Impact of social relationships on income–laughter relationships among older people: the JAGES cross-sectional study

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ABSTRACT

Objectives Laughter has a positive and quantifiable effect on certain aspects of health, and previous studies have suggested that income influences the emotion. However, it is unknown whether social relationship-related factors modify the association between equivalised income and laughter among older people. In the present study, we examined the relationship between equivalised income and the frequency of laughter. In addition, we examined the impact of social relationship-related factors on the association between equivalised income and frequency of laughter using a cross-sectional study design.

Design Cross-sectional study and binomial regression analysis.

Setting We sampled from 30 municipalities in Japan.

Participants We examined 20 752 non-disabled Japanese individuals aged ≥65 years using data from the Japan Gerontological Evaluation Study.

Primary outcome Frequency of laughter.

Results Laughter increased significantly with an increase in equivalent income (p for trend <0.0001). Prevalence ratios (PR) for laughing almost every day were calculated according to quartile equivalised income after adjusting for age, instrumental activities of daily living, depression, frequency of meeting friends, number of social groups and family structure. The results revealed that PRs in Q4 (men; ≥€24 420, women; ≥€21 154) were 1.21 (95% CI 1.13 to 1.30) among men and 1.14 (95% CI 1.08 to 1.20) among women, as compared with Q1 (men; <€12 041, women; <€9518), respectively. After excluding participants with depression, the association remained significant. In addition, we found inadequate social relationships and living alone were associated with a lower frequency of laughter. In comparison with the lowest equivalent income with meeting friends less frequently and living alone, the PRs of the highest equivalent income with meeting friends frequently and living with someone were higher, respectively.

Conclusions The results revealed a significant relationship between equivalent income and the frequency of laughter. Social relationships and family structure were also associated with the frequency of laughter.

INTRODUCTION

In most developed countries, the proportion of older people is growing faster than any other age group. Among these countries, Japan is experiencing the most rapidly ageing population (19.0% in 2005; 26.7% in 2015). The need for health promotion and disease prevention targeting older people is increasing. Various health promotion strategies have been recommended for older people, and laughter therapy has been introduced as a potentially important option. Previous studies have suggested that laughter has positive and quantifiable effects on certain aspects of health, including immune function, allergic dermatitis, cancer, psychiatric diseases, dementia and cardiovascular diseases. In addition, laughter therapy has been found to improve various aspects of mental and physical function in older people, and has been incorporated into complementary medicine. For example, a randomised controlled trial of humour therapy in residential care called the Sydney Multisite Intervention of LaughterBosses and ElderClowns suggested that humour therapy decreased agitation and increased happiness. Laughter is reported to occur most frequently during casual conversation. Surprise is an important element in humour because laughter usually occurs when one encounters a meaningful interpretation of...
Laughter is involved in the expression of emotion and in addition, the threshold association between income and positive emotion (emotional well-being) has been reported. In another study, income was found to have a positive dose–response relationship with positive emotion, up to an annual income of $75,000, whereas insufficient income was a significant predictor for depression. The proportion of people with depression in the lowest income group is 15.8% among men and 15.0% among women, and depression is 6.9 times more prevalent for men and 4.1 times more prevalent for women in this income group than it is in the highest income group among people in Japan aged 65–69 years. Although these findings suggest that emotion varies according to socioeconomic status, no previous studies have demonstrated a relationship between income and the frequency of laughter.

Laughter

The outcome variable was the frequency of laughing. Laughter was assessed through each participant’s response to a question about how frequently they laughed out loud during their daily life. The possible item answers were: almost every day, 1–5 days/week, 1–3 days/month and <1 day/month. Based on a previous study, we defined participants as laughing often if they answered ‘almost every day.’

Equivalised income

Equivalised income was calculated by dividing the median annual household income by the square root of the number of people living together. The annual household income question had 15 categories (<0.5, 0.5–1.0, 1.0–1.5, 1.5–2.0, 2.0–2.5, 2.5–3.0, 3.0–4.0, 4.0–5.0, 5.0–6.0, 6.0–7.0, 7.0–8.0, 8.0–9.0, 9.0–10.0, 10.0–12.0 and ≥12.0 million Japanese yen (JPY)). We used a purchasing power parity rate of €1.00=JPY130 (as of July 2017). We divided the participants into quartiles according to their equivalised income: Q1 (men <€12,041; women <€9,518), Q2 (men €12,041–€15,543; women €9,518–€14,957), Q3 (men €15,544–€24,426; women €14,958–€21,153) and Q4 (men ≥€24,420; women ≥€21,154).

Measures and definitions

Instrumental activities of daily living (IADL) were assessed using the Tokyo Metropolitan Institute of Gerontology Index of Competence, and the results were classified as high IADL (5 points) or low IADL (≤4 points). The evaluation of depression was made using the Geriatric Depression Scale (GDS). The GDS is a 15-item questionnaire, with a score range of 0–15. In accord with previous studies, participants were classified into two groups: not depressed (GDS <5) and depressed (GDS ≥5).

The frequency of meeting friends and acquaintances was measured with a question comprising six categories (≥24 days/week, 2–3 days/week, 1 day/week, 1–3 days/month, several times/year and none). We divided the respondents into three groups: <2 times/week, ≥2 times/week, or missing.

Participants were also presented with 14 different civic associations and social groups, and asked which ones they were regularly involved with. This provided a measure, divided into six categories, for each type of social group (≥4 days/week, 2–3 days/week, 1 day/week, once/month, several times/year and none). Participants were also presented with 14 different civic associations and social groups, and asked which ones they were regularly involved with. This provided a measure, divided into six categories, for each type of social group (≥4 days/week, 2–3 days/week, 1 day/week, once/month, several times/year and none).
week, 1–3 days/month, several times/year, no participation). The total number of types of groups in which each respondent participated at least several times per year was tallied, and respondents were divided into four groups: 0, 1 or 2, ≥3, or missing.

Family structure was assessed through two questions: one regarding the number of people living together, and the other regarding marital status. The marital status question provided five answer categories (married, bereaved, divorced, never married and other). Based on the responses to these questions, we divided participants into four groups: alone, ≥2 without partner, ≥2 with partner, or ≥2 with no information about marital status.

**Statistical analysis**

We used binomial regression analyses to derive prevalence ratios (PR) based on 95% CIs for ‘laughing almost every day’ according to equivalised income. In accord with recent statistical recommendations, we calculated PRs rather than ORs because the prevalence of laughing almost every day was not rare (≥10%).

We used the SAS V.9.4 statistical software package. In each model, the lowest equivalised income category was set as the reference category. A ‘missing’ category was used in analysis to account for missing values in response to questions. In model 1, we controlled for age (65–69, 70–74, 75–79, 80–84, ≥85 years), IADL (high IADL, low IADL, or missing) and depression (no depression, depression, or missing). Model 2 was adjusted for the covariates in model 1 plus social relationship-related factors such as the frequency of meeting friends (<2 times/week, ≥2 times/week, or missing) and number of social groups (0, 1 or 2, ≥3, or missing), and family structure (alone, ≥2 without partner, ≥2 with partner, or ≥2 with no information about marital status). Additionally, to confirm the robustness of our results we also carried out the same series of analyses using the sample excluding subjects with depression (GDS ≥3) and missing information about depression. It should be noted that the results in this study design may be affected by bias related to depression because people with depression might seldom laugh and depression influences employment and income.

To assess whether the prevalence of laughter associated with equivalised income differed between social relationships (frequency of meeting friends or number of social groups) or family structure, we conducted an analysis in which participants were cross-classified into groups according to their equivalised income. The lowest equivalised income group was treated with each inadequate social relationship (meeting friends less frequently or non-participation in an organisation) or living alone as reference categories. The p value for the trend was calculated by categorical variables conducted from binomial regression model adjusting above covariates. All p values were two tailed, and differences of <0.05 were accepted as statistically significant.

**RESULTS**

**Baseline characteristics by equivalised income**

Table 1 shows the baseline characteristics of the study participants according to the categories of equivalised income. The proportions for laughing almost every day were 37.2% for men and 47.6% for women; these proportions increased as equivalised income increased for both men and women. The proportion of respondents who reported laughing <1 time/month was 9.7% for men and 5.3% for women. The mean age was highest in the lowest equivalised income group for both men and women. The proportion of low IADL and depression decreased as equivalised income increased. Meeting friends and participating in social groups increased with a rise in equivalised income. The proportion of people cohabiting was highest in Q2 for men and in Q5 for women.

**Equivalised income and frequency of laughter**

Table 2 shows the results of our binomial regression models for frequency of laughter according to equivalised income. Equivalised income was significantly associated with frequency of laughter among both men and women. The PRs tended to become greater as equivalised income increased. Compared with those in the lowest equivalised income group, the age-adjusted PRs for laughing almost every day for participants in the highest equivalised income group were greater: 1.43 (95% CI 1.33 to 1.54) for men and 1.30 (95% CI 1.23 to 1.38) for women. After adjusting for age, IADL, depression, frequency of meeting friends, number of social groups and family structure, the PRs decreased to 1.21 for men and 1.14 for women in this group; however, the association remained significant.

Table 3 shows the results of our binomial regression models for frequency of laughter according to equivalised income, using a sample that excluded participants with depression (GDS ≥3) and those for whom information about depression was missing. The associations remained unchanged after excluding these participants. The PRs of laughing almost every day for men and women with the highest equivalised income were 1.23 (95% CI 1.13 to 1.34) and 1.10 (95% CI 1.04 to 1.17), respectively.

**Frequency of laughter according to equivalised income, by social relationships and family structures**

Figures 1–3 show the results of the interactions between income and laughing almost every day, by social relationships and family structure. While we observed no significant interactions (p for interaction: frequency of meeting friends=0.73 for men; number of social groups=0.20 for men, 0.11 for women; family structure=0.86 for men, 0.52 for women) without frequency of meeting friends in women, we found that inadequate social relationships (particularly when indicated by meeting friends less frequently or living alone) were associated with a lower frequency of laughter. The PR for men in the
Table 1 Baseline characteristics by categories of household income

| Equivalised income* | Q1 | Q2 | Q3 | Q4 | P values† |
|---------------------|----|----|----|----|-----------|
| **Men**             |    |    |    |    |           |
| Number of participants | 2628 | 2454 | 2739 | 2480 |           |
| Frequency of laughing (%) |    |    |    |    |           |
| Almost every day | 30.9 | 35.3 | 38.7 | 44.2 | <0.0001 |
| 1–5 times/week | 37.6 | 38.7 | 39.0 | 37.4 |           |
| 1–3 times/month | 16.7 | 16.5 | 14.3 | 12.0 |           |
| <1 time/month | 14.8 | 9.6  | 8.0  | 6.4  |           |
| Age (years) (%) |    |    |    |    |           |
| 65–69 | 24.5 | 30.2 | 32.3 | 36.8 | <0.0001 |
| 70–74 | 29.9 | 31.3 | 31.0 | 28.9 |           |
| 75–80 | 25.5 | 23.4 | 19.8 | 17.8 |           |
| 80–85 | 14.3 | 10.8 | 12.0 | 11.4 |           |
| ≥85 | 5.9  | 4.3  | 5.0  | 5.1  |           |
| Mean age (years) (SD) | 74.3 (6.0) | 73.3 (5.8) | 73.2 (6.0) | 72.8 (6.1) | <0.0001 |
| IADL (%) |    |    |    |    |           |
| High IADL | 64.7 | 74.0 | 77.1 | 77.6 | <0.0001 |
| Low IADL | 30.0 | 22.9 | 20.0 | 20.5 |           |
| Missing | 5.4  | 3.1  | 2.9  | 1.9  |           |
| Frequency of meeting friends (%) |    |    |    |    |           |
| <2 times/week | 67.2 | 68.3 | 68.2 | 62.8 | <0.0001 |
| ≥2 times/week | 27.6 | 28.0 | 28.7 | 34.5 |           |
| Missing | 5.3  | 3.8  | 3.2  | 2.7  |           |
| Number of social groups (%) |    |    |    |    |           |
| 0 | 29.0 | 22.9 | 21.1 | 19.1 | <0.0001 |
| 1 or 2 | 25.3 | 27.4 | 29.5 | 28.1 |           |
| ≥3 | 30.2 | 36.8 | 38.8 | 42.6 |           |
| Missing | 15.5 | 12.9 | 10.7 | 10.2 |           |
| Family structure (%) |    |    |    |    |           |
| Alone | 10.5 | 6.4  | 8.9  | 6.7  | <0.0001 |
| ≥2 without partner | 7.5  | 4.7  | 4.1  | 4.9  |           |
| ≥2 with partner | 79.5 | 88.2 | 86.7 | 88.1 |           |
| ≥2 with no information about marital status | 2.6  | 0.6  | 0.3  | 0.3  |           |
| Depression (%) |    |    |    |    |           |
| No depression | 49.3 | 64.7 | 71.5 | 78.4 | <0.0001 |
| Depression | 35.8 | 24.5 | 19.5 | 13.5 |           |
| Missing | 14.9 | 10.9 | 9.0  | 8.2  |           |
| **Women**           |    |    |    |    |           |
| Number of participants | 2688 | 2169 | 2863 | 2731 |           |
| Frequency of laughing (%) |    |    |    |    |           |
| Almost every day | 41.9 | 40.5 | 51.1 | 55.2 | <0.0001 |
| 1–5 times/week | 38.0 | 41.0 | 37.9 | 35.1 |           |
| 1–3 times/month | 11.4 | 12.2 | 7.7  | 6.6  |           |
| <1 time/month | 8.7  | 6.3  | 3.4  | 3.1  |           |

Continued
lowest equivalised income group who met more often with friends was 1.39 (95% CI 1.24 to 1.56), while for men in the highest equivalent income group who met less frequently with friends, the PR was 1.29 (95% CI 1.17 to 1.42). The PR for women in the lowest equivalised income group who met more often with friends was 1.28 (95% CI 1.17 to 1.40), while for women in the highest equivalised income group who met with friends less frequently, the PR was 1.23 (95% CI 1.13 to 1.33). In terms of family structure, the PR for men in the lowest equivalised income group who lived with ≥2 people with a partner was 1.67 (95% CI 1.28 to 2.17), while for men in the highest equivalent income group who lived alone, the PR was 1.31 (95% CI 0.92 to 1.87). The PR for women in the lowest equivalised income group who lived with ≥2 people with a partner was 1.45 (95% CI 1.25 to 1.68), while for women in the highest equivalised income group who lived alone, the PR was 1.10 (95% CI 0.90 to 1.34). Among women, but not men, we observed significant associations between equivalised income and the frequency of laughter if the participant had inadequate social relationships, indicated by meeting friends less frequently or non-participation in organisations. However, we observed no statistically significant associations between equivalised income and frequency of laughter if the women had richer social relationships, indicated by meeting friends more frequently or participating in more social groups.

Table 1

|                                | Q1      | Q2      | Q3      | Q4      | P values† |
|--------------------------------|---------|---------|---------|---------|-----------|
| **Age (years) (%)**            |         |         |         |         |           |
| 65–69                          | 23.0    | 28.3    | 33.7    | 34.5    | <0.0001   |
| 70–74                          | 30.4    | 31.2    | 32.3    | 29.6    |           |
| 75–80                          | 25.3    | 21.5    | 20.8    | 17.7    |           |
| 80–85                          | 14.5    | 13.1    | 9.4     | 12.5    |           |
| ≥85                            | 6.9     | 5.9     | 3.8     | 5.8     |           |
| **Mean age (years) (SD)**      | 74.6 (6.1) | 73.8 (6.0) | 72.8 (5.7) | 73.2 (6.3) | <0.0001   |
| **IADL (%)**                   |         |         |         |         |           |
| High IADL                      | 80.7    | 86.7    | 90.3    | 88.4    | <0.0001   |
| Low IADL                       | 15.1    | 10.5    | 7.7     | 9.0     |           |
| Missing                        | 4.3     | 2.8     | 2.0     | 2.7     |           |
| **Frequency of meeting friends (%)** |         |         |         |         |           |
| <2 times/week                  | 53.5    | 55.2    | 54.4    | 54.0    | <0.0001   |
| ≥2 times/week                  | 40.0    | 40.6    | 42.3    | 43.4    |           |
| Missing                        | 6.5     | 4.2     | 3.3     | 2.7     |           |
| **Number of social groups (%)**|         |         |         |         |           |
| 0                              | 26.1    | 23.1    | 18.6    | 19.4    | <0.0001   |
| 1 or 2                         | 25.7    | 26.1    | 28.9    | 26.9    |           |
| ≥3                             | 25.6    | 34.1    | 38.8    | 41.8    |           |
| Missing                        | 22.7    | 16.7    | 13.7    | 11.9    |           |
| **Family structure (%)**       |         |         |         |         |           |
| Alone                          | 17.6    | 39.5    | 9.8     | 11.4    | <0.0001   |
| ≥2 without partner             | 27.1    | 12.3    | 15.3    | 22.6    |           |
| ≥2 with partner                | 51.8    | 47.2    | 74.2    | 65.4    |           |
| ≥2 with no information about marital status | 3.5 | 1.1 | 0.7 | 0.6 | |
| **Depression (%)**             |         |         |         |         |           |
| No depression                  | 52.0    | 57.3    | 68.2    | 73.0    | <0.0001   |
| Depression                     | 28.1    | 24.9    | 17.5    | 13.6    |           |
| Missing                        | 19.9    | 17.9    | 14.3    | 13.5    |           |

*Q1 (men; <€12 041, women; <€9518), Q2 (men; €12 041–€15 543, women; €9518–€14 957), Q3 (men; €15 544–€24 426, women; €14 958–€21 153), Q4 (men; ≥€24 427, women; ≥€21 154).
†P values were calculated by Χ² test (categorical variables) or ANOVA (continuous variables).
ANOVA, analysis of variance; IADL, instrumental activities of daily living.
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The current study examined and described the relationship between equivalised income and the frequency of laughter. In addition, we examined the impact of social relationship-related factors on the association between equivalised income and the frequency of laughter. We found a positive association between equivalised income and the frequency of laughter among both men and women.

Table 2 Prevalence ratios and 95% CIs of frequency of laughing according to equivalised income

| Equivalised income* | Q1 | Q2 | Q3 | Q4 | P for trend† |
|--------------------|----|----|----|----|--------------|
| **Men**            |    |    |    |    |              |
| Number of participants | 2628 | 2454 | 2739 | 2480 |              |
| Number of participants laughing almost every day | 812 | 866 | 1060 | 1096 |              |
| Crude               | Reference | 1.14 (1.06–1.24) | 1.25 (1.16–1.35) | 1.43 (1.33–1.54) | <0.0001 |
| Age adjusted        | Reference | 1.13 (1.05–1.22) | 1.25 (1.16–1.34) | 1.43 (1.33–1.54) | <0.0001 |
| Multiadjusted model 1‡ | Reference | 1.04 (0.96–1.13) | 1.12 (1.04–1.21) | 1.24 (1.16–1.34) | <0.0001 |
| Multiadjusted model 2§ | Reference | 1.03 (0.96–1.11) | 1.12 (1.05–1.21) | 1.21 (1.13–1.30) | <0.0001 |
| **Women**           |    |    |    |    |              |
| Number of participants | 2688 | 2169 | 2863 | 2731 |              |
| Number of participants laughing almost every day | 1126 | 879 | 1462 | 1507 |              |
| Crude               | Reference | 0.97 (0.90–1.04) | 1.22 (1.15–1.29) | 1.32 (1.25–1.39) | <0.0001 |
| Age adjusted        | Reference | 0.96 (0.89–1.02) | 1.19 (1.13–1.26) | 1.30 (1.23–1.38) | <0.0001 |
| Multiadjusted model 1 | Reference | 0.92 (0.86–0.99) | 1.09 (1.03–1.15) | 1.16 (1.10–1.23) | <0.0001 |
| Multiadjusted model 2 | Reference | 0.98 (0.92–1.05) | 1.06 (1.00–1.12) | 1.14 (1.08–1.20) | <0.0001 |

* Q1 (men; €12 041, women; €9518), Q2 (men; €12 041–€15 543, women; €9518–€14 957), Q3 (men; €15 544–€24 426, women; €14 958–€21 153), Q4 (men; ≥€24 427, women; ≥€21 154).
† P for trend was calculated by categorical variables.
‡ Model 1 is adjusted for age (5 years category), instrumental activities of daily living (independent, not independent, missing), depression (no depression, depression, missing).
§ Model 2 is adjusted for the covariates in model 1 plus frequency of meeting friends (<2 times/week, ≥2 times/week, missing), number of social groups (0, 1 or 2, ≥3, missing), family structure (alone, ≥2 without partner, ≥2 with partner, missing).

**DISCUSSION**

The current study examined and described the relationship between equivalised income and the frequency of laughter. In addition, we examined the impact of social relationship-related factors on the association between equivalised income and the frequency of laughter. We found a positive association between equivalised income and the frequency of laughter among both men and women.

Table 3 Prevalence ratios and 95% CIs of frequency of laughing according to equivalised income without depression

| Equivalised income* | Q1 | Q2 | Q3 | Q4 | P for trend† |
|--------------------|----|----|----|----|--------------|
| **Men**            |    |    |    |    |              |
| Number of participants with no depression | 1296 | 1587 | 1958 | 1943 |              |
| Number of participants laughing almost every day | 499 | 634 | 875 | 945 |              |
| Multiadjusted‡ | Reference | 1.01 (0.93–1.11) | 1.15 (1.06–1.25) | 1.23 (1.13–1.34) | <0.0001 |
| **Women**           |    |    |    |    |              |
| Number of participants with no depression | 1398 | 1242 | 1953 | 1993 |              |
| Number of participants laughing almost every day | 755 | 602 | 1122 | 1209 |              |
| Multiadjusted | Reference | 0.94 (0.87–1.01) | 1.03 (0.97–1.09) | 1.10 (1.04–1.17) | <0.0001 |

* Q1 (men; €12 041, women; €9518), Q2 (men; €12 041–€15 543, women; €9518–€14 957), Q3 (men; €15 544–€24 426, women; €14 958–€21 153), Q4 (men; ≥€24 427, women; ≥€21 154).
† P for trend was calculated by categorical variables.
‡ Prevalence ratios were adjusted for age (5 years category), instrumental activities of daily living (independent, not independent, missing), frequency of meeting friends (<2 times/week, ≥2 times/week, missing), number of social groups (0, 1 or 2, ≥3, missing), family structure (alone, ≥2 without partner, ≥2 with partner, missing).
Importantly, this association differed depending on family structure and the frequency of meeting friends. Among women participants, this association was weaker if they met friends frequently or participated in more social groups. However, we did not find a similar trend among participating men. Therefore, social relationships and family structure may modify the association between equivalised income and the frequency of laughter.

The present study showed an association between equivalised income and the frequency of laughter, while previous studies have shown that depression decreases the frequency of laughter\(^3\) and that household income influences mental health.\(^4\) Because our results could potentially have reflected bias related to participant depression, we conducted further analyses after excluding participants with depression. However, this did not change the tendency exhibited in the results. We believe that this result supports the original prediction of this study that the frequency of laughter would be associated with income, regardless of depression.

Previous studies, however, have indicated that people with more income tend to have more opportunity to come into contact with others.\(^5\) Laughter has been found to occur most frequently during casual conversations.\(^6\) Coming into contact with others is considered to be important to subjective well-being.\(^7\) Thus, it is possible that wealthier people laugh more frequently because they have more opportunities to meet others. Therefore, we examined the influence of social relationship factors and family structure on the relationship between equivalised income and the frequency of laughter.

In a cross-classification analysis of equivalised income and frequency of meeting friends, we found that meeting friends was associated with frequency of laughter for both men and women. A previous study of older Japanese participants indicated that friendship was important for subjective well-being,\(^8\) in accord with the notion that friendship decreases loneliness and anxiety, and increases happiness.\(^9\) These findings suggest that meeting friends leads to more opportunities for laughter.
In our cross-classification analysis on equalised income and family structure, we found a positive association between the number of family members and the frequency of laughter for both men and women. However, for men without a partner, this association was not evident. Particularly for men, the presence of a partner has been found to have a stronger influence than other relationships. The present results revealed that low-income men living with a partner laughed more frequently than unmarried wealthy men. For women, however, living with another person was important for laughter, whether that person was their partner or not. This difference may be related to the finding that women’s satisfaction with their partner and their marital relationship is markedly lower than the partner-related and marital relationship-related satisfaction of men in Japan. Indeed, we found that factors relating to social relationships were associated with the frequency of laughter. This finding supports our hypothesis that wealthier people laugh more frequently than poorer people because they have more opportunities to come into contact with others.

The current findings have two main implications for public health. First, given the multiple positive effects of laughing on certain aspects of health, income redistribution policies may have additional benefits for impoverished older people. That is, increased income may improve material conditions and psychosocial health and cognitive ability. Second, while income redistribution policy reform may take a long time to implement, public health interventions that provide opportunities for more social interactions in local settings may help reduce the deprivation of laughter among low-income populations.

To the best of our knowledge, this is the first study to report significant relationships among equalised income, factors relating to social relationships and family structure, and the frequency of laughter. However, there are several potential limitations that should be considered. First, because the present study design was cross-sectional, we could not demonstrate causal relationships. However, longitudinal analyses of our cohort data can be used to address these issues in future research. Second, the results may have been affected by residual confounders such as the rates of watching television, reading books, or other potential confounding factors for which we did not collect data. Third, it might be that people might not remember frequency of laughter correctly. However, the item of laughter has been used in previous epidemiological studies in Japan. The 1-year test–retest reliability of the item was assessed in a previous study in 2680 men and women aged 30–74 years, though the lowest category in frequency of laughter is different between that study (almost never) and current study (<1 day/month). The Spearman correlation coefficient was found to be 0.61 (p<0.001). Forth, the use of self-reported questionnaires may have introduced reporting bias regarding income and the frequency of laughter. For example, some participants may not know or accurately remember their income or their frequency of laughter. We consider these biases...
to represent cases of non-differential misclassification, which would not be expected to be dependent on each other. However, this misclassification weakens the true association, biasing the data towards the null hypothesis. Fifth, we did not take the diversity of types of laughter into account. There are many different types of laughter (e.g., laughter related to joy, taunting, or tickling), each of which are thought to play distinct roles in social cognition.43 44 One study reported three different types of laughter: ‘laughter of pleasure’, ‘laughter of social obligation’ and ‘laughter as relief from tension’.45 ‘Laughter of pleasure’ is an expression of pleasant emotions. ‘Laughter of social obligation’ occurs consciously, and is a way of communicating in interaction with others. ‘Laughter as relief from tension’ occurs when strain dissipates or is removed. Further research is required to consider these differences in laughter relative to equalised income.

CONCLUSION

In this study, we demonstrated a relationship between equalised income and the frequency of laughter. Additionally, we found an association between frequency of laughter and factors relating to social relationships, particularly family structure and frequency of meeting friends. We suggest that people with higher incomes may experience improved health through a higher frequency of laughter. Future research should examine laughter-related health improvements among older people.

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Contributors

YI, MN and TO contributed to the design of the study. NK, KS and KK participated in data collection. YI and MN participated in data analysis. YI, MN and TO participated in writing the report. All authors participated in critical revision of the manuscript and approved the final version of the report for submission.

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Competing interests

None declared.

Patient consent

Not required.

Ethics approval

The JAGES protocol was reviewed and approved by the Ethics Committee on Research of Human Subjects at Nihon Fukushima University (Approval No 10-05).

Provenance and peer review

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Data sharing statement

No additional data available.

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