

# Relation between a history of glaucoma and subjective happiness: the JPHC-Next study

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## ABSTRACT

**Objective** This population-based, cross-sectional study was performed to investigate the relationship between a history of glaucoma and subjective happiness.

**Methods and analysis** We conducted a cross-sectional questionnaire-based survey of 92 397 Japanese men and women aged 40–74 who participated in the Japan Public Health Center-based Prospective Study for the Next Generation study. A multivariable logistic regression model was used to estimate the ORs of glaucoma associated with subjective happiness and their two-sided 95% CIs.

**Results** Among 40 727 men and 51 670 women, 1733 participants (635 men, 1098 women) had a history of glaucoma. The odds of unhappiness in male participants with a history of glaucoma were higher (OR 1.26; 95% CI 1.05 to 1.51) than in female participants (OR 1.05; 95% CI 0.90 to 1.23). In a subgroup analysis stratified by age, among participants with a history of glaucoma, males in the younger group (40–59 years) showed the most robust association with unhappiness (OR 1.40; 95% CI 1.04 to 1.88).

**Conclusions** These findings suggest that a history of glaucoma is related with subjective unhappiness, especially in men.

## INTRODUCTION

Happiness is a multidimensional construct comprising both emotional and cognitive domains and has been associated with several health behaviours, such as regular exercise, not smoking, reduced alcohol intake, higher sleep quality and quantity, and healthy diet.<sup>1–4</sup> Generally, subjective measures of health, such as self-reported health, are closely related to happiness.<sup>5–7</sup>

Several reports have evaluated the association between health condition and subjective happiness.<sup>8–11</sup> WHO reports warned that visual impairment severely impacts quality of life (QOL) among adult populations as it contributes to social isolation, difficulty in walking, and higher risk of falls and fractures.

## WHAT IS ALREADY KNOWN ON THIS TOPIC

⇒ The large population studies have not revealed a relationship between a history of glaucoma and subjective happiness.

## WHAT THIS STUDY ADDS

⇒ Participants with a history of glaucoma had 26% increased odds of unhappiness compared with those without glaucoma for male, and 5% for female, respectively.

## HOW THIS STUDY MIGHT AFFECT RESEARCH, PRACTICE OR POLICY

⇒ Our current findings suggest a close link between visual function and one's psychological aspects.

Further, adults with visual impairment often have lower rates of workforce participation and productivity and higher rates of depression and anxiety.<sup>12</sup>

Previous studies have shown that subjective happiness is related with dry eye disease and presbyopia.<sup>13</sup> However, the relation between subjective happiness and glaucoma remains unknown.

Vision-related QOL, defined as a person's satisfaction with their visual ability and how their vision impacts their daily life,<sup>14</sup> may be severely compromised in glaucoma patients,<sup>15</sup> and a significant relationship between vision-related QOL and visual field has been reported.<sup>16 17</sup> Here, we assessed the association between a history of glaucoma and subjective happiness in a Japanese population enrolled in the Japan Public Health Center-based Prospective Study for the Next Generation (JPHC-NEXT study).

## MATERIALS AND METHODS

### Study settings and participants

Data were derived from the JPHC-NEXT study.



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The JPHC-NEXT is being conducted under a population-based cohort design in 16 municipalities of 7 prefectural areas across Japan, namely the Ninohe/Karumai area (Ninohe City and Karumai Town in Iwate Prefecture), Yokote area (Yokote City in Akita Prefecture), Saku area (Saku City, Sakuho Town, Koumi Town, Minamimaki Village, Minamiaiki Village, Kitaaiiki Village and Kawakami Village in Nagano Prefecture), Chikusei area (Chikusei City in Ibaraki Prefecture), Konan/Aki area (Kagami and Noichi districts in Konan City and Aki City in Kochi Prefecture), Ozu area (Ozu City in Ehime Prefecture) and Unzen/Minamishimabara area (Unzen City and Minamishimabara City in Nagasaki Prefecture). Details of the study design have been reported previously.<sup>18</sup> The participants were residents aged 40–74 of these seven areas.

This cohort study was initiated in 2011. The baseline survey was completed on 31 December 2016. A self-administered questionnaire was submitted to all residents of these areas, who were asked to report their lifestyle, personal medical history and sociodemographic situation. The questionnaire was mostly distributed by hand, but also by mail, between 2011 and 2016. Incomplete answers were supplemented by telephone interview. Initially, 114 054 participants consented to participate in the JPHC-NEXT study. Of these respondents, participants who had a history of any type of cancer, myocardial infarction, angina pectoris, stroke, heart failure, diabetes mellitus or depression were excluded (n=20 477). We considered that participants who frequently or regularly visited a hospital because of such conditions had a greater chance of consultation with an ophthalmologist.<sup>19</sup> Responders without information on happiness

were also excluded (n=1180). Finally, 92 397 responders were included in this study [figure 1](#).

### History of glaucoma

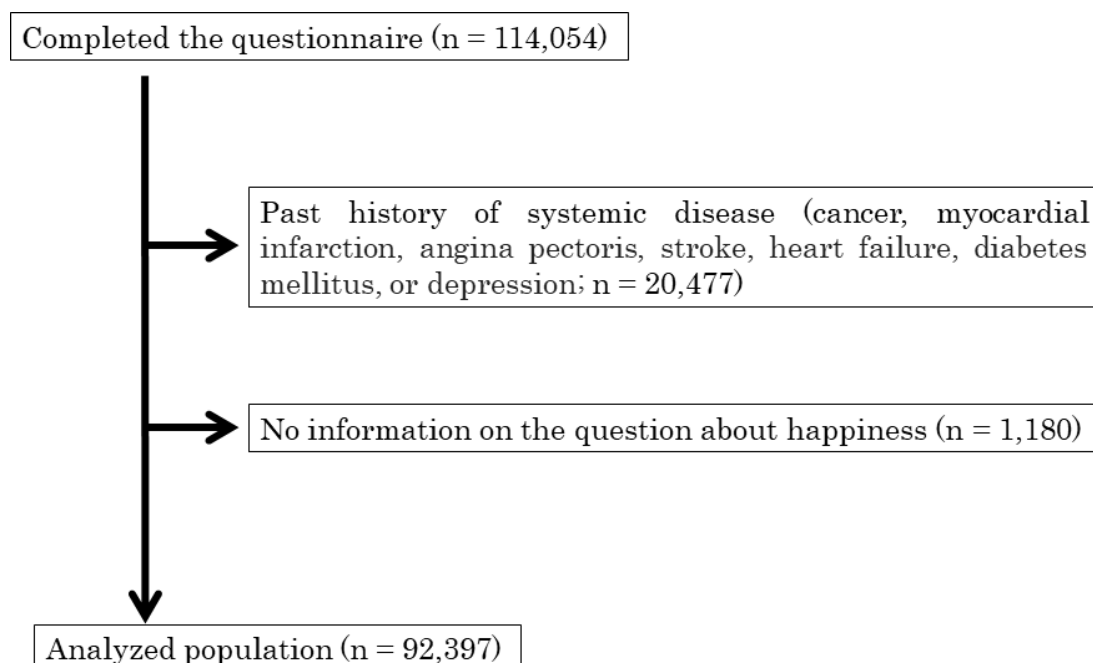
A history of glaucoma was determined based on the participant's answer to the relevant item in the questionnaire, namely the question 'Have you ever been told by a doctor that you have any of the following diseases?'. Possible answer for this study was having a history of glaucoma.

### Subjective happiness

We assessed subjective happiness as an outcome using the single questionnaire item: 'How would you describe your overall state of happiness?' Participants responded with four options, which for this study we dichotomised into unhappy and neither, and happy and very happy, following a previous study.<sup>20</sup>

### Covariates

The following confounding variables were controlled for: age (40–49, 50–59, 60–69 and 70–74 years), cohort area (seven areas), smoking status (never, past and current), alcohol intake (none, past drinker, <150 g/week, 150–299 g/week, 300–449 g/week and ≥450 g/week), education status (junior high school graduate, high school graduate, junior college graduate or more), household income status (<\$30 000/year, \$30 000–59 900/year and ≥\$60 000/year), as well as daily total physical activity level (metabolic-equivalent task score (METs) hours per day). METs hours per day (continuous) was calculated by summing each product of the average time and intensity of physical activity during work-related



**Figure 1** Flow chart of data analysis.

**Table 1** Characteristics of the study population by history of glaucoma

	All participants			Men			Women		
	(-)	(+)	P value	(-)	(+)	P value	(-)	(+)	P value
Glaucoma									
No	90664	1733		40092	635		50572	1098	
Proportion (%)	98.1	1.9		98.4	1.6		98.1	2.1	
Age (mean±SD)	57.5±9.6	63.0±8.3	<0.01	57.3±9.6	62.0±8.5	<0.01	57.6±9.6	63.6±8.1	<0.01
Education (%)									
Junior high school	17.9	21.2	<0.01	18.0	18.4	0.65	17.8	22.8	<0.01
High school	51.1	50.2		51.2	49.4		51.0	50.7	
≥Junior college	31.0	28.6		30.8	32.3		31.2	26.4	
Household income (\$/year) (%)									
<30000	39.8	45.5	<0.01	34.8	38.9	0.07	44.0	49.7	<0.01
30000–59900	37.4	35.3		40.3	36.4		35.0	34.5	
≥60000	22.8	19.3		24.9	24.7		21.0	15.8	
Smoking status (%)									
Never	55.1	67.2	<0.01	20.2	27.3	<0.01	83.6	91.3	<0.01
Past	23.7	23.1		43.3	52.9		8.4	6.2	
Current	20.5	8.8		36.6	19.7		8.0	2.6	
Alcohol intake									
None (%)	37.3	44.3	<0.01	15.5	12.0	0.01	54.7	63.1	<0.01
Past drinker (%)	2.9	3.2		3.7	5.1		2.2	2.2	
Occasional drinker (%)	5.6	4.4		4.1	3.0		6.8	5.2	
Regular drinker (%)									
<150g/week	27.4	27.2		26.6	30.6		27.9	25.2	
150–299g/week	10.7	9.1		17.9	20.0		5.0	2.7	
300–449g/week	8.1	6.0		15.5	14.7		2.1	0.9	
450–g/week	8.2	5.8		16.7	14.7		1.4	0.6	
Total physical activity									
METs-hours/day (%)									
≤34.4	25.4	25.2	<0.01	26.3	29.9	<0.01	24.6	22.4	0.10
34.5–39.4	24.9	28.4		20.7	23.3		28.2	31.3	
39.5–48.8	24.8	24.2		23.5	23.3		25.9	24.7	
48.9–	25.0	22.3		29.6	23.5		21.3	21.6	

Student's t-tests for continuous variables and  $\chi^2$  tests for categorical variables. METs, metabolic-equivalent task score.

walking, strenuous work and leisure-time physical activities.<sup>21</sup>

### Statistical analysis

For our primary analysis, we compared the distribution of variables among each group of participants with a history of diagnosis of glaucoma.

Differences in the distribution of variables between these groups were tested using Student's t-tests for continuous variables and  $\chi^2$  tests for categorical variables. We next used logistic regression to estimate ORs and 95% CIs for the associations of subjective happiness with glaucoma. In the first model, we adjusted for age and living area (OR1). In the final model, we adjusted for age, living area, education, household income, smoking status, alcohol intake and METs hours per day (OR2).

Two-tailed values of  $p < 0.05$  were considered to indicate a statistically significant difference. We performed all statistical analyses using SAS V.9.4.

### RESULTS

Participants in this study were characterised by a history of glaucoma in table 1. The prevalence of glaucoma in this population was 1.9% (1733 participants). The average age of participants with glaucoma was 62.0±8.5 years for males (635 participants, 1.6%) and 63.6±8.1 years for females (1098 participants, 2.1%). Both men and women with a history of glaucoma were significantly older than those without ( $p < 0.01$ ). In addition, characteristics of the study participants stratified with age (younger group:

**Table 2** ORs for happiness by history of glaucoma

Glaucoma	All participants		Men		Women	
	(-)	(+)	(-)	(+)	(-)	(+)
No	90 664	1733	40 092	635	50 572	1098
OR1	1 (referent)	1.03	1 (referent)	1.08	1 (referent)	0.99
(95% CI)		(0.93 to 1.15)		(0.91 to 1.29)		(0.86 to 1.14)
OR2	1 (referent)	1.14	1 (referent)	1.26	1 (referent)	1.05
(95% CI)		(1.02 to 1.28)		(1.05 to 1.51)		(0.90 to 1.23)

OR1, adjusted for age, area; OR2, adjusted for age, area, education, household income, smoking status, alcohol intake, and metabolic-equivalent task score (METs).

40–59 years, older group: 60–74 years) were shown in online supplemental table 1.

Table 2 shows ORs for happiness by history of glaucoma. The odds of unhappiness in participants with a history of glaucoma were significantly higher than in those without among male participants (OR 1.26; 95% CI 1.05 to 1.51). Female participants with a history of glaucoma were subjectively unhappier than those without, but the difference was not significant (OR 1.05; 95% CI 0.90 to 1.23).

In the analysis stratified by age, younger participants aged 40–59 years with a history of glaucoma showed more severe subjective unhappiness (OR 1.40; 95% CI 1.04 to 1.88) than those aged 60–74 years (OR 1.20; 95% CI 0.96 to 1.51) among male participants. In contrast, no significant relationship between subjective unhappiness and history of glaucoma was seen among female participants in either age group (online supplemental table 2).

## DISCUSSION

In this study on the relationship of a history of glaucoma and subjective happiness, we found that participants with a history of glaucoma tended to have more subjective unhappiness than those without this history. In a subgroup analysis stratified by age, among participants with a history of glaucoma, the most robust association with unhappiness was seen in males in the younger group (40–59 years). These findings suggest that younger glaucoma patients may have serious concerns about environmental changes, especially employment, due to progressive visual field impairment.

A nationwide survey of newly certified visually impaired individuals in Japan between 2015 and 2016 showed that glaucoma was the most common disease (28.6%) among all causes of blindness.<sup>22</sup> Here, we found that the OR of unhappiness in participants with a history of glaucoma was high. Although diagnosis and treatment of glaucoma relatively early in its course can help slow the progression rate and minimise functional impairment,<sup>23</sup> a retrospective population-based cohort study by Malihi *et al* estimated that the probability of glaucoma-related blindness in one or both eyes over 20 years' follow-up was

13.5% (95% CI 8.8% to 17.9%).<sup>24</sup> Visual field loss was associated with impaired daily functioning, such as diminished enjoyment of reading and watching television, and a higher risk of incident falling.<sup>25</sup> Further, Zhang *et al* reported that glaucoma patients were subject to being unaware of the progression of their glaucoma, as glaucoma tends to be associated with a younger age at onset and more complex treatment, including both medications and surgeries.<sup>26</sup> In addition, glaucoma surgery was not associated with a significant improvement in Hospital Anxiety and Depression Scale score before and after surgery.<sup>26</sup>

An Australian review indicated that only one-third of the population aged over 65 years with visual impairment was employed, compared with those over this age without visual impairment.<sup>27</sup> Therefore, opportunities for employment may be a concern in glaucoma patients, particularly in the elderly population. Additionally, this review calculated that the total cost of glaucoma, including health system costs, indirect costs and costs of loss of well-being, would increase from \$AUD 1.9 billion in 2005 to \$AUD 4.3 billion in 2025.<sup>27</sup>

In this study, we found that a history of glaucoma increased ORs for unhappiness in men only and that no significant association with subjective happiness was seen in women. In contrast, an institution-based cross-sectional study conducted in Ethiopia<sup>28</sup> showed that female is a risk factor for depression in glaucoma. Considering the social context that the main wage earner in a wage worker's family in Japan is likely to be male,<sup>29</sup> the sex difference in this study may be due to the fact that men are often dependent on their income and that if they have visual impairment, they may have difficulty in working. A multi-ethnic Asian population study showed that even mild visual impairment is associated with unemployment and underemployment.<sup>30</sup> Shimazaki *et al* reported that experience of involuntary informal employment was associated with higher risk of mental health problems, especially among men.<sup>31</sup>

In our male younger group (age 40–59) participants with a glaucoma history, the most prevalent category of household income was the highest category, namely  $\geq$ \$60 000/year. In contrast, among the male

older group (age 60–74) with a glaucoma history, the most prevalent category was the lowest category, at <\$30 000/year (online supplemental table 1). The prevalence of subjective happiness by each household income category is shown in online supplemental table 3. The results showed that 38% of those with the lowest household income (<\$30 000/year) were classified as unhappy and only 17% as happy. Conversely, 38% of those with the highest household income (≥\$60 000/year) were classified as happy and 20% as unhappy. Therefore, we cannot conclude that the higher the income, the unhappier the participants in this study.

A previous cohort study conducted in Taiwan showed that glaucoma patients had a significantly higher risk of depression (adjusted HR=1.71), and raised the possibility that a lack of financial or emotional support may predispose glaucoma patients to depression.<sup>32</sup> In Japan, a multicentre prospective case–control study by Mabuchi *et al* reported a prevalence of anxiety among Japanese patients with primary open-angle glaucoma of 13.0%, and a prevalence of depression of 10.9%.<sup>33</sup> Given that symptoms of depression are associated with happiness,<sup>34</sup> we excluded participants with a history of depression from the main analysis and also conducted a subanalysis which included those with a history of depression (online supplemental table 4). The prevalence of depression among those with a history of glaucoma is almost double that of those without (men: 3.1% vs 1.3%, women: 3.2% vs 1.7%, respectively). Our results are consistent with a previous report showing that younger age was a risk factor for anxiety and depression in glaucoma patients,<sup>35</sup> suggesting that younger glaucoma patients may be anxious about changes in their employment environment, and reduced income due to progressive visual field impairment.

The higher prevalence of glaucoma in women than men in this study might be associated with the difference between sexes in the percentage of participants receiving medical advice in Japan.<sup>36</sup> The Japanese Ministry of Health, Labour and Welfare conducted a patient survey of eligible persons using medical facilities throughout Japan and found that women were more likely to consult a doctor than men.<sup>37</sup>

The strengths of this study are its large participant population and wide enrolment of participants across Japan, and its minimisation of the effects of potential confounding factors in examining the relation between unhappiness and glaucoma.

Several limitations of this study also warrant mention. First, given that the presence of glaucoma was self-reported and information from ophthalmological examinations was lacking, the diagnosis may not be accurate. Additionally, because the current questionnaire did not ask about the severity of glaucoma, this variable cannot be evaluated. While the prevalence of glaucoma in Japanese aged over 40 years is estimated at 5.0%,<sup>38</sup> the self-reported prevalence in this study was low, at 1.9%.

Assessment by self-report might therefore carry the risk of underascertainment of cases, and postsurgical participants may also have answered that they had a history of this disease. Nevertheless, a previous large nationwide population study selected a self-reported history of ophthalmological disease for analysis.<sup>39</sup>

Second, participants who reported that they feel happy may not report histories of disease. Confirmation of these results will require further study using more accurate diagnoses, obtained using medical records or evaluation via ophthalmic examination. Furthermore, as noted above, although the breadwinner in Japanese families is often male, the questionnaire does not enquire about this variable and it cannot be assumed from the answers. Finally, although we excluded participants in the dataset with depression, the potential risk of residual confounding due to depression remains.

In conclusion, this study shows that the presence of glaucoma is associated with subjective unhappiness.

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