



Development and psychometric properties of the age-friendly hospitals scale in older adults

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ABSTRACT

Age-friendly Primary Health Care by the World Health Organization (WHO) provided a framework to guide countries in developing concrete and appropriate care in the health system, including encouraging the development of an Age-Friendly Hospital (AFH) care network. The study aimed to develop and evaluate the psychometric properties of the AFH scale (AFHS) in older adults. A cross-sectional study collected and analyzed data from 330 older adults between June 2018 and June 2019. The instrument was developed and validated according to the proposed guidelines. The study involved item generation and scale development, including content and face validity, pilot testing, exploratory factor analysis (EFA), internal consistency, and test-retest reliability. EFA was performed using principal axis factoring with a promax rotation. The original model of four factors and 22 items was conducted. Three factors with eigenvalues greater than one were extracted, and the scree plot examination confirmed the retention of three factors with 22 items after performing EFA. Using the EFA, we identified three main factors: care processes, communication and service, and physical environment. The developed scale can contribute to establishing AFH and quality healthcare institutions. It may be a valuable reference for healthcare facilities to evaluate and enhance their services, considering factors like limited resources and workforce. Furthermore, this scale can facilitate continuous improvement and long-term development of age-friendly healthcare institutions.

1. Introduction

The population above the age of 65 years is growing more rapidly than the population below that age. The global population of 65 and above is projected to rise from 10% in 2022 to 16% in 2050 [1]. Taiwan is encountering increasing population aging, as in other Asian countries [2]. According to household registration statistics data analysis in Oct 2022, the number of people over 65 in Taiwan is 4,042,790, accounting for 17.42 % of the total population [3]. According to the National Development Commission, the older adult population in Taiwan is projected to exceed 20 % by 2026, and it will enter a super-aged society [4]. With the increase in the older adult population, the demand for medical care is also rising rapidly [5–7]. According to the statistics of the Central Health Insurance Administration, the medical expenses of the older adult population accounted for 37.3 % of the total expenses in 2017, increasing to 38.2 % in 2018 [8]. Most older adults will face health threats, disabilities, and even frailty, leading to an increase in medical and social

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burdens will increase [9,10]. It is necessary to establish AFH for older adults, as many of them have multiple comorbidities, frailty, and sensory impairments, requiring care from professional providers representing various disciplines [11,12], and improve the quality of life of the elderly [13,14].

As people age, they are more likely to need medical care due to an increased risk of chronic diseases [15]. The WHO introduced the Age-friendly Primary Health Care concept, providing a framework to guide countries in developing concrete and appropriate healthcare systems, including encouraging the establishment of an AFH care network [16]. AFH is an integral part of Age-friendly Primary Health Care [16], characterized by three general principles. The first principle emphasizes that professional healthcare providers in AFH receive information, education, and training in the core competencies of elder care. At the same time, older adults and their informal caregivers are educated in health literacy for disease management and health promotion. The second principle involves AFH adopting age-appropriate administrative procedures and providing a continuum of care across primary, secondary, and tertiary levels of healthcare. The last principle centers on AFH implementing universal design principles in the physical environment, ensuring facilities are accessible and convenient for all. Additionally, AFH aims to have easily readable signage, provide safe and affordable transportation options, and offer access to various community-based resources, including volunteers to assist older adults [16,17].

AFH is defined as well-trained professional healthcare providers with geriatric knowledge and skills in multidisciplinary delivery of available and accessible care to elders and families by adopting appropriate communication, service, and care through respect and dignity in the hospital [12,18]. The Ministry of Health and Welfare of Taiwan established the contents of AFH based on age-friendly primary health care [16,17] and health promotion, developed in 2009 [19]. The major domains included management policy, communication and services, care processes, and physical environment [16,20–23]. The management policy involved recruiting medical staff with geriatric knowledge and skills caring for older adults and their families. The hospital wrote guidelines about

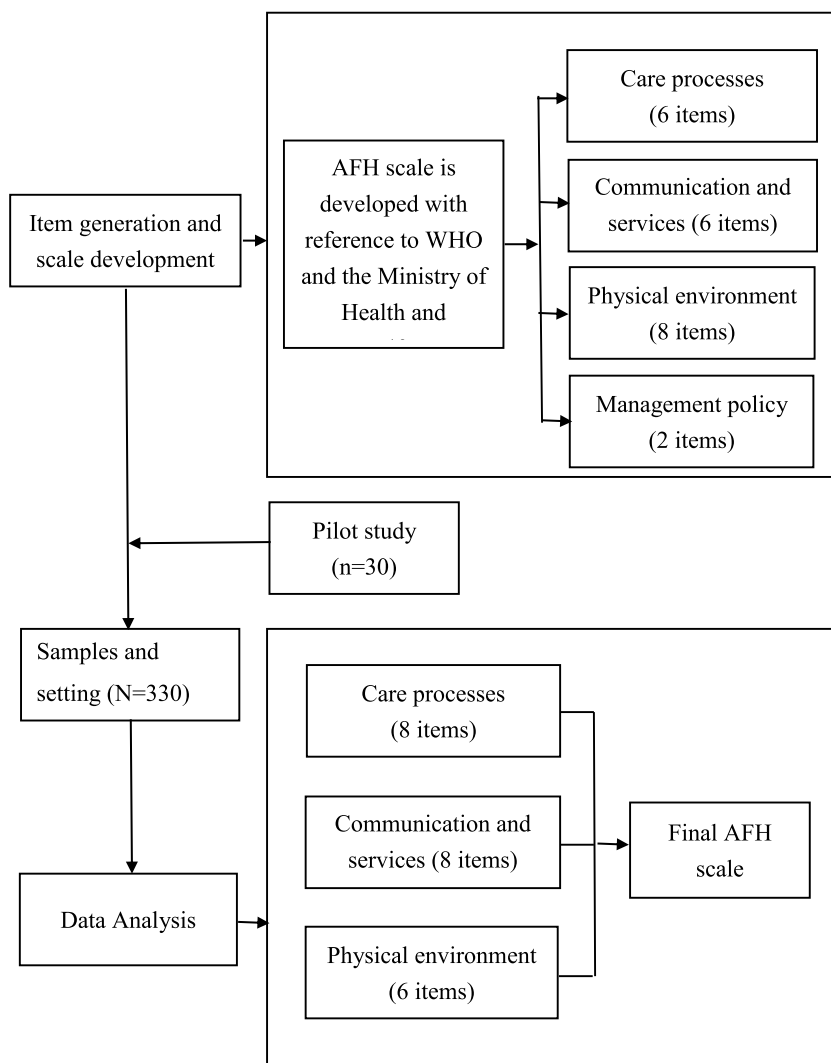


Fig. 1. Research framework.

organizational support, continuous monitoring, and improvement through respected dignity and collaboration among elders. The communication and services domain included two sub-standards of communication and service. In the communication sub-standard, hospital staff provided health education and hospital information age-appropriate to older people and their families, covering fee schedules, medications, and registration procedures. For older patients, AFH provided age-appropriate educational material to patients and families and respected their ability and right in decision-making. In service sub-standard, AFH developed volunteer programs to support patients in reception, navigation, transportation, reading, writing, and accompanying in outpatient and inpatient services. The care process domain included three sub-standards: patient assessment, intervention, management, community

Table 1
Factor structure and item analysis of the 22-item Age-friendly Hospital Satisfactory Scale.

Factor/Item	Mean (SD)	Item-subtotal correlation	Item-total correlation	skewness	kurtosis
Factor 1: Physical Environment					
PE01 The hospital provides a suitable environment for the elderly (including bright light, moderate air conditioning [heating and cooling], non-slip floor, sturdy furniture, safe walkways, stairs, etc.).	4.30 (0.55)	.805**	.719**	-.127	.046
PE02 The overall environment of the hospital is clean, comfortable, and quiet.	4.13 (0.77)	.767**	.629**	-.718	.350
PE03 The hospital has emergency alarm equipment (in the toilet, bathroom, or bedside of the inpatient ward, etc.).	4.50 (0.55)	.728**	.688**	-.489	-.851
PE04 According to the needs of the elderly, the hospital has multiple barrier-free facilities (including toilets, service desks, etc.).	4.34 (0.55)	.875**	.770**	-.169	-.076
PE05 The hospital's external transportation is convenient (such as a shuttle bus), and parking is convenient.	4.13 (0.31)	.823**	.747**	-.449	-.071
PE06 There is a drop-off point at the hospital's main entrance, and service personnel is arranged to assist.	4.13 (0.68)	.848**	.783**	-.164	-.846
PE07 There is a space for getting on and off the car and mobility aids (such as wheelchairs) in the hospital for the disabled.	4.63 (0.52)	.538**	.686**	-.863	-.529
PE08 There are clear and precise instruction strips or kanbans in the hospital to guide the direction.	4.57 (0.56)	.579**	.715**	-.973	.543
Factor 2: Communication and Service					
CS01 All staff in the hospital wear identification cards and are easy to identify.	4.62 (0.52)	.769**	.740**	-.848	-.558
CS02 Hospital staff treat elders with respect and understandable language.	4.62 (0.54)	.714**	.640**	-1.076	.140
CS03 For hospital services (such as age-friendly base: laboratory Priority service for the elderly over the age of 80), charging standards, registration procedures, etc., provided in a way suitable for the elderly.	4.23 (0.66)	.897**	.799**	-.293	-.769
CS04 For outpatient clinics, inspections, or related procedures (such as price approval, drug consultation, etc.), priority services for the elderly are provided to reduce the waiting time for the elderly.	4.22 (0.67)	.896**	.799**	-.355	-.551
CS 05 The hospital has volunteered in outpatient or inpatient departments to assist patients in appropriate ways (including guidance, transportation, reading and writing, companionship, etc.).	4.29 (0.59)	.853**	.844**	-.162	-.574
CS06 The hospital provides healthcare teaching tools or printed materials designed and used in a way suitable for the elderly.	4.36 (0.58)	.855**	.846**	-.263	-.691
Factor 3: Care Processes					
CP01 The doctor carefully examines the condition of the elderly and explains in detail.	4.56 (0.55)	.759**	.742**	-.753	-.520
CP02 Adjustments will be made according to the condition of elderly patients during various examinations, treatments, or operations.	4.50 (0.55)	.844**	.788**	-.501	-.840
CP03 Inform patients (or caregivers) of the examination results of elderly patients and the factors that affect their health, and jointly formulate care goals.	4.46 (0.56)	.870**	.809**	-.375	-.891
CP04 The hospital provides patients or family members with health education information related to healthy aging or various diseases.	4.26 (0.60)	.888**	.845**	-.177	-.545
CP05 Depending on the condition of elderly patients, refer them to other specialists, nutritionists, and health teachers. Other professionals or referral links to related resources (such as assistive device centers, long-term care centers, etc.)	4.13 (0.66)	.883**	.823**	-.141	-.693
CP06 Provide discharge preparation services for elderly people (including health education, information provision, resource referral, etc.)	4.11 (0.66)	.872**	.810**	-.117	-.711
Factor 4: Management Policy					
MP01 In response to the needs of the aging population, the hospital has set up a "Geriatric Medicine" outpatient clinic and has senior care professionals to achieve integration and provide holistic care for the elderly.	4.05 (0.70)	.918**	.783**	-.062	-.938
MP02 Overall impression of our hospital's "age-friendly environment."	4.50 (0.54)	.856**	.785**	-.358	-1.128
Overall (22 items)	4.34 (0.46)				

Physical Environment: PE; Communication and Service: CS; Care Processes: CP; Management policy: MP.

* $p < .05$, ** $p < .01$, *** $p < .001$.

partnership, and continuity of care. In patient assessment sub-standard, AFH had age- and gender-appropriately geriatric strategies to screen, assess, and monitor patients' health condition needs for health promotion and disease management. In intervention and management sub-standard, AFH delivered health literacy to patients and families, multidisciplinary medical staff provided age- and gender-appropriate care to patients and made the discharge plan as early as possible. In community partnership and continuity of care, AFH collaborated with and referred other health care (e.g., social resources, commune health station) and social care when patients need continuity of care or assistive device. The domain of the physical environment encompassed three sub-standards: general environment and equipment, transportation, and accessibility, as well as signage and identification. In the general environment and equipment sub-standard, AFH adopted Universal Design, such as good lighting, non-slip floor surfaces, stable furniture, clear and hand railings on both side walkways and emergency alarm systems in toilets and bathing facilities. In transportation and accessibility sub-standard, AFH's main entrance had enough space for passengers drop off/pick up area, and staff assisted patients with disabilities. In the signage and identification sub-standard, AFH adopted simple and easily readable signage to orientate, and staff used name badges and name boards for easy identification.

The concept of AFH has been addressed for more than a decade. Research on AFH has been investigated, but most of them developed from the perspective of medical professionals or authorities [18,24], such as hospital-based care of older adults in Canada [21], Australia [23], and the United States [25], Korea [26], Iran [27], Indian [28]. To sum up, many studies have not explored the needs of AFH from the perspective of hospitalized elderly individuals. However, the ideal framework of AFH should consider perspectives from the policymaker, medical staff, and older adults [29]. This study aims to develop and evaluate the psychometric properties of the needs of health services in AFH from the perspective of older patients, aiming to deliver the most appropriate geriatric care and facilitate better health outcomes.

2. Materials and methods

2.1. Study design

A cross-sectional and descriptive design was applied to develop and test the AFHS scale for older adults. Based on guidelines for scale development, the study included item generation and scale development, including content and face validity, pilot testing, EFA, and internal consistency reliability [30].

2.2. Developing the scale

The development and validation of the instrument were conducted according to the guidelines proposed by DeVellis [31]. Fig. 1 presents the research framework.

2.2.1. Item generation

The National Health Administration of the Ministry of Health and Welfare [17,19] constructed and wrote the framework of AFH in Taiwan. The items were discussed by multidiscipline experts, including two public health researchers, two medical directors of hospitals, three the director of AFH, physical environment architects, geriatric doctors, and nurses, were discussed to determine definitions, attributes, and instrument items based on the framework of AFH [19] and the literature [12,18]. Finally, the scale of AFH consists of 4 domains and 22 items (Table 1).

2.2.2. Content and face validity

A panel of experts examined the relevance and appropriateness of the items on the AFHS. The panel included seven experts: two nursing professors, three nursing home directors, and two medical doctors specializing in geriatric care. Initially, the experts indicated that some items were clear, equal, and readable based on their attributions, but they found that other items' attributions were unclear. Therefore, those items were revised. All items from the first draft were retained except for those requiring revision. After the item revision, the second draft's equivalence, clarity, and readability scores were 0.97, 0.98, and 0.98, respectively. The acceptable level for the item-level content validity index (I-CVI) and scale-level content validity index (S-CVI) should be greater than 0.80 [32]. The I-CVI ranged from 0.92 to 1.00, and the S-CVI/Ave was 0.97–1.04. Thus, the 22 items demonstrated acceptable content validity without revision. (Table 1).

2.3. Pilot testing

A pilot study of the AFHS was conducted to determine item clarity, ease of understanding, and time required for completion. At least 30 participants were recruited for the pilot study [33]. After obtaining approval from the Institutional Review Board, a convenience sample of 30 elderly inpatients was recruited and invited to complete the scale, evaluate its ease of understanding, and use it when they visited the geriatric clinic in the waiting area in eastern Taiwan. No identifying or demographic information was requested.

2.4. Samples and setting

Study participants were selected from outpatient department older adults using the following inclusion criteria: (1) over 65 years old in the regional teaching hospital; (2) who were conscious, and able to communicate in Chinese or Taiwanese, (3) willing to

participate in the research. Eligible cases were referred by the attending physicians, and they were explained the study by the researchers. Because a new scale is created, the number of samples received is estimated as follows: the clear standard is 100 for poor, 200 for average, 300 for good, and more than 500 for very good, more than 1000 is considered excellent. In the study, 300 cases were accepted, and the sample attrition rate was estimated to be 10 %, resulting in 330 cases [34].

2.5. Ethical consideration

The study was approved by the Hospital Ethics Committee's Institutional Review Board (IRB No. MCH-14-03-003). Written consent was obtained after explaining the purpose of the study to the participants, ensuring the anonymity of their participation, emphasizing voluntary participation, explaining their right to withdraw at any time, and assuring confidentiality during data processing and analysis.

2.6. Data collection

After obtaining Institutional Review Board approval, patients who met the inclusion criteria were referred to the study by the inpatient center. Informed consent was obtained from participants, and data were collected from June 2018 to June 2019. Demographic data collected included gender, age, marital status, education, and occupation. There were 330 questionnaires distributed and recovered.

3. Data analysis

Descriptive statistics for the categorical variables included distributions and percentages, with continuous variables illustrated as the means and standard deviations (SDs). Item analyses evaluated item means, standard deviations, item-total, and item-subscale correlations [32]. Items with item-total correlations below 0.10 or above 0.70 should be evaluated, revised, or deleted [32]. Item analyses explored the relevance and appropriateness between items and domains. The skewness was between -3 to 3 , and the kurtosis was between -10 to 10 , indicating a normal distribution [35].

EFA was used to analyze the structure of the theoretical model, in which links between the items and factors are unknown or uncertain during the early stages of research for instrument development. EFA serves three purposes: (i) to assess the score validity, (ii) to develop theories regarding the nature of constructs, and (iii) to summarize relationships in the form of a reduced set of factor scores that can then be used in analyses such as analysis of variance, regression, or descriptive discriminant analyses [36]. For running EFA, the sample size should be five to ten times the number of variables [37]. The following criteria determined the number of factors to retain, including factor loading >0.4 and eigenvalues greater than 1.0 . The items underwent EFA using principal axis factoring and a promax rotation. Cronbach's alpha coefficient was used to assess internal consistency reliability. After three months, 30 patients repeated the instruments to evaluate test-retest stability.

The SPSS v. 22 (SPSS Inc., Chicago, IL, USA) statistical software package was used for the descriptive data, item analysis, and EFA. Techniques of EFA used to determine factor structure included scree plot examination and eigenvalues over one.

Table 2
Characteristics of study participants (N = 330).

Variable	N	%
Age (years, mean \pm SD)	75.38 \pm 7.85	
65–74 year	166	50.3
75–84 year	102	30.9
≥ 85 year	62	18.8
Gender		
Female	154	46.7
Male	176	53.3
Education		
Illiterate	88	26.7
Japanese education	40	12.1
Elementary school	130	39.4
Junior high school	36	10.9
Senior high school	19	5.8
Above College	17	5.2
Economic status		
Not enough	106	32.1
Fair	169	51.2
Enough	51	15.5
Better	4	1.2
Marital status		
Single/Divorced/Widow	132	40.0
Married/partner	198	60.0

4. Results

4.1. Demographic characteristics

Three hundred thirty older adults responded with an average age of 75.38 (SD = 7.85) (range: 64–102 years), and more than half of the patients were men (53.3 %). Approximately 39.4 % (n = 130) had an elementary education, unemployed (n = 295, 89.4 %), married or with a partner (n = 198, 60.0 %), and lived with family (n = 267, 80.9 %). Over half of them perceived themselves as in fair economic status (n = 169, 51.2 %). The demographic characteristics of older adults are presented in Table 2.

4.2. Item analysis

Item analysis included item means, SDs, item-subtotal, and item-total correlations (Table 1). All item-total and item-subtotal correlations were above 0.30. Most item-subscale correlations are substantially larger than item-total, except for item7 and 8, which indicated that the discriminant validity of a four-factor AFHS was initially not supported.

The mean scores for each item ranged from 4.11 to 4.63 (SD = 0.31–0.77). The range of skewness was -0.09 – 1.08 , and kurtosis ranged from 0.05 ~ -1.13 , which indicated a normal distribution. Therefore, a 22-item AFHS instrument was used for factor analysis in advance.

4.3. EFA

EFA applied principal axis factoring with a promax rotation. The original model of three factors and 22 items was conducted. The Kaiser-Meyer-Olkin (KMO) test indicated adequate sampling, and Bartlett's sphericity test value was $\chi^2 = 8149.16$ ($p < .001$), which shows that the sample was appropriate for factor analysis. Three factors exhibited eigenvalues greater than one, and the scree plot examination showed three factors with 22 items after performing EFA. Therefore, EFA was conducted using a forced 3-factor structure. The explained variances for each factor were 58.69 %, 9.23 %, and 5.52 %, respectively, adding to a total variance of 73.43 %. Eigenvalues for the three factors were 12.91, 2.03, and 1.21, respectively (Fig. 2).

4.4. Internal consistency

After performing EFA, Cronbach's alpha was .965 for the 22-item scale (Table 3), 0.955 with Factor 1 (Care Processes), 0.887 with Factor 2 (Communication and Service), and 0.887 with Factor 3 (Physical Environment), respectively.

Test-retest reliability at three months resulted in a correlation coefficient of $r = 0.70$ ($p < .001$), which is considered acceptable [38] (Table 3).

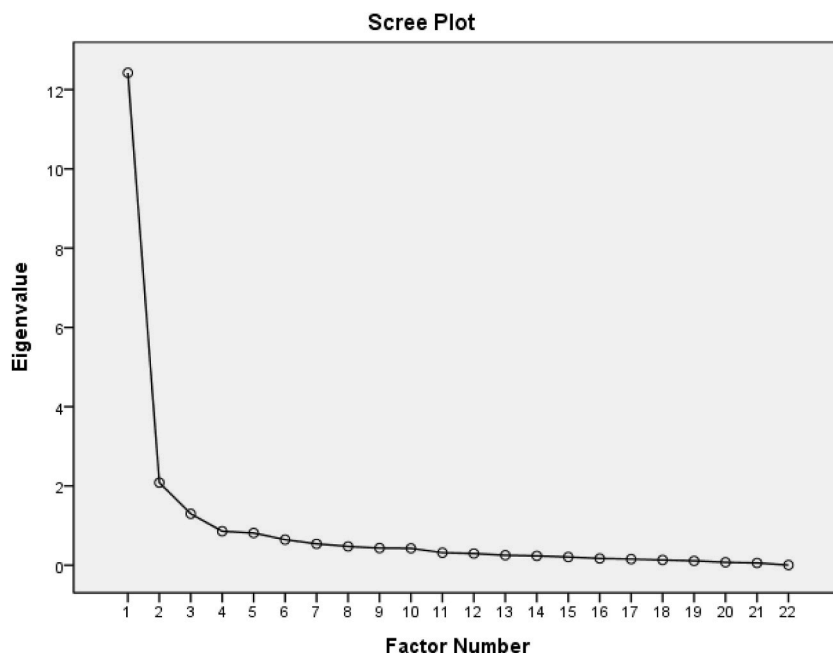


Fig. 2. Scree plot of exploratory factor analysis.

Table 3
Factor structure and Cronbach's alpha of the 22-item Age-friendly Hospital Scale.

Factor/Item	Factor 1	Factor 2	Factor 3	Cronbach's alpha
Factor 1: Care Processes				0.955
CP06 Provide discharge preparation services for elderly people (including health education, information provision, resource referral, etc.)	.837			
CP05 Depending on the condition of elderly patients, refer them to other specialists, nutritionists, and health teachers. Other professionals or referral links to related resources (such as assistive device centers, long-term care centers, etc.)	.815			
MP01 In response to the needs of the aging population, the hospital has set up a "Geriatric Medicine" outpatient clinic, and has senior care professionals to achieve integration and provide holistic care for the elderly.	.784			
CS04 For outpatient clinics, inspections, or related procedures (such as price approval, drug consultation, etc.), priority services for the elderly are provided to reduce the waiting time for the elderly.	.756			
CS03 For hospital services (such as age-friendly base: laboratory Priority service for the elderly over the age of 80), charging standards, registration procedures, etc., provided in a way suitable for the elderly.	.755			
CP04 The hospital provides patients or family members with health education information related to healthy aging or various diseases.	.702			
CS05 The hospital has volunteered in outpatient or inpatient departments to assist patients in appropriate ways (including guidance, transportation, reading and writing, companionship, etc.).	.657			
CS06 The hospital provides healthcare teaching tools or printed materials designed and used in a way suitable for the elderly.	.644			
Factor 2: Communication and Service				0.937
CS01 All staff in the hospital wear identification cards and are easy to identify.		.829		
PE07 There is a space for getting on and off the car, and mobility aids (such as wheelchairs) in the hospital for the disabled.		.801		
CS02 Hospital staff treat elders with respect and understandable language.		.789		
PE08 There are clear and precise instruction strips or kanbans in the hospital to guide the direction.		.782		
CP01 The doctor carefully examines the condition of the elderly and explains in detail.		.725		
CP02 Adjustments will be made according to the condition of elderly patients during various examinations, treatments, or operations.		.676		
CP03 Inform patients (or caregivers) of the examination results of elderly patients and the factors that affect their health, and jointly formulate care goals.		.603		
MP02 Overall impression of our hospital's "age-friendly environment."		.598		
Factor 3: Physical Environment				0.887
PE04 According to the needs of the elderly, the hospital has multiple barrier-free facilities (including toilets, service desks, etc.).				.742
PE02 The overall environment of the hospital is clean, comfortable, and quiet.				.722
PE01 The hospital provides a suitable environment for the elderly (including bright light, moderate air conditioning [heating and cooling], non-slip floor, sturdy furniture, safe walkways, stairs, etc.).				.710
PE06 There is a drop-off point at the hospital's main entrance, and service personnel is arranged to assist.				.648
PE05 The hospital's external transportation is convenient (such as a shuttle bus), and parking is convenient.				.627
PE03 The hospital has emergency alarm equipment (in the toilet, bathroom, or bedside of the inpatient ward, etc.).				.559
Eigenvalue	12.91	2.03	1.21	
Explained Variance(%)	58.69	9.23	5.52	
Overall Cronbach's alpha				0.965

Note. The number in bold indicates the factor loading of Age-friendly Hospital Satisfactory Scale items. Physical Environment: PE; Communication and Service: CS; Care Processes: CP; Management policy: MP.

5. Discussion

In recent years, countries have successively introduced the concept of AFH health care, providing an excellent medical environment for older adults, encouraging medical care institutions to participate in the establishment of AFH health care, and making AFH care services widely available, popular, and suitable to provide a variety of AFH services. In this study, we systematically developed an instrument to assess elderly inpatients in hospitals based on the scale development guideline by DeVellis [31]. We confirmed that the scale has acceptable reliability and validity. According to the results of AFHS and an extensive literature review, the hospital provided a physical environment, communication and service, care processes, and management policy from policymakers' perspectives [16,17]. The AFHS was structured as a 22-item instrument under four factors. Each factor consists of items that reflect the age-friendly concept's role.

The AFHS is a valid and reliable instrument for exploring the satisfactory contents of an AFH. The AFHS was developed by the framework of AFH [19] and an extensive literature review [12,18]. Multidisciplinary experts discussed to determine definitions, attributes, and instrument items generated items and analyzed their psychometric characteristics.

All item-total and item-subtotal correlations were above 0.30. Most of the correlations of item-subscale are substantially larger than

item-total, except item7 and 8, which indicated that the initial discriminant validity of a four-factor AFHS was not supported. The results of item-total and item-subtotal correlations did not keep them. This scale has been reduced from four factors to three factors. The possible reason is that the scale users are elderly patients, so the policy factor has been reduced. It may also be that only two items in the policy factor cannot constitute a factor [31]. Another possibility is with the management policy item, “This hospital prepares for the needs of aging persons, establishes a department of geriatrics, sets up comprehensive outpatient evaluations, and is assisted by professional case managers in elderly care to provide holistic care for elderly persons.” Because most inpatients do not use it after passing these geriatrics-related services [39,40], the scale needs to be explored further.

Correlation analyses of item analysis indicated a strong association between items-total and item-subscale. The values of item-subtotal correlations were greater than item-total correlations, indicating those items possessed item discrimination.

After the original theoretical model contained four factors-physical environments, communication and services, care processes, community services, and management policy [17,20–23], the internal consistency reliability represents the degree of correlation among items and indicates how many items should be retained in the instrument [31]. The Cronbach’s coefficient alpha should be in the range of 0.7–0.9. The value of internal consistency among the items in communication and service (8 items), as well as care process (8 items), exceeded 0.9; shortening of the instrument should be considered [31] in the future.

Hospital standards define this assessment scale with health, humanity, and human rights as the core value assessment scale. It envisions improving older adults’ health, dignity, and participation, covering four major aspects of management policies, communication, and services, physical environment, care processes, etc., to provide healthcare institutions with a reference for introducing and self-assessing implementation progress [41]. The scale offers an independent tool to assess, track, and improve age-friendly activities in hospitals, creating a friendly, supportive, respectful, and accessible healing environment that meets the unique needs of the elderly according to their needs, and promoting healthy, effective, whole-person, patient-centered, and coordinated care. This aims to empower older adults and their families to take control over their health and care, prevent and delay the occurrence of aging disability, and provide older adults with the greatest opportunity for friendly care throughout the aging process.

6. Conclusion

This AFHS can provide hospitals and quality institutions that are friendly to the elderly and health care with a basis for reviewing the limited workforce, time, and funds of the current hospital operation and for gradual improvement in the improvement process. It can become a standard reference index for institutions that develop quality improvement work in the long-term development of age-friendly healthcare hospitals in the future.

7. Limitations

The object of this study is elderly inpatients, and the hospital service model includes outpatient and emergency services. Therefore, this study’s AFH service satisfaction results are suitable for interpreting inpatients and do not represent outpatient and emergency services. Due to convenience, the research objects of this study are inpatients in a hospital in eastern Taiwan as the data source, and it is difficult to generalize to patients in the overall medical system, which limits the generalizability of the results of this study.

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Data availability statement

Data will be made available on request.

CRedit authorship contribution statement

Tse-Tsung Liu: Resources, Methodology, Investigation, Formal analysis, Data curation, Conceptualization. **Su-Jung Liao:** Writing – review & editing, Writing – original draft, Methodology, Investigation, Formal analysis, Data curation, Conceptualization. **Lou-Ching Kuo:** Writing – review & editing, Writing – original draft, Formal analysis. **Shu-Mei Chao:** Writing – original draft, Formal analysis.

Declaration of competing interest

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

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References

- [1] United Nations Department of Economic and Social Affairs World Population. Prospects Summary of Results, 2022. <https://www.un.org/development/desa/pd/>.
- [2] National Development Council, Population Estimates of the Republic of China (2020–2070), National Development Council, Taipei, 2020. [https://pop-roj.ndc.gov.tw/upload/download/Population%20Projections%20for%20the%20Republic%20of%20China%20\(Taiwan\)-2020-2070.pdf](https://pop-roj.ndc.gov.tw/upload/download/Population%20Projections%20for%20the%20Republic%20of%20China%20(Taiwan)-2020-2070.pdf).
- [3] Ministry of the Interior Republic of China, Household Registration Statistics Data Analysis in Oct 2022, 2022. <https://www.ris.gov.tw/app/en/2121?sn=22314479>.
- [4] National Development Council, Important Demographic Indicators, 2021. © National Development Council Population Estimate Inquiry System, <https://pop-proj.ndc.gov.tw/dataSearch.aspx?uid=3109&pid=59>.
- [5] World Health Organization, Ageing and Health, 2023. <https://www.who.int/news-room/fact-sheets/detail/ageing-and-health>.
- [6] Y. Zeng, S. Que, C. Lin, Y. Fang, The expected demand for elderly care services and anticipated living arrangements among the oldest old in China based on the andersen model, *Front. Public Health* 9 (2021), 715586. Oct 5, <https://doi.org/10.3389/fpubh.2021.715586>.
- [7] D.S. Jopp, K. Boerner, O. Ribeiro, C. Rott, Life at age 100: an international research agenda for centenarian studies, *J Aging Soc Policy* 28 (2016) 133–147, <https://doi.org/10.1080/08959420.2016.1161693>, 2016.
- [8] National Health Insurance Administration, National health insurance statistics. https://www.nhi.gov.tw/Content_List.aspx?n=81B8369AB1628185&topn=23C660CAACAA159D, 2018.
- [9] G. Sum, S.O. Nicholas, Z.L. Nai, et al., Health outcomes and implementation barriers and facilitators of comprehensive geriatric assessment in community settings: a systematic integrative review, *BMC Geriatr.* 22 (2022) 379, <https://doi.org/10.1186/s12877-022-03024-4>.
- [10] N. Leigh-Hunt, D. Bagguley, K. Bash, V. Turner, S. Turnbull, N. Valtorta, W. Caan, Social isolation, loneliness and health in old age: a scoping review, *Health Soc. Care Community* 25 (2017) 799–812, <https://doi.org/10.1111/hsc.12311>.
- [11] *White Paper on Aging Society*, Ministry of Health and Welfare, 2021.
- [12] J. Tavares, G. Santinha, N.P. Rocha, Age-friendly health care: a systematic review, *Healthcare* 9 (2021) 83, <https://doi.org/10.3390/healthcare9010083>.
- [13] J.G. Ouslander, I. Naharci, G. Engstrom, et al., Lessons learned from root cause analyses of transfers of skilled nursing facility (SNF) patients to acute hospitals: transfers rated as preventable vs. non-preventable by SNF staff, *J. Am. Med. Dir. Assoc.* 17 (2016) 256–262, <https://doi.org/10.1016/j.jamda.2015.11.018>.
- [14] S. Tiraphat, K. Peltzer, K. Thamma-Aphiphol, K. Suthisukon, The role of age-friendly environments on quality of life among Thai older adults, *Int. J. Environ. Res. Public Health* 14 (2017) 282, <https://doi.org/10.3390/ijerph14030282>.
- [15] B.A. Alharbi, N. Masud, F.A. Alajlan, N.I. Alkhanein, F.T. Alzahrani, Z.M. Almajed, R.K.M. Alessa, A.I. Al-Farhan, Association of elderly age and chronic illnesses: role of gender as a risk factor, *J Family Med Prim Care* 9 (2020) 1684–1690. https://doi.org/10.4103/jfmpc.jfmpc_1060_19.
- [16] World Health Organization, Towards Age-Friendly Primary Health Care, World Health Organization, Geneva, Switzerland, 2004. <https://apps.who.int/iris/handle/10665/43030>.
- [17] S.Y. Chiou, Age-friendly primary health care, *J. Healthc. Qual.* 5 (2011) 20–24.
- [18] A.M. Mudge, A. Young, P. McRae, F. Graham, E. Whiting, R.E. Hubbard, Qualitative analysis of challenges and enablers to providing age friendly hospital care in an Australian health system, *BMC Geriatr.* 21 (2021) 147, <https://doi.org/10.12927/cjnl.2004.16344>, 2021.
- [19] S.T. Chiou, L.K. Chen, Towards age-friendly hospitals and health services, *Arch. Gerontol. Geriatr.* 49 (2009), [https://doi.org/10.1016/S0167-4943\(09\)70004-4](https://doi.org/10.1016/S0167-4943(09)70004-4), S3–S6.
- [20] B. Parke, P. Brand, An elder-friendly hospital: translating a dream into reality, *Nurs. Leader.* 17 (2004) 62–76. <https://doi.org/10.12927/cjnl.2004.16344>.
- [21] A.R. Huang, N. Larente, J.A. Morais, Moving towards the age-friendly hospital: a paradigm shift for the hospital-based care of the elderly, *Can Geriatr J* 14 (2011) 100–103, 2011, <https://doi.org/10.57700/cgj.v14i4.8>.
- [22] Regional Geriatric Program of Toronto, The Senior Friendly Care Framework, Regional Geriatric Program of Toronto, Toronto, Canada, 2017. https://www.rgptoronto.ca/wp-content/uploads/2017/12/sfCare_Framework.pdf.
- [23] Care of Older Australians Working Group (COAWG), Age-friendly principles and practices. Managing Older People in the Health Service Environment, Australian Health Ministers' Advisory Council, Melbourne, Australia, 2004.
- [24] P.Z. Cacchione, Age-friendly health systems: the 4Ms framework, *Clin. Nurs. Res.* 29 (2020) 139–140, <https://doi.org/10.1177/1054773820906667>.
- [25] M. Boltz, E. Capezuti, N. Shabbat, Building a framework for a geriatric acute care model, *Leader. Health Serv.* 23 (4) (2010) 334–360, <https://doi.org/10.1108/17511871011079029>.
- [26] Y.S. Kim, S.H. Han, J.H. Hwang, et al., Development of the Korean framework for senior-friendly hospitals: a Delphi study, *BMC Health Serv. Res.* 17 (2017) 528, <https://doi.org/10.1186/s12913-017-2480-0>.
- [27] A. Ahmadi, H. Seyedin, R. Fadayee-Vatan, Towards age-friendly hospitals in developing countries: a case study in Iran, *Health Promote Perspect* 5 (1) (2015) 42–51.
- [28] M.R. Rashmi, A. Kasthuri, R.J. Rodrigues, Senior friendly hospitals: development and application of criteria: a descriptive study, *Indian J. Community Med.* 41 (4) (2016) 256–262. <https://doi.org/10.4103/0970-0218.193334>.
- [29] H. Geng, Q. Wang, J. Cui, Q. Gu, J. Long, Management and organization construction status and development suggestions of aged-friendly medical institutions in mainland China, *Aging Med (Milton)* 5 (2) (2022) 113–119, <https://doi.org/10.1002/agm2.12209>.
- [30] C.I. Shih, Y.H. Hsu, H.F. Yang, et al., Development of an age-friendly health service recognition framework for primary health centers in taiwan, *Int. J. Gerontol.* 15 (1) (2021) 58–63.
- [31] R.F. DeVellis, Chapter 5. Guidelines in scale development, in: L. Bickman, D.J. Rog (Eds.), *Scale Development: Theory and Applications*, fourth ed., Sage publications, Thousand Oaks, CA, 2017, pp. 105–151. <https://uk.sagepub.com/en-gb/asi/scale-development/book246123>.
- [32] D.F. Polit, C.T. Beck, The content validity index: are you sure you know what's being reported? Critique and recommendations, *Res. Nurs. Health* 29 (2006) 489–497, <https://doi.org/10.1002/nur.20147>.
- [33] G. Johanson, G. Brooks, Initial scale development: sample size for pilot studies, *Educ. Psychol. Meas.* 70 (2010) 394–400, <https://doi.org/10.1177/0013164409355692>.
- [34] R.B. Kline, *Principles and Practice of Structural Equation Modeling* (3rd ed.), Guilford Press, New York, NY, 2011.
- [35] R.B. Kline, *Structural Equation Modeling*, Guilford, New York, NY, 1998.
- [36] B. Thompson, *Exploratory and Confirmatory Factor Analysis: Understanding Concepts and Applications*, American Psychological Association, Washington, DC, 2004. International Standard Book Number: 1-59147-093-5).
- [37] J.F. Hair, W.C. Black, B.J. Babin, R.E. Anderson, *Multivariate Data Analysis: a Global Perspective*, seventh ed., Pearson Prentice Hall, New Jersey, 2009, pp. 91–151 (Chapter 3), *Exploratory factor analysis*.
- [38] Streiner, David L., Geoffrey R. Norman, and John Cairney, "Reliability", *Health Measurement Scales: A practical guide to their development and use* (5 edn). <https://doi.org/10.1093/med/9780199685219.003.0008>.
- [39] L.G. Liu, M.H. Lin, Integrated medical clinic for the elderly, *Clin. Med.* 79 (2017) 13–18, <https://doi.org/10.6666/ClinMed.2017.79.1.004>.
- [40] M.H. Lin, C.L. Liu, L.N. Peng, Y.T. Chen, L.K. Chen, Demographic characteristics and clinical benefits of outpatient geriatric evaluation and management service in Taiwan, *Arch Gerontology Geriatrics* 55 (2012) 42–44, <https://doi.org/10.1016/j.archger.2011.04.016>.
- [41] Health Promotion Administration, Ministry of Health and Welfare, Health Promotion Administration, Ministry of Health and Welfare annual report: health living, active aging. <https://www.hpa.gov.tw/Pages/Detail.aspx?nodeid=3801&pid=10231>, 2018.