BMC Geriatrics

RESEARCH Open Access

Developing an indicator for community-level age-friendly communities: the Japan gerontological evaluation study

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Abstract

Background Age-friendly communities (AFCs) aim to create inclusive societies for older adults. The World Health Organization (WHO) highlights dementia considerations in AFC development; however, few community-level indicators include these elements. This study aimed to develop a community-level AFC indicator incorporating dementia-friendly elements based on WHO guidelines and to test its validity and reliability.

Methods A repeated cross-sectional design used data from the 2016 and 2019 waves of the Japan Gerontological Evaluation Study (JAGES) covering 61 school districts in 16 municipalities (45,162 individuals aged 65 and older in 2016 and 39,313 in 2019). The 2016 and 2019 datasets served as the development and retest samples, respectively. The item selection process involved extracting indicators from the JAGES survey items that aligned with WHO guidelines as well as those based on prior research on dementia-friendly communities (DFCs). Following expert consultations, 23 candidate items were identified. Data were aggregated at the school district level. Exploratory factor analysis (EFA) was conducted on the 2016 data to derive the factor structure, and confirmatory factor analysis (CFA) was used to assess model fit. The reproducibility of the factor structure was evaluated using EFA on the 2019 retest sample. Internal consistency and test-retest reliability were assessed.

Results The final 17-item indicator comprised three subscales: Social inclusion and dementia-friendliness (7 items, $\alpha = 0.86$; e.g., Sense of belonging to the community), Social engagement and communication (5 items, $\alpha = 0.78$; e.g., Participation in hobby groups), and Age-friendly physical environment (5 items, $\alpha = 0.82$; e.g., Accessibility of barrier-free streets). The CFA showed an unsatisfactory model fit; however, test-retest reliability was adequate ($r = 0.71$–0.79; ICC = 0.67–0.78).

Conclusions A valid and reliable 17-item community-level indicator was developed, aligning with the WHO framework and incorporating dementia-friendly elements. This indicator is a valuable tool for monitoring, evaluation, and inter-community comparisons, aiding the development of AFCs and DFCs in aging societies like Japan. Additionally, this indicator can be adapted for other high-income countries with similar socioeconomic backgrounds, healthcare systems, and community structures, providing a useful tool for age- and dementia-friendly initiatives.

Clinical trial number Not applicable.

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Keywords Age-friendly communities, Dementia-friendly communities, Community-level indicators, Healthy aging

Background

The global population aged 65 and older was approximately 761 million in 2021 and is projected to more than double to 1.6 billion by 2050 [1]. Urbanization is progressing at a similar pace, with 55% of the global population residing in urban areas as of 2018; this figure is projected to grow to 68% by 2050 [2]. Rapid urbanization presents risks to health, society, and the environment [3]. It often adversely affects older adults' health and well-being and limits their ability to meet basic needs, build and maintain relationships, and make decisions. Japan serves as a notable case study. According to Japan's Ministry of Internal Affairs and Communications [4], the aging rate has reached 29.1%, the highest in the world. In rural areas, the aging rate has risen to 39.7%, raising concerns about the sustainability of healthcare and infrastructure [5]. In urban areas, the Tokyo Metropolitan Government projects that the population aged 65 and older will increase from 3.2 million in 2020 to 4.2 million by 2050 [6].

In this context, the development of Age-Friendly Communities (AFCs) has become an urgent priority. The World Health Organization (WHO) defines AFCs as communities that promote active aging and provide guidelines for addressing the challenges of rapid population aging [7]. WHO and United Nations member states launched the Decade of Healthy Aging in 2020 [8], and the development of age-friendly environments such as AFCs has gained attention as a critical social issue.

Moreover, with the global population of people with dementia exceeding 55 million [9], the concept of Dementia-Friendly Communities (DFCs) has emerged to support people with dementia and their caregivers [10]. While AFCs and DFCs share common goals of supporting older adults' independence and fostering supportive environments through stakeholder engagement, they are not identical [11–13]. AFCs primarily focus on older adults and are defined as "cities that promote active aging by optimizing opportunities for health, participation, and security to enhance quality of life as people age", encompassing eight focal areas (outdoor spaces and buildings, transportation, housing, social participation, respect and social inclusion, civic participation and employment, communication and information, and community support and health services) [7]. In contrast, DFCs address dementia-specific challenges, adopting a framework that emphasizes people, places, resources, networks, and individuals with dementia [14]. The WHO Dementia-Friendly Initiative outlines key principles of participation, cross-sector collaboration, coordination, and sustainability [11]. Rather than being separate approaches, AFCs and DFCs are complementary. WHO guidelines highlight the importance of integrating dementia-conscious principles into the planning, implementation, and evaluation stages of AFCs [11].

The implementation of effective AFCs requires robust monitoring and evaluation systems that can comprehensively capture community-level impacts and outcomes. WHO has identified gaps in current AFC monitoring and evaluation systems, particularly noting the lack of alignment between local, national, and global frameworks [3]. This misalignment hampers effective coordination and systematic assessment of AFC initiatives. Since AFCs are implemented at the community level, community-level indicators are essential for evaluating their effectiveness and implementation. While individual-level indicators provide valuable insights into AFC initiatives, they have certain limitations. They often fail to capture broader community dynamics, lack cross-community scalability, and do not adequately assess the systemic impact of policies and interventions [15]. In contrast, community-level indicators address these challenges by enabling the evaluation of collective environmental and social factors that influence age-friendliness [15]. These indicators are essential for evidence-based policymaking, providing standardized metrics for cross-regional comparisons, and bridging the gap between local implementation and global monitoring frameworks.

The development of indicators evaluating AFCs is based on the WHO AFC guidelines [16–23]. Previous studies have developed individual-level AFC indicators in countries such as the United Kingdom [18], the Netherlands [19], the United States [21], and Turkey [23] and tested their validity and reliability. In Turkey [23], a 20-item indicator spanning eight domains was developed and validated among 306 older adults, following Dikken et al. [19]. Meanwhile, only a few community-level AFC indicators have been developed [24–27]. Rugel et al. [27] developed a community-level healthy aging index across six domains, based on the Prospective Urban and Rural Epidemiological study, which includes urban and rural populations across 20 countries. However, while several community-level AFC indicators have been developed, they do not incorporate dementia-friendly elements.

This study aims to (1) develop a community-level AFC indicator grounded in the WHO AFC guidelines that incorporates the considerations of dementia-friendly elements and (2) examine its validity and reliability, including its consistency over time (temporal stability), which is essential for long-term community assessment and monitoring.

Methods

Data

This study used repeated cross-sectional data from the 2016 and 2019 waves of the Japan Gerontological Evaluation Study (JAGES). JAGES is an ongoing cohort study investigating social and behavioral factors related to health decline, including mortality and functional or cognitive impairment among individuals aged 65 and older [28]. The 2016 and 2019 waves served as the development and retest samples, respectively. Participants were selected from official municipal records, excluding those requiring long-term care. Municipalities with fewer than 5,000 eligible individuals underwent full enumeration, whereas those with 5,000 or more were random sampling. Of the 16 municipalities, nine underwent full enumeration, while seven used random sampling.

The development sample consisted of physically and cognitively independent older adults aged 65 and older who were ineligible to receive benefits from public long-term care insurance (LTCI). Self-administered questionnaires were mailed to them in October and November 2016. A total of 115,350 questionnaires were mailed to individuals in 250 school district-defined communities across 16 municipalities in eight prefectures. A total of 81,515 questionnaires were returned (response rate: 70.7%), of which 65,722 contained valid responses. The survey consisted of two parts: a core questionnaire administered to all respondents and eight randomly assigned modules. The development sample included responses to the core questionnaire and three module items from the eight modules, including AFC and DFC indicators.

School districts were adopted as the community unit; to avoid inaccuracies due to sample size, school districts with fewer than 30 respondents were excluded to avoid non-precise community-level values due to small sample size [29], resulting in 62 school districts with 45,503 respondents. School districts were chosen as the primary community unit due to their geographical suitability for older adults, who can easily navigate these areas on foot or by bicycle, and because they align with the daily living areas defined in Japan's community-based integrated care system [30]. Furthermore, these districts host various local activities, such as senior citizen clubs and sports organizations, making them integral to evaluating local public health initiatives [31]. The retest sample also comprised physically and cognitively independent older adults aged 65 and older who were ineligible to receive benefits from public LTCI. A self-administered postal survey was conducted between November 2019 and January 2020. The retest sample used data from responses to the core questionnaire and one module item from each of the eight models, including AFC and DFC measures. As in the development sample, we excluded areas with school districts with fewer than 30 respondents, resulting in a sample of 68 school districts with 40,998 respondents.

In both the development and retest samples, school districts with fewer than 30 respondents were excluded. However, some school districts appeared in only one sample. Therefore, school districts not present in both samples were excluded. As a result, the final analysis included 61 school districts, with 45,162 respondents from 2016 to 39,313 respondents from 2019 (Fig. 1).

The JAGES protocol was approved by the Ethics Committee of Chiba University (approval no. M10460). The self-administered questionnaire included a study description, and returning the completed questionnaire was considered informed consent. To ensure confidentiality, all data were fully anonymized, with no personally identifiable information included. Each participant was assigned a unique ID for secure data management, and analyses were conducted using de-identified datasets. Data were securely stored in accordance with JAGES data protection guidelines, and researchers adhered to strict security measures, including responsible data disposal after the study was completed. This study was conducted in accordance with the Declaration of Helsinki.

Selection of candidate indicators for AFCs

To develop the indicator set, we extracted potential indicators from JAGES survey items.

that aligned with the WHO guidelines [32] and those relevant to DFCs based on dementia-related research [33–35], particularly dementia-friendly elements related to the social environment. These candidate indicators were selected to comprehensively assess both age-friendliness and dementia-friendliness in community settings.

The selection process involved two steps: (1) identifying potential indicators relevant to WHO AFC criteria or dementia-related research, and (2) evaluating these indicators based on their alignment with specific WHO domains and established dementia-friendly community principles. Indicators lacking conceptual clarity, empirical support, or relevance to community-level interventions were excluded.

Six gerontology experts—including a geriatrician, gerontological nurse, geriatric physiotherapist, healthcare official, and welfare policy expert—reviewed and refined the indicators to 23 items. Additionally, during a monthly research meeting hosted by the JAGES office, approximately 20 experts further assessed their applicability for evaluating age- and dementia-friendliness in the social environment.

The 23 items spanned nine domains, including eight WHO AFC domains and dementia-friendly elements. The WHO AFC domains encompassed key areas such as Outdoor Spaces and Buildings and Social Participation

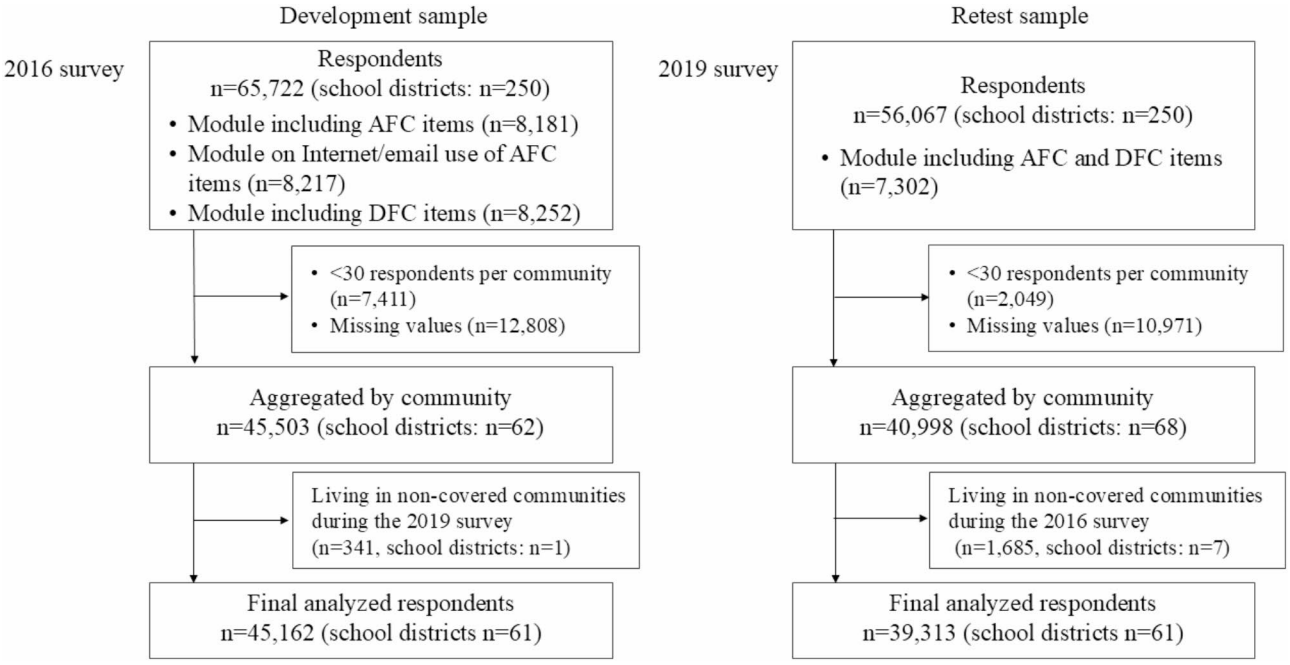

Fig. 1 Flowchart of the study population: JAGES 2016 survey and 2019 survey

(see Table S1). For instance, one item related to outdoor spaces for exercise, which falls under the Outdoor Spaces and Buildings domain, asks: *"Are there parks or sidewalks within walking distance (about 1 km) of your home for exercise or walking?"* The dementia-friendliness domain included five items. One item that corresponds to the Support for Families of People with Dementia asks: *"If a family member were affected by dementia, would you want your neighbors and acquaintances to be aware so that they could provide assistance?"*

Responses were dichotomized, as Japanese respondents tend to prefer middle options (e.g., "undecided") [36, 37]. Following previous studies [38, 39], the dichotomized responses were aggregated by school district to create community-level indicators, an approach also used in JAGES Health Equity Assessment and Response Tool (JAGES-HEART) [40] and the Ministry of Health, Labour and Welfare integrated care visualization system. Higher composite scores indicate greater age-friendliness at the community level.

Statistical analysis

We first computed the mean and standard deviation of each item in both the development and retest samples and used an independent t-test to compare sample means. Missing data were handled by excluding cases with missing responses for each variable during aggregation at the school district level. Potential confounders, such as socioeconomic status (SES) and urban–rural differences, were not included in the analysis since this study primarily aimed to develop and validate the community-level indicator.

Before conducting exploratory factor analysis (EFA), we examined the inter-item correlations and assessed the sampling adequacy using the Kaiser-Meyer-Olkin (KMO) test and Bartlett's test of sphericity to confirm the suitability of the dataset for factor analysis. A KMO value above 0.80 is considered meritorious, 0.70–0.79 acceptable, and below 0.60 inadequate for factor analysis [41]. Bartlett's test was conducted to examine whether the observed correlation matrix significantly differed from an identity matrix, ensuring that factor analysis was appropriate [42].

Subsequently, EFA was performed on the development sample to assess construct validity. The number of factors was determined based on the scree plot, parallel analysis, and Kaiser's criterion (eigenvalues > 1). EFA was performed using maximum likelihood estimation with Promax rotation. Factor loadings below the 0.40 threshold were eliminated.

Confirmatory factor analysis (CFA) was conducted to validate the factor model identified by EFA [43]. To assess model fit, the following fit indices were used: comparative fit index (CFI) > 0.90, Tucker–Lewis index (TLI) > 0.90, root mean square error of approximation (RMSEA) < 0.05, standardized root mean residual (SRMR) < 0.08 [44, 45]. To assess the replicability of the identified factor structure, EFA was subsequently conducted on the retest sample. For both the development and retest samples, the indicators' internal consistency reliability was evaluated by calculating Cronbach's α.

Subscale scores were also calculated by averaging item scores within each subscale of the extracted factor structure. To examine the developed scale's stability over time, test-retest reliability was evaluated using Pearson correlation coefficients for each subscale score in the two time-series samples, along with the intraclass correlation coefficient (ICC), calculated as ICC(1,2).

All statistical analyses were conducted using R software (version 4.3.0 for Windows; R Foundation for Statistical Computing, Vienna, Austria). EFA was performed using psych (version 2.4.1) and GPArotation (version 2024.2.1) for parallel analysis. CFA was performed using lavaan (version 0.6.19), and ICC was calculated using irr (version 0.84.1). Additional statistical analyses, including t-tests and correlation analyses, were conducted using stats (base R).

Results

Table 1 presents the characteristics of the candidate items. Some items remained stable across both samples, such as "Participation in learning or cultural groups." By contrast, "Internet use" increased by 13.0%, whereas "Understanding of people with dementia" declined by 8.7%.

Tables S2 and S3 present the correlations for the development sample in 2016 and the retest sample in 2019. To assess the suitability of the dataset for factor analysis, we conducted the KMO test and Bartlett's test of sphericity. The KMO test revealed that six items had values below 0.60, including "Housing type", "Participation in senior citizen clubs", "Participation in paid work", "Awareness and understanding of dementia", "Understanding of people with dementia" and "Decision-making support for people with dementia". However, these items were retained due to their conceptual significance in representing age- and dementia-friendly communities. Bartlett's test of sphericity was significant (χ^2 = 801.2, $p < 0.001$), supporting the appropriateness of factor analysis. Factor extraction was based on eigenvalues, scree plot, and parallel analysis, all of which consistently supported a three-factor structure.

Table 2 presents the results of EFA conducted in 2016 and 2019. In 2016, EFA identified six items—"Housing type", "Participation in senior citizen clubs", "Participation in paid work", "Awareness and understanding of dementia", "Understanding of people with dementia" and "Decision-making support for people with dementia"—that were excluded due to low factor loadings (less than

Table 1 Candidate items for age-friendly communities in 2016 and 2019 (23 items, $n = 61$)

Possible factors within each domain	Development sample (2016)		Retest sample (2019)			
	Mean (SD)		Mean (SD)		Difference	$p^{\dagger}$
Parks and sidewalk for exercise and walking	73.3	(10.1)	73.1	(11.4)	-0.1	0.898
Barrier-free public facilities	15.1	(7.3)	11.1	(6.1)	-4.0	< 0.001
Barrier-free trains and buses	10.4	(5.1)	9.4	(5.4)	-1.0	0.190
Barrier-free sidewalks and roads	23.0	(8.1)	23.2	(8.6)	0.3	0.760
Stations and bus stops within walking distance	24.3	(10.3)	21.9	(11.1)	-2.4	0.024
Housing type	93.4	(3.5)	93.6	(3.3)	0.2	0.594
Participation in hobby activity groups	35.0	(5.2)	31.1	(4.8)	-3.8	< 0.001
Participation in sports groups/clubs	27.6	(5.1)	26.7	(5.0)	-1.0	0.074
Participation in learning or cultural groups	8.3	(2.0)	8.3	(2.1)	0.0	0.985
Participation in senior citizen clubs	10.5	(4.6)	9.1	(5.0)	-1.4	< 0.001
Sense of belonging to the community	36.7	(10.6)	35.1	(10.9)	-1.6	0.164
Participation in community decisions	42.8	(11.5)	35.9	(11.9)	-6.9	< 0.001
Norms of reciprocity	53.9	(6.1)	55.3	(6.1)	1.4	0.008
Participation in volunteer groups	15.1	(3.1)	14.1	(3.4)	-1.1	0.005
Participation in paid work	27.4	(3.5)	32.5	(4.1)	5.1	< 0.001
Use of internet or email	41.1	(9.1)	54.2	(9.6)	13.0	< 0.001
Frequency of contact with friends	74.3	(3.7)	73.5	(4.9)	-0.8	0.073
Health and welfare services	45.0	(9.4)	44.0	(9.1)	-1.0	0.392
Awareness of living with dementia	62.8	(5.3)	56.5	(6.7)	-6.3	< 0.001
Participation of people with dementia in community activities	50.7	(6.9)	48.1	(6.5)	-2.6	0.016
Understanding of people with dementia	62.1	(6.0)	53.4	(5.7)	-8.7	< 0.001
Decision-making support for people with dementia	10.6	(3.6)	13.2	(4.0)	2.6	< 0.001
Support for families with dementia	78.5	(5.8)	75.5	(6.5)	-2.9	0.004

†Independent t-test

SD, standard deviation

Table 2 Factor loadings of age-friendly indicators in 2016 and 2019

	Development sample (2016)			Retest sample (2019)		
	Factor 1	Factor 2	Factor 3	Factor 1	Factor 2	Factor 3
	Social inclusion and dementia friendliness	Social engagement and communication	Age-friendly physical environment	Social inclusion and dementia friendliness	Social engagement and communication	Age-friendly physical environment
Sense of belonging to the community	0.86	0.02	-0.19	0.89	0.00	-0.10
Perception of community reciprocity	0.85	-0.15	0.13	0.74	0.07	-0.06
Community healthcare service	0.79	0.11	0.03	0.58	-0.03	0.25
Participation in community decisions	0.78	-0.07	-0.10	0.82	-0.19	0.01
Support for families of people with dementia	0.58	-0.21	-0.01	0.62	-0.12	-0.09
Frequency of meeting with friends	0.56	0.11	-0.27	0.39	0.33	-0.46
Social participation of people with dementia	0.56	0.26	0.21	0.58	0.10	0.12
Participation in hobby groups	-0.19	0.90	0.05	-0.05	0.93	0.02
Participation in sports groups and clubs	-0.13	0.88	0.08	-0.10	0.80	0.18
Participation in volunteer groups	0.28	0.75	-0.04	0.14	0.77	-0.19
Participation in learning or cultural groups	0.20	0.63	0.09	0.05	0.64	0.00
Internet use	-0.34	0.62	-0.17	-0.17	0.57	0.17
Accessibility of barrier-free streets	-0.14	-0.28	0.99	0.31	-0.06	0.91
Accessibility of barrier-free public spaces and buildings	0.05	-0.01	0.80	0.09	-0.06	0.88
Outdoor space suitable for exercise	-0.08	0.08	0.72	0.01	0.22	0.69
Accessibility of barrier-free public transportation vehicles	-0.02	0.16	0.59	0.01	0.01	0.68
Accessibility of public transportation stops	0.00	0.20	0.42	-0.16	0.17	0.48
Correlation coefficients between factors						
Factors 1	1.00	-0.06	-0.23	1.00	-0.40	-0.22
Factors 2		1.00	0.52		1.00	0.31
Factors 3			1.00			1.00
α	0.86	0.78	0.82	0.85	0.79	0.81

Exploratory factor analysis was applied Promax rotation and maximum likelihood method

0.40). Consequently, 17 items were retained, forming a three-factor structure.

The 2016 results showed that *Factor 1*: *Social inclusion and dementia-friendliness* comprises seven items, including "Sense of belonging to the community," "Perception of community reciprocity," and "Community health care service" (α = 0.86). The item with the highest factor loading in *Factor 1* was for "Sense of belonging to the community" (0.86), while the lowest was "Social participation of people with dementia" (0.56).

Factor 2: *Social engagement and communication* comprises five items, including "Participation in hobby groups" and "Participation in volunteer groups" (α = 0.78). The item with the highest factor loading in *Factor 2* was for "Participation in hobby groups" (0.90), while the lowest was "Internet use" (0.62).

Factor 3: *Age-friendly physical environment* comprises five items, including "Accessibility of barrier-free streets," "Accessibility of barrier-free public spaces and buildings," and "Outdoor space suitable for exercise" (α = 0.82). The item with the highest factor loading in *Factor 3* was for "Accessibility of barrier-free streets" (0.99), while the lowest was "Accessibility of public transportation stops" (0.42).

Table 3 Scores of sub-indicators of the age-friendly indicator and test-retest reliability in 2016 and 2019

	Development sample (2016)			Retest sample (2019)			$r^{\dagger}$	ICC (95% CI)
	Mean (SD)	Minimum	Maximum	Mean (SD)	Minimum	Maximum		
Social inclusion and dementia friendliness	54.6 (6.2)	43.8	70.4	52.9 (6.0)	43.3	66.5	0.73*	0.69 (0.49–0.82)
Social engagement and communication	25.4 (4.0)	13.5	35.4	26.9 (4.1)	16.0	34.9	0.71*	0.67 (0.46–0.81)
Age-friendly physical environment	29.2 (6.4)	15.7	44.2	27.8 (6.7)	14.5	49.8	0.79*	0.78 (0.64–0.86)

†Pearson correlation coefficients; *$p < 0.05$

SD, standard deviation; ICC, intraclass correlation coefficient; CI, confidence interval

To assess the model fit of the three-factor structure identified through EFA, we conducted CFA. The fit showed that the model did not fit the data satisfactorily: χ^2 (202.667, $p < 0.001$), CFI = 0.86, TLI = 0.83, RMSEA = 0.11, SRMR = 0.14 (see Figure S1).

In 2019, most items had similar loadings as in 2016. However, "Frequency of meeting with friends" in *Factor 1* had a factor loading of 0.39 and exhibited similar loadings across *Factors 2* and *3*. Items with factor loadings below the 0.40 threshold were eliminated. When an item exhibited similar loadings on multiple factors, it was assigned to the factor where it demonstrated stronger conceptual alignment. Other than this exception, the factor structure in 2019 remained consistent with the 2016 findings, confirming its reproducibility.

Factor 2 was positively correlated with *Factor 3* ($r = 0.52$, $p < 0.001$). The factor structure identified in the development sample was further validated in the retest sample, showing a similar configuration.

Table 3 presents sub-indicator scores and test-retest reliability for 2016 and 2019. The subscale stability scores across the two time points were assessed using Pearson's correlation coefficient and ICC. For the *Factor 1* subscale, Pearson's *r* was 0.73 ($p < 0.001$) and ICC was 0.69 (95% confidence interval [CI]: 0.49–0.82). The *Factor 2* subscale had Pearson's $r = 0.71$ ($p < 0.001$) and ICC = 0.67 (95% CI: 0.46–0.81). For the *Factor 3* subscale, the coefficients were Pearson's $r = 0.79$ ($p < 0.001$) and ICC = 0.78 (95% CI: 0.64–0.86).

Discussion

We developed a 17-item, community-level AFC indicator based on the WHO AFC guidelines, incorporating considerations of dementia-friendly elements. This indicator demonstrated validity and reliability in assessing temporal stability.

This indicator has a three-factor structure. *Factor 1*: *Social inclusion and dementia friendliness* covers the WHO AFC core indicators: "Respect and social inclusion," "Communication and information," and "Community support and health services." It also includes principles related to the inclusion of people with dementia. Thus, *Factor 1* reflects an inclusive social environment for older people, including those with dementia, such as "Sense of belonging to the community" and "Participation in community decisions." *Factor 2*: *Social engagement and communication* includes items related to group participation and Internet/email use. The introduction of Internet and technology use has been discussed within the AFC context [46, 47]. Such use of the Internet suggests a link with enhanced social participation [48]. Thus, *Factor 2* assesses older adults' social participation and use of online communication. This factor covers the following WHO AFC core indicators: "Social participation," "Civic participation and employment," and "Communication and information." Notably, "Communication and information" is also included in *Factor 1*. *Factor 3*: *Age-friendly physical environment* covers the WHO core indicators "Outdoor spaces and buildings" and "Transportation," representing older adults' physical environment. Thus, our indicator covers seven of the eight WHO AFC core domains, incorporating both physical and social environments.

The CFA results indicated that the model did not achieve a satisfactory fit, suggesting the need for further refinement. Despite this, the three-factor structure demonstrated acceptable internal consistency (Cronbach's $\alpha = 0.78–0.86$), and the subscale scores exhibited adequate test-retest reliability (ICC ≥ 0.70) [49], suggesting that the indicator provides consistent results over time.

Housing-related items were ultimately excluded from the study, probably because we asked the housing-related questions in terms of housing type and home-ownership status. As the rate of owner-occupied housing is high in this Japanese cohort, this question may not be entirely aligned with the AFC framework within the Japanese context. Given that housing is a crucial element for supporting aging in place (AIP) [50, 51], excluding housing-related items from the indicator may have led to an inadequate assessment of older adults' basic living needs and AIP. Therefore, future research should consider incorporating housing-related items such as housing comfort, degree of barrier-free accessibility, and access to community and social services [52] to ensure a more comprehensive assessment of age-friendliness.

Notably, two dementia-friendliness indicators remained in the developed indicator set—"Support for families of people with dementia" and "Social participation of people with dementia"—likely due to their alignment with the "Respect and social inclusion" domain in

the WHO framework. The excluded dementia-friendly elements, such as "Awareness of living with people with dementia" and "Understanding people with dementia," may not necessarily reflect community conditions that support people with dementia. Therefore, it may be necessary to measure behaviors and attitudes in addition to knowledge-based items.

Differences in attitudes toward dementia and DFCs content may be influenced by each country's sociocultural context. For example, the United Kingdom [53] and the Netherlands [54] have incorporated dementia measures into their national strategies, while in the United States, "Dementia-Friendly America" [55] has been implemented. In contrast, Turkey does not have an official national strategy; however, awareness-raising activities and support programs for dementia [56] are ongoing. Additionally, Lion et al. [57] indicate that the stigma experienced by people with dementia varies across countries and cultures. Despite differences in national strategies and sociocultural contexts, the WHO emphasizes respect, dignity, and family support as core elements of DFCs[11], highlighting their universal importance across countries.

Developing this community-level AFC indicator that incorporates dementia-friendly elements is highly meaningful. This indicator captures key social and physical environmental factors aligned with WHO domains. While further refinement is needed, it provides a valuable tool for monitoring and evaluating AFC and DFC initiatives. Its validity and reliability were demonstrated through testing with a large sample of older adults from various regions in Japan. Future studies can use this indicator to examine its relationship with older adults' health and well-being.

The implementation of this indicator in policies and municipal measures will enable the systematic monitoring of changes in older adults' well-being. Additionally, community assessments using this indicator can help identify areas with lower levels of age-friendliness, guiding targeted support programs. This approach is expected to facilitate the development of effective initiatives to enhance older adults' quality of life.

However, this study has several limitations. First, as the data do not include responses from individuals with physical disabilities or dementia, they may not fully capture the actual conditions of the area. Further research should include these groups to develop a more comprehensive indicator. Second, there are constraints on generalizability. The study's small sample size and its restriction to 16 Japanese municipalities may limit the generalizability of the findings to the broader population. Future studies with larger and more diverse samples are needed to improve the indicator's applicability. Moreover, school districts with fewer than 30 respondents were excluded to maintain statistical stability and avoid imprecise community-level estimates. However, this exclusion criterion reduced the number of school districts analyzed, potentially affecting the sample's representativeness and the findings' transferability to smaller or rural communities. Additionally, the study did not account for potential confounding variables, such as SES and urban–rural disparities, which may influence the indicator's performance across different community settings. Future research should examine the stability and validity of the indicator across varying socioeconomic and geographical contexts. Furthermore, as the study was conducted in Japan, a high-income country, the applicability of the developed indicator to nations with different social structures, healthcare systems, and cultural contexts remains uncertain. Given the potential influence of these factors, further validation in diverse international settings is necessary to establish the indicator's robustness and cross-cultural relevance. Third, as noted earlier, the CFA results indicated that the model did not achieve satisfactory fit. This may be due to the limited sample size, which could have affected the model fit. Future research with larger samples is needed to improve model fit and ensure robustness. Fourth, although the indicator incorporates dementia-friendly elements, it only partially captures the social environment aspects of the DFCs. It also does not fully address the important physical environment features that reduce anxiety and confusion among people with dementia, such as clear color contrasts in mats and floors, clear directions and street signage, and strategically placed trees and furniture for navigation assistance [58]. Therefore, this indicator requires further refinement in the future. Finally, the exclusion of six items—such as "Paid work," "Housing conditions," and "Participation in senior clubs"—due to low factor loadings may limit the indicator's ability to fully capture older adults' economic activities, social networks, dementia coping strategies, and AIP environments.

Conclusions

We developed a community-level, age-friendly indicator with demonstrated validity and reliability that incorporates DFC elements. It comprises three factors—*Social inclusion and dementia friendliness*, *Social engagement and communication*, and *Age-friendly physical environment*—aligning with the WHO framework. This indicator will enable community-level monitoring, evaluation, and inter-community comparisons, as well as support the development of AFCs and DFCs in Japan, a rapidly aging society. Additionally, it could be adapted for use in other high-income countries with similar socioeconomic backgrounds, healthcare systems, and community structures, offering a valuable tool for promoting age- and dementia-friendly initiatives globally.

Abbreviations

AFC	Age-friendly community
EFA	Exploratory factor analysis
ICC	Intraclass correlation coefficient
JAGES-HEART	Japan gerontological evaluation study health equity assessment and response tool
JAGES	Japan gerontological evaluation study
WHO	World health organization

Supplementary Information

The online version contains supplementary material available at https://doi.org/10.1186/s12877-025-05919-4.

Supplementary Material 1: **Table S1**: Candidate items for age-friendly communities. **Table S2**: Correlation coefficient of the development sample in 2016. **Table S3**: Correlation coefficient of the retest sample in 2019. **Figure S1**: Confirmatory factor analytical model of the three-factors dimensional model.

Acknowledgements

We thank the study participants and members of the 300 BM and AFC working group of the JAGES team for data collection.

Author contributions

SF: Writing– original draft, Conceptualization, Data curation, Formal analysis, Methodology. TN: Writing– review & editing, Methodology, Methodology, Supervision Conceptualization. KI: Writing–review & editing, Methodology. SJ: Writing–review & editing, Methodology. KK: Writing– review & editing, Project administration, Resources, Funding acquisition. TO: Writing– review & editing, Project administration.

Funding

This study used data from JAGES (the Japan Gerontological Evaluation Study). This study was supported by Grant-in-Aid for Scientific Research (20H00557, 20K10540, 21H03153, 21H03196, 21K17302, 21K11108, 21H00792, 22H00934, 22H03299, 22K04450, 22K17409, 23H00449, 23H03117), Health Labour Sciences Research Grants (19FA1012, 19FA2001, 21FA1012, 22FA2001, 22FA1010, 22FG2001), the Research Institute of Science and Technology for Society (JPMJOP1831, JPMJRX21K6) within the Japan Science and Technology (JST), a grant from Japan Health Promotion & Fitness Foundation, and a TMDU priority research areas grant, the National Research Institute for Earth Science and Disaster Resilience, and Research Grants on Specific Themes from THE KAJIMA FOUNDATION. The views and opinions expressed in this article are those of the authors and do not necessarily reflect the official policy or position of the respective funding organizations.

Data availability

Data were obtained from the JAGES study. All JAGES datasets have ethical or legal restrictions for public deposition due to the inclusion of sensitive information from human participants. Following the regulation of local governments that cooperated in our survey, the JAGES data management committee imposed these restrictions upon the data. All enquiries can be addressed to the data management committee, via email: dataadmin.ml@jages.net.

Declarations

Ethics approval and consent to participate

The JAGES protocol was approved by the Ethical Committee of Chiba University (approval no. M10460). The self-administered questionnaire included a description of the study objectives and procedures, and the return of the completed questionnaire was regarded as providing informed consent to participate in the study.

Competing interests

The authors declare no competing interests.

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Received: 3 December 2024 / Accepted: 9 April 2025
Published online: 26 April 2025

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