that is, accuracy and sufficiency of data could possibly weaken the study results. For example, known factors that may affect the self-care behaviors, such as knowledge, health literacy, and social support [8], was not addressed in this secondary analysis. Last, the dimension of self-care management was not included in the model because the percentage of respondents who self-managed when they had symptoms was found to be too low, and we did not consider other factors that affected self-care together in the model.

## **Strengths and Clinical implication**

These study results imply that a periodic memory function screening among cognitive function tests is recommended during the HF patients' outpatient visits, especially middle-aged patients, for the regular check-ups and to enhance their self-care behaviours, memory training could be beneficial. Patient education about self-care is also critical to successfully manage the care of HF in which telemedicine or telemonitoring is a useful method for an evaluation of the adherence and ability of self-care of patients with HF. We also suggest further qualitative research on the relationship between memory function and self-care maintenance and confidence, as well as its feasibility.

## **Conclusions**

The present study contributes to the knowledge that the memory function of cognitive domains only had a direct effect on self-care maintenance in Korean patients with HF. Memory and global cognitive function indirectly affected self-care maintenance through self-care confidence. They were also found to be mediators between depressive symptoms and self-care maintenance, and also produced direct effects.

## **Declarations**

### **Ethics approval and consent to participate**

This study was approved by the Hanyang University Medical Centre Ethics Committee (HY-16-05-14). Ethical issues including plagiarism, informed consent, data fabrication and falsification, double publication have been completely observed by the four authors

### **Consent for publication**

Not applicable

### **Availability of data and materials**

Data sharing not applicable.

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### **Competing interests**

The authors declare no competing interest.

### **Author Contributions**

Conceptualisation, writing—original draft, and formal analysis, S.Y.H, J.K; investigation and superviso, S.Y.H, J.K; methodology and software, S.H.K, J.L.S; resources and data curation, S.H.K, J.L.S; funding acquisition, S.Y.H. All authors have read and agreed to the published version of the manuscript.

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## Tables

**Table 1.** General characteristics of the participants (N=201)

Variables	Categories	n(%)	M±SD
Gender	Male	127(63.2)	
	Female	74(36.8)	
Age (yrs)	30-64	100(49.8)	62.51±11.40
	65-84	101(50.2)	
Marital state	Married	155(77.1)	
	Single/Divorced/Widowed	46(22.9)	
Education	≤Elementary school	56(27.9)	
	Middle school	45(22.4)	
	High school	61(30.3)	
	≥College	39(19.4)	
Occupation	Yes	80(39.8)	
	Retired/None	119(59.2)	
Economic status (10,000 dollars)	<1000	84(41.8)	
	1000-3000	77(38.3)	
	>3000	40(19.9)	
Living assistance	Yes	144(71.6)	
HF duration (month)	5~264		37.40±40.90
Readmission frequency	0~12		1.42±1.54
Smoking	Current	33(16.4)	
	Ex-smoker	63(31.3)	
Comorbidity_ Hypertension	Yes	52(25.8)	
	Diabetes	Yes	30(14.9)
Blood pressure (mmHg)			124±74
LVEF (%)	15 ~ 40	84(41.8)	43.73±14.92
	40 ~ 49	57(28.4)	
	50 ~ 78	58(28.9)	
NYHA	Class I	79(39.3)	1.81±0.79
	Class II	87(43.3)	
	Class III	29(14.4)	
	Class IV	6(3.0)	
HgbA1c (mg/dl)	5.0~13.6		6.46±1.27
HDL cholesterol (mg/dl)	21~265		47.91±24.62
LDL cholesterol (mg/dl)	21.8~208		92.71±37.49
Triglyceride (mg/dl)	24~379		134.45±69.55
Total cholesterol (mg/dl)	58~294		164.47±39.99

HF, heart failure; LVEF, left ventricular ejection fraction; NYHA, New York Heart Association; HgA1c, glycated haemoglobin; LDL, low-density lipoprotein; HDL, high-density lipoproteins.

**Table 2.** Comparison of cognitive function, self-care confidence and maintenance by younger and older group

Variables	Younger group	Older group	t	p
	< 65 years	≥ 65 years		
	Mean ± SD	Mean ± SD		
Cognitive function				
GI Global cognition (MMSE)	27.63±2.63	25.34±4.54	3.70	.001
Memory function				
Immediate recalls	15.79±5.90	12.94±5.03	3.69	.001
Delayed recalls	5.11±2.33	3.66±2.12	3.60	.001
Executive function	21.67±11.40	16.25±10.83	4.50	.001
Self-care confidence	115.35±3.44	14.76±4.10	0.97	.33
S Self-care maintenance	25.97±4.40	26.34±4.75	0.56	.58

SD, standard deviation; MMSE, mini-mental status examination

**Table 3.** Correlations among variables and validity of measured variables

Variables	Global cognition	Immediate recalls	Delayed recalls	Executive function	Depressive symptoms	Self-care confidence	CR	AVE
	r(p)	r(p)	r(p)	r(p)	r(p)	r(p)		
Global cognition	1						-	-
Immediate recalls	.56 (<.001)	1					-	-
Delayed recalls	.46 (<.001)	.77 (<.001)	1				-	-
Executive function	.40 (<.001)	.44 (<.001)	.38 (<.001)	1			-	-
Depressive symptoms	-.24 (.001)	-.16 (.023)	-.16 (.021)	-.25 (<.001)	1		.78	.74
Self-care confidence	.07 (.317)	-.15 (.038)	-.21 (.003)	.09 (.225)	-.19 (.007)	1	.89	.80
Self-care maintenance	.17 (.016)	.05 (.494)	.07 (.339)	.11 (.138)	-.18 (.013)	.40 (<.001)	.70	.50

CR, construct reliability; AVE, average variance extracted.

Table 4. Regression analysis of the factors on self-care maintenance by age group

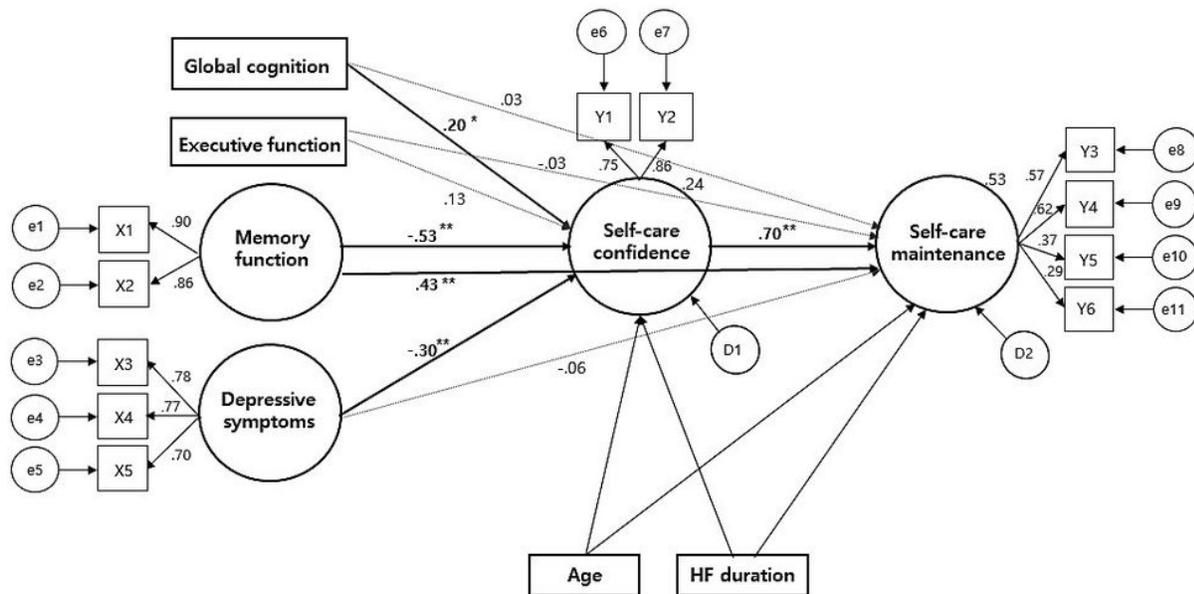
Variables	Younger group < 65 years					Older group ≥ 65 years				
	B	SE	β	t	p	B	SE	β	t	p
Constant	4.76	6.34		0.93	.355	3.86	8.48		0.45	.650
Age	.13	.05	.25	2.27	.025	.09	.10	.09	.92	.360
Global cognition	.19	.18	.11	1.03	.298	.18	.12	.18	1.56	.130
Memory function										
Immediate recalls	-.13	.13	-.17	-1.01	.300	-.03	.13	-.03	-.19	.821
Delayed recalls	.92	.32	.48	2.77	.006	.16	.26	.07	.62	.538
Executive function	.01	.05	.01	.06	.947	.01	.04	.01	.16	.873
Self-care confidence	.38	.13	.30	3.03	.003	.63	.11	.55	5.57	<.001

Table 5. Standardised direct, indirect, and total effects of the modified model

Endogenous variables	Exogenous variables	B	SE	CR	SMC	Standardised direct effects (p)	Standardised indirect effects (p)	Standardised total effects (p)
Self-care confidence	Global cognition	0.03	.01	2.03	.24	<b>.20 (.043)</b>		<b>.20 (.043)</b>
	Memory function <sup>a</sup>	-0.14	.03	-4.25		<b>-.53 (&lt;.001)</b>		<b>-.53 (&lt;.001)</b>
	Executive function	0.01	.01	1.45		.13 (.148)		.13 (.148)
	Depressive symptoms	-0.30	.09	-3.17		<b>-.30 (.002)</b>		<b>-.30 (.002)</b>
Self-care maintenance	Global cognition	0.01	.01	0.29	.53	.03 (.769)	<b>.14 (.030)</b>	.17 (.210)
	Memory function <sup>a</sup>	0.11	.04	2.73		<b>.43 (.006)</b>	<b>-.37 (.002)</b>	.06(.661)
	Executive function	-0.01	.01	-.29		-.03 (.772)	.09 (.116)	.06 (.582)
	Depressive symptoms	-0.05	.11	-.52		-.06 (.605)	<b>-.21 (.005)</b>	<b>-.27 (.048)</b>
Self-care confidence	0.69	.14	4.81	<b>.70 (&lt;.001)</b>		<b>.70 (&lt;.001)</b>		

SE, standard error; CR, critical ratio; SMC, squared multiple correlations. <sup>a</sup>Included immediate and delayed recall memory.

## Figures



**Figure 1**

Final results of the model analysis. \*  $p < .05$ , \*\* $p < .01$  X1: immediate memory function; X2: delayed memory function; X3: depressive mood; X4: physical symptoms; X5: negative thinking; Y1: symptom appraisal; Y2: symptom management; Y3: diet control; Y4: exercise; Y5: symptom monitoring & medication; Y6: medical follow-up; e1~e11: measurement error; D1-D2: structural error. Notes: The values on the line refers to standardised regression coefficients; Rectangle: measurement variables; Circle: Exogenous and endogenous latent variables.