

The Relationship between Frequency of Laughter and Happiness

Megumi Shibata

yoshisatoyui8888@gmail.com

Seirei Christopher University

Toshiyuki Ojima

Hamamatsu University School of Medicine

Article

Keywords: laughter, happiness, social network, green tea, older adults

Posted Date: October 4th, 2026

DOI: <https://doi.org/10.21203/rs.3.rs-10986812/v1>

License:   This work is licensed under a Creative Commons Attribution 4.0 International License.

[Read Full License](#)

Additional Declarations: No competing interests reported.

Abstract

Although laughter is a familiar part of everyday life and often arises in moments shared with other people, its association with happiness has rarely been examined in a large population-based sample while simultaneously accounting for social network size. We analyzed cross-sectional data from the 2016 Japan Gerontological Evaluation Study. Participants rated happiness on a 1–10 scale, which was analyzed as a continuous outcome using multivariable linear regression. Among 12,624 participants in the unified complete-case analytical sample, 42.3% reported laughing almost every day. Compared with participants who almost never laughed, those who laughed almost every day had a 1.79-point higher happiness score (95% CI 1.52–2.06, $p < 0.001$) in the fully adjusted model including the laughter frequency $\times$ social network size interaction. The interaction was not statistically significant (95% CI –0.041 to 0.013), suggesting that the positive association between laughter and happiness was observed irrespective of social network size. Additional adjustment for green tea consumption in the same 12,624 participants left the association essentially unchanged ($\beta = 1.786$, 95% CI 1.518–2.054, $p < 0.001$). These findings suggest that laughter, an ordinary behavior often woven into human relationships and daily social life, may be independently associated with greater happiness among community-dwelling older adults in Japan.

Introduction

Happiness is a significant aspect of human life, and numerous studies have been conducted to measure it and to identify its determinants [1–9]. For example, income has been shown to have a robust association with emotional well-being [10], although the causal interpretation of such associations remains debated [11]. Although Japan is well known for healthy longevity, subjective happiness among older adults is often reported to be relatively modest, and identifying modifiable daily behaviors that enhance happiness remains an important public health goal [1, 2]. Laughter is a universal, largely non-verbal human behavior that functions as emotional expression and social communication [12, 13]. From a physiological perspective, laughter has been shown to reduce circulating cortisol and other stress-related biomarkers [14], and to modulate immune and cardiovascular function [15, 16]. Sociologically, laughter predominantly occurs within social interaction and is thought to strengthen social bonds, buffer against loneliness, and reinforce social capital [16–18], consistent with the broader literature linking social ties to mental health [19].

In Japan, several studies conducted within the Japan Gerontological Evaluation Study (JAGES) cohort have shown that a low frequency of laughter is associated with adverse health outcomes among older adults, including poorer subjective health [20], a higher prevalence of cardiovascular disease [21], depressive symptoms [22], incident functional disability [23, 24], reduced oral function and oral frailty [25–27], and loneliness [28], although one large cohort found no significant association between laughter frequency and all-cause mortality [23]. Laughter frequency has also been linked to visual status [29] and to lifestyle factors and social ties following disaster exposure [30]. Laughter frequency itself appears to be shaped by social context: a greater variety and frequency of social interactions [17] and

equivalised household income [18] have both been linked to more frequent laughter among older Japanese adults, in keeping with broader evidence that social isolation and loneliness shape health and well-being in later life [31, 32]. While these studies have clarified the physical, cognitive, and affective correlates of low laughter frequency, comparatively few large-scale studies have directly examined the relationship between the frequency of laughter and subjective happiness itself while simultaneously accounting for the size of an individual's social network.

Recently, a study using the same JAGES framework demonstrated a significant positive association between green tea consumption and happiness after adjustment for social network size, underscoring both the utility of this large-scale cohort and the importance of accounting for social network size when investigating modifiable lifestyle and behavioral correlates of happiness [33]. Other JAGES-based studies have similarly linked specific daily activities and socioeconomic conditions, such as watching sports [34] and pension type [35], to happiness among older Japanese adults. Given that laughter, like tea consumption, is a routine behavior deeply embedded in everyday social life and in Japanese cultural values of interdependence [36–39], we hypothesized that the frequency of laughter would show a comparable, independent, graded association with happiness.

To the best of our knowledge, no previous large-scale population-based study has directly examined the association between frequency of laughter and subjective happiness while simultaneously accounting for social network size and additionally evaluating the robustness of this association to adjustment for green tea consumption.

Therefore, this cross-sectional study aimed to examine the association between the frequency of laughter and happiness while accounting for social network size, using the same 2016 JAGES dataset and analytic framework as our companion study of green tea consumption and happiness [33]. In addition to estimating this association, we sought to consider laughter in the context in which it commonly occurs: everyday relationships and opportunities for connection with other people.

Results

Among the 12,624 participants included in the unified analysis, 6,258 (49.6%) were female and 6,366 (50.4%) were male. Table 1 presents the distribution of participant characteristics across four happiness-score groups (0–6, 7, 8, and 9–10). Participants who laughed almost every day accounted for 42.3% of the total sample, and this proportion increased markedly with happiness level, from 27.7% among participants with happiness scores of 0–6 to 60.4% among those with scores of 9–10. A similar gradient was observed for social network size: the proportion of participants with 10 or more friends met per month rose from 25.6% in the 0–6 group to 46.5% in the 9–10 group.

Table 1
Descriptive statistics by happiness level (N = 12,624)

Characteristic	Category	0–6	7	8	9–10	Total	p-value
		N = 4,011	N = 2,268	N = 3,231	N = 3,114	N = 12,624	
Frequency of laughter	Almost never	433 (10.8%)	89 (3.9%)	88 (2.7%)	55 (1.8%)	665 (5.3%)	< 0.001
	1–3 days/month	760 (18.9%)	309 (13.6%)	320 (9.9%)	198 (6.4%)	1,587 (12.6%)	
	1–5 days/week	1,706 (42.5%)	1,007 (44.4%)	1,333 (41.3%)	980 (31.5%)	5,026 (39.8%)	
	Almost every day	1,112 (27.7%)	863 (38.1%)	1,490 (46.1%)	1,881 (60.4%)	5,346 (42.3%)	
Social network size (no. friends met/month)	0	466 (11.6%)	136 (6.0%)	189 (5.8%)	169 (5.4%)	960 (7.6%)	< 0.001
	1–2	941 (23.5%)	392 (17.3%)	476 (14.7%)	408 (13.1%)	2,217 (17.6%)	
	3–5	1,051 (26.2%)	568 (25.0%)	778 (24.1%)	668 (21.5%)	3,065 (24.3%)	
	6–9	525 (13.1%)	339 (14.9%)	471 (14.6%)	421 (13.5%)	1,756 (13.9%)	
	≥ 10	1,028 (25.6%)	833 (36.7%)	1,317 (40.8%)	1,448 (46.5%)	4,626 (36.6%)	
Green tea consumption (cups/day)	< 1	881 (22.0%)	411 (18.1%)	565 (17.5%)	515 (16.5%)	2,372 (18.8%)	< 0.001
	1	662 (16.5%)	366 (16.1%)	500 (15.5%)	440 (14.1%)	1,968 (15.6%)	
	2–3	1,398 (34.9%)	839 (37.0%)	1,151 (35.6%)	1,044 (33.5%)	4,432 (35.1%)	
	≥ 4	1,070 (26.7%)	652 (28.7%)	1,015 (31.4%)	1,115 (35.8%)	3,852 (30.5%)	
Sex	Female	1,790 (44.6%)	1,053 (46.4%)	1,633 (50.5%)	1,782 (57.2%)	6,258 (49.6%)	< 0.001
	Male	2,221 (55.4%)	1,215 (53.6%)	1,598 (49.5%)	1,332 (42.8%)	6,366 (50.4%)	

Characteristic	Category	0–6	7	8	9–10	Total	p-value
		N = 4,011	N = 2,268	N = 3,231	N = 3,114	N = 12,624	
Age (years)	< 70	1,398 (34.9%)	856 (37.7%)	1,133 (35.1%)	975 (31.3%)	4,362 (34.6%)	< 0.001
	70–74	1,165 (29.0%)	681 (30.0%)	884 (27.4%)	846 (27.2%)	3,576 (28.3%)	
	75–79	886 (22.1%)	438 (19.3%)	698 (21.6%)	689 (22.1%)	2,711 (21.5%)	
	80–84	426 (10.6%)	227 (10.0%)	351 (10.9%)	387 (12.4%)	1,391 (11.0%)	
	≥ 85	136 (3.4%)	66 (2.9%)	165 (5.1%)	217 (7.0%)	584 (4.6%)	
Education (years)	≤ 9	1,292 (32.2%)	545 (24.0%)	739 (22.9%)	917 (29.4%)	3,493 (27.7%)	< 0.001
	10–12	1,744 (43.5%)	1,032 (45.5%)	1,423 (44.0%)	1,227 (39.4%)	5,426 (43.0%)	
	≥ 13	975 (24.3%)	691 (30.5%)	1,069 (33.1%)	970 (31.1%)	3,705 (29.3%)	
Equivalent income (USD)	< 10,000	637 (15.9%)	198 (8.7%)	271 (8.4%)	313 (10.1%)	1,419 (11.2%)	< 0.001
	10,000–19,999	1,702 (42.4%)	799 (35.2%)	1,052 (32.6%)	937 (30.1%)	4,490 (35.6%)	
	20,000–29,999	946 (23.6%)	623 (27.5%)	841 (26.0%)	757 (24.3%)	3,167 (25.1%)	
	30,000–39,999	463 (11.5%)	395 (17.4%)	624 (19.3%)	564 (18.1%)	2,046 (16.2%)	
	≥ 40,000	263 (6.6%)	253 (11.2%)	443 (13.7%)	543 (17.4%)	1,502 (11.9%)	
Smoking status	Never	2,052 (51.2%)	1,223 (53.9%)	1,920 (59.4%)	2,079 (66.8%)	7,274 (57.6%)	< 0.001
	Former	1,385 (34.5%)	778 (34.3%)	1,004 (31.1%)	787 (25.3%)	3,954 (31.3%)	
	Current	574 (14.3%)	267 (11.8%)	307 (9.5%)	248 (8.0%)	1,396 (11.1%)	

Characteristic	Category	0–6	7	8	9–10	Total	p-value
		N = 4,011	N = 2,268	N = 3,231	N = 3,114	N = 12,624	
Drinking status	Never	1,846 (46.0%)	1,067 (47.0%)	1,567 (48.5%)	1,690 (54.3%)	6,170 (48.9%)	< 0.001
	Former	511 (12.7%)	230 (10.1%)	310 (9.6%)	247 (7.9%)	1,298 (10.3%)	
	Current	1,654 (41.2%)	971 (42.8%)	1,354 (41.9%)	1,177 (37.8%)	5,156 (40.8%)	
Any disease (incl. depression)	No	542 (13.5%)	398 (17.5%)	662 (20.5%)	728 (23.4%)	2,330 (18.5%)	< 0.001
	Yes	3,469 (86.5%)	1,870 (82.5%)	2,569 (79.5%)	2,386 (76.6%)	10,294 (81.5%)	
Living alone	No	3,352 (83.6%)	2,001 (88.2%)	2,919 (90.3%)	2,835 (91.0%)	11,107 (88.0%)	< 0.001
	Yes	659 (16.4%)	267 (11.8%)	312 (9.7%)	279 (9.0%)	1,517 (12.0%)	

Values are n (%) within each happiness-score group. Happiness was categorized as scores of 0–6, 7, 8, and 9–10, consistent with the classification used in our companion study of green tea consumption and happiness [33]. p-values were calculated using the χ^2 test.

Association between Frequency of Laughter, Social Network Size, and Happiness

Table 2 shows the results of the multivariable linear regression analysis in the unified analytical sample (N = 12,624). In Model 3, which adjusted simultaneously for social network size, sex, age, education, income, smoking, alcohol use, disease status, living alone, and the laughter frequency $\times$ social network size interaction, participants who laughed 1–3 days per month had a 0.690-point higher happiness score (95% CI 0.530–0.850, $p < 0.001$), those who laughed 1–5 days per week had a 1.162-point higher score (95% CI 0.972–1.351, $p < 0.001$), and those who laughed almost every day had a 1.792-point higher score (95% CI 1.524–2.060, $p < 0.001$), compared with participants who almost never laughed. Larger social network size was also positively associated with happiness. The interaction term between laughter frequency and social network size was not statistically significant ($\beta = -0.014$, 95% CI – 0.041 to 0.013), indicating no evidence that the positive association between laughter and happiness differed according to social network size.

Table 2

Association of each factor with happiness from multivariable linear regression analysis (N = 12,624)

Characteristic	Category	β	95% CI	p-value
Frequency of laughter	Almost never	Reference		
	1–3 days/month	0.690	0.530–0.850	< 0.001
	1–5 days/week	1.162	0.972–1.351	< 0.001
	Almost every day	1.792	1.524–2.060	< 0.001
Social network size (no. friends met/month)	0	Reference		
	1–2	0.155	0.021–0.289	0.024
	3–5	0.368	0.212–0.523	< 0.001
	6–9	0.488	0.284–0.692	< 0.001
	≥ 10	0.728	0.476–0.980	< 0.001
Sex	Female	Reference		
	Male	–0.048	–0.131–0.035	0.258
Age (years)	< 70	Reference		
	70–74	0.066	–0.009–0.140	0.084
	75–79	0.192	0.110–0.273	< 0.001
	80–84	0.397	0.294–0.500	< 0.001
	≥ 85	0.933	0.786–1.080	< 0.001
Education (years)	≤ 9	Reference		
	10–12	–0.024	–0.096–0.049	0.523
	≥ 13	0.152	0.071–0.233	< 0.001
Equivalent income (USD)	< 10,000	Reference		
	10,000–19,999	0.196	0.096–0.296	< 0.001
	20,000–29,999	0.382	0.275–0.488	< 0.001
	30,000–39,999	0.543	0.427–0.659	< 0.001
	$\geq 40,000$	0.824	0.699–0.949	< 0.001
Smoking status	Never	Reference		

Characteristic	Category	β	95% CI	p-value
	Former	-0.188	-0.272– -0.104	< 0.001
	Current	-0.358	-0.465– -0.251	< 0.001
Drinking status	Never	Reference		
	Former	-0.146	-0.251– -0.041	0.007
	Current	0.000	-0.071–0.072	0.995
Any disease (incl. depression)	No	Reference		
	Yes	-0.396	-0.472– -0.320	< 0.001
Living alone	No	Reference		
	Yes	-0.353	-0.445– -0.261	< 0.001
Laughter $\times$ network interaction		-0.014	-0.041–0.013	0.302
Constant		5.603	5.394–5.811	< 0.001

CI, confidence interval. Model adjusted simultaneously for all variables shown, including the laughter $\times$ social-network-size interaction term.

Additional Analysis Adjusting for Green Tea Consumption

In the same unified analytical sample (N = 12,624), the positive association between laughter frequency and happiness remained essentially unchanged after additional adjustment for green tea consumption. Compared with participants who almost never laughed, the coefficients before versus after additional adjustment for green tea consumption were 0.690 (95% CI 0.530–0.850) versus 0.687 (95% CI 0.527–0.847) for 1–3 days per month, 1.162 (95% CI 0.972–1.351) versus 1.159 (95% CI 0.969–1.348) for 1–5 days per week, and 1.792 (95% CI 1.524–2.060) versus 1.786 (95% CI 1.518–2.054) for almost every day (all $p < 0.001$). Green tea consumption of ≥ 4 cups/day was positively associated with happiness compared with < 1 cup/day ($\beta = 0.113$, 95% CI 0.026–0.201, $p = 0.011$), whereas the estimates for 1 cup/day and 2–3 cups/day were not statistically significant.

Table 3
Same-sample additional analysis with and without adjustment for green tea consumption
(N = 12,624)

Characteristic	Category	β	95% CI	p-value
Frequency of laughter (without green tea)	1–3 days/month	0.690	0.530–0.850	< 0.001
	1–5 days/week	1.162	0.972–1.351	< 0.001
	Almost every day	1.792	1.524–2.060	< 0.001
Frequency of laughter (with green tea)	1–3 days/month	0.687	0.527–0.847	< 0.001
	1–5 days/week	1.159	0.969–1.348	< 0.001
	Almost every day	1.786	1.518–2.054	< 0.001
Green tea consumption	< 1 cup/day	Reference		
	1 cup/day	0.051	–0.049–0.151	0.316
	2–3 cups/day	0.015	–0.069–0.099	0.727
	≥ 4 cups/day	0.113	0.026–0.201	0.011

CI, confidence interval. Both models used the same analytical sample and were adjusted for social network size, sex, age, education, equivalent annual income, smoking, alcohol use, disease status, living alone, and the laughter $\times$ social-network-size interaction term. The green-tea-adjusted model additionally included green tea consumption (< 1, 1, 2–3, or ≥ 4 cups/day).

Discussion

To the best of our knowledge, this is the first large-scale population-based study to demonstrate a graded, independent association between the frequency of laughter and subjective happiness among community-dwelling older adults while simultaneously accounting for social network size and additionally evaluating the robustness of this association to adjustment for green tea consumption. When the interaction between laughter frequency and social network size was examined, no significant interaction was found. Thus, the association between more frequent laughter and greater happiness was not confined to older adults with larger social networks; a similar pattern was observed across different network sizes. This point may be especially meaningful from a community-health perspective. The number of people in one's network is important, but the present findings also invite attention to the quality of everyday moments within and beyond those networks—including occasions to smile, laugh, feel at ease, and experience connection. This finding parallels our companion analysis of green tea

consumption and happiness using the same JAGES dataset [33], in which another culturally embedded daily behavior was positively associated with happiness independently of social network size.

Our findings are consistent with, and extend, a growing body of JAGES-based evidence linking a low frequency of laughter with adverse health outcomes among older Japanese adults, including a higher prevalence of cardiovascular disease [21], greater risk of incident functional disability [23, 24], and increased loneliness [28]. Most directly relevant, a recent six-year longitudinal JAGES study found that older adults who rarely laughed had a substantially higher risk of subsequent depression onset than those who laughed almost every day [40]. In the present study, the association between laughter frequency and happiness was also highly stable when green tea consumption was added to the model in the same 12,624 participants. For example, the coefficient for laughing almost every day changed only from 1.792 (95% CI 1.524–2.060) to 1.786 (95% CI 1.518–2.054), supporting the robustness of the association to additional adjustment for this daily lifestyle factor. The association remained essentially unchanged after additional adjustment for green tea consumption, supporting the robustness of the observed association between laughter frequency and happiness.

Several mechanisms may explain the observed association. From a physiological standpoint, a recent systematic review and meta-analysis found that spontaneous laughter significantly reduces salivary and serum cortisol levels [14], and laughter has also been shown to enhance immune function, including natural killer cell activity [15], and to be associated with an elevated pain threshold through the release of endorphins during social laughter [16]. From a psychosocial standpoint, laughter predominantly occurs within social interaction [17, 18]. It may therefore be more than an individual emotional response: in daily life, laughter can be part of shared experiences through which people communicate ease, belonging, and mutual presence. According to the broaden-and-build theory of positive emotions, positive experiences such as laughter may broaden an individual's momentary thought-action repertoire and build enduring social and psychological resources over time [41, 42]. At the neural and physiological level, humor and laughter have been shown to activate mesolimbic reward circuitry [43] and to modulate autonomic nervous system activity [44]. Within the Japanese cultural emphasis on interdependence and communal harmony [36–39], opportunities to laugh with family, friends, neighbors, and others in the community may therefore be relevant not only as pleasant moments, but also as expressions of relationally grounded well-being [38].

These findings have potential public health relevance. Because laughter frequency appears to be shaped by opportunities for social interaction [17, 18], efforts to support well-being should not be interpreted simply as asking individuals to laugh more. Rather, communities may benefit from creating welcoming and inclusive opportunities in which older adults can meet others, participate at their own pace, and naturally share enjoyable moments. Group activities, cultural or recreational gatherings, comedy events, and laughter-yoga sessions are possible examples, and laughter-based interventions have shown benefits for mood and quality of life in older populations [14]. Importantly, such approaches should respect individual preferences, relationships, and cultural contexts, with the broader aim of nurturing places where people can feel connected and valued.

Strengths and Limitations

The strengths of this study include its large, population-based sample and its simultaneous adjustment for social network size alongside a broad range of demographic, socioeconomic, lifestyle, and health-related covariates, using an analytic framework directly comparable to our companion study of green tea consumption and happiness [33]. However, several limitations should be noted. First, the cross-sectional design precludes causal inference; it remains plausible that happier individuals simply laugh more often (reverse causation), and longitudinal JAGES data have shown that the onset of frequent laughter is associated with subsequent reductions in loneliness [28], suggesting that bidirectional pathways are likely. Second, both laughter frequency and happiness were assessed by self-report, which may be subject to recall bias, social desirability bias, and common method bias [45]. Third, the municipalities participating in the JAGES survey were not randomly selected, which may limit the generalizability of these findings to other populations. Fourth, although we adjusted for a substantial set of covariates and conducted a same-sample additional analysis including green tea consumption, residual confounding by unmeasured factors cannot be excluded.

This study found that a higher frequency of laughter was independently associated with greater happiness among community-dwelling older adults in Japan, even after adjusting for social network size and a broad range of demographic, socioeconomic, lifestyle, and health-related confounding factors. The association remained stable after additional adjustment for green tea consumption. Although the cross-sectional design does not establish causality, the findings suggest that laughter may be understood not only as an individual behavior but also as part of the ordinary social moments through which people experience enjoyment and connection. Supporting opportunities for meaningful interaction, while respecting the diversity of older adults' relationships and ways of living, may therefore be relevant to efforts to promote well-being in aging communities.

Methods

Participants

This cross-sectional study investigated whether the frequency of laughter is associated with happiness and examined the influence of social network size on this relationship, using data from the same 2016 wave of the Japan Gerontological Evaluation Study (JAGES) analyzed in our companion study of green tea consumption and happiness [33, 46]. The JAGES is one of the few population-based gerontological surveys in Japan that focuses on social environments and the social determinants of health [46]. A self-administered questionnaire including items on the frequency of laughter was mailed between October and December 2016 to 34,567 functionally independent, community-dwelling residents aged 65 years or older in 39 municipalities, of whom 19,634 individuals were independent in Activities of Daily Living (ADL) and were treated as the base study population. For the present unified complete-case analysis, participants with missing values for laughter frequency, happiness, social network size, covariates, or

green tea consumption were excluded. The final analytical sample comprised 12,624 participants (7,010 excluded from the base study population; 35.7%).

Dependent Variable

The dependent variable in this study was happiness, measured using the same single-item indicator as in our companion study [33]. Participants rated their happiness on a scale of 1 to 10, with 10 indicating the happiest and 1 indicating the least happy. This score was treated as a continuous variable and used as the dependent variable in the multivariate linear regression analyses.

Independent Variable

The frequency of laughter was evaluated using a single self-reported item widely used in prior JAGES investigations, “How often do you usually laugh out loud in your daily life?”, with four response categories: almost never, 1–3 days per month, 1–5 days per week, and almost every day [21, 22]. These categories were used as an independent, ordinal variable in the multivariate linear regression analyses, with “almost never” as the reference category. As in our companion study of green tea consumption [33], an interaction term between social network size and laughter frequency was additionally created to examine interaction effects. Social network size (number of friends met per month: 0, 1–2, 3–5, 6–9, or ≥ 10) was assessed using the same JAGES item as in the tea-consumption study [33].

Covariates

The following variables were considered potential confounders: social network size (number of friends met per month), sex, age category (< 70 , 70–74, 75–79, 80–84, or ≥ 85 years), years of education (≤ 9 , 10–12, or ≥ 13 years), equivalent annual income (USD $< 10,000$, 10,000–19,999, 20,000–29,999, 30,000–39,999, or $\geq 40,000$; 100 yen = 1 USD), smoking status (never, former, or current), drinking status (never, former, or current), presence of any disease including depressive symptoms assessed using a validated screening approach [47] (yes/no), and living alone (yes/no).

Statistical Analyses

Descriptive statistics were summarized by happiness level. For descriptive presentation, happiness scores were grouped as 0–6, 7, 8, and 9–10, using the same cut-off scheme as our companion study of green tea consumption and happiness [33]. Happiness was retained as a continuous variable in the linear regression analyses. Linear regression models were used to examine the association between laughter frequency and happiness. Model 1 included laughter frequency, social network size, sex, age, education, and equivalent annual income. Model 2 additionally included smoking, alcohol use, disease status, and living alone. Model 3 additionally included an interaction term between laughter frequency and social network size, with both variables modeled as ordinal scores for the interaction term. Missing data were handled using complete-case analysis. To ensure direct comparability across all models and

the green-tea-adjusted analysis, all analyses reported in Tables 1–3 used the same unified analytical sample with complete green tea consumption data (N = 12,624).

As an additional analysis, we examined whether the association between laughter frequency and happiness was robust to additional adjustment for green tea consumption. Using the same unified analytical sample (N = 12,624), the fully adjusted model including the laughter frequency × social network size interaction was first fitted without green tea consumption and subsequently refitted with green tea consumption (< 1, 1, 2–3, or ≥ 4 cups/day) included as an additional covariate. This same-sample comparison ensured that changes in coefficients reflected adjustment for green tea consumption rather than differences in the analytical sample.

All analyses were conducted using Stata 18 software (Stata Corp, College Station, TX, USA), and a two-sided test with $p < 0.05$ was considered statistically significant.

Declarations

Competing interests

The authors declare no competing interests.

Funding

This study is based on data from the Japan Gerontological Evaluation Study (JAGES), which was conducted and managed by the JAGES Research Group. This work was supported by JSPS

KAKENHI (Grant Numbers: 22K21341, 23H00060, 23H00449, 23K24610, 24K02658, 25K01387,

25K02884, 25K05563, 26K02649), Health Labour Sciences Research Grants (24LA1002), the National Research Institute for Earth Science and Disaster Resilience, and the Tanuma Greenhouse Foundation. The authors express their sincere gratitude for this support. The views expressed in this article are those of the authors and do not necessarily reflect the official views of the funding agencies.

Author Contribution

Conceptualization, M.S. and T.O.; methodology, M.S. and T.O.; software, M.S. and T.O.; validation, M.S. and T.O.; formal analysis, M.S. and T.O.; investigation, M.S. and T.O.; resources, M.S. and T.O.; data curation, M.S. and T.O.; writing—original draft preparation, M.S. and T.O.; writing—review and editing, M.S. and T.O.; visualization, M.S. and T.O.; supervision, M.S. and T.O.; project administration, M.S. and T.O.; funding acquisition, M.S. and T.O. All authors have read and agreed to the published version of the manuscript.

Acknowledgement

This study is based on data from the Japan Gerontological Evaluation Study (JAGES), which was conducted and managed by the JAGES Research Group. The authors would like to express their sincere gratitude to all community-dwelling older adults in Japan who participated in the JAGES survey and generously contributed their time and valuable information to this research. We also gratefully acknowledge the JAGES Research Group for their substantial efforts in conducting and managing the study. This work was supported by JSPS KAKENHI (Grant Numbers: 22K21341, 23H00060, 23H00449, 23K24610, 24K02658, 25K01387, 25K02884, 25K05563, and 26K02649), Health Labour Sciences Research Grants (24LA1002), the National Research Institute for Earth Science and Disaster Resilience, and the Tanuma Greenhouse Foundation. The authors gratefully acknowledge this financial support. The views expressed in this article are those of the authors and do not necessarily reflect the official views of the funding agencies.

Ethical considerations

The study was conducted in accordance with the Declaration of Helsinki. Ethical approval was obtained from the Ethics Committee of the National Center for Geriatrics and Gerontology (Approval No. 992), Chiba University (Approval No. 2493), and Hamamatsu University School of Medicine (Approval No. 91–123). Informed consent was obtained from all participants.

Data availability

Data are not open to the public due to ethical concerns. Data from the JAGES study may be requested by contacting the management committee: dataadmin@jages.net.

References

1. Rowe, J. W., Kahn, R. L. & Successful aging *Gerontologist* **37**, 433–440. <https://doi.org/10.1093/geront/37.4.433>. (1997).
2. World Health Organization. *Decade of Healthy Ageing: Baseline Report* (World Health Organization: Geneva, Switzerland,, 2020).
3. Steptoe, A., Deaton, A. & Stone, A. A. Subjective wellbeing, health, and ageing. *Lancet* **385**, 640–648. [https://doi.org/10.1016/S0140-6736\(13\)61489-0](https://doi.org/10.1016/S0140-6736(13)61489-0) (2015).
4. Zager Kocjan, G., Jose, P. E., Sočan, G. & Avsec, A. Measurement Invariance of the Subjective Happiness Scale Across Countries, Gender, Age, and Time. *Assess.* **2022**, **29**, 826–841. <https://doi.org/10.1177/1073191121993558>
5. Song, I., Kwon, J. W. & Jeon, S. M. The relative importance of friendship to happiness increases with age. *PLoS One.* **18**, e0288095. <https://doi.org/10.1371/journal.pone.0288095> (2023).
6. Milovanska-Farrington, S., Farrington, S. & Happiness domains of life satisfaction, perceptions, and valuation differences across genders. *Acta Psychol. (Amst.)* **230**, 103720.

- <https://doi.org/10.1016/j.actpsy.2022.103720> (2022).
7. Rudaz, M., Ledermann, T. & Fincham, F. D. Initial Development and Validation of a Brief Scale to Measure Genuine Happiness in the USA. *J. Relig. Health.* **62**, 2163–2180. <https://doi.org/10.1007/s10943-022-01659-6> (2023).
 8. Liu, B. et al. Million Women Study Collaborators. Does happiness itself directly affect mortality? The prospective UK Million Women Study. *Lancet* **387**, 874–881. [https://doi.org/10.1016/S0140-6736\(15\)01087-9](https://doi.org/10.1016/S0140-6736(15)01087-9) (2016).
 9. Li, C., Ning, G. & Xia, Y. Does exercise participation promote happiness? Mediations and heterogeneities. *Front. Public. Health.* **11**, 1033157. <https://doi.org/10.3389/fpubh.2023.1033157> (2023).
 10. Killingsworth, M. A., Kahneman, D. & Mellers, B. Income and emotional well-being: A conflict resolved. *Proc. Natl. Acad. Sci. USA* **120**, e2208661120. (2023). <https://doi.org/10.1073/pnas.2208661120>
 11. Rohrer, J. M. & Wenz, S. E. Inappropriate causal assumptions underlie Killingsworth, Kahneman, and Mellers' conclusions. *Proc. Natl. Acad. Sci. USA* **121**, e2313712121. (2024). <https://doi.org/10.1073/pnas.2313712121>
 12. Provine, R. R. & Laughter *A Scientific Investigation* (Viking, 2001).
 13. Gervais, M. & Wilson, D. S. The evolution and functions of laughter and humor: A synthetic approach. *Q. Rev. Biol.* **80**, 395–430. <https://doi.org/10.1086/498281> (2005).
 14. Kramer, C. K. & Leita, C. B. Laughter as medicine: A systematic review and meta-analysis of interventional studies evaluating the impact of spontaneous laughter on cortisol levels. *PLoS One* **2023**, **18**, e0286260. <https://doi.org/10.1371/journal.pone.0286260>
 15. Bennett, M. P. & Lengacher, C. Humor and laughter may influence health: IV. Humoral immunity. *Evid. Based Complement. Alternat Med.* **6**, 159–164. <https://doi.org/10.1093/ecam/nem149> (2009).
 16. Dunbar, R. I. M. et al. Social laughter is correlated with an elevated pain threshold. *Proc. Biol. Sci.* **279**, 1161–1167. (2012). <https://doi.org/10.1098/rspb.2011.1373>
 17. Nagai, M., Ohira, T., Shirai, K. & Kondo, K. Does variety of social interactions associate with frequency of laughter among older people? The JAGES cross-sectional study. *BMJ Open.* **11**, e039363. <https://doi.org/10.1136/bmjopen-2020-039363> (2021).
 18. Imai, Y. et al. Impact of social relationships on income–laughter relationships among older people: the JAGES cross-sectional study. *BMJ Open.* **8**, e019104. <https://doi.org/10.1136/bmjopen-2017-019104> (2018).
 19. Kawachi, I. & Berkman, L. F. Social ties and mental health. *J. Urban Health.* **78**, 458–467. <https://doi.org/10.1093/jurban/78.3.458> (2001).
 20. Hayashi, K. et al. Laughter and Subjective Health Among Community-Dwelling Older People in Japan: Cross-Sectional Analysis of the Japan Gerontological Evaluation Study Cohort Data. *J. Nerv. Ment Dis.* **203**, 934–942. <https://doi.org/10.1097/NMD.0000000000000399> (2015).

21. Hayashi, K. et al. Laughter is the Best Medicine? A Cross-Sectional Study of Cardiovascular Disease Among Older Japanese Adults. *J. Epidemiol.* **26**, 546–552. <https://doi.org/10.2188/jea.JE20150196> (2016).
22. Funakubo, N. et al. Effects of a laughter program on body weight and mental health among Japanese people with metabolic syndrome risk factors: a randomized controlled trial. *BMC Geriatr.* **22**, 361. <https://doi.org/10.1186/s12877-022-03038-y> (2022).
23. Tamada, Y. et al. Does Laughter Predict Onset of Functional Disability and Mortality Among Older Japanese Adults? The JAGES Prospective Cohort Study. *J. Epidemiol.* **31**, 301–307. <https://doi.org/10.2188/jea.JE20200051> (2021).
24. Tamada, Y. et al. Does laughing with others lower the risk of functional disability among older Japanese adults? The JAGES prospective cohort study. *Prev. Med.* **155**, 106945. <https://doi.org/10.1016/j.ypmed.2021.106945> (2022).
25. Nagayoshi, M. et al. Frequency of Conversation, Laughter and Other Vocalising Opportunities in Daily Life and Maximum Tongue Pressure: The Goto Longevity Study. *J. Oral Rehabil.* **52**, 1288–1296. <https://doi.org/10.1111/joor.13979> (2025).
26. Tamada, Y. et al. Reduced number of teeth with and without dental prostheses and low frequency of laughter in older adults: mediation by poor oral function. *J. Prosthodont. Res.* **68**, 441–448. https://doi.org/10.2186/jpr.JPR_D_23_00071 (2024).
27. Funakubo, N. et al. Association of laughter and social communication with oral frailty among residents in Fukushima: a cross-sectional study. *Sci. Rep.* **14**, 1–10. <https://doi.org/10.1038/s41598-024-77966-7> (2024).
28. Hajek, A., Kondo, N. & König, H. H. How is the Beginning and End of Frequent Laughter Associated With Changes in Loneliness Amongst Older People in Japan? A JAGES Longitudinal Study. *Int. J. Geriatr. Psychiatry.* **40**, e70177. <https://doi.org/10.1002/gps.70177> (2025).
29. Murakami, A., Hiratsuka, Y., Inoue, A. & Takesue, A. Association between visual status and the frequency of laughter in older Japanese individuals: the JAGES cross-sectional study. *BMJ Open. Ophthalmol.* **7**, e000908. <https://doi.org/10.1136/bmjophth-2021-000908> (2022).
30. Hirosaki, M. et al. Lifestyle factors and social ties associated with the frequency of laughter after the Great East Japan Earthquake: Fukushima Health Management Survey. *Qual. Life Res.* **27**, 639–650. <https://doi.org/10.1007/s11136-017-1750-y> (2018).
31. Nakagomi, A. et al. Social isolation and subsequent health and well-being in older adults: A longitudinal outcome-wide analysis. *Soc. Sci. Med.* **327**, 115937. <https://doi.org/10.1016/j.socscimed.2023.115937> (2023).
32. Hajek, A., Posi, G. & König, H. H. Chronic loneliness and chronic social isolation among older adults: a systematic review, meta-analysis and meta-regression. *Aging Ment Health* 2025, **29**, 185–200. <https://doi.org/10.1080/13607863.2024.2385448>
33. Shibata, M., Ojima, T. & Aida, J. The Relationship between Green Tea Consumption and Happiness. *Sci. Rep.* **15**, 41436 (2025).

34. Kawaguchi, K., Ide, K., Kanamori, S., Tsuji, T. & Kondo, K. Watching sports and happiness among older adults in Japan: The JAGES cohort study. *PLoS One*. **20**, e0320213. <https://doi.org/10.1371/journal.pone.0320213> (2025).
35. Sasaki, I. et al. Are pension types associated with happiness in Japanese older people? JAGES cross-sectional study. *PLoS One*. 13e0197423. <https://doi.org/10.1371/journal.pone.0197423> (2018).
36. Kitayama, S., Karasawa, M., Curhan, K. B., Ryff, C. D. & Markus, H. R. Independence and Interdependence Predict Health and Wellbeing: Divergent Patterns in the United States and Japan. *Front. Psychol.* **1**, 163. <https://doi.org/10.3389/fpsyg.2010.00163> (2010).
37. Uchida, Y. & Rappleye, J. An Interdependent Approach to Happiness and Well-Being; Springer Nature: Singapore, (2024). <https://doi.org/10.1007/978-3-031-26260-9>
38. Uchida, Y., Kanamori, M., Fukushima, S. & Takemura, K. Interdependent culture and older adults' well-being: Health and psychological happiness in Japanese communities. *Curr. Opin. Psychol.* **55**, 101729. <https://doi.org/10.1016/j.copsyc.2023.101729> (2024).
39. Hommerich, C., Ohnuma, S., Sato, K. & Mizutori, S. Determinants of interdependent happiness focusing on the role of social capital: empirical insight from Japan. *Jpn Psychol. Res.* **64**, 205–221. <https://doi.org/10.1111/jpr.12415> (2022).
40. Tamada, Y. et al. Frequency of laughter and depression onset among older adults: a 6-year longitudinal study from the Japan Gerontological Evaluation Study. *J. Affect. Disord.* **392**, 120209. <https://doi.org/10.1016/j.jad.2025.120209> (2026).
41. Fredrickson, B. L. What good are positive emotions? *Rev. Gen. Psychol.* **2**, 300–319. <https://doi.org/10.1037/1089-2680.2.3.300> (1998).
42. Fredrickson, B. L. The role of positive emotions in positive psychology: The broaden-and-build theory of positive emotions. *Am. Psychol.* **56**, 218–226. <https://doi.org/10.1037/0003-066X.56.3.218> (2001).
43. Mobbs, D., Greicius, M. D., Abdel-Azim, E., Menon, V. & Reiss, A. L. Humor modulates the mesolimbic reward centers. *Neuron* **40**, 1041–1048. [https://doi.org/10.1016/S0896-6273\(03\)00751-7](https://doi.org/10.1016/S0896-6273(03)00751-7) (2003).
44. Fujiwara, Y. & Okamura, H. Hearing laughter improves the recovery process of the autonomic nervous system after a stress-loading task: A randomized controlled trial. *Biopsychosoc. Med.* **12**, 22. <https://doi.org/10.1186/s13030-018-0141-0> (2018).
45. Podsakoff, P. M., MacKenzie, S. B., Lee, J. Y. & Podsakoff, N. P. Common method biases in behavioral research: A critical review of the literature and recommended remedies. *J. Appl. Psychol.* **88**, 879–903. <https://doi.org/10.1037/0021-9010.88.5.879> (2003).
46. Kondo, K. Progress in aging epidemiology in Japan: the JAGES Project. *J. Epidemiol.* **26**, 331–336. <https://doi.org/10.2188/jea.JE20160093> (2016).
47. Sheikh, J. I. & Yesavage, J. A. Geriatric Depression Scale (GDS): Recent evidence and development of a shorter version. *Clin. Gerontol.* **5**, 165–173. https://doi.org/10.1300/J018v05n01_09 (1986).

Figures

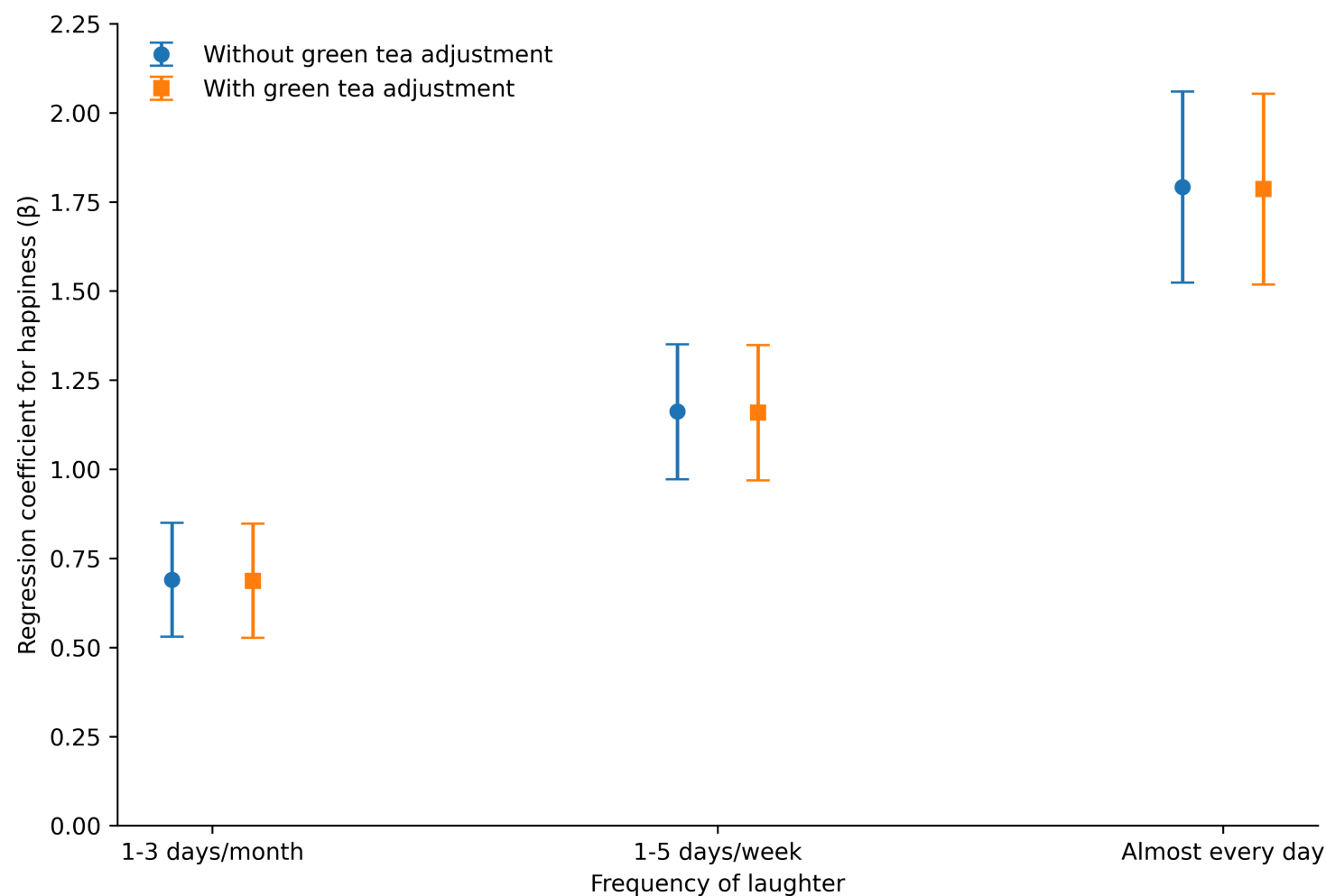


Figure 1

Association between laughter frequency and happiness before and after adjustment for green tea consumption. Regression coefficients (β) and 95% confidence intervals are shown for each laughter-frequency category, with “almost never” as the reference group. Both models were based on the same unified analytical sample (N=12,624). Estimates remained nearly unchanged after additional adjustment for green tea consumption, indicating the stability of the association between laughter frequency and happiness.