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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.

Strengths and limitations of this study

- This is the first study to investigate relationships among equivalised income and frequency of laughter, and to examine the impact of social relationship-related factors on this association.
- The present study design was cross-sectional, and thus we cannot demonstrate causal relationships.
- The use of self-reported questionnaires may have introduced reporting bias regarding income and 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 2003; 26.7% in 2015).[1 2] 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.[3–5] Previous studies have suggested that laughter has positive and quantifiable effects on certain aspects of health, including immune function,[6] allergic dermatitis,[7–9] cancer,[10 11] psychiatric diseases,[12] dementia[13] and cardiovascular diseases.[14] In addition, laughter therapy has been found to improve various aspects of mental and physical function in older people,[3–5] 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[15] suggested that humour therapy decreased agitation and increased happiness.[16 17]

Laughter is reported to occur most frequently during casual conversation.[18] Surprise is an important element in humour because laughter usually occurs when one encounters a meaningful interpretation of

some stimulus or event that differs from the meaning that was initially assumed.[19] An individual's emotions are influenced by their character and social background, and previous studies have reported that socioeconomic status, particularly income, influences emotions.[20 21] In addition, the threshold association between income and positive emotion (emotional well-being) has been reported.[21] 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.[20] The proportion of people with depression in the lowest income group is 15.8% among men and 15.0% among women,[22] 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.

In the current study, we hypothesised that the frequency of laughter would be positively associated with equivalised income. We further hypothesised that social relationships and family structure would modify the association between equivalised income and laughter for older people. Closer personal relationships are associated with more frequent laughter,[23] and living alone has been correlated with reduced psychological well-being.[24] Laughter is involved in the expression of emotion and in the maintenance of social bonds.[25] In the present study, therefore, we examined the relationship between equivalised income and frequency of laughter. In addition, we examined the impact of social relationship-related factors on this relationship association among men and women aged 65 years and older in Japan.

METHODS

Study sample

The present study had a cross-sectional design using data from the Japan Gerontological Evaluation Study (JAGES). The JAGES was designed to describe the health status and social determinants of non-disabled people aged 65 years and older, sampled from 30 municipalities in Japan. We used the 2013 wave of JAGES, which was obtained from self-reported questionnaires mailed to a source population of 195 290 community-dwelling individuals between 1 October and 2 December 2013. These individuals were 65 years and older, and were not eligible to receive benefits from public long-term care insurance services. Of this sample, 138 293 individuals responded to the survey (response rate=70.8%). In addition to basic questions, there were five modules in the survey covering different topics[26]—module A: nursing care, medical care and lifestyles; module B: oral hygiene, optimism, subjective health; module C: social capital, history of abuse; module D: subjective quality of life, sleep, cognitive function; and module E: physical activity. We examined data from module B, which included questions about laughter. Of the 138 293 respondents, the current study examined the data of 26 368 individuals who responded to the JAGES basic questions as well as module B, including questions about the frequency of laughter. The final analysis involved 20 006 participants (9912 men and 10 094 women), after excluding 6362 participants with missing information about the frequency of laughter (n=1306), annual household income (n=3386) or the number of people living together (n=1670).

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,[14] we defined participants as laughing often if they answered 'almost every day.'

Equivalised income

Equivalised income was calculated by dividing the median value of the multiple-choice 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=JPY\130 (as of July 2017). We divided the participants into quartiles according to their equivalised income: 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) 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,[27] 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).[28] The GDS is a 15-item questionnaire, with a score range of 1–15.[29] In accord with previous studies,[30 31] 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 (≥4 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 measurement, divided into six categories, for each type of social group (≥4 days/week, 2–3 days/week, 1 day/

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%).[32] 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 ≥5) 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 Q3 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 ≥5) 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

Table 1 Continued

	Equivalised income*				
	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 X^2 test (categorical variables) or ANOVA (continuous variables).
ANOVA, analysis of variance; IADL, instrumental activities of daily living.

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 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 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 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).

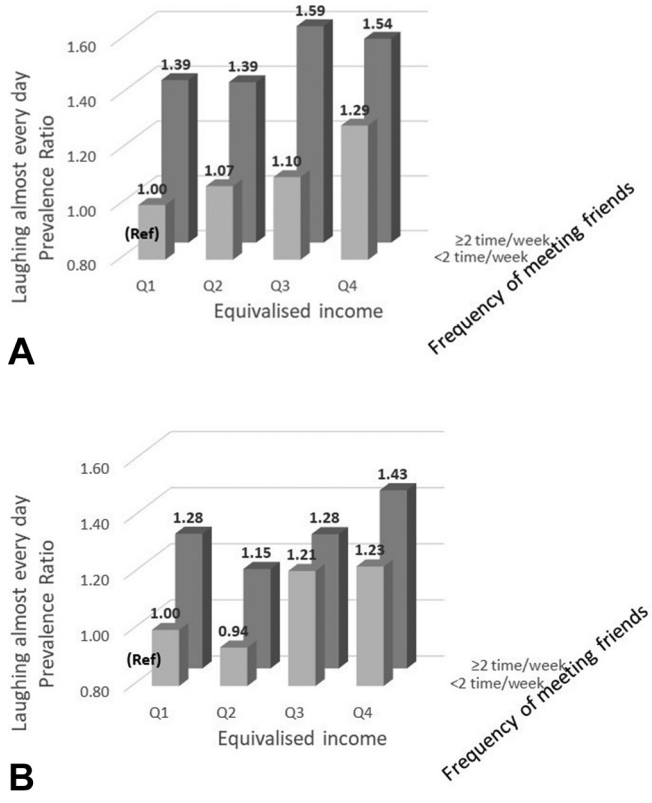

Figure 1 Adjusted prevalence ratios (PR) for laughing almost every day in each group according to equivalised income and frequency of meeting friends in men (A) and women (B) were calculated using binomial regression analysis. PRs were adjusted for age (5 years category), instrumental activities of daily living (IADL; independent, not independent, missing) and depression (no depression, depression, missing). The lowest equivalised income and meeting friends less frequently category was set as the reference category.

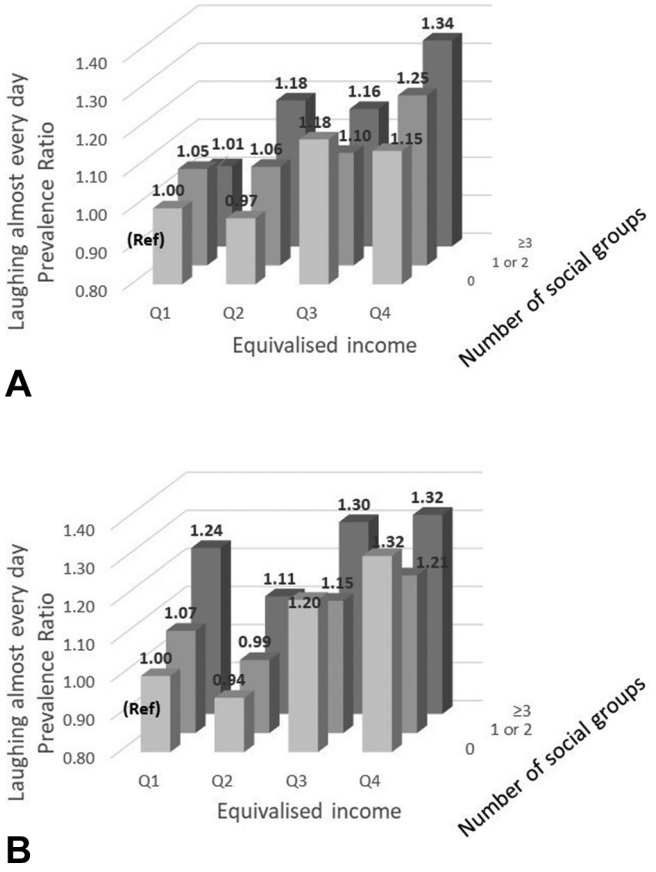

Figure 2 Adjusted prevalence ratios (PRs) for laughing almost every day in each group according to equivalised income and the number of social groups in men (A) and women (B) were calculated using binomial regression analysis. PRs were adjusted for age (5 years category), instrumental activities of daily living (IADL; independent, not independent, missing) and depression (no depression, depression, missing). The lowest equivalised income and non-participation in social group category was set as the reference category.

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[33] and that household income influences mental health.[34] 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.[35] Laughter has been found to occur most frequently during casual conversation.[18] Coming into contact with others is considered to be important to subjective well-being.[36] 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,[36] in accord with the notion that friendship decreases loneliness and anxiety, and increases happiness.[37] These findings suggest that meeting friends leads to more opportunities for laughter.

In a cross-classification analysis of equivalised income and number of social groups, we observed no significant

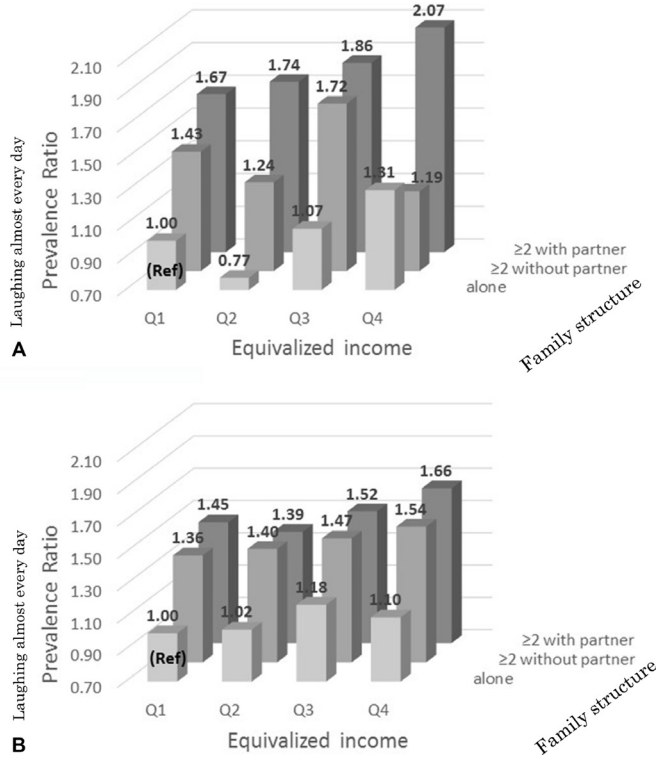

Figure 3 Adjusted prevalence ratios (PR) for laughing almost every day in each group according to equivalised income and family structure in men (A) and women (B) were calculated using binomial regression analysis. PRs were adjusted for age (5 years category), instrumental activities of daily living (IADL; independent, not independent, missing) and depression (no depression, depression, missing). The lowest equivalised income and living alone category was set as the reference category.

associations between participating in social groups and the frequency of laughter among men in Q1–3; however, the PRs of men in Q4 tended to become greater as their number of social groups increased. Previous research has suggested that relative poverty might be a risk factor for poor emotional well-being among older men[38]; for an older man, relative poverty had a bigger impact on well-being than social isolation. In the present study, relatively poor men (Q1–3) laughed less frequently regardless of the number of social groups in which they participated. In contrast, PRs were higher for women in wealthier groups (Q3 and Q4) and/or those participating in three or more social groups. For older women, interpersonal relationships might have a strong protective or buffering effect for psychosocial stress.[38] The current results revealed that women with three or more social groups laughed frequently even if they had a low equivalised income. In the evolution of human societies, laughing is thought to function as an essential behavioural mechanism for expression of emotion and for the maintenance of social bonds.[25] Larson reviewed research from the past 30 years examining the subjective well-being of older Americans,[39] and found a positive correlation between social activity and well-being.

In our cross-classification analysis on equivalised 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.[40] 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.[41] 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,[6–8 10 13 14] 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 equivalised 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.[14 26] 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 ($p<0.001$).[42] 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 (eg, 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 equivalised income.

CONCLUSION

In this study, we demonstrated a relationship between equivalised 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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