



# Characteristics associated with optimistic or pessimistic perception about the probability of contracting COVID-19: A cross-sectional study of Japanese older adults

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## ABSTRACT

**Introduction:** Excessive optimistic perception about the probability of acquiring coronavirus disease (COVID-19) may hinder people from exercising preventive measures, whereas excessive pessimistic perception can induce psychological problems. Not much focus has been paid to this topic, and prior studies are only online surveys. We determined the characteristics of older adults with optimistic and pessimistic perceptions of the probability of contracting COVID-19.

**Methods:** We used data from the Japan Gerontological Evaluation Study (JAGES), including 18,045 participants aged  $\geq 65$  years (mean age: 75.7 years) who were physically and cognitively independent. Self-reported questionnaires were sent to 11 municipalities between November 2020 and February 2021. Multinomial logistic regression was used for data analysis.

**Results:** The characteristics of 1,596 (8.8%) participants with optimistic perception and 1,276 (7.1%) with pessimistic perception were compared with that of others (80.4%) with moderate perception. Optimism about infection probability was positively associated with older age; better perceived financial conditions but negatively associated with higher education level; trust in TV news programs, TV information programs, and government-issued newsletters; depressive symptoms; and higher levels of reciprocity. Pessimism was negatively associated with higher levels of social cohesion. In contrast, it was positively associated with engagement in paid work; trust in TV news programs, the Internet, and information from medical staff; and depressive symptoms.

**Conclusion:** Optimistic and pessimistic perceptions about the probability of acquiring infection correlated differently with various characteristics. Thus, risk communication during a pandemic should be tailored based on specific individual characteristics.

## 1. Introduction

Coronavirus disease (COVID-19) has spread worldwide, and various measures, including the recommendation of staying home to city lockdown have been taken at the government level. In Japan, the number of COVID-19 cases is much lower than that in European countries and the United States; the number of cases per million population was 115.1 in Japan, whereas it was 2703.1 in the United Kingdom, 3371.6 in the United States, 3430.7 in Italy, and 432.4 in the world as of May 1, 2020 (Idogawa et al., 2020). Nonetheless, the pandemic and the associated measures significantly impacted Japanese people's lives and behaviors.

The government declared a state of emergency for the first time from April to May 2020 and requested citizens to refrain from going out. Although the request was not legally mandated, the number of people going out decreased by 60%–80% in major cities during the declaration period (Agoop Corp., 2021). Various social, physical, and cognitive factors may have triggered this voluntary behavioral change. Among them, risk perception of infection and its consequence is a key factor to consider when developing infection prevention strategies by policy-makers and public health practitioners (Brewer et al., 2007).

In an uncertain situation such as a disaster or an infectious disease pandemic, people's cognitive biases tend to be heightened, which can

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lead to distorted risk perception and excessive or inappropriate behavior (Amos Tversky & Daniel Kahneman, 1974). Specifically, optimism bias is a cognitive bias wherein people overestimate the probability of positive events and underestimate the probability of negative events (Sharot, 2011). Previous research has shown that optimistically biased people tend to underestimate their infection probability and are less likely to experience anxiety and fear of acquiring infectious diseases (H. Kim & Niederdeppe, 2013). They are also less likely to take preventive measures against health-related risks of Alzheimer's disease and sexually transmitted infections and more likely to smoke (Dillard et al., 2006; Fontaine & Smith, 1995; Park et al., 2014; Park & Ju, 2016; Popova & Halpern-Felsher, 2016; Wendt, 2005; Wiebe & Black, 1997). People with an optimistic perception of contracting COVID-19 may not wear a mask and may go outside without precaution, which can increase their probability of acquiring the infection and spreading it (Bavel et al., 2020; Chen et al., 2021; H. Kim & Niederdeppe, 2013). A recent study showed that people with an optimistic perception, i.e., those who thought they would not contract COVID-19, were unwilling to take the COVID-19 vaccine (Nomura et al., 2021). However, optimism aids in stress-coping and has shown protective effects against stress and psychological problems during the COVID-19 pandemic (Arslan et al., 2020). In contrast, some people may be biased pessimistically and take strict preventive measures; however, excessive pessimism can induce psychological problems such as anxiety due to fear of infection (Arslan et al., 2020).

Given the potential optimistic and pessimistic perceptions about the probability of acquiring infection in the society-wide health crisis, such as the COVID-19 pandemic, there is a need for effective tailored risk communication based on the characteristics of individuals for promoting preventive behavior. Tailored risk communication is often utilized in social marketing, defined by Kotler and Lee as "a process that applies marketing principles and techniques to create, communicate, and deliver value in order to influence target audience behaviors that benefit society (public health, safety, the environment, and communities) as well as the target audience" (Kotler & Lee, 2008). For example, interventions based on social marketing have succeeded in increasing participation in cancer screening (Hirai et al., 2016; Ishikawa et al., 2012; Olubodun et al., 2022). Despite the merits of social marketing, only a few studies have explored the characteristics of people with optimistic or pessimistic perceptions of the probability of acquiring infection, especially those associated with optimistic or pessimistic perceptions of COVID-19 (Hammad et al., 2021; Jovančević & Milićević, 2020). However, participants in these studies comprised 80% women and did not represent the general population because these surveys were conducted online. Therefore, evidence on the characteristics associated with optimistic or pessimistic perceptions of the probability of contracting COVID-19 is limited.

This study aimed to investigate the characteristics of people with optimistic and pessimistic perceptions of the probability of contracting COVID-19 using a large dataset of older adults in Japan. We focused on older adults because they are one of the high-risk groups for contracting COVID-19 (Petrilli et al., 2020) and require careful communication. Additionally, older adults were more likely to be optimistically biased about the future than younger counterparts owing to less updating beliefs when they face negative events (Chowdhury et al., 2014). Nevertheless, most existing studies on mental health problems during the pandemic have focused on the general population or adolescents, and only a few studies have focused on older adults (Xiong et al., 2020).

## 2. Materials and methods

### 2.1. Study participants

This study was conducted as part of the Japan Gerontological Evaluation Study, a nationwide study of people aged  $\geq 65$  years who are not certified as needing assistance from public long-term care insurance. We

randomly selected eligible residents from 11 municipalities in Japan and sent them self-reported questionnaires from November 30, 2020, to February 8, 2021. Among 24,613 invited residents, 18,238 returned the questionnaires with informed consent for research (response rate: 74.1%). We excluded 193 participants whose sex, age, or municipality of residence were not confirmed or answered in error. Thus, our analytical data consisted of 18,045 participants.

### 2.2. Optimistic and pessimistic perceptions about the probability of contracting COVID-19

Our primary outcome was optimistic and pessimistic perceptions of the probability of contracting COVID-19. We asked participants, "How likely did you feel that you would be infected with COVID-19 during the declaration of a state of emergency (April–May 2020)?" with four options: not at all, possibly, perhaps, or very likely. Based on the question, we constructed a variable including three categories; people who answered "not at all" were defined as being optimistic about infection probability; those who answered "very likely" were defined as being pessimistic; those who answered "possibly" or "perhaps" were set to a reference group.

### 2.3. Characteristics of participants

We examined various characteristics of the participants measured by the self-reported questionnaires: age; sex; marital status (married and spouse is alive; others); education level (low,  $\leq 9$  years; middle, 10–12 years; high,  $\geq 13$  years); living with someone or alone; perceived financial conditions measured by asking, "How do you think about your daily life from a financial viewpoint?" (poor, intermediate, well); engaging in paid work or not; depressive symptoms measured using the 15-item Geriatric Depression Scale (not depressed:  $\leq 4$  points, moderately depressed: 5–9 points, severely depressed:  $\geq 10$  points) (Burke et al., 1991; Wada, T., Ishine, M., Kita, T., Fujisawa, M., & Matsubayashi, K., 2003); Instrumental activities of daily living (IADL) measured using the Tokyo Metropolitan Institute of Gerontology Index of Competence (fully capable: 5 points, less capable:  $< 5$  points) (Koyano et al., 1991); self-reported disease diagnoses (stroke, heart diseases, diabetes, respiratory diseases, cancer, and others (hypertension, hyperlipidemia, gastrointestinal diseases, kidney or prostate gland diseases, musculoskeletal diseases, traumatic injury, blood or immune system diseases, depression, dementia, Parkinson's disease, eye diseases, ear diseases, and other diseases)); providing care measured by asking "Do you look after someone when he/she is sick and confined to a bed for a few days?"; trust in information from media and people that was measured by asking "Which media or people did you refer to the most for taking action during the declaration of a state of emergency?" (TV news programs, TV information programs [an entertaining TV program where celebrities, commentators, or professionals discuss various information], the Internet, government-issued newsletters, family members, friends, and medical staff [multiple answers were allowed]). We selected these covariates, referencing related previous studies (Bavel et al., 2020; Bhuiya et al., 2021; Chen et al., 2021; Hammad et al., 2021).

We also explored social capital consisting of three validated subscales: civic participation, social cohesion, and reciprocity (Saito et al., 2017). Civic participation was calculated as the number of group activities in which the person participated more than once a month. We asked "How often do you participate in each of the following group activities?: (1) volunteer groups, (2) sports groups, (3) hobby activities, (4) study or cultural groups, and (5) activities for teaching skills." If the person participated in more than three activities, we coded the score as 3 to align the range with other subscales. Social cohesion was calculated as the number of answers "moderately agree" or "strongly agree" for the following items: "Do you think people living in your community can be trusted in general?" "Do you think people living in your community try to help others in most situations?" and "How attached are you to the

community you live in?” Reciprocity was calculated as the number of “Yes” answers to the following questions: “Do you have someone who listens to your concerns and complaints?” “Do you listen to someone’s concerns or complaints?” and “Do you have someone who looks after you when you are sick and confined to bed for a few days?”

Additionally, the number of new cases of COVID-19 for each municipality was included in the model. We collected daily data from the website of the municipality or prefecture and averaged the monthly number of new cases per million population across the 4 months of the study period.

## 2.4. Statistical analysis

We performed a multinomial logistic regression analysis to determine the characteristics associated with the optimistic or pessimistic perceptions of infection probability. We employed cluster-robust standard errors at the municipality level to calculate 95% confidence intervals. People who answered “possibly” or “perhaps” to the question about infection probability were included in the reference group, and the odds ratios for optimistic (i.e., for the answer “not at all”) or pessimistic (i.e., for the answer “very likely”) were calculated. We included all the characteristic variables in the model, and crude associations for each variable without adjustment for other variables are also shown in [Supplementary Table S1](#) (see Additional file 1).

Missing values were imputed using random forest (number of trees to grow in each forest = 100), assuming the data were missing at random. We performed a complete case analysis using data from people who did not have missing values ( $n = 14,226$ ; [Supplementary Table S2](#)) (see Additional file 1). All analyses were conducted using R, version 4.1.0 (R Foundation for Statistical Computing, Vienna, Austria).

## 3. Results

The mean age of our participants was 75.7 years (standard deviation: 6.5), and there were 9,468 women (52.5%) and 8,577 men (47.5%). Overall, 86.5% of the participants were fully capable of instrumental activities of daily living, and over 70% reported that they had been diagnosed as having some diseases. More participants trusted information from TV news programs or information programs (88.6% and 60.6%, respectively) than those who trusted information from the Internet or government-issued newsletters (17.9% and 22.6%, respectively). Regarding social capital, people who reported at least one civic participation were 37.9%, while over 80% of participants reported at least one social cohesion or reciprocity (84% and 95%, respectively). Among the participants, 1,596 (8.8%) had an optimistic perception of their infection probability and 1,276 (7.1%) had a pessimistic perception, whereas 80.4% had a moderate perception ([Table 1](#)).

In the multinomial logistic regression model, older age (odds ratio = 1.05, 95% confidence interval: 1.04 to 1.07), better financial conditions compared to those who perceived it as intermediate (1.10, 1.0003 to 1.20), and self-reported diabetes (1.11, 1.01 to 1.23) was positively associated with optimistic perception ([Table 2](#)). In contrast, the following characteristics were negatively associated with optimistic perception: higher education level compared to lower education level (middle: 0.76, 0.66 to 0.86, high: 0.72, 0.62 to 0.83); self-reported heart diseases (0.72, 0.62 to 0.83), and other diseases (0.72, 0.55 to 0.94); trust in TV news programs (0.79, 0.69 to 0.92), TV information programs (0.84, 0.74 to 0.94), and government-issued newsletters (0.94, 0.89 to 0.99); depressive symptoms versus those without depressive tendency (moderately depressed: 0.73, 0.63 to 0.84, severely depressed 0.69, 0.55 to 0.85); and higher levels of reciprocity (0.82, 0.71, 0.95). Conversely, higher levels of social cohesion (0.94, 0.90 to 0.99) was negatively associated with pessimistic perception. In contrast, the following characteristics were positively associated with pessimistic perception; engagement in paid work (1.81, 1.58 to 2.06); self-reported respiratory diseases (1.54, 1.22 to 1.94), and other diseases (1.12, 1.03

**Table 1**

Descriptive statistics of participants (N = 18,045).

| Characteristic                                                    |                  |
|-------------------------------------------------------------------|------------------|
| Age, years, mean (SD)                                             | 75.7 (6.5)       |
| Men, n (%)                                                        | 8,577 (47.5)     |
| Marital status, n (%)                                             |                  |
| Married and spouse is alive                                       | 12,097 (67.0)    |
| Others                                                            | 5,495 (30.5)     |
| Missing                                                           | 453 (2.5)        |
| Educational attainment, n (%)                                     |                  |
| Low ( $\leq 9$ years)                                             | 4,259 (23.6)     |
| Middle (10–12 years)                                              | 7,398 (41.0)     |
| High ( $\geq 13$ years)                                           | 5,936 (32.9)     |
| Missing                                                           | 452 (2.5)        |
| Living with someone, n (%)                                        | 14,451 (80.1)    |
| Missing                                                           | 175 (1.0)        |
| Perceived financial conditions, n (%)                             |                  |
| Poor                                                              | 3,922 (21.7)     |
| Intermediate                                                      | 10,660 (59.1)    |
| Well                                                              | 3,198 (17.7)     |
| Missing                                                           | 265 (1.5)        |
| Engaging in paid work, n (%)                                      | 5,249 (29.1)     |
| Missing                                                           | 602 (3.3)        |
| Depressive symptoms, n (%)                                        |                  |
| Not depressed                                                     | 11,124 (61.6)    |
| Moderately depressed                                              | 3,148 (17.4)     |
| Severely depressed                                                | 1,052 (5.8)      |
| Missing                                                           | 2,721 (15.1)     |
| Instrumental activities of daily living (IADL), n (%)             |                  |
| Fully capable (5)                                                 | 15,616 (86.5)    |
| Less capable ( $< 5$ )                                            | 1,850 (10.3)     |
| Missing                                                           | 579 (3.2)        |
| Self-reported disease diagnoses, n (%)                            |                  |
| Stroke                                                            | 527 (2.9)        |
| Heart diseases                                                    | 1,890 (10.5)     |
| Diabetes                                                          | 2,464 (13.7)     |
| Respiratory diseases                                              | 1,133 (6.3)      |
| Cancer                                                            | 810 (4.5)        |
| Other diseases                                                    | 12,764 (70.7)    |
| Missing                                                           | 656 (3.6)        |
| Providing care, n (%)                                             | 12,917 (71.6)    |
| Missing                                                           | 529 (2.9)        |
| Trust in information from media and people, n (%)                 |                  |
| TV news programs                                                  | 15,982 (88.6)    |
| TV information programs                                           | 10,930 (60.6)    |
| The Internet                                                      | 3,235 (17.9)     |
| Government-issued newsletters                                     | 4,077 (22.6)     |
| Family members                                                    | 4,629 (25.7)     |
| Friends                                                           | 2,347 (13.0)     |
| Medical staff                                                     | 1,180 (6.5)      |
| Civic participation, n (%)                                        |                  |
| None                                                              | 9,886 (54.8)     |
| One                                                               | 3,439 (19.1)     |
| Two                                                               | 2,096 (11.6)     |
| Over three                                                        | 1,297 (7.2)      |
| Missing                                                           | 1,327 (7.4)      |
| Social cohesion, n (%)                                            |                  |
| None                                                              | 2,329 (12.9)     |
| One                                                               | 2,976 (16.5)     |
| Two                                                               | 4,295 (23.8)     |
| Three                                                             | 7,891 (43.7)     |
| Missing                                                           | 554 (3.1)        |
| Reciprocity, n (%)                                                |                  |
| None                                                              | 370 (2.1)        |
| One                                                               | 515 (2.9)        |
| Two                                                               | 1,564 (8.7)      |
| Three                                                             | 15,048 (83.4)    |
| Missing                                                           | 548 (3.0)        |
| The number of new cases of COVID-19, median (interquartile range) | 9.30 (5.3, 10.6) |
| Perceived probability of contracting COVID-19, n (%)              |                  |
| Not at all (optimistic)                                           | 1,596 (8.8)      |
| Possibly                                                          | 6,770 (37.5)     |
| Perhaps                                                           | 7,734 (42.9)     |
| Very likely (pessimistic)                                         | 1,276 (7.1)      |
| Missing                                                           | 669 (3.7)        |

**Table 2**

Multinomial regression for characteristics associated with optimistic and pessimistic perceptions.

| Characteristics                            | Optimistic perception |        |      | Pessimistic perception |        |      |
|--------------------------------------------|-----------------------|--------|------|------------------------|--------|------|
|                                            | Odds Ratio            | 95% CI |      | Odds Ratio             | 95% CI |      |
| Age                                        | 1.05                  | 1.04   | 1.07 | 0.98                   | 0.95   | 1.02 |
| Men                                        | 0.90                  | 0.78   | 1.04 | 1.16                   | 0.95   | 1.41 |
| Marital status                             |                       |        |      |                        |        |      |
| Married and spouse is alive                | 0.98                  | 0.84   | 1.13 | 0.90                   | 0.71   | 1.16 |
| Educational attainment                     |                       |        |      |                        |        |      |
| Low                                        | Reference             |        |      | Reference              |        |      |
| Middle                                     | 0.76                  | 0.66   | 0.86 | 0.92                   | 0.82   | 1.04 |
| High                                       | 0.72                  | 0.62   | 0.83 | 1.06                   | 0.81   | 1.40 |
| Living with someone                        | 0.94                  | 0.84   | 1.06 | 0.98                   | 0.80   | 1.21 |
| Perceived financial conditions             |                       |        |      |                        |        |      |
| Intermediate                               | Reference             |        |      | Reference              |        |      |
| Poor                                       | 1.01                  | 0.85   | 1.22 | 1.21                   | 0.99   | 1.47 |
| Well                                       | 1.10                  | 1.0003 | 1.20 | 0.79                   | 0.61   | 1.02 |
| Engaging in paid work                      | 0.88                  | 0.67   | 1.16 | 1.81                   | 1.58   | 2.06 |
| IADL (Less capable)                        | 1.09                  | 0.88   | 1.36 | 0.98                   | 0.73   | 1.31 |
| Self-reported disease diagnoses            |                       |        |      |                        |        |      |
| Stroke                                     | 0.93                  | 0.78   | 1.13 | 1.09                   | 0.39   | 3.10 |
| Heart diseases                             | 0.72                  | 0.62   | 0.83 | 1.11                   | 0.71   | 1.75 |
| Diabetes                                   | 1.11                  | 1.01   | 1.23 | 1.16                   | 0.88   | 1.54 |
| Respiratory diseases                       | 0.89                  | 0.54   | 1.48 | 1.54                   | 1.22   | 1.94 |
| Cancer                                     | 0.89                  | 0.66   | 1.22 | 1.46                   | 0.98   | 2.17 |
| Other diseases                             | 0.72                  | 0.55   | 0.94 | 1.12                   | 1.03   | 1.22 |
| Trust in information from media and people |                       |        |      |                        |        |      |
| TV news programs                           | 0.79                  | 0.69   | 0.92 | 1.22                   | 1.13   | 1.32 |
| TV information programs                    | 0.84                  | 0.74   | 0.94 | 1.17                   | 0.97   | 1.42 |
| The Internet                               | 0.84                  | 0.69   | 1.02 | 1.22                   | 1.09   | 1.37 |
| Government-issued newsletters              | 0.94                  | 0.89   | 0.99 | 1.12                   | 0.83   | 1.52 |
| Family members                             | 0.96                  | 0.77   | 1.21 | 1.11                   | 0.86   | 1.45 |
| Friends                                    | 1.04                  | 0.58   | 1.86 | 1.06                   | 0.95   | 1.18 |
| Medical staff                              | 1.03                  | 0.43   | 2.46 | 1.60                   | 1.47   | 1.74 |
| Depressive symptoms                        |                       |        |      |                        |        |      |
| Not depressed                              | Reference             |        |      | Reference              |        |      |
| Moderately depressed                       | 0.73                  | 0.63   | 0.84 | 1.37                   | 1.24   | 1.51 |
| Severely depressed                         | 0.69                  | 0.55   | 0.85 | 1.91                   | 1.35   | 2.71 |
| Providing care                             | 0.91                  | 0.81   | 1.03 | 1.10                   | 0.62   | 1.97 |
| Individual-level social capital            |                       |        |      |                        |        |      |
| Civic participation                        | 0.97                  | 0.91   | 1.04 | 1.02                   | 0.94   | 1.10 |
| Social cohesion                            | 1.01                  | 0.92   | 1.11 | 0.94                   | 0.90   | 0.99 |
| Reciprocity                                | 0.82                  | 0.71   | 0.95 | 0.94                   | 0.52   | 1.70 |
| The number of new cases of COVID-19        | 0.97                  | 0.83   | 1.14 | 1.04                   | 0.94   | 1.15 |
| Intercept                                  | 0.01                  | 0.003  | 0.06 | 0.10                   | 0.02   | 0.65 |

to 1.22); trust in TV news programs (1.22, 1.13 to 1.32), the Internet (1.22, 1.09 to 1.37), and medical staff (1.60, 1.47 to 1.74); and depressive symptoms (moderately depressed: 1.37, 1.24 to 1.51, severely depressed: 1.91, 1.35 to 2.71).

Similar results were obtained in the crude analysis (Supplementary Table S1) and complete case analysis (Supplementary Table S2) (see Additional file 1).

#### 4. Discussion

This study explored the characteristics associated with the optimistic or pessimistic perceptions of older adults about their probability of contracting COVID-19. The optimistic perception was positively associated with older age; better perceived financial conditions; and self-

reported diabetes, but negatively associated with higher education level; self-reported heart diseases and other self-reported diseases; trust in TV news programs, TV information programs, and government-issued newsletters; depressive symptoms; and higher levels of reciprocity. On the contrary, the pessimistic perception was negatively associated with social cohesion and positively associated with engagement in paid work; self-reported respiratory diseases and other diseases; trust in TV news programs, the Internet, and medical staff; and depressive symptoms.

Physical factors, such as age and self-reported disease diagnoses, were associated with the perception of the probability of contracting COVID-19. This study showed that older age was associated with the tendency of an optimistic perception. A previous study reported that the association between age and optimistic bias against the risk of COVID-19 was stronger in China than in the US and Israel (Lin et al., 2021). The authors attributed this difference to the cultural context and argued that optimistic bias could be reinforced with aging in a society with strong ties. In line with the finding in an Asian country, we added that the age-related correlation was confirmed even among people aged  $\geq 65$  years. In another interpretation, optimism may protect older adults from distress because they are more likely to fear COVID-19 than younger people (Han et al., 2021; Strunk et al., 2006). Furthermore, we found that self-reported heart diseases, diabetes, and respiratory diseases were associated with risk perception of COVID-19. Diabetes was positively associated with an optimistic perception about the probability of contracting the virus, probably because those with diabetes usually cared for themselves and did not know that diabetes was one of the exacerbation factors of COVID-19. In contrast, people who reported heart or respiratory diseases tended not to be optimistic probably because older age with those diseases, especially respiratory diseases, were famous for exacerbation factors of COVID-19.

Socioeconomic status was also associated with the perception of the probability of contracting COVID-19. We found that low levels of education were associated with optimistic perceptions. A previous study found that lower educational status was positively associated with having misperceptions about COVID-19 (Bhuiya et al., 2021). Indeed, there were many falsehoods about COVID-19 in the early stage of the pandemic, and participants with a low education level might believe such falsehoods and underestimate their infection probability. In this study, those who perceived their financial conditions as wealthy were more likely to be optimistic. Participants whose household economy was wealthy probably did not need to worry about medical expenditure and their life after contracting COVID-19; therefore, they became more optimistic about infection probability (Alicia-Planas et al., 2021; Qin et al., 2021). Engaging in paid work was also positively associated with pessimism about infection probability in this study, although some previous research found that unemployed people were more likely to experience psychological symptoms than employed people at the beginning of the COVID-19 outbreak (Xiong et al., 2020). Employed participants perhaps needed to go outside to work and may have had difficulty in maintaining social distance, which could have evoked a pessimistic perception (Bhuiya et al., 2021). Another possibility is that they could easily realize the influences of the pandemic because some of their work had changed into telework or was canceled suddenly. In addition, we found that people taking care of someone were less likely to be optimistic. Their optimistic perception may have been tempered by a sense of avoiding infecting the people they were taking care of by becoming infected themselves.

Our findings indicated that people who trusted TV news programs and the Internet had more apparent correlations with a pessimistic tendency about their susceptibility than other media, whereas TV information programs and government-issued newsletters were negatively associated with only an optimistic tendency. This may be due to the difference in how each medium covered the information. Previous research found that people's practice of social distancing was more influenced by a government official than a celebrity as a spokesman (Abu-Akel et al., 2021). This finding suggests that who reports the

information and how it is reported influence people's risk perception and their behavior. In Japan, TV news programs objectively reported information about COVID-19 primarily based on press releases from public organizations (e.g., the number of new patients), whereas TV information programs and the Internet often include interpretation of information and subjective opinions of casts and writers. Several professionals or government officials are commentators or writers in TV information programs and government-issued newsletters, and they properly interpret and explain the information about COVID-19. This probably led people who trusted TV information programs or government-issued newsletters to avoid being excessively optimistic about their probability of contracting COVID-19. In contrast, people who trusted TV news programs needed to interpret the information about COVID-19 by themselves, and the Internet was full of not-evidence-based information. In such conditions, people probably accept negative information more strongly than positive information because of negativity bias (Rozin & Royzman, n.d.). Therefore, people who trusted TV news programs or the Internet tended to be excessively pessimistic about their risk of contracting COVID-19. The creators of TV programs and Internet articles should carefully report appropriate interpretations of information and not arouse viewers' anxiety. Additionally, viewers also need to be media-literate to avoid excessive pessimism when perceiving information from media.

Regional variables were also associated with residents' perceptions of the probability of infection. This study showed that those who felt strong social cohesion were less likely to be excessively pessimistic about their probability of contracting COVID-19. This finding was consistent with the evidence that strong social cohesion was negatively associated with negative affect, depression, and hopelessness, whereas it was positively associated with health mastery (E. S. Kim et al., 2020). Furthermore, we found that a strong reciprocity feeling was negatively associated with the optimistic risk perception of COVID-19. This may be because people who felt strong reciprocity could modify their risk perception due to more opportunities to talk with someone about COVID-19. Another possibility is that they could not optimistically think about COVID-19 because they needed to avoid troubling the neighborhood that took care of them.

Our study had some limitations. First, due to the cross-sectional design, our study could not infer causal relationships between participants' characteristics and their perception of infection probability. Second, our findings may lack general application to other demographics because the enrolled participants were limited to Japanese older adults and because the survey focused on the early stage of the COVID-19 pandemic. We found both consistent and contrasting results with the findings of previous studies conducted in other contexts, as discussed above. Third, our measure of the perception of infection probability was a single-item question due to limited space. However, the question seemed face valid, and optimistic and pessimistic perceptions have often been measured using such a single-item question. Similar to our questionnaire, the German Socio-economic Panel measures the tendency of optimistic/pessimistic perception using a 4-point Likert scale. A previous study confirmed that the single-item question was highly correlated with the Life Orientation Test-Revised, a widely-used 10-item scale (Chopik et al., 2020; Scheier et al., 1994). Fourth, some people were invited to the survey but did not return the questionnaire. We could not obtain information on the characteristics of non-respondents; thus, sample selection bias may remain. Nonetheless, the response rate of our survey was higher than that in similar surveys of community-dwelling older adults (Santos-Eggimann et al., 2009). Finally, the participants were asked to recall their infection probability that was perceived more than 6 months ago; thus, the responses may have been subject to recall bias. However, recall bias was unlikely to weaken the perception because the number of new infections was higher during the survey period than during the first declaration of a state of emergency. Although our study has the aforementioned limitations, it also has several strengths. Unlike early findings reported based on the

Internet survey, we conducted a rigorous random sampling survey to obtain population-representative data. Many older adults could not use the Internet; thus, a mail-based survey was crucial to reduce selection bias. Moreover, the large sample size provided sufficient statistical power to detect the observed differences.

## 5. Conclusions

In conclusion, our research found that various characteristics were associated with the perception of the probability of contracting COVID-19. Older age, lower levels of education, perceived wealthy financial conditions, and diabetes were positively associated with an optimistic perception of infection probability. It may be better to educate people with such characteristics regarding the severity and contagious nature of COVID-19 and the importance of preventing the spread of the disease in society. On the contrary, depressive workers tended to be pessimistic. It may be suitable to educate people with such characteristics that they do not need to feel too anxious as long as they properly adhere to preventive measures against COVID-19. Additionally, we found that people who trusted information from TV news programs and the Internet were more likely to have pessimistic perceptions. Both senders and receivers of information using media should be careful not to overstimulate anxiety. Our study provides valuable insights into setting the target and communicating with the vulnerable population to dampen the negative aspects of excessive optimistic and pessimistic perceptions of infection probability through tailored risk communication during this prolonged pandemic. These insights are probably useful for assessing the adequacy of risk communication in this pandemic and preparing for a future pandemic. In this study, we studied Japanese older adults at the early time of the COVID-19 pandemic. Further studies, including younger people, in other countries or in time when people have gotten used to the COVID-19 pandemic, are valuable to guide an appropriate risk communication in more general situations.

## Author statement

Yuta Takemura: Conceptualization, Methodology, Software, Formal analysis, Writing - Original Draft; Koryu Sato: Conceptualization, Methodology, Validation, Writing - Review & Editing, Supervision, Funding acquisition; Katsunori Kondo: Writing - Review & Editing, Project administration, Funding acquisition; Naoki Kondo: Writing - Review & Editing, Supervision, Funding acquisition.

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## Ethical statement

This study was reviewed and approved by the ethics committees of Kyoto University (R3153-2), the National Center for Geriatrics and Gerontology (1274-2), and Chiba University (3442).

## Declaration of competing interest

None.

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## Appendix A. Supplementary data

Supplementary data to this article can be found online at <https://doi.org/10.1016/j.ssmph.2022.101186>.

## References

- Abu-Akel, A., Spitz, A., & West, R. (2021). Who is listening? Spokesperson effect on communicating social and physical distancing measures during the COVID-19 pandemic. *Frontiers in Psychology*, 11. <https://www.frontiersin.org/article/10.3389/fpsyg.2020.564434>.
- Alicea-Planas, J., Trudeau, J. M., & Vázquez Mazariegos, W. F. (2021). COVID-19 risk perceptions and social distancing practice in Latin America. *Hispanic Health Care International*, 19(4), 254–259. <https://doi.org/10.1177/1540415320985141>.
- Amos, T., & Kahneman, D. (1974). Judgment under uncertainty: Heuristics and biases. *Science*, 185. <https://doi.org/10.1126/science.185.4157.1124>.
- Arslan, G., Yıldırım, M., Tanhan, A., Buluş, M., & Allen, K.-A. (2020). Coronavirus stress, optimism-pessimism, psychological inflexibility, and psychological health: Psychometric properties of the coronavirus stress measure. *International Journal of Mental Health and Addiction*, 1–17. <https://doi.org/10.1007/s11469-020-00337-6>.
- Bavel, J. J. V., Baicker, K., Boggio, P. S., Capraro, V., Cichocka, A., Cikara, M., Crockett, M. J., Crum, A. J., Douglas, K. M., Druckman, J. N., Drury, J., Dube, O., Ellemers, N., Finkel, E. J., Fowler, J. H., Gelfand, M., Han, S., Haslam, S. A., Jetten, J., ... Willer, R. (2020). Using social and behavioural science to support COVID-19 pandemic response. *Nature Human Behaviour*, 4(5), 460–471. <https://doi.org/10.1038/s41562-020-0884-z>.
- Bhuiya, T., Klares, R., III, Conte, M. A., & Cervia, J. S. (2021). Predictors of misperceptions, risk perceptions, and personal risk perceptions about COVID-19 by country, education and income. *Journal of Investigative Medicine*, 69, 1473–1478. <https://doi.org/10.1136/jim-2021-001835>.
- Brewer, N. T., Chapman, G. B., Gibbons, F. X., Gerrard, M., McCaul, K. D., & Weinstein, N. D. (2007). Meta-analysis of the relationship between risk perception and health behavior: The example of vaccination. *Health Psychology: Official Journal of the Division of Health Psychology, American Psychological Association*, 26(2), 136–145. <https://doi.org/10.1037/0278-6133.26.2.136>.
- Burke, W. J., Roccaforte, W. H., & Wengel, S. P. (1991). The short form of the geriatric depression scale: A comparison with the 30-item form. *Journal of Geriatric Psychiatry and Neurology*, 4(3), 173–178. <https://doi.org/10.1177/089198879100400310>.
- Chen, S., Liu, J., & Hu, H. (2021). A norm-based conditional process model of the negative impact of optimistic bias on self-protection behaviors during the COVID-19 pandemic in three Chinese cities. *Frontiers in Psychology*, 12, Article 659218. <https://doi.org/10.3389/fpsyg.2021.659218>.
- Chopik, W. J., Oh, J., Kim, E. S., Schwaba, T., Krämer, M. D., Richter, D., & Smith, J. (2020). Changes in optimism and pessimism in response to life events: Evidence from three large panel studies. *Journal of Research in Personality*, 88, Article 103985. <https://doi.org/10.1016/j.jrp.2020.103985>.
- Chowdhury, R., Sharot, T., Wolfe, T., Düzel, E., & Dolan, R. J. (2014). Optimistic update bias increases in older age. *Psychological Medicine*, 44(9), 2003–2012. <https://doi.org/10.1017/S0033291713002602>.
- Corp, A. (2021). Analysis of human flow changes in the spread of a novel coronavirus. [https://corporate-web.agooop.net/pdf/covid-19/agooop\\_analysis\\_coronavirus.pdf](https://corporate-web.agooop.net/pdf/covid-19/agooop_analysis_coronavirus.pdf).
- Dillard, A. J., McCaul, K. D., & Klein, W. M. P. (2006). Unrealistic optimism in smokers: Implications for smoking myth endorsement and self-protective motivation. *Journal of Health Communication*, 11(sup001), 93–102. <https://doi.org/10.1080/10810730600637343>.
- Fontaine, K. R., & Smith, S. (1995). Optimistic bias in cancer risk perception: A cross-national study. *Psychological Reports*, 77(1), 143–146. <https://doi.org/10.2466/pr0.1995.77.1.143>.
- Hammad, A. M., Hamed, R., Al-Qerem, W., Bandar, A., & Hall, F. S. (2021). Optimism bias, pessimism bias, magical beliefs, and conspiracy theory beliefs related to COVID-19 among the Jordanian population. *The American Journal of Tropical Medicine and Hygiene*, 104(5), 1661–1671. <https://doi.org/10.4269/ajtmh.20-1412>.
- Han, M. F. Y., Mahendran, R., & Yu, J. (2021). Associations between fear of COVID-19, affective symptoms and risk perception among community-dwelling older adults during a COVID-19 lockdown. *Frontiers in Psychology*, 12, Article 638831. <https://doi.org/10.3389/fpsyg.2021.638831>.
- Hirai, K., Ishikawa, Y., Fukuyoshi, J., Yonekura, A., Harada, K., Shibuya, D., Yamamoto, S., Mizota, Y., Hamashima, C., & Saito, H. (2016). Tailored message interventions versus typical messages for increasing participation in colorectal cancer screening among a non-adherent population: A randomized controlled trial. *BMC Public Health*, 16(1), 431. <https://doi.org/10.1186/s12889-016-3069-y>.
- Idogawa, M., Tange, S., Nakase, H., & Tokino, T. (2020). Interactive web-based graphs of coronavirus disease 2019 cases and deaths per population by country. *Clinical Infectious Diseases: An Official Publication of the Infectious Diseases Society of America*, 71(15), 902–903. <https://doi.org/10.1093/cid/ciaa500>.
- Ishikawa, Y., Hirai, K., Saito, H., Fukuyoshi, J., Yonekura, A., Harada, K., Seki, A., Shibuya, D., & Nakamura, Y. (2012). Cost-effectiveness of a tailored intervention designed to increase breast cancer screening among a non-adherent population: A randomized controlled trial. *BMC Public Health*, 12(1), 760. <https://doi.org/10.1186/1471-2458-12-760>.
- Jovančević, A., & Miličević, N. (2020). Optimism-pessimism, conspiracy theories and general trust as factors contributing to COVID-19 related behavior – a cross-cultural study. *Personality and Individual Differences*, 167, Article 110216. <https://doi.org/10.1016/j.paid.2020.110216>.
- Kim, E. S., Chen, Y., Kawachi, I., & VanderWeele, T. J. (2020). Perceived neighborhood social cohesion and subsequent health and well-being in older adults: An outcome-wide longitudinal approach. *Health & Place*, 66, Article 102420. <https://doi.org/10.1016/j.healthplace.2020.102420>.
- Kim, H. K., & Niederdeppe, J. (2013). Exploring optimistic bias and the integrative model of behavioral prediction in the context of a campus influenza outbreak. *Journal of Health Communication*, 18(2), 206–222. <https://doi.org/10.1080/10810730.2012.688247>.
- Kotler, P., & Lee, N. (2008). *Social marketing: Influencing behaviors for good*. Sage Publications.
- Koyano, W., Shibata, H., Nakazato, K., Haga, H., & Suyama, Y. (1991). Measurement of competence: Reliability and validity of the TMIG Index of competence. *Archives of Gerontology and Geriatrics*, 13(2), 103–116. [https://doi.org/10.1016/0167-4943\(91\)90053-S](https://doi.org/10.1016/0167-4943(91)90053-S).
- Lin, H., Chang, Y., Chen, C., Ho, Y. W., Xi, W., Zhang, X., ... Ayalon, L. (2021). Are older adults more optimistic? Evidence from China, Israel, and the United States. *The Journals of Gerontology: Series B*, gbab046, 77(4), e83–e94. <https://doi.org/10.1093/geronb/gbab046>.
- Nomura, S., Eguchi, A., Yoneoka, D., Kawashima, T., Tanoue, Y., Murakami, M., Sakamoto, H., Maruyama-Sakurai, K., Gilmour, S., Shi, S., Kunishima, H., Kaneko, S., Adachi, M., Shimada, K., Yamamoto, Y., & Miyata, H. (2021). Reasons for being unsure or unwilling regarding intention to take COVID-19 vaccine among Japanese people: A large cross-sectional national survey. *The Lancet Regional Health - Western Pacific*, 14, Article 100223. <https://doi.org/10.1016/j.lanwpc.2021.100223>.
- Olubodun, T., Balogun, M. R., Odeyemi, K. A., Osibogun, A., Odukoya, O. O., Banjo, A. A., Sonusi, S. E., Olubodun, A. B., Ogundele, O. O. P., & Dolapo, D. C. (2022). Effect of social marketing on the knowledge, attitude, and uptake of pap smear among women residing in an urban slum in Lagos, Nigeria. *BMC Women's Health*, 22(1), 42. <https://doi.org/10.1186/s12905-022-01620-5>.
- Park, J. S., & Ju, I. (2016). Prescription drug advertising, disease knowledge, and older adults' optimistic bias about the future risk of alzheimer's disease. *Health Communication*, 31(3), 346–354. <https://doi.org/10.1080/10410236.2014.957375>.
- Park, J. S., Ju, I., & Kim, K. E. (2014). Direct-to-Consumer antidepressant advertising and consumers' optimistic bias about the future risk of depression: The moderating role of advertising skepticism. *Health Communication*, 29(6), 586–597. <https://doi.org/10.1080/10410236.2013.785318>.
- Petrilli, C. M., Jones, S. A., Yang, J., Rajagopalan, H., O'Donnell, L., Chernyak, Y., Tobin, K. A., Cerfolio, R. J., Francois, F., & Horwitz, L. I. (2020). Factors associated with hospital admission and critical illness among 5279 people with coronavirus disease 2019 in New York City: Prospective cohort study. *BMJ*, 369, m1966. <https://doi.org/10.1136/bmj.m1966>.
- Popova, L., & Halpern-Felsher, B. L. (2016). A longitudinal study of adolescents' optimistic bias about risks and benefits of cigarette smoking. *American Journal of Health Behavior*, 40(3), 341–351. <https://doi.org/10.5993/AJHB.40.3.6>.
- Qin, S., Zhou, M., & Ding, Y. (2021). Risk perception measurement and influencing factors of COVID-19 in medical college students. *Frontiers in Public Health*, 9. <https://www.frontiersin.org/article/10.3389/fpubh.2021.774572>.
- Rozin, P., & Royzman, E. B. (n.d.). Negativity bias, negativity Dominance, and contagion. Vol. 25.
- Saito, M., Kondo, N., Aida, J., Kawachi, I., Koyama, S., Ojima, T., & Kondo, K. (2017). Development of an instrument for community-level health related social capital among Japanese older people: The JAGES Project. *Journal of Epidemiology*, 27(5), 221–227. <https://doi.org/10.1016/j.je.2016.06.005>.
- Santos-Eggimann, B., Cuénoud, P., Spagnoli, J., & Junod, J. (2009). Prevalence of frailty in middle-aged and older community-dwelling Europeans living in 10 countries. *The Journals of Gerontology: Series A, Biological Sciences and Medical Sciences*, 64(6), 675–681. <https://doi.org/10.1093/gerona/glp012>.
- Scheier, M. F., Carver, C. S., & Bridges, M. W. (1994). Distinguishing optimism from neuroticism (and trait anxiety, self-mastery, and self-esteem): A reevaluation of the life orientation test. *Journal of Personality and Social Psychology*, 67(6), 1063–1078. <https://doi.org/10.1037/0022-3514.67.6.1063>.
- Sharot, T. (2011). The optimism bias. *Current Biology*, 21(23), R941–R945. <https://doi.org/10.1016/j.cub.2011.10.030>.
- Strunk, D. R., Lopez, H., & DeRubeis, R. J. (2006). Depressive symptoms are associated with unrealistic negative predictions of future life events. *Behaviour Research and Therapy*, 44(6), 861–882. <https://doi.org/10.1016/j.brat.2005.07.001>.
- Wada, T., Ishine, M., Kita, T., Fujisawa, M., & Matsubayashi, K. (2003). Depression screening of elderly community-dwelling Japanese. *Journal of the American Geriatrics Society*, 51(9), 1328–1329. <https://doi.org/10.1046/j.1532-5415.2003.514207.x>.

- Wendt, S. J. (2005). Perception of future risk of breast cancer and coronary heart disease in female undergraduates. *Psychology Health & Medicine*, 10(3), 253–262. <https://doi.org/10.1080/13548500412331334145>
- Wiebe, D. J., & Black, D. (1997). Illusional beliefs in the context of risky sexual Behaviors1. *Journal of Applied Social Psychology*, 27(19), 1727–1749. <https://doi.org/10.1111/j.1559-1816.1997.tb01622.x>
- Xiong, J., Lipsitz, O., Nasri, F., Lui, L. M. W., Gill, H., Phan, L., Chen-Li, D., Iacobucci, M., Ho, R., Majeed, A., & McIntyre, R. S. (2020). Impact of COVID-19 pandemic on mental health in the general population: A systematic review. *Journal of Affective Disorders*, 277, 55–64. <https://doi.org/10.1016/j.jad.2020.08.001>