

Associations between objectively measured smartphone screen time and ikigai in community-dwelling older adults: roles of physical function and social frailty

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Abstract

Background

Although smartphones have rapidly proliferated among older adults, it remains unclear whether screen time (smartphone usage time) is associated with "ikigai" (a sense of life worth living), and how physical function or social frailty relates to these factors.

Objectives

This study aimed to investigate the association between objectively measured smartphone screen time and ikigai among community-dwelling older adults, and to comprehensively examine their associated factors including physical function and social frailty.

Methods

A cross-sectional study was conducted with 270 community-dwelling older adults (95 males, 175 females, mean age: 73.0 ± 6.4 years) in X City, Hyogo Prefecture. Weekly average screen time (min/day) was objectively measured using built-in smartphone system log functions. Ikigai was assessed using the K-1 Ikigai Scale (range: 0–32 points). Physical function (Timed Up & Go [TUG] test, walking speed), cognitive function (Rapid Dementia Screening Test [RDST-J]), social frailty (5-item screening), and sociodemographic covariates were also evaluated. Statistical analyses included group comparisons among screen time tertiles and multivariable linear regression analyses for ikigai and screen time.

Results

The mean screen time and ikigai score were 91.3 ± 111.7 min/day and 25.6 ± 5.8 , respectively. Comparisons among screen time tertiles revealed that participants with longer screen time were significantly younger ($p < 0.001$) and had better TUG ($p = 0.030$), walking speed ($p = 0.037$), and cognitive function ($p = 0.004$); however, no significant differences were observed in ikigai ($p = 0.139$) or social frailty ($p = 0.912$). Multivariable regression analysis showed that social frailty ($\beta = -0.462$, $p < 0.001$) was independently associated with ikigai, whereas physical function (TUG: $\beta = -0.091$, $p = 0.153$), cognitive function ($\beta = -0.037$, $p = 0.536$), and screen time ($\beta = 0.109$, $p = 0.051$) were not. In the model predicting screen time, only age was significantly associated ($\beta = -0.225$, $p < 0.001$).

Conclusions

Although smartphone usage time is not directly associated with ikigai in older adults, it may reflect preserved physical and cognitive abilities required to navigate digital environments. To maintain and

enhance ikigai among older adults, comprehensive support to prevent social frailty and maintain mobility, rather than simply promoting digital device use, is essential.

Background

Screen time refers to the total amount of time spent looking at screens of digital devices such as smartphones, tablets, computers, and televisions, and interest in its health impacts has risen in recent years with the widespread adoption of these devices. Particularly among older adults, smartphone usage has expanded rapidly. According to the 2024 Communications Usage Trend Survey by the Ministry of Internal Affairs and Communications, the internet usage rate among older adults is 85.6%, and approximately 80% of individuals aged 60–69 use smartphones (Ministry of Internal Affairs and Communications, 2025). As digital device utilization becomes an integral part of daily life for older adults, clarifying the effects of screen time on their physical and psychological health has become an important issue.

Previous research has reported that increased screen time is associated with declines in physical function and various health risks. Studies targeting Japanese adults have shown that individuals with longer "passive screen-based sedentary behavior" times, such as television viewing where they one-sidedly watch a screen, have higher risks of health issues like obesity (Kikuchi et al., 2014). Furthermore, smartphone use can cause forward head posture and decreased postural control, and it has been pointed out that long-term use can reduce dynamic balance and gait stability (Li et al., 2026). In addition, increased screen time associated with digital device dependency is reported to be linked to multifaceted psychological issues such as depression, anxiety, sleep disturbances, and suicide-related behaviors (Nakshine et al., 2022). It has also been suggested that screen time may affect mental health through mechanisms such as the continuation of hyperarousal states, disruption of circadian rhythms, and changes in stress hormone secretion (Nakshine et al., 2022).

On the other hand, screen time is not merely an indicator of health risk; it may also reflect an individual's physical function, cognitive function, and social participation status. ICT use by older adults requires multiple capacities, including visual function, attentional function, manual dexterity, and information processing ability, suggesting that individuals with preserved physical and cognitive functions are more likely to utilize digital devices (Choi & DiNitto, 2013). Smartphone use has also been shown to be positively associated with physical and cognitive function among older adults (Kera et al., 2022). It has also been reported that ICT utilization ability itself is associated with social participation and independence in older adults (Czaja et al., 2019), and ICT is considered an effective tool for addressing social isolation among older adults, primarily by enhancing social support and connections (Wang & Zhang, 2025). However, prolonged sedentary behavior itself can impair metabolic health (Bull et al., 2025), and it has been shown that older adults with decreased physical activity have an increased risk of all-cause and cardiovascular mortality (Lopez et al., 2024). Therefore, screen time may serve as an "exposure factor" that negatively affects health, while simultaneously acting as an "outcome indicator" reflecting the preservation of physical and cognitive functions.

Additionally, "ikigai" (a sense of life worth living) is an important concept when considering the psychological health of Japanese older adults. "Ikigai" is a concept that encompasses a sense of meaning and purpose in life, as well as a feeling of fulfillment in daily activities, and it has been studied internationally as "ikigai" with connections to subjective well-being and resilience (Fukuzawa et al., 2019). Particularly among older adults, having ikigai has been reported to be associated with lower mortality risk, maintenance of psychological health, and increased life satisfaction (Okuzono et al., 2022).

Ikigai is also closely linked to physical and social health. It has been reported that older adults with high ikigai have higher levels of physical activity and frequency of social participation (Kamei et al., 2021), suggesting that the maintenance of physical function and social roles is important for psychological well-being in older adults. In recent years, the importance of social frailty has received significant attention. Social frailty is a concept that includes a decrease in social participation opportunities, loss of roles, and reduced interaction with others, and it has been reported to be associated with physical frailty, cognitive decline, and mortality risk (Makizako et al., 2015). Furthermore, while digital device use can facilitate social interaction, older adults who cannot use these devices may experience progressive social isolation due to the digital divide (Zhou & Jin, 2026). As social isolation has also been reported to be associated with decreased physical activity and depressive tendencies (Zhao & Liu, 2025), social frailty may be a key mediating concept between physical function and psychological health.

However, consistent findings regarding the association between screen time and ikigai have not been obtained. Moreover, screen time is a broad concept that includes not only smartphone use but also television viewing, and its health impacts may differ depending on the content and context of use. On the other hand, a study on smartphone proficiency among community-dwelling older adults reported that higher-level digital competence is positively associated with physical function and instrumental activities of daily living (Kim & Park, 2024). Furthermore, problematic smartphone usage and high screen time are reported to be associated with increased risk of depressive symptoms, sleep disturbances, and decreased quality of life among older adults (Lee & Jung, 2024). In evaluating the biological impacts and associations of screen time, traditional subjective evaluations using self-reported questionnaires are prone to recall bias (underestimation or overestimation due to frequent screen activation below conscious awareness) the influence of which cannot be avoided, highlighting the importance of objective measurement data based on device system logs (Oh et al., 2024). However, few studies have comprehensively examined the association between screen time and ikigai, including physical function and social participation.

Thus, while screen time is a comprehensive concept encompassing a wide variety of digital devices, there is extremely high academic and practical significance in focusing specifically on smartphones when discussing the health impacts and life functions of older adults in daily life. First, while passive screen viewing such as television (screen-based sedentary behavior) is known as an unhealthy behavior with low energy expenditure (Bull et al., 2025), smartphone operation requires active physical and mental activities such as fine hand movements, visual attention, and information processing (Li et al., 2026),

which may reflect different health characteristics from simple sedentary time. Second, the adoption rate of smartphones among older adults has expanded explosively in recent years (Ministry of Internal Affairs and Communications, 2025), making smartphones a core infrastructure supporting their social participation and quality of life. Third, utilizing smartphone log data (objective screen time measurement via built-in system functions) completely eliminates recall bias, such as memory ambiguity or over/underestimation, which has plagued traditional self-reported questionnaires, enabling objective and highly precise measurement (Oh et al., 2024). Therefore, it is necessary to rigorously examine the objective screen time of smartphones as a high-precision activity indicator reflecting the active social participation ability and physical/mental reserves of older adults.

Accordingly, rather than treating screen time merely as an exposure factor, it is necessary to comprehensively examine it within the mutual relationships among ikigai, physical function, and social participation. Therefore, this study aimed to investigate the association between objectively measured smartphone screen time and ikigai among community-dwelling older adults, and to clarify the associated factors of smartphone usage time, including physical function and social participation.

Methods

Participants

A total of 300 community-dwelling older adults aged 65 years or older were initially screened. After excluding 30 individuals due to predefined exclusion criteria (cognitive decline, $n = 12$; requiring long-term care insurance level 1 or higher, $n = 8$; history of psychiatric illness, $n = 4$; orthopedic treatment or exercise restrictions, $n = 4$; or primary physician's decision, $n = 2$) and missing data, a final sample of 270 community-dwelling older adults (95 males, 175 females, mean age: 73.0 ± 6.4 years) residing in X City, Hyogo Prefecture, was included in this study. The study was conducted from September 9 to 14, 2024. All participants provided written informed consent. This study complied with the Declaration of Helsinki and was approved by the Research Ethics Committee of Kobe International University (Approval No. G2023-184).

The exclusion criteria were: (1) individuals with cognitive decline who had difficulty responding, (2) individuals certified as requiring long-term care insurance level 1 or higher, (3) individuals with a history of psychiatric illness, (4) individuals undergoing orthopedic treatment or having exercise restrictions, and (5) individuals for whom participation was deemed inappropriate by their primary physician.

Since this study was a cross-sectional study using existing data, the adequacy of the sample size was verified post-hoc. The sample size was calculated using G*Power 3.1, assuming a multiple linear regression analysis. The effect size was set to medium ($f^2 = 0.15$), based on general standards in behavioral and health-related research (Cohen, 1988). With the significance level set to 0.05, power to 0.80, and the number of predictors to 6, the required sample size was 98. The 270 participants included

in the final analysis of this study sufficiently met this requirement. The details of the selection process, including recruitment, exclusion, and the final analytic sample (N = 270), are illustrated in Fig. 1.

[Figure 1 near here]

Figure 1. Flowchart of participant selection process (N = 270).

Measurements

Socio-demographics and Baseline Characteristics

Age, sex, height, and weight were surveyed, and body mass index (BMI; weight [kg] / height [m]²) was calculated.

Smartphone Screen Time Assessment

Screen time was measured objectively using the built-in system log functions of the participants' smartphones. Daily screen time (minutes/day) for the past week was obtained, and the weekly average was calculated. Data with at least four valid days of recording were included in the analysis. Screen time was analyzed as a continuous variable and also classified into tertiles (Low, Middle, and High groups).

Ikigai Assessment: The K-1 Ikigai Scale for the elderly was used (Hasegawa et al., 2003). This scale consists of 16 items representing four factors: "self-realization and motivation," "fulfillment of daily life," "will to live," and "sense of existence." Each question was answered on a 3-point scale (yes = 2, neutral = 1, no = 0), and the total score (0–32 points) was calculated. A higher score indicates a higher sense of ikigai.

Physical Function Assessment: The Timed Up & Go (TUG) test was conducted in accordance with the procedures of Podsiadlo and Richardson (Podsiadlo & Richardson, 1991). From a seated position in a chair with a backrest (seat height: 42 cm), the participant stood up, walked at a normal pace around a cone placed 3 m away, and sat back down. The time (seconds) taken to complete the task was measured. To ensure safety, an examiner stood nearby to prevent falls. One trial was used for analysis. Walking speed was evaluated using the 5m walking test. Participants were instructed to walk at their normal comfortable speed along a straight line. The time taken to pass through the 5m measurement section was timed with a stopwatch. To eliminate the effects of acceleration and deceleration, buffer zones of several meters were established before and after the measurement section. Walking speed was calculated by dividing the distance (5 m) by the time (seconds) (m/s). This indicator is widely used in the evaluation of physical function and frailty in older adults.

Cognitive Function Assessment: The Rapid Dementia Screening Test Japanese version (RDST-J) developed by Meguro et al. was used (Meguro et al., 2004). This includes the supermarket task (category fluency, listing as many items buyable at a supermarket or convenience store as possible in 1 minute)

and the digit conversion task (mutual conversion between Arabic and Chinese numerals, 4 items total). The total score (0–12 points) was calculated, with a cut-off score of 7/8 points. The testing time was approximately 3 to 5 minutes.

Social Frailty Assessment: In accordance with the previous study by Makizako et al. (Makizako et al., 2015), participants were asked five questions: (1) "Compared to last year, has your frequency of going out decreased?" (yes), (2) "Do you visit your friends' homes?" (no), (3) "Do you feel that you are helpful to your family or friends?" (no), (4) "Are you living alone?" (yes), and (5) "Do you talk with someone daily?" (no). Meeting two or more of these criteria was classified as "social frailty," meeting one criterion as "social pre-frailty," and meeting zero criteria as "robust."

Covariates

Factors assumed to be associated with screen time and ikigai were assessed. Specifically, these included education history (years), exercise habits (yes/no), living alone (yes/no), marital status (married / widowed or divorced / unmarried), and employment status (yes/no).

Statistical Analysis

Statistical analysis was performed using SPSS Statistics (IBM Corp.). Continuous variables are presented as mean $\pm$ standard deviation (SD), and categorical variables as frequencies and percentages. The normality of continuous variables was assessed using histograms and the Shapiro–Wilk test. Because some variables were not normally distributed, non-parametric tests were used for group comparisons.

Smartphone screen time was classified into tertiles (Low, Middle, and High groups). Group comparisons were performed using the Kruskal–Wallis test for continuous variables and the chi-squared test for categorical variables. When significant differences were found, post-hoc pairwise comparisons were conducted with Bonferroni correction.

For multivariable analysis, two multivariable linear regression models were constructed, with ikigai and smartphone screen time as the respective dependent variables. In the ikigai model, age, sex, cognitive function, physical function (TUG), social frailty score, and smartphone screen time were entered as independent variables. In the smartphone screen time model, age, sex, cognitive function, social frailty score, and ikigai were entered as independent variables. Social frailty was entered as a continuous score. Multicollinearity was evaluated using the Variance Inflation Factor (VIF), with $VIF < 10$ deemed acceptable. Results are presented as unstandardized coefficients (B), standard errors (SE), standardized coefficients (β), and 95% confidence intervals (CI). The significance level was set at $p < 0.05$ for all two-tailed tests.

Results

Participant Characteristics

A total of 270 participants were included in this study. The mean age was 73.0 ± 6.4 years, and the mean BMI was 21.9 ± 3.2 kg/m². The mean smartphone screen time was 91.3 ± 111.7 minutes/day, and the mean ikigai score was 25.6 ± 5.8 . The mean TUG time was 5.93 ± 1.54 seconds, walking speed was 1.45 ± 0.22 m/s, and cognitive function score was 10.83 ± 1.56 points. Regarding socio-demographics, 95 participants (35.2%) were male, 179 (66.3%) had regular exercise habits, 60 (22.2%) lived alone, and 184 (68.1%) had social frailty (including social pre-frailty, defined as meeting one or more criteria). The baseline characteristics of the participants are summarized in Table 1.

Table 1
Baseline characteristics of participants (n = 270).

Variable	Value
Age, years	73.0 ± 6.4
BMI, kg/m ²	21.9 ± 3.2
Screen time, min/day	91.3 ± 111.7
Ikigai score (0–32)	25.6 ± 5.8
TUG, sec	5.93 ± 1.54
Walking speed, m/s (NEW)	1.45 ± 0.22
Cognitive function, points (0–12) (NEW)	10.83 ± 1.56
Education, years	14.3 ± 2.4
Male, n (%)	95 (35.2)
Exercise habit, n (%)	179 (66.3)
Living alone, n (%)	60 (22.2)
Married, n (%)	187 (69.3)
Employment, n (%)	100 (37.0)
Social frailty (including pre-frailty)†, n (%)	184 (68.1)

Values are presented as mean ± standard deviation or number (%). †Social frailty (including pre-frailty) indicates individuals who met one or more of the social frailty criteria (score ≥ 1).

Comparison Across Smartphone Screen Time Tertiles

In the comparisons across smartphone screen time tertiles, significant differences were observed in age ($p < 0.001$), TUG ($p = 0.030$), walking speed ($p = 0.037$), and cognitive function ($p = 0.004$) (Table 2, Fig. 2).

Specifically, participants with longer screen time were significantly younger and had better physical function (walking speed) and cognitive function (Fig. 2). In contrast, no significant differences were observed in ikigai score ($p = 0.139$) or BMI ($p = 0.332$). Furthermore, there were no significant group differences in categorical socio-demographic factors, including sex ($p = 0.606$), exercise habits ($p = 0.153$), living alone ($p = 0.249$), marital status ($p = 0.864$), employment status ($p = 0.466$), or social frailty ($p = 0.912$). The detailed comparisons are shown in Table 2.

Table 2
Comparison of socio-demographic and health characteristics across smartphone screen time tertiles.

Variable	Low (n = 91)	Middle (n = 89)	High (n = 90)	p-value
Age, years	75.6 ± 6.2	73.1 ± 6.0	70.2 ± 5.8	< 0.001
BMI, kg/m ²	22.0 ± 3.1	21.8 ± 3.2	21.8 ± 3.2	0.332
Ikigai score	25.3 ± 5.9	25.8 ± 5.6	25.7 ± 5.8	0.139
TUG, sec	6.2 ± 1.6	5.9 ± 1.5	5.6 ± 1.4	0.030
Walking speed, m/s (NEW)	1.40 ± 0.21	1.46 ± 0.22	1.49 ± 0.22	0.037
Cognitive function, points (0–12) (NEW)	10.47 ± 1.58	10.90 ± 1.65	11.13 ± 1.38	0.004
Male, n (%)	30 (33.0)	35 (39.3)	30 (33.3)	0.606
Exercise habit, n (%)	63 (69.2)	52 (58.4)	64 (71.1)	0.153
Living alone, n (%)	16 (17.6)	19 (21.3)	25 (27.8)	0.249
Married, n (%) (ADDED)	72 (79.1)	76 (85.4)	73 (81.1)	0.864
Employment, n (%)	30 (33.0)	32 (36.0)	38 (42.2)	0.466
Social frailty (including pre-frailty)†, n (%)	62 (68.1)	62 (69.7)	60 (66.7)	0.912

Values are presented as mean ± standard deviation or number (%). Comparisons were performed using the Kruskal-Wallis test for continuous variables and chi-squared test for categorical variables. †Social frailty (including pre-frailty) indicates individuals who met one or more of the social frailty criteria (score ≥ 1).

[Figure 2 near here]

Figure 2. Comparison of walking speed, cognitive function, and ikigai across screen time tertiles. Error bars represent standard errors. Screen time is positively and significantly associated with walking speed ($p = 0.037$) and cognitive function ($p = 0.004$), but shows no significant association with ikigai ($p = 0.139$).

Multivariable Linear Regression Analysis for Ikigai

The multivariable linear regression analysis with ikigai as the dependent variable showed that only the "social frailty score" (standardized coefficient $\beta = -0.462$, $p < 0.001$) was independently and significantly associated with lower ikigai, indicating that individuals with more advanced social frailty had significantly lower ikigai. Conversely, age ($p = 0.485$), sex ($p = 0.236$), cognitive function ($p = 0.536$), smartphone screen time ($p = 0.051$), and physical function (TUG) ($p = 0.153$) did not show independent and significant associations with ikigai. These results are presented in Table 3.

Table 3
Multivariable linear regression analysis for ikigai (n = 270).

Variable	B	SE	β	p-value	95% CI
Age	-0.042	0.060	-0.046	0.485	-0.160 to 0.076
Sex (female)	-0.760	0.640	-0.067	0.236	-2.021 to 0.501
Cognitive function (RDST-J)	-0.126	0.203	-0.037	0.536	-0.525 to 0.274
Social frailty score	-2.315	0.280	-0.462	< 0.001	-2.866 to -1.764
Screen time	0.004	0.002	0.109	0.051	-0.000 to 0.008
TUG, sec	-0.426	0.298	-0.091	0.153	-1.012 to 0.160

B = unstandardized coefficient; SE = standard error; β = standardized coefficient; CI = confidence interval. Sex coded as 0 = male, 1 = female. Social frailty score entered as a continuous score.

Multivariable Linear Regression Analysis for Smartphone Screen Time

The multivariable linear regression analysis with smartphone screen time as the dependent variable revealed that sex (female: $\beta = 0.124$, $p = 0.048$) and cognitive function ($\beta = 0.130$, $p = 0.049$) were significantly and positively associated with screen time. This indicates that female older adults and those with better cognitive function tended to have longer smartphone screen time. On the other hand, age ($p = 0.086$), social frailty score ($p = 0.210$), and ikigai ($p = 0.052$) did not show significant associations with screen time. These results are summarized in Table 4.

Table 4
Multivariable linear regression analysis for smartphone screen time (n = 270).

Variable	B	SE	β	p-value	95% CI
Age	-2.894	1.680	-0.116	0.086	-6.164 to -1.696
Sex (female)	39.074	19.709	0.124	0.048	0.261 to 77.887
Cognitive function (RDST-J)	12.505	6.324	0.130	0.049	0.051 to 24.960
Social frailty score	12.401	9.861	0.082	0.210	-7.018 to 31.819
Ikigai score	3.810	1.948	0.136	0.052	-0.027 to 7.647

B = unstandardized coefficient; SE = standard error; β = standardized coefficient; CI = confidence interval. Screen time expressed as minutes/day. Sex coded as 0 = male, 1 = female. Social frailty score entered as a continuous score.

Discussion

This study investigated the association between objectively measured smartphone screen time and ikigai among community-dwelling older adults, as well as their respective associated factors. The results showed that while participants with longer screen time were younger and had better physical and cognitive functions, smartphone screen time was not directly associated with ikigai. Furthermore, multivariable analysis revealed that only social frailty was independently associated with ikigai, whereas TUG, screen time, and cognitive function showed no independent direct associations.

The finding that participants with longer smartphone screen time had better physical and cognitive functions is intriguing. Generally, screen time is treated as an indicator of sedentary behavior, which is reported to be associated with decreased physical activity and physical decline (Bull et al., 2025). A systematic review of screen time and physical activity in older adults also discussed the negative impacts of sedentary screen time on mobility (Taylor et al., 2024). However, in this study, longer screen time did not reflect physical decline; rather, it appeared to reflect the characteristic that older adults with preserved physical and cognitive functions are more capable of utilizing ICT devices. Older adults' ICT use has been reported to be associated with age and health status (Andrews et al., 2019; Czaja et al., 2019), and the results of this study are consistent with these existing findings.

ICT device utilization in older adults requires multiple capacities, such as visual function, attentional function, manual dexterity, and information processing ability. Therefore, older adults with declined physical or cognitive functions may find it difficult to access digital devices, leading to shortened screen time. In this regard, a longitudinal study showed that smartphone use contributes to the maintenance and improvement of cognitive function (Cho et al., 2022). Furthermore, ICT utilization ability itself is associated with social participation and independence in older adults (Czaja et al., 2019), suggesting that screen time in this study reflects "the ability to participate in digital environments" rather than simple

sedentary time. The high integration of physical and cognitive functions (screen time and cognitive function) is also consistent with brain imaging research showing that activation of the fronto-parietal network is involved in the interaction between motor and working memory tasks (Ishihara et al., 2020). Furthermore, because this study objectively measured screen time using built-in smartphone functions, it represents a major methodological strength by completely eliminating recall bias (discrepancy between subjective and objective measurements) associated with traditional self-reports (Oh et al., 2024). Measuring direct screen activation times from device logs rather than using subjective, inaccurate time assessments (Oh et al., 2024) likely allowed us to clearly identify the positive associations between screen time and physical/cognitive functions as a reflection of unbiased physiological and cognitive adaptation capacities.

On the other hand, no significant association was observed between smartphone screen time and ikigai in this study. This suggests that screen usage duration itself does not directly dictate psychological fulfillment in older adults. In recent years, it has been pointed out that ICT use among older adults can contribute to reducing social isolation and maintaining subjective well-being (Wang & Zhang, 2025). However, our results suggest that "duration of use" alone is insufficient to explain psychological health. Specifically, the quality of screen use—such as the purpose of use or whether it leads to social interaction and role maintenance—may be more important than the quantity. This is also highlighted in a systematic review of reviews on the effects of ICT-based interventions on reducing social isolation (Gabilondo et al., 2021). Furthermore, a previous study using objective measurements reported that objective screen time shows a more consistent association with physical function and mental health compared to subjective self-reports (Oh et al., 2024).

Additionally, social frailty showed a strong association with ikigai in this study. Social isolation has been reported to be associated with decreased subjective well-being and life satisfaction (Zhao & Liu, 2025), and our results support the importance of maintaining social connections for psychological health in older adults. Social frailty is a concept encompassing decreased social participation, role loss, and reduced interaction opportunities, which are reported to be mutually associated with physical frailty and cognitive decline (Makizako et al., 2015). Specifically, a recent longitudinal study by Shimokihara et al. (2025) confirmed that smartphone screen time is associated with social frailty among community-dwelling older adults. Therefore, the strong association between social frailty and ikigai suggests that older adults' ikigai is formed within their relationships with society rather than solely by individual factors. Particularly, a recent meta-analysis demonstrated that social frailty is strongly associated with depression and decreased psychological well-being, which strongly supports our findings (Teo et al., 2023).

Furthermore, in the multivariable analysis of this study, TUG did not show an independent, significant association with ikigai ($p = 0.153$). However, TUG was significantly associated with screen time duration in the univariate comparison (Table 2) and is an indicator closely linked to the progression of social frailty. A decline in physical function (TUG) is likely to lead to reduced opportunities for going out and interacting with others, thereby indirectly affecting ikigai through the mediation of social frailty (the

mediation effect of social frailty). Particularly, TUG is a comprehensive evaluation index reflecting not only walking and mobility but also balance and activities of daily living, serving as an important marker of independence in older adults (Podsiadlo & Richardson, 1991). Because walking ability is also associated with social participation frequency and life space in older adults (Shumway-Cook et al., 2002), the linkage between TUG and social frailty in this study suggests that "maintaining mobility as a foundation for social participation" is indispensable for preserving ikigai.

These results may also align with Activity Theory (Havighurst, 1961), which posits that life satisfaction and subjective well-being in older age are determined by maintaining social participation and roles (Havighurst, 1961). Activity Theory suggests that "maintaining connection with society" rather than aging itself is crucial for psychological health. In this study, social participation factors (social frailty) and mobility (TUG) supporting social participation were more closely associated with ikigai than individual factors (cognitive function or screen time), suggesting that a "living foundation to maintain social connections" is critical for psychological well-being in older adults.

Moreover, in this study, only age was significantly associated with smartphone screen time, with older age being associated with shorter screen time. This may reflect age-related declines in digital skills and ICT opportunities. In recent years, the "grey digital divide" has become an important social issue, and it has been reported that a lack of digital skills can prevent older adults from utilizing digital networks for social connections, leading to social exclusion (Mubarak & Suomi, 2022). Furthermore, older adults' self-efficacy and anxiety toward digital devices are reported to affect ICT adoption (Heart & Kalderon, 2013), suggesting that psychological factors in addition to access opportunities may influence screen time.

Additionally, the "quality" of screen time has been pointed out as important in recent years (Vanden Abeele, 2023). For example, passive video viewing and active communication with family or friends may have different psychological impacts. Because this study evaluated screen time as a total volume, its qualitative aspects could not be fully assessed. Future studies should examine screen time in relation to its content and purposes of use.

In conclusion, the findings of this study suggest that older adults' ikigai is not determined simply by digital usage time, but is more strongly influenced by physical functions that support social connection and participation. Therefore, to enhance psychological well-being in older adults, comprehensive support—such as securing social participation opportunities, maintaining roles, and preventing physical decline—is crucial, rather than merely promoting ICT use. Furthermore, ICT support should focus on "using digital technology to facilitate social interaction" rather than simply increasing usage time.

Study Limitations

This study has several limitations. First, because this was a cross-sectional study, causal relationships cannot be established. For example, it remains unclear whether decreased physical function leads to reduced screen time or whether ICT use helps maintain daily activity levels; thus, future longitudinal studies are needed. Second, this study did not distinguish the content or purpose of screen time (e.g.,

information gathering, entertainment, communication), and the differences in impacts based on usage content were not fully examined. Third, there may have been unadjusted confounding factors, such as socioeconomic status or ICT literacy. Finally, because the participants were limited to community-dwelling older adults, caution is required when generalizing these results. Future research should comprehensively investigate the qualitative aspects of screen use and its association with social participation.

Declarations

Ethics approval and consent to participate: The study was approved by the Research Ethics Committee of Kobe International University (Approval No. G2023-184) and was conducted in accordance with the Declaration of Helsinki. Informed consent was obtained from all participants involved in the study.

Consent for publication: Not applicable.

Availability of data and materials: The datasets analyzed during the current study are available from the corresponding author on reasonable request.

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References

1. Andrews JA, Brown LJ, Hawley MS, Astell AJ (2019) Older adults' perspectives on using digital technology to maintain good mental health: interactive group study. *J Med Internet Res* 21(2):e11694. <https://doi.org/10.2196/11694>
2. Bull FC et al (2025) Sedentary behavior and metabolic health in older populations: An updated review of recent evidence. *J Act Aging* 14(1):45–56. <https://doi.org/10.1007/s44155-024-01024-x>
3. Cho J et al (2022) Smartphone use and cognitive function in older adults: A longitudinal study. *Int J Geriatr Psychiatry* 37(8):e5772. <https://doi.org/10.1002/gps.5772>

4. Choi NG, DiNitto DM (2013) The digital divide among low-income homebound older adults: Internet use patterns, eHealth literacy, and attitudes toward computer/internet use. *J Med Internet Res* 15(5):e93. <https://doi.org/10.2196/jmir.2433>
5. Czaja SJ, Boot WR, Charness N, Rogers WA (2019) *Designing for Older Adults: Principles and Creative Human Factors Approaches*, 3rd edn. CRC, Boca Raton. <https://doi.org/10.1201/9781351111874>
6. Fukuzawa A, Katagiri K, Harada K, Masumoto K, Chogahara M, Kondo N, Okada S (2019) A longitudinal study of the moderating effects of social capital on the relationships between changes in human capital and ikigai among Japanese older adults. *Asian J Soc Psychol* 22(2):172–182. <https://doi.org/10.1111/ajsp.12351>
7. Gabilondo A et al (2021) Information and communication technologies (ICT) interventions for reducing social isolation in older adults: a systematic review of reviews. *BMC Geriatr* 21(1):501. <https://doi.org/10.1186/s12877-021-02449-0>
8. Hasegawa E, Niino N et al (2003) Development and validation of the K-1 Ikigai Scale for the elderly (in Japanese). *Japanese J Geriatr* 40(3):268–275. <https://doi.org/10.3143/geriatrics.40.268>
9. Havighurst RJ (1961) Successful aging. *Gerontologist*, 1(1), 8–13. <https://doi.org/10.1093/geront/1.1.8>
10. Heart T, Kalderon E (2013) Older adults: are they ready to adopt health-related ICT? *Int J Med Informatics* 82(11):e209–e231. <https://doi.org/10.1016/j.ijmedinf.2011.03.002>
11. Ishihara T, Miyazaki A, Tanaka H, Matsuda T (2020) Identification of the brain networks that contribute to the interaction between physical function and working memory: An fMRI investigation with over 1,000 healthy adults. *NeuroImage* 221:117151. <https://doi.org/10.1016/j.neuroimage.2020.117151>
12. Kamei M, Motohashi C, Inoue N, Nishina M, Ohta A, Miyazaki T et al (2021) Ikigai', subjective well-being and participation in community support activities among the elderly in Japan. *Int J Epidemiol* 50(Supplement1). <https://doi.org/10.1093/ije/dyab168.333>. dyab168.333
13. Kera T, Kawai H, Hirano H, Kojima M, Watanabe Y, Motokawa K, Ihara K (2022) Relationships of smartphone use with physical and cognitive function, and social frailty in community-dwelling older adults. *Geriatr Gerontol Int* 22(10):855–861. <https://doi.org/10.1111/ggi.14452>
14. Kikuchi H, Inoue S, Sugiyama T, Owen N, Oka K, Nakaya T et al (2014) Distinct associations of different sedentary behaviors with health-related attributes among older adults. *Prev Med* 67:335–339. <https://doi.org/10.1016/j.ypmed.2014.08.011>
15. Kim J, Park S (2024) Smartphone Proficiency in Community-Dwelling Older Adults is Associated With Higher-Level Competence and Physical Function. *Geriatr Gerontol Int* 24(3):291–298. <https://doi.org/10.1111/ggi.14781>
16. Lee SY, Jung YM (2024) Smartphone Addiction, Use Preferences, and Depression Among Older Adults. *Int J Mental Health Addict* 22(4):1012–1025. <https://doi.org/10.1007/s11469-023-01102-w>

17. Li Z, Wang L, Liu Y (2026) Effects of smartphone use on postural control and gait performance in older adults. *J Aging Phys Act* 34(1):112–119. <https://doi.org/10.1123/japa.2025-0102>
18. Lopez A et al (2024) Sedentary behavior and health outcomes in community-dwelling older adults: An updated systematic review. *Eur J Pub Health* 34(2):241–249. <https://doi.org/10.1093/eurpub/ckad112>
19. Makizako H, Shimada H, Tsutsumimoto K et al (2015) Social frailty in community-dwelling older adults as a risk factor for disability. *J Am Med Dir Assoc* 16(11):1003e7–1003e11. <https://doi.org/10.1016/j.jamda.2015.05.019>
20. Meguro K et al (2004) Rapid Dementia Screening Test Japanese version (RDST-J) (in Japanese). *Japanese J Geriatric Psychiatry* 15:1033–1039. <https://doi.org/10.11234/jsg.15.1033>
21. Ministry of Internal Affairs and Communications (2025) Communications Usage Trend Survey in 2024 (in Japanese). <https://www.soumu.go.jp/johotsusintokei/statistics/statistics05.html>. Accessed 10 Aug 2026
22. Mubarak F, Suomi R (2022) Elderly Forgotten? Digital Exclusion in the Information Age and the Rising Grey Digital Divide. *Inquiry* 59:00469580221096272. <https://doi.org/10.1177/00469580221096272>
23. Nakshine VS, Thute P, Khatib MN, Sarkar B (2022) Increased screen time as a cause of declining physical, psychological health, and sleep patterns: a literary review. *Cureus* 14(10):e30051. <https://doi.org/10.7759/cureus.30051>
24. Oh SJ et al (2024) Association of objectively measured smartphone screen time with physical and mental health in older adults. *Gerontology* 70(2):112–121. <https://doi.org/10.1159/000535311>
25. Okuzono S, Shiba K, Kim E, Shirai K, Kondo N, Fujiwara T et al (2022) Ikigai and subsequent health and wellbeing among Japanese older adults: Longitudinal outcome-wide analysis. *Lancet Reg Health - Western Pac* 21:100391. <https://doi.org/10.1016/j.lanwpc.2021.100391>
26. Podsiadlo D, Richardson S (1991) The timed Up & Go: a test of basic functional mobility for frail elderly persons. *J Am Geriatr Soc* 39(2):142–148. <https://doi.org/10.1111/j.1532-5415.1991.tb01616.x>
27. Shimokihara S et al (2025) Longitudinal association between smartphone screen time and social frailty among community-dwelling older adults. *J Physiol Anthropol* 44(1):12–20. <https://doi.org/10.1186/s40101-024-00350-x>
28. Shumway-Cook A, Patla AE, Stewart A, Ferrucci L, Ciol MA, Guralnik JM (2002) Environmental demands associated with community mobility in older adults with and without mobility disabilities. *Phys Ther* 82(7):670–681. <https://doi.org/10.1093/ptj/82.7.670>
29. Taylor S et al (2024) Screen time, physical activity, and physical function in older adults: a systematic review and meta-analysis. *J Aging Phys Act* 32(3):478–489. <https://doi.org/10.1123/japa.2023-0143>
30. Teo N et al (2023) Association between social frailty and depressive symptoms among community-dwelling older adults: a systematic review and meta-analysis. *Geriatr Gerontol Int* 23(4):245–253.

<https://doi.org/10.1111/ggi.14556>

31. Vanden Abeele M (2023) The quality of screen time: Active vs passive digital engagement in later life. *Curr Opin Psychol* 52:101595. <https://doi.org/10.1016/j.copsyc.2023.101595>
32. Wang H, Zhang X (2025) Association between internet use and social isolation among older adults. *Comput Hum Behav* 162:108422. <https://doi.org/10.1016/j.chb.2024.108422>
33. Zhao Y, Liu Q (2025) Predicting and explaining life satisfaction among older adults: Evidence from the digital divide survey. *Arch Gerontol Geriatr* 128:105210. <https://doi.org/10.1016/j.archger.2024.105210>
34. Zhou X, Jin S (2026) The impact and mechanism effect of the digital divide on the quality of life in older adults. *Soc Sci Med* 368:118432. <https://doi.org/10.1016/j.socscimed.2025.118432>

Figures

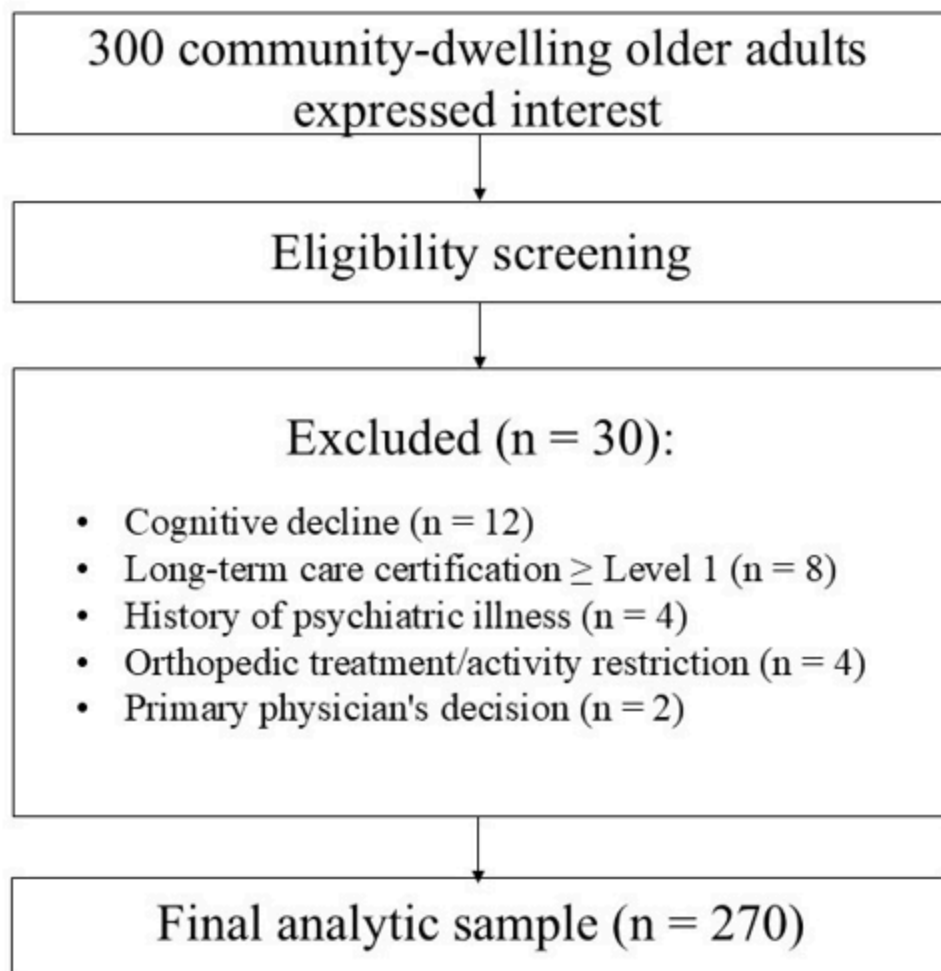


Figure 1

Flowchart of participant selection process (N = 270).

Footnote: A total of 300 community-dwelling older adults were screened. After excluding 30 individuals due to predefined criteria (cognitive impairment, long-term care certification, orthopedic treatments/restrictions) and missing data, 270 participants were included in the final analytic sample.

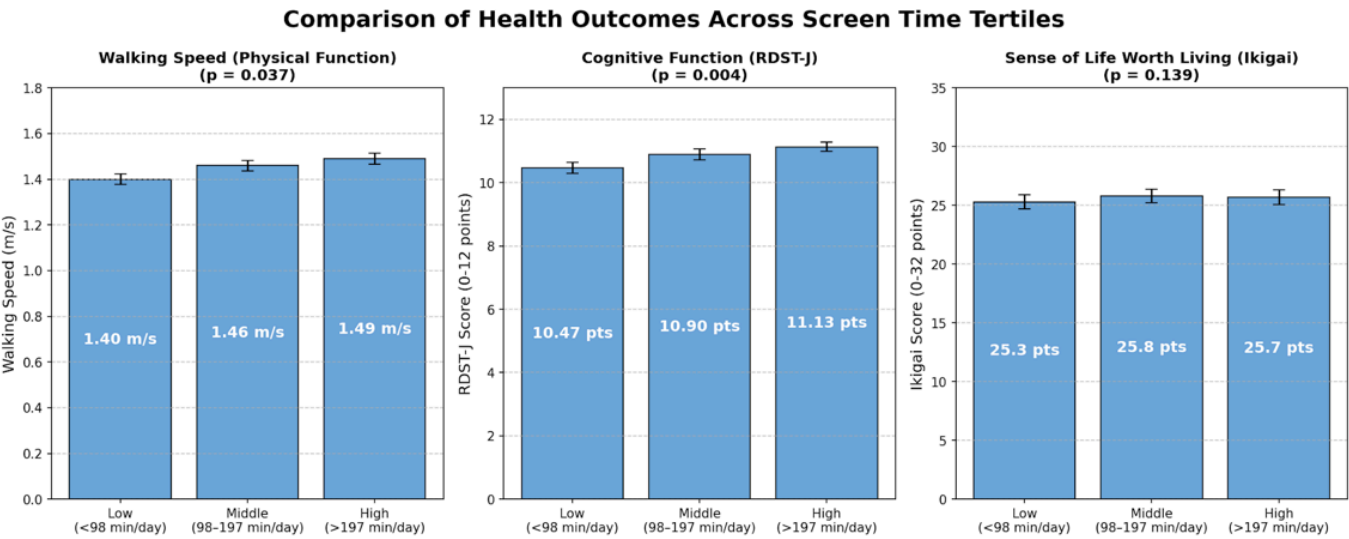


Figure 2

Comparison of walking speed, cognitive function, and ikigai across screen time tertiles.

Footnote: Error bars represent standard errors. Screen time is grouped into tertiles (Low, Middle, and High). Kruskal-Wallis tests show that smartphone screen time is positively and significantly associated with walking speed ($p = 0.037$) and cognitive function ($p = 0.004$), reflecting preserved motor and cognitive abilities required to navigate digital environments. No significant association is observed with ikigai ($p = 0.139$), indicating that quantity of usage does not directly dictate psychosocial health in community-dwelling older adults.