ASI Asia Social Issues ASIA SOCIAL ISSUES 2026; 19(6): 294984
https://doi.org/10.48048/asi.2026.294984 RESEARCH ARTICLE

A Structural Equation Model of Digital Inclusion, Active Aging, and Perceived Value in Shaping the Longevity Economy

Pattarapon Chummee

College of Innovative Management, Valaya Alongkorn Rajabhat University under the Royal Patronage, Pathum Thani 13180, Thailand

(Corresponding author's e-mail: pattarapon@vru.ac.th)

Received: 21 April 2026, Revised: 13 May 2026, Accepted: 29 May 2026, Published: 15 June 2026

Abstract

This study aims to (1) validate the measurement model of digital inclusion, perceived value, active aging, and the longevity economy using confirmatory factor analysis (CFA); (2) examine the causal relationships among these constructs through structural equation modeling (SEM) and (3) investigate the mediating role of perceived value. Data were collected from 400 older adults in Bangkok and analyzed using CFA and SEM. The CFA results indicated a good model fit, with all factor loadings exceeding 0.70, confirming strong convergent validity. The SEM results also demonstrated a satisfactory model fit ($\chi^2/df = 2.51$, GFI = 0.93, AGFI = 0.90, NFI = 0.94, CFI = 0.97, TLI = 0.96, RMSEA = 0.049, SRMR = 0.041). The findings revealed that digital inclusion significantly influences perceived value and active aging, while both variables positively affect the longevity economy. Mediation analysis confirmed that perceived value and active aging significantly transmit the effects of digital inclusion. Qualitative findings highlighted challenges such as digital inequality, limited digital literacy, and cybersecurity concerns, while also showing that digital inclusion enhances social participation, economic engagement, and well-being. The study recommends improving digital infrastructure, promoting digital literacy, strengthening cybersecurity, and developing age-inclusive markets to support the longevity economy.

Keywords: Digital inclusion, Active aging, Perceived value, Longevity economy, Digital literacy

Introduction

The rapid expansion of the longevity economy has become a defining phenomenon in contemporary socio-economic systems, particularly within the context of global demographic transitions toward aging societies, and this transformation is especially visible in metropolitan areas such as Bangkok. Worldwide, declining fertility rates and increasing life expectancy have reshaped population structures, leading to a growing proportion of older adults who are increasingly concentrated in urban centers. In the Asia-Pacific region, the share of the population aged 65 years and above continues to rise significantly, reflecting a structural demographic shift that is most pronounced in large cities where economic opportunities and healthcare systems are concentrated (Organization for Economic Co-operation and Development [OECD], 2024). Similarly, projections indicate that the proportion of individuals aged 60 years and above in Southeast Asia will increase from 12.2% in 2024 to 22.9% by 2050, reinforcing the need for metropolitan-level strategies to support healthy, active, and economically engaged aging populations (World Health Organization [WHO], 2024). In this context, Bangkok exemplifies how global demographic trends are translated into local urban challenges and opportunities within the longevity economy.

Chen and Phanumartwiwath (2025); Li and Shao (2025) within metropolitan environments such as Bangkok, the development of the longevity economy is strongly influenced by the level of digital inclusion

among older adults. As cities become increasingly digitized, access to digital infrastructure and services is more advanced, yet disparities in digital literacy and usability persist, particularly among aging populations. Older adults in metropolitan settings often face challenges related not only to access but also to cognitive and experiential barriers that limit their effective use of digital technologies. Recent research highlights that digital inclusion encompasses multiple dimensions beyond access, including behavioral and usability aspects that are critical for technology adoption among older individuals. In Bangkok, where digital platforms are widely integrated into daily life, these disparities can significantly affect the ability of older adults to participate in economic and social activities, thereby limiting the full realization of the longevity economy.

In addition to digital inclusion, perceived value plays a crucial role in shaping how older adults in metropolitan areas such as Bangkok respond to digital technologies and services. Perceived value reflects the extent to which individuals evaluate digital tools as beneficial relative to their costs, including factors such as ease of use, usefulness, and emotional satisfaction. In urban contexts, where a wide range of digital services is available, the perceived relevance and usability of these services become critical determinants of adoption. For older adults in Bangkok, digital technologies that enhance convenience, improve access to healthcare, and support social connectivity are more likely to be perceived as valuable, thereby encouraging continued usage and engagement. Empirical evidence suggests that higher perceived value is associated with increased participation in activities that promote well-being and social inclusion among aging populations. (Tipayalai et al., 2026; Yi & Jia, 2026)

Active aging, as a multidimensional concept encompassing health, participation, and security, is particularly relevant in metropolitan contexts such as Bangkok, where urban living conditions both enable and constrain the well-being of older adults. Cities offer greater access to healthcare, transportation, and social services, yet they also present challenges such as social isolation, economic inequality, and high living costs. Digital technologies have been shown to play a significant role in promoting active aging by facilitating social interaction, enabling access to health services, and supporting lifelong learning. Furthermore, empirical studies have demonstrated that active aging is influenced by a combination of socio-economic, technological, and psychological factors, which are often more complex and interrelated in urban environments. In Bangkok, the promotion of active aging therefore requires integrated approaches that leverage digital innovation while addressing socio-economic disparities. (Paoli et al., 2025; Srikolchan et al., 2025)

From a theoretical perspective, integrating digital inclusion, perceived value, and active aging within a structural equation model provides a comprehensive framework for understanding the dynamics of the longevity economy in metropolitan settings such as Bangkok. While previous research has examined these constructs individually, there is a lack of integrated models that capture their interrelationships within urban contexts characterized by rapid digital transformation. Structural equation modeling enables the examination of complex causal pathways and mediating effects, offering deeper insights into how digital and psychological factors interact to influence aging outcomes in cities. Such an approach is particularly relevant for Bangkok, where the convergence of demographic aging and digitalization creates a unique environment for studying the longevity economy.

In response, this study aims to (1) validate the measurement model of the latent constructs related to digital inclusion, perceived value, active aging, and the longevity economy using confirmatory factor analysis (CFA); (2) examine the causal relationships among digital inclusion, perceived value, active aging, and longevity economy outcomes through structural equation modelling (SEM); and (3) investigate the mediating role of perceived value in linking digital inclusion to active aging, as well as the subsequent impact on the longevity economy, while providing practical and policy-oriented recommendations to address the identified research gaps. By focusing on Bangkok as a rapidly developing metropolitan area, this study highlights the unique socio-economic and technological dynamics of urban aging populations and offers empirical insights to strengthen sustainable longevity economy development in Thailand.

Literature reviews

The longevity economy provides a critical theoretical foundation for understanding the evolving role of older adults as active contributors to economic and social systems. Drawing on productive and successful aging theories, it emphasizes that individuals aged 60 and above continue to generate economic value through consumption, employment, and social participation (Rowe & Kahn, 1997). Evidence from Grinin and Korotayev (2023) highlights that aging populations represent a significant driver of economic growth rather than a societal burden. In parallel, digital inclusion theory, rooted in the digital divide perspective (Zhang et al., 2025), explains disparities in access, skills, and meaningful use of digital technologies among older adults. This perspective is further supported by the capability approach of Aldhi et al. (2025), which posits that access to digital resources must be accompanied by the ability to convert them into valuable outcomes. In urban environments such as Bangkok, digital inclusion plays a pivotal role in enabling older individuals to participate effectively in the longevity economy.

Perceived value theory and the Technology Acceptance Model developed by Davis (1989) provide an explanatory mechanism for how older adults evaluate and adopt digital technologies, emphasizing the roles of perceived usefulness and ease of use in shaping behavioral intentions. Perceived value acts as a mediating construct linking digital inclusion to behavioral and well-being outcomes (Salisu, et al., 2026). These outcomes are conceptualized through the active aging framework proposed by Cocchi et al. (2025), which defines active aging as the optimization of health, participation, and security to enhance quality of life. Integrating these perspectives, the study conceptualizes a structural model in which the longevity economy shapes digital inclusion, digital inclusion influences perceived value, and perceived value ultimately drives active aging, thereby providing a comprehensive explanation of how digital transformation impacts the well-being and participation of older adults in contemporary societies. Based on the theoretical foundations, the literature review is presented as follows.

Relationship between digital inclusion and perceived value

The relationship between digital inclusion and perceived value can be theoretically explained within the context of the longevity economy, particularly in urban settings such as Bangkok, where population aging and digital transformation occur simultaneously. The longevity economy suggests that older adults remain active contributors to economic and social systems, but their participation increasingly depends on their ability to access and use digital technologies (Grinin & Korotayev, 2023; Rowe & Kahn, 1997). In this regard, digital inclusion encompassing access, skills, and meaningful use acts as a critical enabling factor that allows older adults in Bangkok to engage with digital services such as e-commerce, e-government, and digital finance (Aldhi et al., 2025; Zhang et al., 2025). Drawing on the Technology Acceptance Model (Davis, 1989) and perceived value theory, digital inclusion enhances individuals' perceptions of usefulness and ease of use, which in turn increases perceived value and encourages continued technology usage. Thus, digital inclusion does not directly lead to active participation, but instead operates through perceived value as a mediating mechanism that shapes behavioral outcomes and supports active aging in Bangkok's digital society (Cocchi et al., 2025; Salisu et al., 2026). The following hypothesis is proposed:

H1: Digital inclusion has a positive effect on Perceived value in Bangkok

Relationship between digital inclusion and active aging

The relationship between digital inclusion and active aging can be explained through the integration of the longevity economy, aging theory, and the active aging framework, particularly in the context of older adults in Bangkok. The longevity economy suggests that individuals aged 60 years and above continue to play significant economic and social roles; however, their ability to remain active increasingly depends on access to and effective use of digital technologies (Bongelli et al., 2025; Grinin & Korotayev, 2023). In Bangkok, where digital infrastructure and smart city initiatives are rapidly expanding, digital inclusion encompassing access to devices, internet connectivity, and digital skills enables older adults to participate in essential activities

such as online healthcare services, financial transactions, and social communication. Drawing on aging theory and the capability approach, the mere availability of digital resources is insufficient unless older individuals possess the capability to utilize them to enhance their well-being and social participation (Butsabong & Ritcharoen, 2025; Durongdei, 2025). This aligns with the active aging framework, which emphasizes the optimization of health, participation, and security as key dimensions of quality of life in later years (Gianfredi et al., 2025). Therefore, digital inclusion functions as a critical antecedent of active aging by reducing social isolation, increasing access to services, and promoting continuous engagement in economic and social activities among older adults in Bangkok, ultimately supporting their overall well-being and sustained participation in a digitally driven society. This relationship can be hypothesized as follows:

H2: Digital inclusion has a positive effect on Active aging in Bangkok

Relationship between active aging and perceived value

Globally, active aging is closely linked to perceived value, as older adults are more likely to engage in social and digital activities when they perceive technologies and services as useful, easy to use, and beneficial to their daily lives (Schroeder et al., 2023; Wu & Lim, 2024). Perceived usefulness and ease of use core elements of the Technology Acceptance Model have been consistently found to drive technology adoption, which in turn enhances independence, social participation, and well-being among older populations (Azzi et al., 2026). However, in Bangkok, this relationship appears more immediate and context-specific due to rapid urban digitalization; older adults tend to adopt technologies primarily when they deliver clear, practical value in everyday life, such as convenience in transportation, healthcare access, and communication. Compared to global contexts where systems are often proactively designed for aging populations, Bangkok reflects a more reactive pattern, where perceived value must be quickly realized to trigger usage. Consequently, the linkage between perceived value and active aging in Bangkok is more accelerated but also more conditional, depending on how effectively digital services reduce complexity and demonstrate tangible benefits, thereby directly influencing older adults' willingness to participate actively in an increasingly digital urban environment (Srikolchan et al., 2025). This relationship can be proposed as a hypothesis:

H3: Active aging has a positive effect on Perceived value in Bangkok

Relationship between active aging and longevity economy

Active aging enhances the longevity economy by enabling continued productivity, consumption, and social participation among aging populations, thereby transforming demographic change into measurable economic value. At the global level, rising life expectancy averaging around 73 years and the increasing share of older consumers, who contribute to more than half of total consumption in several developed economies, reflect the growing economic significance of this demographic group. In Thailand, the scale of this transition is evident, with the aging population reaching 23.7% in 2024 and projected to increase to 35% by 2030, indicating a rapid shift toward an age-structured economy (Keanjoom et al., 2024). In Bangkok Pengpid et al. (2025) and Ponpichai et al. (2026) and study this relationship is intensified due to its status as a high-density economic center, where better healthcare systems, higher income levels, and greater access to digital technologies facilitate more effective active aging, leading to stronger participation in the longevity economy through extended employment and consumption activities. However, when compared to global cities in developed countries, structural inequalities in income distribution and access to age-friendly urban services in Bangkok may limit the full realization of this economic potential. Consequently, the extent to which Bangkok can capitalize on the longevity economy depends significantly on its ability to strengthen active aging mechanisms as a driver of inclusive and sustainable urban economic growth. This can be developed as a research hypothesis:

H4: Active aging has a positive effect on Longevity economy in Bangkok

Relationship between perceived value and longevity economy

The relationship between perceived value and the longevity economy is reflected in how older consumers evaluate and engage with products and services that enhance their quality of life, thereby driving economic activity. At the global level, older adults account for more than 50% of total consumer spending in developed economies, with their purchasing decisions strongly influenced by perceived value in terms of health benefits, convenience, and trust. In contrast, within Bangkok, where Thailand has already entered an aging society with 23.7% of the population in later life stages, perceived value becomes a critical determinant shaping consumption behavior, particularly in sectors such as healthcare, wellness, and digital services that cater to urban lifestyles (Arias et al., 2024). Compared to global markets, Bangkok demonstrates a more price-sensitive yet rapidly evolving perception of value, influenced by income disparities and increasing digital adoption, which together affect how older consumers contribute to the longevity economy. Consequently, perceived value acts as a key behavioral driver linking individual consumption decisions to the broader expansion of the longevity economy, especially in rapidly aging urban contexts (Chaisiripaibool et al., 2025; Choomplang & Negishi., 2025). This can be extended into a formal research hypothesis:

H5: Perceived value has a positive effect on Longevity economy in Bangkok

From this integrated theoretical foundation and literature review (Bongelli et al., 2025; Keanjoom et al., 2024; Seifert et al. 2021; Yum & Kim, 2024; etc.), the conceptual framework is illustrated in Figure 1.

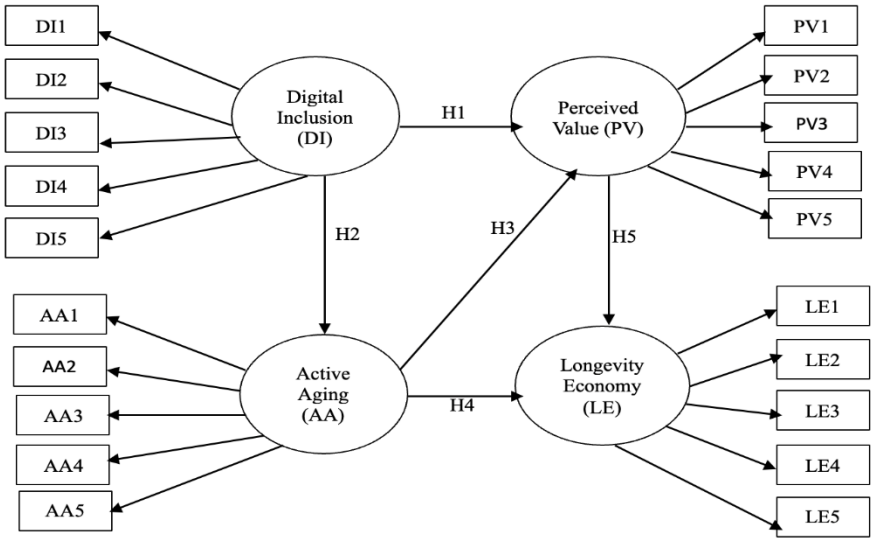


Figure 1 Conceptual framework

Research methodology

This study adopts a mixed-methods research design integrating both quantitative and qualitative approaches in order to provide a comprehensive examination of the structural relationships among digital inclusion, perceived value, active aging, and the longevity economy in the context of Bangkok. The use of a mixed-methods approach is particularly appropriate for this study because it allows for both hypothesis testing through statistical modeling and the exploration of contextual insights that explain behavioral mechanisms underlying the observed relationships. The quantitative component focuses on validating the measurement model and testing causal relationships using confirmatory factor analysis (CFA) and structural equation modeling (SEM), while the qualitative component complements these findings by providing in-depth perspectives from key stakeholders involved in the longevity economy.

Target population and sample group

The target population of this study consists of individuals aged 60 years and above residing in Bangkok. This age threshold is consistent with the

definition of older persons in Thailand and aligns with international frameworks on aging societies, which commonly classify individuals aged 60 and above as older adults (United Nations, 2023; World Health Organization, 2022). This population represents a critical segment of the longevity economy, as they increasingly participate in economic activities, consumption, and digital environments despite age-related transitions.

The sample size is determined based on the guideline of using 20 times the number of observed variables, which is widely recommended in structural equation modeling to ensure sufficient statistical power and model stability (Hair et al., 2019). In this study, there are a total of 20 observed variables (DI1–DI5, PV1–PV5, AA1–AA4, LE1–LE5), resulting in a required sample size of 400 respondents**.** This sample size is considered adequate for conducting CFA and SEM analyses, particularly for models involving multiple latent constructs and complex relationships.

To obtain the sample, this study employs a multi-stage sampling technique combined with purposive and convenience sampling. In the first stage, a stratified spatial sampling method is used by dividing Bangkok into three groups: inner, intermediate, and outer urban areas based on urbanization, socio-economic conditions, and digital infrastructure. The selected districts include Pathum Wan and Bang Rak for inner urban areas, Chatuchak and Huai Khwang for intermediate areas, and Min Buri and Nong Chok for outer areas. This approach helps ensure that the sample reflects differences in consumer behavior across diverse urban contexts in Bangkok. This step is important to ensure variability in digital inclusion and aging-related experiences across different urban contexts. In the second stage**,** purposive sampling is applied to identify individuals aged 60 years and above, as this group specifically represents the target population of the longevity economy and aligns with the study objectives. This approach allows the researcher to focus on respondents who have direct experience with aging-related transitions and digital engagement. In the final stage, convenience sampling is used to recruit participants from accessible locations such as community centers, elderly clubs, healthcare facilities, and public areas, as well as through online platforms where older adults are active.

Research instruments

The development of the research instrument in this study was developed based on the integrated theoretical framework and prior literature on digital inclusion, perceived value, active aging, and the longevity economy. Questionnaire items were adapted from established studies to ensure construct validity and contextual relevance, particularly within the urban context of Bangkok. All items were measured using a 5-point Likert scale**,** ranging from 5 = strongly agree, 4 = agree, 3 = neutral, 2 = disagree, to 1 = strongly disagree. The measurement of digital inclusion was constructed based on key dimensions identified in prior research, including access to digital technologies, digital skills, and meaningful usage, ensuring comprehensive coverage of the construct. (Bongelli et al., 2025; Seifert et al., 2021). These studies highlight that digital inclusion is not limited to physical access but also includes the capability to effectively use digital technologies, which is particularly relevant for older adults in urban environments. Accordingly, the items (DI1–DI5) are adapted to reflect accessibility, affordability, skills, and frequency of digital engagement in the context of Bangkok. The construct of perceived value is operationalized by integrating insights from consumer behavior and technology adoption literature, particularly studies that examine how older adults evaluate the benefits of digital services (Arias et al., 2024; Yum & Kim, 2024). These studies emphasize multidimensional value perceptions, including functional, emotional, and social aspects. Therefore, the measurement items (PV1–PV5) are developed to capture the perceived usefulness, convenience, and overall benefits derived from digital participation among older adults.

For active aging**,** the questionnaire items are developed based on contemporary aging research that links participation, health, and independence with digital engagement and socio-economic involvement (Bongelli et al., 2025; Keanjoom et al., 2024). These studies support the view that active aging is a multidimensional construct influenced by both individual capabilities and environmental factors. As such, the items (AA1–AA4) are designed to reflect health maintenance, social participation, independence, and continuous engagement in daily activities. The measurement of the longevity economy is derived from

recent literature that conceptualizes older adults as active economic agents contributing through consumption, labor participation, and value creation (Chaisiripaibool et al., 2025; Choomplang & Negishi, 2025). These studies provide empirical support for the role of aging populations in driving economic growth, particularly in rapidly aging urban settings. Consequently, the items (LE1–LE5) are constructed to capture economic participation, spending behavior, and contributions to the broader economic system.

Validity and reliability of instruments

The validity and reliability of the research instrument were rigorously evaluated to ensure that all measurement items accurately capture the intended constructs and produce consistent results suitable for subsequent CFA and SEM analysis. Content validity was assessed using the Index of Item- Objective Congruence (IOC), with three experts in digital economy, aging, and quantitative research evaluating each item. The IOC values ranged from 0.67 to 1.00, exceeding the acceptable threshold of 0.50, indicating that all items were consistent with the research objectives and constructs (Rovinelli & Hambleton, 1977).

A pilot test was conducted with 30 respondents to examine reliability and clarity of the questionnaire. The results showed high internal consistency, with Cronbach's alpha values of 0.91 for digital inclusion, 0.93 for perceived value, 0.89 for active aging, and 0.92 for longevity economy. All values exceed the recommended threshold of 0.70, confirming strong reliability (Nunnally & Bernstein, 1994). Additionally, corrected item-total correlations were all above 0.30, indicating acceptable item discrimination, and no items were removed. These results confirm that the instrument is both valid and reliable for further CFA and SEM analysis.

Data analysis

The data analysis in this quantitative study was conducted using both descriptive and inferential statistics. Descriptive statistics, including frequency, percentage, mean, and standard deviation, were employed to describe the general characteristics of the sample. For inferential analysis, Confirmatory Factor Analysis (CFA) was used to assess the construct validity of the latent variables, followed by Structural Equation Modeling (SEM) to test the research hypotheses and examine the relationships among variables.

The evaluation of model fit in this study is based on widely accepted criteria in structural equation modeling. The relative chi-square (χ^2/df) should be less than 3.00, while the Comparative Fit Index (CFI) and Tucker-Lewis Index (TLI) should be greater than 0.90 to indicate an acceptable model fit. In addition, the Root Mean Square Error of Approximation (RMSEA) should be below 0.08, and the Standardized Root Mean Square Residual (SRMR) should be less than 0.08. These thresholds are considered sufficient to demonstrate that the model adequately fits the empirical data (Hair et al., 2022; Hu & Bentler, 1999).

Qualitative methodology

The qualitative component of this study involves in-depth interviews with 30 key informants selected purposive sampling. These informants include older adults, policymakers, digital service providers, and business practitioners involved in aging- related industries in Bangkok. The qualitative data are collected semi- structured interviews, allowing flexibility to explore participants' experiences, perceptions, and insights related to digital inclusion, active aging, and economic participation. The qualitative data are analyzed using thematic analysis, which involves coding, categorizing, and identifying key themes. The findings reveal that digital accessibility and digital literacy are critical factors enabling independence and social participation among older adults. Participants emphasize that perceived value is strongly influenced by ease of use, trust, and relevance of digital services to their daily lives. Furthermore, active aging behaviors such as continuous learning, social engagement, and health maintenance are found to play a significant role in enhancing economic participation. These qualitative insights provide contextual support for the quantitative findings and help explain the underlying mechanisms driving the observed relationships.

Research results

Demographic Information

A total of 400 respondents participated in this study (Table 1). In terms of gender, the majority were female (57.75%), while males accounted for 42.25%.

Regarding age, most respondents were aged 60–65 years (30.00%), followed by 66–70 years (27.50%), 71–75 years (23.75%), and 76–79 years (18.75%). No respondents were found in the 80 years and above category. For educational level, most respondents held a bachelor's degree (42.50%), followed by those with education below a bachelor's degree (33.00%). Additionally, 20.00% held a master's degree and 4.50% held a doctoral degree. In terms of previous occupation, the majority were private sector employees (30.00%), followed by government officers (25.00%), self-employed individuals (25.00%), and others (20.00%). Regarding monthly income, the results show that most respondents earned between 10,000–20,000 THB (36.00%), followed by those earning less than 10,000 THB (28.25%), 20,001–30,000 THB (20.75%), and more than 40,001 THB (15.00%). No respondents were found in the 30,001–40,000 THB or "other" categories. The income categories were arranged in ascending order to ensure consistency with the questionnaire design.

Table 1 Demographic of respondents

n = 400

Variable	Category	Frequency (n)	Percentage (%)
Gender	Male	169	42.25
	Female	231	57.75
Age	60–65 years	120	30.00
	66–70 years	110	27.50
	71–75 years	95	23.75
	76–79 years	75	18.75
	80 years and above	0	0.00
Education Level	Below Bachelor's Degree	132	33.00
	Bachelor's Degree	170	42.50
	Master's Degree	80	20.00
	Doctoral Degree	18	4.50
Previous Occupation	Government Officer	100	25.00
	Private Sector Employee	120	30.00
	Self-employed	100	25.00
	Other	80	20.00
Monthly Income	Less than 10,000 THB	113	28.25
	10,000–20,000 THB	144	36.00
	20,001–30,000 THB	83	20.75
	30,001–40,000 THB	0	0.00
	More than 40,001 THB	60	15.00

Convergent and discriminants validity

The assessment of the measurement model demonstrated satisfactory levels of convergent validity (Table 2). All constructs achieved composite reliability (CR) values ranging from 0.914 to 0.938, exceeding the recommended threshold of 0.70, indicating strong internal consistency (Hair et al., 2021). Additionally, the average variance extracted (AVE) values ranged between 0.680 and 0.752, which are above the acceptable criterion of 0.50 (Fornell & Larcker, 1981). These results confirm that the constructs adequately capture the variance of their respective indicators. In terms of descriptive statistics, the mean scores of all constructs ranged from 3.96 to 4.13, suggesting a

relatively high level of agreement among respondents in Bangkok. The standard deviation values, ranging from 0. 66 to 0. 73, indicate a moderate dispersion of responses, reflecting acceptable variability within the sample. Discriminant validity was evaluated using the Fornell–Larcker criterion. The square root of AVE for each construct (ranging from 0.825 to 0.867) was greater than the inter- construct correlations, confirming that each construct is empirically distinct from the others (Fornell & Larcker, 1981; Hair et al. , 2021) . Specifically, although Perceived Value showed relatively strong correlations with Longevity Economy ($r = 0.701$) and Active Aging ($r = 0.655$), these values remained lower than the corresponding square root of AVE, supporting adequate discriminant validity.

Table 2 Convergent and discriminants validity

Construct	Mean	SD	CR	AVE	R^2	DI	PV	AA	LE
Digital Inclusion (DI)	4.02	0.69	0.921	0.701	-	0.837			
Perceived Value (PV)	4.13	0.66	0.938	0.752	0.386	0.621	0.867		
Active Aging (AA)	3.96	0.73	0.914	0.680	0.472	0.588	0.655	0.825	
Longevity Economy (LE)	4.10	0.68	0.933	0.736	0.593	0.602	0.701	0.673	0.858

Confirmatory factor analysis

From Table 3, the results indicate that the overall model demonstrates a good fit to the empirical data. The goodness- of- fit indices fall within acceptable ranges, including $\chi^2/df = 1.765–1.902$, GFI 0.915–0.927), CFI = 0. 952–0. 962), TLI = 0. 941–0. 953, RMSEA 0. 043–0. 047, and SRMR = 0. 038–0. 042. In the term of the standardized factor loadings (λ) of all observed variables were statistically significant at the 0. 001 level and exceeded the acceptable threshold of 0. 70, indicating strong convergent validity. Specifically, for Digital Inclusion (DI), the factor loadings ranged from 0.781 to 0. 872, with DI3 (λ = 0. 872) showing the highest contribution, followed by DI2 (λ = 0. 845), DI5 (λ = 0. 833), DI1 (λ = 0. 812), and DI4 (λ = 0. 781). For Perceived Value (PV) , the factor loadings ranged between 0. 768 and 0. 861, with PV3 (λ = 0. 861) being the strongest indicator, followed by PV4 (λ = 0. 835), PV5 (λ = 0.809), PV2 (λ = 0.801), and PV1 (λ = 0.768). In terms of Active Aging (AA) , the factor loadings ranged from 0.752 to 0.845, where AA3 (λ = 0.845) had the highest loading, followed by AA4 (λ = 0.821), AA2 (λ = 0.798), AA5 (λ = 0.779), and AA1 (λ = 0.752). For Longevity Economy (LE) , the factor loadings ranged from 0. 773 to 0. 868, with LE3 (λ = 0. 868) as the most significant indicator, followed by LE4 (λ = 0.844), LE5 (λ = 0.829), LE2 (λ = 0.812), and LE1 (λ = 0.773)

Table 3 Confirmatory factor analysis

Construct	Indicator	Factor Loading (λ)	χ^2/df	GFI	CFI	TLI	RMSEA	SRMR
Digital Inclusion (DI)	DI1	0.812						
	DI2	0.845						
	DI3	0.872						
	DI4	0.781						
	DI5	0.833	1.765	0.927	0.962	0.953	0.043	0.038
Perceived Value (PV)	PV1	0.768						
	PV2	0.801						
	PV3	0.861						

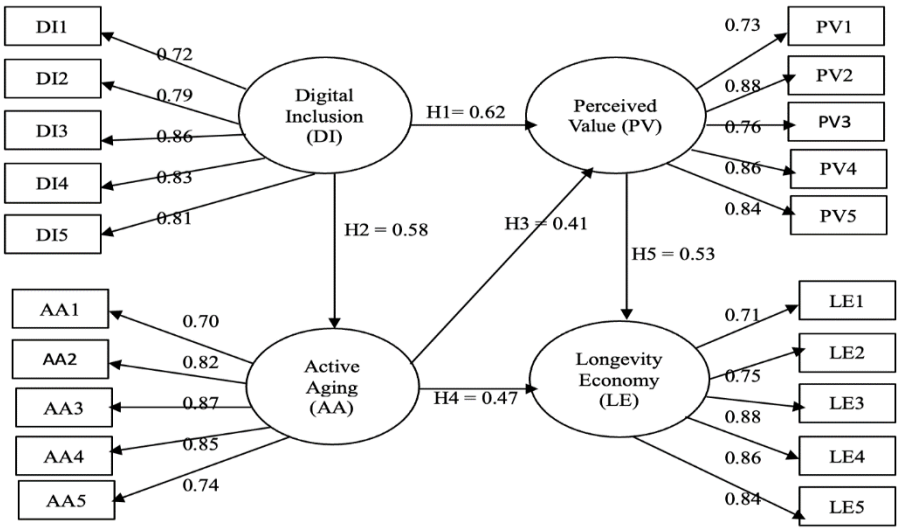
Construct	Indicator	Factor Loading (λ)	χ^2/df	GFI	CFI	TLI	RMSEA	SRMR
	PV4	0.835						
	PV5	0.809	1.902	0.918	0.955	0.946	0.047	0.040
Active Aging (AA)	AA1	0.752						
	AA2	0.798						
	AA3	0.845						
	AA4	0.821						
	AA5	0.779	1.889	0.915	0.952	0.941	0.046	0.042
Longevity Economy (LE)	LE1	0.773						
	LE2	0.812						
	LE3	0.868						
	LE4	0.844						
	LE5	0.829	1.821	0.923	0.960	0.950	0.044	0.039

Structural equation modelling

The structural equation modeling (SEM) analysis (Figure 2) was conducted to evaluate both the measurement and structural components of the proposed model, For Digital Inclusion (DI), the factor loadings ranged from 0.72 to 0.86, with DI3 showing the highest loading (β = 0.86), followed by DI4 (β = 0.83), DI5 (β = 0.81), DI2 (β = 0.79), and DI1 (β = 0.72). Perceived Value (PV) demonstrated loadings between 0.73 and 0.88, where PV2 had the strongest loading (β = 0.88), followed by PV4 (β = 0.86), PV5 (β = 0.84), PV3 (β = 0.76), and PV1 (β = 0.73). Active Aging (AA) showed factor loadings ranging from 0.70 to 0.87, with AA3 highest (β = 0.87), followed by AA4 (β = 0.85), AA2 (β = 0.82), AA5 (β = 0.74), and AA1 (β = 0.70). For Longevity Economy (LE), loadings ranged from 0.71 to 0.88, with LE3 highest (β = 0.88), followed by LE4 (β = 0.86), LE5 (β = 0.84), LE2 (β = 0.75), and LE1 (β = 0.71). These results confirm strong convergent validity.

The overall model fit demonstrated good adequacy. The chi-square statistic was χ^2 = 412.36 with df = 164, resulting in a relative chi-square (χ^2/df) of 2.51, which is below the recommended threshold of 3.00. The Goodness-of-Fit Index (GFI) was 0.93 and the Adjusted Goodness-of-Fit Index (AGFI) was 0.90, indicating good absolute fit. Incremental fit indices were also satisfactory, with the Normed Fit Index (NFI) = 0.94, Comparative Fit Index (CFI) = 0.97, and Tucker-Lewis Index (TLI) = 0.96, all exceeding recommended levels. In addition, the Root Mean Square Error of Approximation (RMSEA) was 0.049 and the Standardized Root Mean Square Residual (SRMR) was 0.041, both below the threshold of 0.08, indicating a good fit between the model and empirical data (Hair et al., 2019; Hu & Bentler, 1999).

The hypothesis testing results indicated that all proposed hypotheses were statistically significant ($p < 0.001$). Hypothesis 1 (H1) was supported, as Digital Inclusion (DI) positively influenced Perceived Value (PV) (β = 0.62). Hypothesis 2 (H2) was supported, with Digital Inclusion (DI) positively affecting Active Aging (AA) (β = 0.58). Hypothesis 3 (H3) was supported, as Active Aging (AA) had a positive effect on Perceived Value (PV) (β = 0.41). Furthermore, Hypothesis 4 (H4) was supported, indicating that Active Aging (AA) positively influenced the Longevity Economy (LE) (β = 0.47). Hypothesis 5 (H5) was also supported, as Perceived Value (PV) had a significant positive effect on the Longevity Economy (LE) (β = 0.53).



Remark: X^2/df = 2.51, GFI = 0.93, AGFI = 0.90, NFI = 0.94, CFI = 0.97, TLI = 0.96, RMSEA = 0.049, SRMR = 0.041

Figure 2 Finalized model

Direct and indirect relationship

From table 4, Digital Inclusion (DI) has a significant positive direct effect on Perceived Value (PV) (H1: DE = 0.62) and Active Aging (AA) (H2: DE = 0.58), indicating that increased digital access and usage enhance both value perception and active engagement among older individuals. Furthermore, Active Aging significantly influences Perceived Value (H3: DE = 0.41), suggesting that individuals with higher levels of active aging tend to perceive greater value. Regarding the Longevity Economy (LE), Active Aging has a direct positive effect (H4: DE = 0.47), while Perceived Value exerts the strongest direct influence (H5: DE = 0.53). In addition to these direct effects, mediation analysis shows that Digital Inclusion indirectly affects Perceived Value through Active Aging (IE = 0.24), resulting in a substantial total effect (TE = 0.86). Moreover, Digital Inclusion has no direct effect on the Longevity Economy but demonstrates a significant indirect effect through both Perceived Value and Active Aging (IE = 0.46). Active Aging also indirectly influences the Longevity Economy via Perceived Value (IE = 0.22), yielding a strong total effect (TE = 0.69).

Table 4 Direct and indirect relationship

Latent Variable	Active Aging (AA)			Perceived Value (PV)			Longevity Economy (LE)		
	DE	IE	TE	DE	IE	TE	DE	IE	TE
Digital Inclusion (DI)	0.58		0.58	0.62	0.24	0.86		0.46	0.46
Acting Aging (AA)				0.41		0.41	0.47	0.22	0.69
Perceived Value (PV)							0.53		0.53

$p < 0.001$

*DE=Direct effect, IE= Indirect effect, TE= Total effect

Qualitative results

The results indicate that digital inclusion functions as a fundamental enabler that allows individuals, particularly older adults, to participate more effectively in economic and social activities. However, participants consistently reported disparities in access to digital infrastructure, including limitations in internet connectivity and availability of digital devices, especially in semi-urban and rural areas. In addition, digital literacy emerged as a critical challenge, as many older adults lacked the necessary skills and confidence to use digital technologies effectively, even when access

was available. Concerns related to cybersecurity and data privacy further reduced trust in digital platforms and limited user engagement.

The findings also reveal that active aging plays a significant mediating role in translating digital inclusion into tangible socio-economic outcomes. Participants who were digitally included demonstrated higher levels of engagement in productive activities, such as online businesses, freelance work, and participation in digital marketplaces. Moreover, digital technologies facilitated social interaction, access to health-related information, and continuous learning opportunities, which contributed to improved well-being and quality of life. The concept of active aging, therefore, extends beyond physical health and encompasses economic participation, social inclusion, and lifelong learning.

Perceived value was identified as a key determinant influencing the adoption and continued use of digital technologies. Participants emphasized that their willingness to engage with digital platforms depended largely on the perceived benefits relative to the associated risks. Functional value, such as convenience and efficiency, emotional value, including increased confidence and independence, and economic value, particularly opportunities for income generation, were all significant motivators. Nevertheless, when perceived risks, especially those related to security and complexity, outweighed these benefits, individuals were less likely to adopt or continue using digital technologies.

Furthermore, the integration of digital inclusion, active aging, and perceived value contributes significantly to the development of the longevity economy. The findings suggest that enhancing digital capabilities among older adults can lead to increased economic participation, the expansion of age-inclusive markets, and improved productivity within society. Participants from the business sector also recognized the growing importance of older consumers as a distinct market segment, particularly in areas such as healthcare, financial services, and digital platforms.

Conclusions and discussions

The confirmatory factor analysis results demonstrate strong construct validity across all constructs, with high and statistically significant factor loadings. Digital inclusion is effectively reflected through access, skills, and usage, consistent with Aldhi et al. (2025) and Zhang et al. (2025), highlighting that meaningful engagement with digital technologies extends beyond mere access. Similarly, perceived value shows strong loadings aligned with the Technology Acceptance Model (Davis, 1989), confirming that perceived usefulness and ease of use are key determinants of technology adoption. Active aging is consistent with the framework of Gianfredi et al. (2025), while the longevity economy reflects economic participation patterns in line with Arias et al. (2024). In the context of Bangkok, where digital infrastructure and services are highly developed, digital inclusion significantly enhances older adults' ability to engage with digital technologies, thereby increasing perceived value and supporting active aging. This is consistent with Bongelli et al. (2025) and Grinin & Korotayev (2023), who emphasized the importance of digital skills and meaningful usage. Across ASEAN, although disparities in digital readiness exist, the role of digital inclusion remains critical for enabling older populations to participate in digital and economic activities.

These findings are further supported by the qualitative results, which confirm the multidimensional nature of the constructs. Participants emphasized that digital inclusion extends beyond mere access to technology, encompassing digital skills and the ability to meaningfully use digital tools in daily life, particularly for communication, accessing services, and economic participation, thereby reinforcing the strong representation of access, skills, and usage identified in the measurement model. Moreover, respondents indicated that perceived value is largely determined by the usefulness, ease of use, and tangible benefits of digital technologies, as individuals are more likely to adopt and continue using technologies that enhance convenience, efficiency, and independence, which supports the robustness of the perceived value construct. The findings reveal that active aging is reflected through continuous social participation, lifelong learning, and engagement in productive activities, with digital technologies playing a crucial role in enabling older adults to remain active, connected, and independent, consistent with the dimensions of well-being, participation, and security.

For Objective 2, the results of the confirmatory factor analysis indicate that all constructs, namely

digital inclusion, perceived value, active aging, and the longevity economy, demonstrate strong construct validity, as reflected by the high and statistically significant factor loadings of all observed variables. The factor loadings for digital inclusion range from 0.781 to 0.872, for perceived value from 0.768 to 0.861, for active aging from 0.752 to 0.845, and for the longevity economy from 0.773 to 0.868, suggesting that all indicators are well represented within their respective constructs. These findings confirm that digital inclusion is effectively captured through dimensions related to access, skills, and usage, which is consistent with prior studies (Butsabong & Ritcharoen, 2025; Durongdei, 2025), as these dimensions reflect individuals' ability to meaningfully engage with digital technologies. Similarly, the strong loadings of perceived value support the theoretical foundation of the Technology Acceptance Model (Davis, 1989), indicating that perceived usefulness and ease of use are critical components shaping user evaluation. In the context of Bangkok, where digital infrastructure and services are highly developed, digital inclusion significantly enhances older adults' ability to engage with digital technologies, thereby increasing perceived value and supporting active aging. Chaisiripaibool et al., (2025); Choomplang and Negishi. (2025), who emphasized the importance of digital skills and meaningful usage. Across ASEAN, although disparities in digital readiness exist, the role of digital inclusion remains critical for enabling older populations to participate in digital and economic activities.

The qualitative results reinforce this relationship by demonstrating that digitally included older adults are more likely to engage in productive activities such as online businesses, freelance work, and participation in digital marketplaces, as well as maintain social connections and access continuous learning opportunities, which collectively enhance their perceived value and economic participation.

Regarding the third objective, which focused on the mediating role of perceived value, the findings suggest that perceived value partially mediates the relationship between digital inclusion and active aging, as well as its subsequent impact on the longevity economy. This is consistent with the theoretical perspective that digital inclusion alone is insufficient to drive behavioral outcomes unless individuals perceive clear benefits from technology use (Davis, 1989; Salisu et al., 2026). The qualitative results strongly support this mechanism, showing that even when access is available, low perceived value due to complexity, lack of trust, or security concerns can hinder adoption.

Recommendations

First, governments across ASEAN and Asia should prioritize equitable digital infrastructure development, particularly in underserved and rural areas, to reduce the digital divide. This includes expanding high-speed internet access and ensuring affordability of digital devices. Such policies are essential because digital inclusion has been shown to be a foundational driver that enhances both perceived value and active participation among older adults. Regional cooperation mechanisms, such as ASEAN digital integration frameworks, can further support cross-border knowledge sharing and infrastructure investment.

Second, targeted digital literacy programs for older adults should be systematically implemented. These programs should focus not only on basic digital skills but also on practical applications such as digital finance, e-commerce, telehealth, and cybersecurity awareness. Tailored training initiatives can help increase confidence and perceived value, thereby encouraging sustained engagement with digital technologies. Policymakers should collaborate with educational institutions, private sector platforms, and community organizations to deliver inclusive and accessible learning opportunities.

Third, policies promoting active aging should be integrated into national development strategies. Governments should create opportunities for older adults to participate in the economy through flexible employment, lifelong learning, and support for senior entrepreneurship. Incentives such as tax benefits, training subsidies, and age-friendly workplace policies can enhance productivity and extend workforce participation. This is particularly important in Asia, where demographic aging is occurring at an accelerated pace.

Fourth, strengthening digital trust and cybersecurity is critical to increasing adoption. Governments should establish clear regulatory frameworks for data protection, consumer rights, and

platform accountability. Enhancing trust will directly improve perceived value and reduce resistance to digital engagement among older populations. Public awareness campaigns and user-friendly security systems are also necessary to build confidence in digital ecosystems.

Fifth, ASEAN and Asian countries should promote the development of age-inclusive digital markets. Businesses should be encouraged to design products and services that cater specifically to older consumers, such as user-friendly interfaces, accessible financial services, and health-related digital solutions. Public–private partnerships can play a key role in fostering innovation and scaling solutions that support the longevity economy.

Finally, at the regional level, ASEAN and Asian policymakers should establish collaborative platforms for research, data sharing, and policy alignment on aging and digitalization. A coordinated approach will enable countries to learn from best practices, address common challenges, and accelerate the development of a resilient and inclusive longevity economy.

Future research directions

First, future studies should adopt longitudinal research designs to better capture causal dynamics and changes over time. While this study provides cross-sectional evidence, longitudinal data would allow researchers to examine how digital inclusion evolves and influences active aging and economic participation across different life stages of older adults.

Second, researchers are encouraged to conduct comparative and cross-cultural studies, particularly across ASEAN and other aging societies. Such investigations would help identify contextual differences in digital infrastructure, policy environments, and cultural norms that may influence the effectiveness of digital inclusion initiatives.

Third, future studies should expand the model by incorporating additional variables, such as digital trust, technology anxiety, health status, and social support, which may act as moderators or mediators. These factors could provide a more comprehensive explanation of older adults' engagement with digital technologies and their contribution to the longevity economy.

Fourth, there is a need for multi-group analysis to explore heterogeneity among older populations, such as differences by age cohorts, gender, education level, or urban–rural residence. This would enable more targeted policy and practical interventions.

Fifth, future research should employ mixed-methods approaches with deeper qualitative exploration, such as in-depth interviews or ethnographic studies, to better understand the lived experiences, barriers, and motivations of older adults in digital environments.

Finally, future studies should investigate the role of emerging technologies, such as artificial intelligence, digital platforms, and smart health systems, in enhancing active aging and shaping the longevity economy. This would provide forward-looking insights for policymakers and businesses in designing age-inclusive digital ecosystems.

Declaration of generative AI in scientific writing

Grammarly AI was used to improve clarity, grammar, verb tense, and APA6th edition formatting. It was also used to rephrase text and create concise summaries. All AI-assisted changes were reviewed and approved by the authors to ensure accuracy and originality. No other AI tools were used for data collection, coding, or statistical analysis.

CRediT author statement

Pattarapon Chummee: Conceptualization, Methodology, data Curation, formal Analysis, Writing-Original Draft, Writing – Review & Editing, visualization, Project Administration, supervision.

References

Aldhi, I. F., Suhariadi, F., Rahmawati, E., Supriharyanti, E., Hardaningtyas, D., Sugiarti, R., & Abbas, A. (2025). Bridging digital gaps in smart city governance: the mediating role of managerial digital readiness and the moderating role of digital leadership. *Smart Cities*, *8*(4), 117.

Arias, C., Cadena Lozano, J. B., & Bello Bernal, M. A. (2024). The role of value in extending the lifetime of products: An analysis of perceived value and green consumption values on pro-circular behaviors of repair and reuse. *Sustainability*, *16*(1567), 26.

Azzi, S., Daramola, O., & Gagnon, S. (2026). Health information technology acceptance by older people: A systematic review. *Discover Public Health*, *23*, 453.

Binsumsuree, W. (2025). *Digital transformation in public services challenges and opportunities: Bangkok's smart city development* (pp. 38-50). In Proceedings of the International Conference on Social Science and Humanity. Bangkok, Thailand: International Conference on Social Science and Humanity.

Bongelli, R., Aleffi, C., Fermani, A., Guardabassi, V., del Moral Arroyo, G., & Nicolini, P. (2025). Aging: challenges and opportunities for inclusion and active participation. *Frontiers in Psychology*, *16*, 1725888.

Chaisiripaibool, S., Kraiwanit, T., Rafiyya, A., Snongtaweeporn, T., & Yuenyong, N. (2025). Digital asset adoption in developing economy: A study of risk perception and related issues. *Risk Governance & Control: Financial Markets & Institutions*, *15*(1), 37-49.

Chen, I. C., & Phanumartwiwath, A. (2025). Bridging the gray digital divide: A cross-cultural qualitative study on digital inclusion and healthy aging in Germany, Japan, and Thailand. *Telematics and Informatics Reports*, *18*, 100218.

Choomplang, N., & Negishi, Y. (2025). Comparative Analysis of Population Aging and Socio-economic Implications in Thailand and Japan. *Thammasat Review*, *28*(1), 209-242.

Cocchi, C., Zazzara, M. B., Levati, E., Calvani, R., & Onder, G. (2025). How to promote healthy aging across the life cycle. *European Journal of Internal Medicine*, *135*, 5-13.

Davis, F. D. (1989). Perceived usefulness, perceived ease of use, and user acceptance of information technology. *MIS quarterly*, *13*(3), 319-340.

Durongdej, S. (2025). The development of an elderly-friendly city model for Bangkok, Thailand. *Lex Localis*, *23*(S6), 3116-3136.

Gianfredi, V., Nucci, D., Pennisi, F., Maggi, S., Veronese, N., & Soysal, P. (2025). Aging, longevity, and healthy aging: the public health approach. *Aging Clinical and Experimental Research*, *37*(1), 125.

Hair, J. F., Hult, G. T. M., Ringle, C. M., Sarstedt, M., Danks, N. P., & Ray, S. (2021). *Partial least squares structural equation modeling (PLS-SEM) using R: A workbook*. Cham, Switzerland: Springer.

Hu, L. T., & Bentler, P. M. (1999). Cutoff criteria for fit indexes in covariance structure analysis: Conventional criteria versus new alternatives. *Structural Equation Modeling: A Multidisciplinary Journal*, *6*(1), 1-55.

Fornell, C., & Larcker, D. F. (1981). Evaluating structural equation models with unobservable variables and measurement error. *Journal of Marketing Research*, *18*(1), 39-50.

Grinin, L., Grinin, A., & Korotayev, A. (2023). *Global Aging: An Integral Problem of the Future: How to Turn a Problem into a Development Driver?* (pp. 117-135). In Sadovnichy, V. Akaev, A., Ilyin, I., Malkov, S., Grinin, L., & Korotayev, A. (Eds.). Reconsidering the limits to growth: A report to the Russian association of the club of Rome. Cham, Switzerland: Springer.

Hair, J. F., Black, W. C., Babin, B. J., & Anderson, R. E. (2022). *Multivariate data analysis* (9th eds.). Hampshire, United Kingdom: Cengage Learning.

Hair, J. F., Black, W. C., Babin, B. J., & Anderson, R. E. (2019). *Multivariate data analysis* (8th eds.). Boston, MA, USA: Cengage Learning.

Keanjoom, R., Toyoda, P., & Nakamura, K. (2024). Geographical variation, demographic and socioeconomic disparities in active ageing: The situation in Thailand. *Public Health in Practice*, *7*, 100509.

Li, R., & Shao, J. (2025). Activating the longevity economy: Digital literacy among older residents and household consumption structure upgrading. *Humanities and Social Sciences Communications*, *12*(1), 1908.

Nunnally, J. C., & Bernstein, I. H. (1994). *Psychometric theory* (3rd eds.). New York, USA: McGraw-Hill.

Organization for Economic Co-operation and Development (OECD). (2024). *Health at a glance: Asia/Pacific 2024*. Paris, France: OECD Publishing.

Pengpid, S., Peltzer, K., Hajek, A., Anantanasuwong, D., & Kaewchankha, W. (2025). Sociodemographic, lifestyle and psychological factors associated with healthy ageing in a national longitudinal study of middle-aged and older adults in Thailand. *Psychology, Health & Medicine*, *30*(6), 1069-1082.

Ponpichai, W., Inyarat, J., Uieng, J., & Angachariya, A. (2026). Development of Programs Promoting Active Ageing among the Older Adults. *Asia Social Issues*, *19*(1), e283139.

Rovinelli, R. J., & Hambleton, R. K. (1977). On the use of content specialists in the assessment of criterion-referenced test item validity. *Dutch Journal of Educational Research, 2*(2), 49-60.

Rowe, J. W., & Kahn, R. L. (1997). Successful aging. *The gerontologist*, *37*(4), 433-440.

Salisu, I., Al-Mamary, Y. H., Alfalah, A. A., Abubakar, A. A., Al-Samhi, N. M., Goaill, M. M., ... & Alshammari, A. F. (2026). Bridging the Digital Inclusion Gap for Social Sustainability: Digital Inclusion and Students' Sustainable Well-Being in Saudi Arabia. *Sustainability*, *18*(2), 813.

Schroeder, T., Dodds, L., Georgiou, A., Gewald, H., & Siette, J. (2023). Older adults and new technology: Mapping review of the factors associated with older adults' intention to adopt digital technologies. *JMIR Aging*, *6*, e44564.

Seifert, A., Cotten, S. R., & Xie, B. (2021). A double burden of exclusion? Digital and social exclusion of older adults in times of COVID-19. *The Journals of Gerontology: Series B*, *76*(3), e99-e103.

Srikolchan, A., Promjittiphong, C., Losiri, C., Dabphet, S., & Thaijongrak, N. (2025). Developing a resource-constrained age-friendly city framework: A mixed-methods study of urban aging in Bangkok, Thailand. *Sustainability*, *17*(16), 7394.

Paoli, A., Iaccarino, G., Lucidi, F., Pagnini, F., Boccuzzo, G., & Illario, M. (2025). Multidimensional determinants of active and healthy aging trajectories: a position paper from the Age-It Research Program. *The Journals of Gerontology, Series B: Psychological Sciences and Social Sciences*, *80*(Supplement_2), S145-S157.

Tipayalai, K., Chittavimongkhon, N., & Sattayanurak, P. (2026). Not Over the Hill: Exploring the Digital Divide among Vulnerable Older Adults in Thailand. *Journal of Aging & Social Policy*, 1-30.

United Nations. (2023). *World social report 2023: Leaving no one behind in an ageing world*. Retrieved from https://www.un.org

World Health Organization (WHO). (2022). *Global report on ageism*. Retrieved from https://www.who.int

Wu, C., & Lim, G. G. (2024). Investigating older adults users' willingness to adopt wearable devices by integrating the technology acceptance model (UTAUT2) and the Technology Readiness Index theory. *Frontiers in Public Health, 12*, 1449594.

Yi, Y., & Jia, C. (2026). Does digital inclusion lead to different perceptions of well-being among the middle-aged and the young-old? *Ageing & Society*, *46*, e24.

Yum, K., & Kim, J. (2024). The influence of perceived value, customer satisfaction, and trust on loyalty in entertainment platforms. *Applied Sciences*, *14*(13), 5763.

Zhang, K., Cheng, X., Li, D., & Meng, X. (2025). The digital divide of older people in communities: Urban-rural, gender, and health disparities and inequities. *Health & Social Care in the Community*, *2025*(1), 1361214.