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Age Differences in the Association Between Household Financial Assets and Loneliness Across Five Survey Waves in Japan

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Research Article

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Abstract

Background

Whether within-person changes in household financial resources are associated with loneliness, and whether these associations differ by age, remains unclear.

Methods

We analyzed five annual waves (2020–2024) of a Japanese online household survey, comprising 4,165 respondents and 15,105 person-wave observations. Individual fixed-effects models examined associations of log household financial assets and income with a three-item loneliness score (range 3–9). Models included survey-wave effects, baseline age-group-by-wave effects, and respondent-clustered standard errors.

Results

The association between financial assets and loneliness differed by baseline age group (65 years or older versus younger than 65): the age-group interaction coefficient was − 0.1888 (standard error 0.0580; p = 0.001). The financial-assets coefficient in the younger group was 0.0088 (p = 0.755), implying a coefficient of approximately − 0.1800 in the older group. The corresponding age-group interaction for income was not significant (p = 0.979). The negative asset interaction persisted across several sensitivity analyses, including sample restrictions and inverse-probability weighting. However, it was not statistically significant under the stricter binary loneliness definition (p = 0.372).

Conclusions

Within-person associations between reported household financial assets and loneliness differed between younger and older respondents, whereas no comparable age-group difference was found for household income. These observational results do not establish causality and may not generalize beyond the selected online panel.

1. Introduction

Loneliness has become an important public health concern because of its associations with mental and physical health outcomes. A meta-analysis has also documented an association between loneliness and increased mortality risk [1]. Although loneliness is often examined in relation to social networks, living arrangements, and health conditions, individuals' financial circumstances may also be relevant. Financial resources can influence opportunities for social participation and the ability to cope with unexpected

events. However, the relationship between financial resources and loneliness remains incompletely understood, particularly when changes within the same individuals are considered.

Household income and financial assets represent different dimensions of financial resources. Income measures a flow of resources over a given period, whereas financial assets represent accumulated resources that may help households manage future uncertainty. These differences may be particularly relevant in later life, when the relative roles of earnings and accumulated resources can change. Previous studies have reported associations between financial circumstances and loneliness, but their findings are mixed. Using longitudinal European data, Hajek and König [2] found that changes in income were associated with changes in loneliness among older adults. In a cross-sectional German study, the same authors [3] reported that relatively low wealth was associated with adverse psychosocial outcomes, including loneliness, although the associations were mainly observed among adults aged 43–64 years. By contrast, Drost et al. [4], using longitudinal data from older adults in the United States, found an association between subjective financial strain and loneliness but not between changes in household income or net assets and loneliness. A subsequent US study found that access to emergency savings, rather than household income, was associated with loneliness during the initial COVID-19 emergency [5]. These findings suggest that different financial measures should not be treated as interchangeable.

The association between financial circumstances and loneliness may also vary across age groups. Luhmann and Hawkley [6] showed that the relationships of income, employment, and household characteristics with loneliness differed across stages of adulthood. In Japan, Khan and Kadoya [7] examined loneliness before and during the COVID-19 pandemic and documented differences between younger and older adults. Using three waves of the Household Behavioral and Financial Survey, Lal et al. [8] investigated different patterns of loneliness and included changes in household financial assets and income in analyses stratified by age. Another study using the same survey examined loneliness in 2022 and reported an association between household assets and loneliness among older men in a cross-sectional specification [9]. Thus, previous Japanese research has already considered financial resources, age differences, and loneliness. However, these studies do not provide the same assessment of within-person changes in continuous loneliness scores and their associations with financial assets across five annual waves.

More recently, Amarsanaa et al. [10] examined loneliness trajectories in Japan from 2020 to 2024 using the same underlying household survey. Their study described annual loneliness prevalence and patterns of persistence and transition among 1,673 respondents with complete five-wave data. It provided evidence on the dynamics of loneliness over the COVID-19 period but did not estimate multivariable associations between changes in household financial resources and loneliness. The present study addresses a different research question by examining whether within-person variation in household financial assets and income is associated with changes in loneliness and whether these associations differ between younger and older respondents.

We use five annual waves (2020–2024) of the Household Behavioral and Financial Survey. The analytical sample consists of 4,165 respondents and 15,105 person-year observations, including respondents with at least two waves of valid information on loneliness, household income, and household financial assets. Loneliness is measured using the continuous three-item UCLA loneliness score. Individual fixed-effects models are employed to account for time-invariant individual characteristics, together with year effects and age-group-specific year effects. We examine interactions between household financial resources and an indicator for being aged 65 years or older at baseline. The age classification is used to compare two substantively motivated life-stage groups, rather than to identify a discontinuity at age 65.

This study contributes to the literature by extending earlier evidence from Japan in three respects. First, it examines within-person associations using five annual waves rather than relying only on cross-sectional variation or shorter observation periods. Second, it considers household financial assets and income separately within the same model. Third, it directly tests whether their associations with loneliness differ by baseline age group. These analyses provide evidence on age-related heterogeneity in the relationship between household financial circumstances and loneliness, without implying a causal effect of financial resources.

2. Data and methods

2.1. Data source and study population

This study uses five annual waves (2020–2024) of the Household Behavioral and Financial Survey. The questionnaire was designed by the author, and the survey was administered online by Nikkei Research using its own and affiliated registered survey panels. Eligible participants were adults aged 20 years or older residing in Japan. The survey procedures and longitudinal data collection have been described by Amarsanaa et al. [10] using the same survey series.

The baseline survey was conducted from February 20 to 25, 2020, and obtained 17,463 valid responses. Follow-up surveys were conducted from February 19 to 26, 2021; February 18 to 28, 2022; February 22 to March 6, 2023; and February 27 to March 11, 2024. The numbers of respondents linked to the original 2020 cohort were 6,103 in 2021, 4,281 in 2022, 3,410 in 2023, and 2,817 in 2024.

The original survey protocol was reviewed internally by Nikkei Research in accordance with its ethical and survey administration procedures. Participants provided informed consent before completing the questionnaires.

Unlike the previous study, which examined the prevalence and trajectories of loneliness among respondents with complete information across all five waves, the present analysis uses an unbalanced longitudinal panel. Respondents were retained when they had valid information on loneliness, household income, and household financial assets in at least two survey waves. Observations from earlier waves were retained even when a respondent subsequently left the survey.

This approach yielded an analytic sample of 4,165 respondents and 15,105 person-year observations. Of these respondents, 3,479 were younger than 65 years at baseline, and 686 were aged 65 years or older. Because the data were collected through an online respondent panel and experienced substantial attrition, the analytic sample should not be considered nationally representative.

2.2. Measurement of loneliness

Loneliness was assessed using the three-item loneliness measure developed by Hughes et al. [11] (referred to here as UCLA-3). Respondents were asked how frequently they experienced three feelings: lacking companionship, feeling left out, and feeling isolated from others. Each item was answered using three response categories: “hardly ever or never,” “some of the time,” and “often,” coded from 1 to 3.

For the primary analysis, we summed the three responses to construct a continuous loneliness score ranging from 3 to 9, with higher values indicating greater loneliness. The score was calculated only when all three item responses were valid.

Two alternative binary measures were used in sensitivity analyses. The inclusive definition classified a respondent as lonely if at least one UCLA-3 item was answered “some of the time” or “often.” The stricter definition classified a respondent as lonely only if at least one item was answered “often.” Both definitions were also examined in the previous longitudinal study by Amarsanaa et al. [10].

2.3. Household income, financial assets, and age groups

The principal explanatory variables were household annual income and household financial assets.

Household income referred to the annual pretax income of the entire household, including bonuses. Financial assets referred to the household's holdings of financial assets, including savings and investment assets. Both variables were reported using ordered response categories rather than exact monetary amounts.

We followed the coding procedures documented in the original annual data-cleaning files. Valid income responses were classified into 12 categories, while valid financial-asset responses were classified into 10 categories. Each category was assigned a representative monetary value in Japanese yen, and the natural logarithm of that value was used in the primary analysis. Responses indicating missing or unavailable financial information were excluded from the corresponding person-year observations.

The representative values for annual household income ranged from JPY 500,000 to JPY 21,000,000. The corresponding values for household financial assets ranged from JPY 1,250,000 to JPY 125,000,000. These variables approximate household financial resources based on reported intervals and should not be interpreted as exact monetary measurements.

Age was measured at baseline in 2020. Respondents were divided into two groups: those younger than 65 years and those aged 65 years or older. This classification was fixed throughout the observation period.

The age-group comparison was motivated by differences in the economic circumstances and life stages of older and younger adults. It was not intended to identify a discontinuity at age 65 or to estimate the causal consequences of retirement.

2.4. Statistical analysis

We estimated individual fixed-effects regression models to examine the association between within-person changes in household financial resources and loneliness.

The dependent variable in the primary model was the continuous UCLA-3 score. The main explanatory variables were the natural logarithms of household income and financial assets, together with their interactions with the indicator for being aged 65 years or older at baseline.

Individual fixed effects were included to account for time-invariant characteristics of respondents. Year fixed effects were included to account for common changes across survey waves. We also interacted the baseline age-group indicator with year indicators to allow the two age groups to follow different annual patterns in loneliness.

The coefficient on the interaction between baseline age group and log household financial assets was the principal parameter of interest. It estimated the difference between the two age groups in the within-person association between financial assets and loneliness, conditional on the other terms in the model.

Standard errors were clustered at the respondent level to account for repeated observations within individuals. Statistical analyses were conducted using Stata 14.2.

Because the models use observational data, estimated coefficients are interpreted as associations rather than causal effects. Individual fixed effects remove time-invariant individual heterogeneity but do not eliminate confounding from time-varying unobserved characteristics or reverse causality. The age-group interaction was examined in an exploratory analysis, and its statistical significance should be interpreted as nominal evidence rather than confirmation of a preregistered hypothesis.

2.5. Sensitivity analyses

We conducted several sensitivity analyses to evaluate whether the primary age-group interaction depended on the measurement of financial resources, the inclusion of additional covariates, the analytic sample, or the definition of loneliness.

First, we replaced the logarithm of the representative financial-asset value with the original ordered financial-asset category. We also estimated models incorporating time-varying indicators for full-time employment, having a spouse, and living alone. A further specification additionally included indicators of self-reported health and depressive feelings. The latter variables were treated as sensitivity controls rather than as a basis for causal interpretation, because they could be jointly determined with loneliness.

Second, we examined sample restrictions. We repeated the analysis among respondents retained through the 2024 survey, allowing financial information to be missing in some waves, and among respondents with valid financial information in all five waves. We also excluded respondents above the 99th percentile of their within-person range in log financial assets to assess the sensitivity of the results to unusually large changes in reported asset categories. We also conducted an exhaustive leave-one-respondent-out analysis, reestimating the primary fixed-effects model after excluding each respondent individually to assess whether the main interaction was driven by a single influential respondent.

Third, we reestimated the primary specification using the two binary loneliness measures. These models were estimated as fixed-effects linear probability models.

Finally, we assessed potential selection associated with observed baseline characteristics using inverse-probability weighting. Inclusion probabilities were estimated among respondents with valid baseline information on income, assets, and loneliness. The logistic model included baseline sex, age, age squared, household income category, financial-asset category, and UCLA-3 score. Inverse predicted inclusion probabilities were used as respondent weights. We compared weighted and unweighted results in the same eligible sample and additionally examined weights capped at their respondent-level 95th percentile.

These weighting procedures adjust for differences in measured baseline characteristics but cannot correct for selection related to unobserved factors. In addition, the reported cluster-robust standard errors for the weighted models do not incorporate uncertainty from estimating the inclusion probabilities.

3. Results

3.1. Characteristics of the analytic sample

Table 1 presents descriptive characteristics of the 4,165 respondents included in the primary analysis.

The mean age at baseline was 49.7 years, and 66.1% of respondents were male. Respondents aged 65 years or older at baseline accounted for 16.5% of the analytic sample. The proportion of male respondents was higher in the older group (82.8%) than in the younger group (62.8%).

The analytic sample contributed 15,105 person-year observations, comprising 12,495 observations from respondents younger than 65 years at baseline and 2,610 observations from respondents aged 65 years or older.

The overall mean UCLA-3 score across observed person-years was 5.07. The corresponding means were 5.25 in the younger group and 4.24 in the older group. These descriptive differences should be interpreted in light of the selected sample and do not represent adjusted estimates of age-group differences.

The number of usable observations varied across survey waves because of attrition and missing financial information. Supplementary Table S1 provides the annual observation counts and loneliness-score distributions.

Table 1. Characteristics of the analytic sample

Japan online longitudinal panel, 2020–2024

Characteristic	Overall	Baseline age < 65	Baseline age 65+
Respondents (n)	4165	3479	686
Person-year observations (n)	15105	12495	2610
Male respondents (n)	2751	2183	568
Male respondents (%)	66.05	62.75	82.80
Age at baseline, mean (years)	49.72	45.68	70.19
Age at baseline, SD (years)	13.66	11.02	4.02
UCLA-3 sum, mean	5.07	5.25	4.24
UCLA-3 sum, SD	1.94	1.97	1.50
Household income category, mean	4.68	4.82	4.02
Household financial-assets category, mean	4.44	4.21	5.55

Note: Age and sex refer to respondents at 2020 baseline. UCLA and category means are calculated over observed person-years; they are not person-weighted.

The sample is not nationally representative. Category means are ordinal summaries, not exact household amounts.

3.2. Household financial resources and loneliness: Primary analysis

Table 2 reports the results of the primary individual fixed-effects regression.

Among respondents younger than 65 years at baseline, the coefficient on log household financial assets was 0.0088 (SE = 0.0284, p = 0.755). The coefficient was not statistically distinguishable from zero.

The interaction between the indicator for baseline age 65 years or older and log household financial assets was negative and statistically significant (β = −0.1888, SE = 0.0580, p = 0.001; 95% CI: −0.3025 to − 0.0752).

The estimated interaction indicates that the within-person association between financial assets and loneliness differed between the two age groups. The estimated coefficient on log household financial assets among respondents aged 65 years or older was − 0.1800 (SE = 0.0506, $p < 0.001$; 95% CI: −0.2791 to − 0.0809), compared with 0.0088 among younger respondents.

Thus, higher reported household financial assets were associated with lower loneliness scores among older respondents, while no comparable negative association was observed among younger respondents in the primary specification.

By contrast, household income showed little evidence of an association with loneliness in either age group. The coefficient on log household income among younger respondents was − 0.0133 (SE = 0.0407, $p = 0.744$), and the age-group interaction for log household income was 0.0029 (SE = 0.1113, $p = 0.979$).

The results therefore indicate a difference between the age groups in the association involving household financial assets, but not household income.

Table 2
Within-person fixed-effects regression

Outcome: UCLA-3 sum (3–9); N = 15,105 observations, 4,165 respondents					
Regressor	Coefficient	Clustered SE	p-value	95% CI lower	95% CI upper
Log household income (< 65 reference)	-0.013	0.041	0.744	-0.093	0.067
Log household financial assets (< 65 reference)	0.009	0.028	0.755	-0.047	0.064
Age 65+ × log household income	0.003	0.111	0.979	-0.215	0.221
Age 65+ × log household financial assets	-0.189	0.058	0.001	-0.302	-0.075
Wave 2021 (ref. 2020)	0.147	0.030	< 0.001	0.089	0.205
Wave 2022 (ref. 2020)	-0.162	0.034	< 0.001	-0.229	-0.096
Wave 2023 (ref. 2020)	-0.163	0.036	< 0.001	-0.233	-0.093
Wave 2024 (ref. 2020)	-0.154	0.039	< 0.001	-0.230	-0.077
Age 65+ × wave 2021	-0.106	0.060	0.076	-0.224	0.011
Age 65+ × wave 2022	-0.014	0.063	0.825	-0.138	0.110
Age 65+ × wave 2023	0.054	0.070	0.440	-0.083	0.190
Age 65+ × wave 2024	0.114	0.074	0.124	-0.031	0.260
Note: Individual fixed effects; wave effects and age-group-specific wave effects. Standard errors clustered by respondent. Baseline age group is fixed at 2020; the age-group main effect is absorbed by individual fixed effects.					

3.3. Alternative financial measures and covariate specifications

Table 3 summarizes the sensitivity analyses for the interaction between baseline age group and household financial assets.

Replacing the log financial-asset measure with the original ordered asset category produced a negative age-group interaction ($\beta = -0.0947$, SE = 0.0268, $p < 0.001$). Although the coefficient is expressed in different units, its direction is consistent with the primary specification.

Adding indicators for full-time employment, having a spouse, and living alone produced an interaction coefficient of − 0.1842 (SE = 0.0581, $p = 0.002$).

The interaction also remained negative after the additional inclusion of self-reported health and depressive feelings ($\beta = -0.1867$, SE = 0.0587, $p = 0.001$). These results indicate that the estimated age-group difference was not materially altered by the inclusion of these observed time-varying characteristics, although these adjustments do not establish a causal relationship.

Table 3
Age 65+ × financial-assets interaction: sensitivity analyses

Specification	Outcome	Coefficient	Clustered SE	p-value	Person-years	People	Definition / caveat
Primary model	UCLA sum 3–9	-0.189	0.058	0.001	15105	4165	Reference specification
Financial-assets ordinal category	UCLA sum 3–9	-0.095	0.027	< 0.001	15105	4165	Coefficient is per category, not per log JPY
+ work and household controls	UCLA sum 3–9	-0.184	0.058	0.002	15105	4165	Employment, spouse, living alone
+ health and depression controls	UCLA sum 3–9	-0.187	0.059	0.001	15105	4165	Includes above controls; possible post-treatment covariates
Five-wave survey survivors	UCLA sum 3–9	-0.203	0.065	0.002	9832	2122	At least two complete financial waves
Five complete financial waves	UCLA sum 3–9	-0.191	0.071	0.007	8415	1683	All five years observed with valid finances
Exclude asset-range outliers above 99th percentile	UCLA sum 3–9	-0.155	0.063	0.014	14952	4130	35 people excluded; above 99th percentile
Inclusive binary loneliness	LPM 0/1	-0.037	0.017	0.032	15105	4165	At least one UCLA item 2 or 3
Strict binary loneliness	LPM 0/1	-0.017	0.019	0.372	15105	4165	At least one UCLA item 3; non-significant
Baseline-eligible unweighted	UCLA sum 3–9	-0.185	0.060	0.002	14287	3867	Same selection-eligible

Note: All estimations are individual fixed-effects models with respondent-clustered SE. Binary models use FE linear probability models. Baseline propensity IPW adjusts for observed 2020 characteristics only. Standard errors do not account for uncertainty in the estimated inclusion probabilities.

Specification	Outcome	Coefficient	Clustered SE	p-value	Person-years	People	Definition / caveat
							sample as IPW
Baseline-observable IPW	UCLA sum 3–9	-0.169	0.061	0.006	14287	3867	Stata unpenalized baseline logistic propensity
IPW capped at 95th percentile	UCLA sum 3–9	-0.168	0.061	0.006	14287	3867	Respondent weight capped at person-level p95

Note: All estimations are individual fixed-effects models with respondent-clustered SE. Binary models use FE linear probability models. Baseline propensity IPW adjusts for observed 2020 characteristics only. Standard errors do not account for uncertainty in the estimated inclusion probabilities.

3.4. Sample restrictions and influential observations

The negative age-group interaction remained apparent when the analytic sample was restricted to respondents who participated through the final survey wave.

Among respondents retained through 2024 who had at least two usable financial observations, the interaction coefficient was − 0.2032 (SE = 0.0648, p = 0.002; 2,122 respondents and 9,832 person-year observations).

Among respondents with valid financial observations in all five waves, the interaction coefficient was − 0.1905 (SE = 0.0707, p = 0.007; 1,683 respondents and 8,415 person-year observations).

We also assessed sensitivity to large changes in reported financial assets. The 99th percentile of the within-person range in log financial assets was approximately 2.996. Excluding the 35 respondents whose asset range exceeded this value reduced the analytic sample to 4,130 respondents and 14,952 person-year observations.

The estimated age-group interaction was smaller in magnitude but remained negative and statistically significant (β = −0.1553, SE = 0.0631, p = 0.014). In the leave-one-respondent-out analysis, the estimated age-group interaction ranged from − 0.2060 to − 0.1724 across 4,165 reestimations, indicating that the main result was not driven by any single respondent.

3.5. Alternative loneliness measures

The sensitivity analyses using binary loneliness measures produced less uniform evidence.

Under the inclusive binary definition, the interaction between baseline age group and log household financial assets was negative and statistically significant (β = −0.0369, SE = 0.0172, p = 0.032).

Under the stricter definition, which required a response of “often” on at least one UCLA-3 item, the interaction remained negative but was not statistically significant (β = −0.0170, SE = 0.0191, p = 0.372).

The point estimates were negative under both binary definitions, but the stricter measure did not provide statistically conclusive evidence of an age-group difference. The findings are therefore sensitive to the operational definition of loneliness, particularly when the continuous score is reduced to a stricter binary outcome.

3.6. Sensitivity to observed baseline selection

The inverse-probability-weighting analysis was conducted using respondents with valid baseline information required for estimating inclusion probabilities.

Among 11,384 eligible baseline respondents, 3,867 contributed to the corresponding longitudinal analytic sample, comprising 14,287 person-year observations.

In this restricted sample, the unweighted interaction coefficient was − 0.1849 (SE = 0.0598, p = 0.002).

After inverse-probability weighting based on measured baseline characteristics, the interaction coefficient remained negative (β = −0.1689, SE = 0.0615, p = 0.006).

Capping weights at the respondent-level 95th percentile yielded a similar estimate (β = −0.1684, SE = 0.0615, p = 0.006).

The estimated interaction was therefore not eliminated by weighting for differences in the observed baseline characteristics included in the selection model. Nevertheless, these results do not exclude bias arising from unobserved selection factors.

Overall, the primary analysis and several sensitivity specifications yielded a negative interaction between older age-group membership and log household financial assets. The evidence was less consistent under the strict binary loneliness definition, and none of the models establishes the causal direction of the association.

4. Discussion

This study examined the associations of household financial assets and income with loneliness using five annual waves of panel data from Japan. The main finding is that the association between household financial assets and loneliness differs significantly between respondents aged 65 years or older at baseline and those younger than 65 years. In the individual fixed-effects model, the interaction between baseline age 65 or older and log household financial assets was negative and statistically significant (β = −0.189, SE = 0.058, p = 0.001). The estimated asset coefficient was close to zero among younger

respondents (β = 0.009), whereas the corresponding coefficient among older respondents was approximately − 0.180. Thus, within-person increases in reported household financial assets were associated with lower loneliness scores among older respondents, while no comparable association was detected among younger respondents. Neither the income coefficient nor its interaction with the older age group was statistically significant.

These findings add to a literature that has produced mixed results regarding objective financial resources and loneliness. Hajek and König [2] reported a negative association between income and loneliness in a longitudinal European study, whereas Drost et al. [4] found that changes in income and net assets were not significantly associated with loneliness among older US adults. In another study, Drost et al. [5] found that emergency savings, rather than household income, were associated with loneliness during the early COVID-19 period. Our findings are consistent with the broader possibility that accumulated financial resources and current income capture different aspects of household financial circumstances. However, the absence of a statistically significant income coefficient in our models does not establish that income is irrelevant to loneliness. Nor do the results demonstrate that financial assets are inherently more important than income.

The age-related pattern also deserves attention. Luhmann and Hawkley [6] documented differences across age groups in the associations between socioeconomic characteristics and loneliness, suggesting that these relationships need not remain constant throughout adulthood. Nevertheless, the existing evidence does not point to a uniform age pattern. For example, the cross-sectional study by Hajek and König [3] found that associations between low wealth and adverse psychosocial outcomes were mainly evident among respondents aged 43–64 years. Our analysis, in contrast, identified a negative within-person association between financial assets and loneliness among respondents aged 65 years or older at baseline. These findings need not be contradictory because the studies differ in countries, financial measures, loneliness measures, samples, and analytical designs. Importantly, our results establish a difference between the two specified age groups; they do not identify age 65 as a precise threshold at which the relationship changes.

The findings should also be interpreted in relation to previous studies using the same Japanese survey. Lal et al. [8] examined associations involving changes in household financial assets and different loneliness patterns during 2020–2022, including age-stratified analyses. Nguyen et al. [9] reported a positive association between household assets and a binary measure of loneliness among older men in a 2022 cross-sectional analysis. Our negative association among older respondents differs from that particular estimate. However, the studies use different outcomes, observation periods, samples, and estimators. The present individual fixed-effects analysis focuses on changes within respondents, whereas the earlier cross-sectional analysis also reflects differences between individuals. Consequently, the findings should not be interpreted as evidence that the underlying relationship reversed over time. The contribution of the current study is a distinct longitudinal estimate, rather than a rejection of the earlier findings.

Several explanations could account for the observed age-related difference. Accumulated financial assets may be associated with perceived financial security, the ability to maintain social activities, or greater flexibility in responding to unexpected needs. Conversely, changes in social or health circumstances could influence both financial asset holdings and loneliness. These explanations remain hypotheses. The survey analysis does not directly identify the mechanisms linking financial assets and loneliness, and it does not establish whether changes in financial resources precede changes in loneliness. In particular, although age 65 is often associated with transitions in employment and retirement, retirement itself was not identified as the mechanism underlying the interaction. The finding should therefore be interpreted as age-group heterogeneity rather than a retirement effect.

The principal result was examined using several sensitivity analyses. The negative age-group interaction remained when household assets were represented by their ordinal categories instead of log-transformed representative monetary values and when additional time-varying employment, household, and health-related controls were included. It also remained negative after excluding the 35 respondents whose within-person log-asset range exceeded the 99th percentile, and after weighting for selection on observed baseline characteristics. Leave-one-respondent-out estimates did not indicate that the main interaction was driven by a single participant. These findings provide some reassurance regarding the stability of the continuous-score result.

Nevertheless, the findings were sensitive to the definition of loneliness. When loneliness was dichotomized using the more inclusive definition based on reporting loneliness at least some of the time on any item, the age-group interaction remained statistically significant. Under the stricter binary definition based on reporting loneliness often on at least one item, the interaction retained a negative sign but was not statistically significant. Thus, the evidence is stronger for differences in the continuous loneliness score than for differences in the probability of meeting the stricter loneliness definition. The findings should not be presented as uniformly robust across all loneliness outcomes.

This study has several limitations. First, the data come from an online panel with substantial attrition, and the analytical sample is not nationally representative. The older subgroup is relatively small and predominantly male, which limits generalizability, particularly to older women. Although inverse-probability weighting based on observed baseline characteristics did not materially change the main interaction, it cannot correct selection associated with unobserved characteristics or subsequent events. Second, household income and financial assets were reported in categories and converted to representative values. The resulting measures are approximations rather than exact financial balances. They also do not capture all dimensions of household wealth, including nonfinancial assets and liabilities. Third, individual fixed effects account for time-invariant unobserved characteristics but do not eliminate time-varying confounding, reverse causality, or measurement error. Fourth, the age-group comparison does not distinguish retirement status, pension receipt, or other transitions that may occur around later life. Finally, the study uses annual observations, which limits the ability to establish the temporal sequence between changes in financial circumstances and changes in loneliness.

The study also builds on a previously published descriptive analysis of the same five-wave survey [10]. That study characterized loneliness persistence and transitions among respondents with complete five-wave information. The present analysis uses a broader, unbalanced panel and a different analytical framework to examine within-person financial associations. Its contribution is therefore complementary and specific: it identifies an age-related difference in the association between household financial assets and loneliness, while making no causal claim.

In conclusion, this study provides evidence that within-person changes in reported household financial assets are associated with changes in loneliness among older respondents in Japan, with a significantly different association from that observed among younger respondents. No corresponding age-related difference was detected for household income. These findings suggest that accumulated financial resources warrant consideration in research on loneliness in later life. Further work is needed to establish the mechanisms and causal direction of these associations.

Declarations

Ethical approval

The survey was conducted by Nikkei Research, which reviewed the survey procedures for ethical compliance. The present study uses secondary analysis of the survey data.

Consent to participate

Informed consent was obtained from all participants before their participation in the survey.

Consent for publication

Not applicable. No identifiable individual-level information is presented in this manuscript.

Competing interests

The author declares no competing interests.

Use of generative AI and AI-assisted technologies

During the preparation of this manuscript, the author used generative AI tools, including ChatGPT (OpenAI) and Claude (Anthropic), to assist with statistical code development, and quality-control checks. All reported statistical analyses were executed and verified by the author using Stata 14.2. The author critically reviewed and verified the AI-assisted outputs and takes full responsibility for the content of the manuscript.

Clinical trial number

not applicable.

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Author Contribution

Y.K. conceived and designed the study, conducted the statistical analyses, interpreted the results, and wrote and revised the manuscript. Y.K. read and approved the final manuscript.

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Not applicable.

Data Availability

The anonymized dataset necessary to reproduce the findings of this study will be made publicly available as supplementary material upon publication.

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12. Supplementary Table. S1. Observed person-years by survey wave.

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