The Effect of the Positive Feedback Health Check-up on Health Activities of Older Adults: A Case Study of One District in Japan

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Abstract

This study focuses on the effect of participation in the Yoitoko check-up, a novel check-up that aims to promote health by positive feedback on the actual lifestyle habits of older adults. The Yoitoko check-up provides incentives to increase motivation using praising feedback and promoting their health, this check-up is expected to solve social issues such as well-being for older adults in an aging society. This study contributes to indicating whether there are any differences in older adults' health-promoting activities, between people who have taken this novel check-up with praising feedback and those who have not, that were not analyzed before.

We quantitatively analyze the effect of this novel check-up on health-promoting activities using individual data from a questionnaire created by our research group in 2023 targeting longevity association's members in Maenosho district, Himeji-City, Japan, a mountainous area where aging rapidly and is conducted the novel check-up. Specifically, our research group created a paper questionnaire and asked the district's longevity association president to distribute and collect the questionnaire to 990 members, 700 responded (response rate of 70.7%), and 446 of 700 responses were used as a sample. Our empirical model uses the older adult's health-promoting habits such as moderate exercise, brain-intensive work, enough rest, and careful about meals as a dependent variable; receiving positive feedback participating in the novel check-up as the main independent variable; respondent attributes such as sex, age, working, and cohabiting family members are also independent variables. This study uses a general probit model.

Empirical analysis reveals a significantly positive relationship between participation in the novel check-up and some healthy activities. Specifically, statistically significant and the coefficients are high for active exercise, brain-intensive work, moderate alcohol drinking habits, regular check-ups, and mild exercise, in that order. However, positive feedback does not have a significant effect on being careful about meals and smoking habits, and enough rest. In addition to not being significant, these variables also tend to have low coefficients. These results suggest that the novel check-up brings about certain improvements in some physical and brain healthy habits and provides positive feedback on their habits to promote health.

Key words: Yoitoko check-up, positive feedback, health activities of older adults, probit model
JEL Classification: I10, I12, Z13

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1. Introduction

Maintaining people's health and recommending health-promoting behaviors are becoming increasingly important as the population ages. Therefore, efforts to voluntarily improve the health of older adults are attracting attention worldwide as a measure to combat the aging population and increase healthcare costs. Previous research showed that physical inactivity increases the economic burden and promoting exercise for older people reduce health care costs (Ding et al., 2016; Kamimura et al., 2023). Additionally, incentives such as commendation for positive actions, can be highly motivating, fostering feelings of confidence and satisfaction, and incentives can effectively function as a motivational tool (Yavuz, 2004; Jyothi, 2016; Kefay and Kero, 2019). In an aging society, activities at the private sector level need to promote the health of older people by providing them with incentives to increase their motivation.

This study focuses on the relationship between participation in Yoitoko check-up. This novel health check-up aims to improve the health of elderly people by praising their habits that lead to good health in Japan and implementing actual health habits among older people.[1] In other words, this novel check-up is an attempt to promote the health activity of older people by providing non-financial incentives. This study aims to demonstrate how participation in a novel check-up based on positive feedback works to encourage health-promoting behaviors in older adults. This study provides solutions to the ongoing challenges of aging worldwide by suggesting ways in which older adults can proactively improve their health and cope. Specifically, this study analyzes whether members who have undergone the novel check-up tend to be more proactive in engaging in activities to maintain their health than members who have not.

Previous research showed the importance of positive thinking (optimism), confidence in own abilities, and goal setting in maintaining elderly health (Holahan and Suzuki, 2006; Steptoe et al., 2006; Spiteri et al., 2019). Self-determined exercise motivation and having an optimistic attitude about eating habits promote health (Sproesser et al., 2015; Harada et al., 2024). Next, we confirm empirical studies that have examined the effect of various social factors on health promotion activities. Some studies have shown that health promotion activities are influenced by social support and socioeconomic status, such as income and education (e.g., Kavlak et al., 2013; Liu et al., 2021; Ogunbamowo et al., 2022; Xie et al., 2022; Zheng et al., 2022). On the other hand, some studies suggested that the good effect of positive feedback (e.g., Halperin et al., 1976; Taylor and Brown, 1988; Schuettler and Kiviniemi, 2006; Kluger and Dijk, 2010; Layous et al., 2017).[2]The results of these studies are substantiated through the novel check-up which is a check-up with positive feedback. Yahata et al. (2021) conducted an analysis related to the novel check-up; they also did not compare whether there were any differences in health activities whether receiving a check-up or not. Inoue and Saeki (2022) and Kinugasa et al. (2023) have also conducted some analysis. However, these studies only included participants in the novel check-up and did not include non-participants. In other words, no analysis has been conducted to determine whether

[1] For detail information about the Yoitoko check-up shows in the Japanese website of the Kobe University Graduate School of Medicine (2024).

[2] Although some studies have pointed out problems with a feedback model with using positive feedback (Dohrenwend, 2002; Parks et al., 2013) and research showing no effect of feedback skills themselves (Ramani et al., 2019), how to respond to these studies is a topic for future research.

there are differences between participants and non-participants in the novel check-up regarding the impact on subsequent health-promoting activities.

The main contribution of this study is as follows: we quantitatively demonstrate the effect of the check-up on healthy activities accompanied by positive feedback on the health of older adults; in addition, this study indicates whether there is a difference in the implementation of health activities between who receive a check-up and those who do not, there are no empirical analyses in previous research. Below, we analyze whether receiving positive feedback from undergoing the novel check-up improves physical and mental health activities in addition to daily living functions compared to those who have not undergone the check-up, and examine in what ways this novel check-up is effective in a world where the population is aging.

We explain the structure of this study as follows. Section 2 describes the theoretical background of the Health Belief Model (Becker et al., 1977; Rosenstock et al., 1988) and Self-Determination Theory (Ryan and Deci, 2000), which are the basis of the idea of the novel check-up. Section 3 explains the model and data used to analyze whether or not receiving positive feedback by participating in the novel check-up affects the implementation of health-promoting activities. Section 4 explains and discusses the results of the empirical analysis using a probit model, and Section 5 gives a conclusion.

2. Theoretical Background

One of the most representative health behavior theories is the Health Belief Model (HBM). In the HBM, for people to take health-promoting activities, (i) the threat of disease, (ii) the effectiveness of the health-promoting behavior, and (iii) a reduction in the barriers associated with the behavior are necessary in addition to (i)-(iii), a trigger (motivation) for the behavior is also necessary (Becker et al., 1977; Rosenstock et al., 1988). Furthermore, Rosenstock et al. (1988) proposed adding self-efficacy to the HBM. Self-efficacy is the confidence that one can "perform a certain action successfully," and there are four sources of information that increase self-efficacy: (i) performance accomplishments: one's own successful experiences; (ii) vicarious experience: seeing others perform well; (iii) verbal persuasion: being persuaded by others that "you can perform well" (e.g., being praised); (iv) physiological state: changes appear in one's own body and mind as a result of acting (Bandura, 1977).

About the threat of disease, Rajpura and Nayak (2014) suggest that a threatening view of illness leads to better medication adherence and better health. However, some empirical studies based on HBM have found that interventions to inform people about lifestyle-related threats have no or only weak effects (Sas-Nowosielski et al., 2013; Sas-Nowosielski et al., 2016).

On the other hand, about self-efficacy, many studies have shown that positive thinking (optimism) and self-confidence are important in promoting health activities. Achat et al. (2000) suggested that optimism does not directly affect physical or social functioning but does increase general health awareness, vitality, and mental health levels. For older participants in the Terman Study of the Gifted, the goal of maintaining health and optimism were significant predictors of positive health behaviors (Holahan and Suzuki, 2006). Steptoe et al. (2006) concluded that optimism was related to indices of healthy aging, and effects were partly mediated through health behaviors. Spiteri et al. (2019) indicated that for the age groups of 65-70, peer encouragement and having fun were key motivators of physical activity and lack of belief in capabilities worked as the key

barriers. Thus, to promote the health activities of the elderly, positive thinking, confidence in their capabilities, and the goal of maintaining health appear to be effective. Additionally, Sardella et al. (2021) have shown that an optimistic disposition improves health-related quality of life.

From the above, to promote health activities, it is considered more desirable to encourage people to engage in health activities by encouraging them to think positively (optimism) and gain self-confidence rather than by making them aware of the threat of disease. A related theory is the Self-Determination Theory (SDT: Ryan and Deci, 2000), a theory of human motivation. SDT distinguishes between "controlled (extrinsic) motivation" and "intrinsic motivation." Even within "extrinsic motivation," fear of punishment or (financial) incentives can compel people to act regardless of their inner will. On the other hand, SDT shows that when people are autonomously motivated (acting according to their own inner will) through "intrinsic motivation" or "(sufficiently internalized) extrinsic motivation," they show greater interest, excitement, energy, and confidence in the target behavior, which results in improved performance and overall well-being (Ryan and Deci, 2000; Ryan and Deci, 2017; Ryan and Deci, 2024). The idea behind the novel check-up, which is the check-up with positive feedback, is to "praise" participants to encourage them to think positively (optimism) and engage in health activities following their own inner will without using any coercion, thereby improving the patient's performance in health activities and their health. Some empirical analyses have demonstrated the good impact of positive feedback on health (e.g., Halperin et al., 1976; Taylor and Brown, 1988; Schuettler and Kiviniemi, 2006; Kluger and Dijk, 2010; Layous et al., 2017).

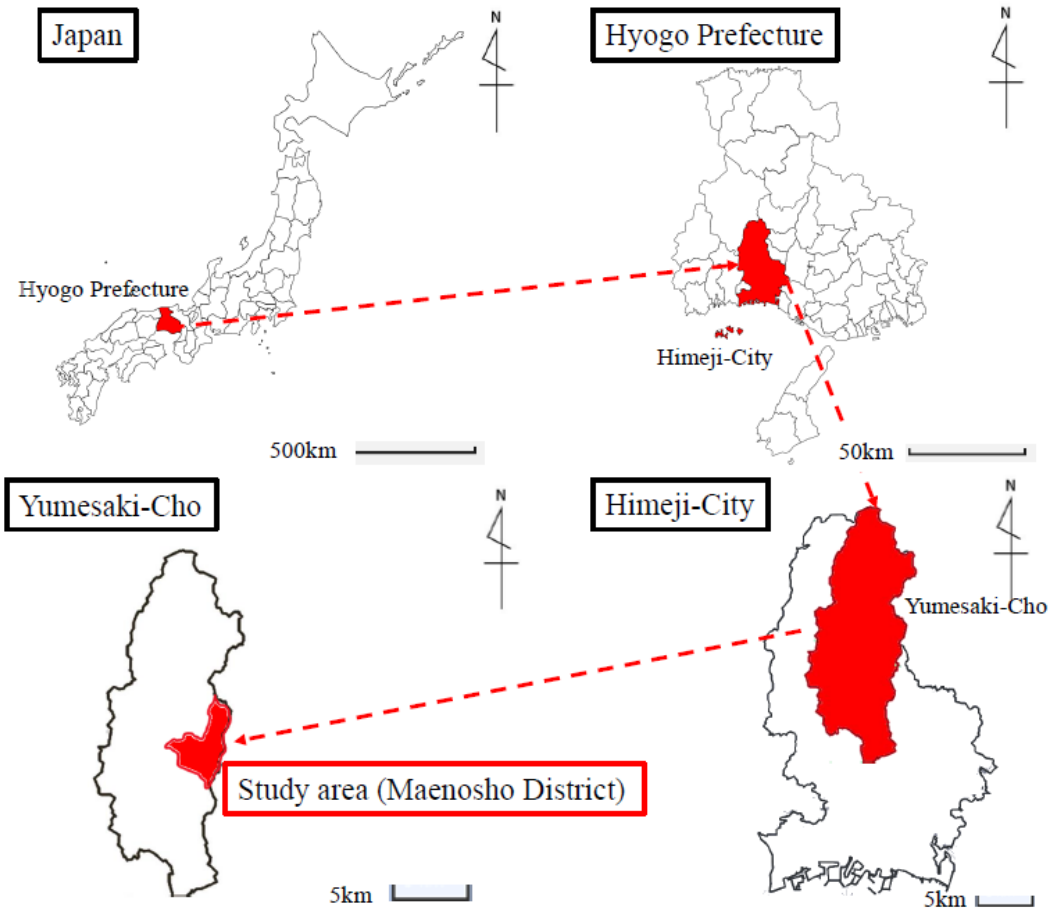
3. Model and Data

In this study, we conduct quantitative analysis using individual data from a questionnaire survey conducted in the Maenosho district in Himeji-city, Japan, where the Yoitoko check-up was conducted. Figure 1 shows the location of the Maenosho district. Maenosho district is located in Yumesaki-cho, Himeji-City, Hyogo, Japan. Maenosho district in Yumesaki-cho is located in a hilly and mountainous area approximately 20km north of the center of Himeji-city.[3] There is also such a geographical environment that this area has a very high aging rate. This questionnaire's specific survey and collection method are as follows: our research group created a paper questionnaire and asked the president of Maenosho district's longevity association to distribute and collect the questionnaire. The questionnaire survey was conducted in 2023, targeting all 990 members of the district's longevity association; 700 members responded to this questionnaire (a response rate of 70.7%).[4]

[3] According to Himeji City (2025), the population of Yumesaki-cho is 15,641 as of the end of December 2024. Yumesaki-cho has an area of 146.22 km^2, giving it a population density of approximately 107 people/km^2, lower than one-third of the average population density in Japan (approximately 334 people/km^2).

[4] Yamaoka et al. (2024) is a related study using the same questionnaire survey. However, they conducted a qualitative analysis of the outlook for a community-based society based on analyzing the factors that influence older people's participation in local activities. The purpose and content differ from this study, which quantitatively discusses the effect of the novel check-up with positive feedback on health-promotive activities.

Figure 1: Location of the Maenosho district of Yumesaki-cho, Himeji-City



Source: Produced by the authors based on the Geospatial Information Authority of Japan map.

Using the data from this survey, we quantitatively analyze the impact of receiving positive feedback by participation in the novel check-up on the health activities of members. This novel check-up provides positive feedback on the health habits of older people and allows them to check what healthy activities they have already achieved. Unlike traditional check-ups, this study predicts that check-up helps older people gain confidence and set goals to maintain health, motivating them to engage in healthy activities. Specifically, we conduct analysis based on the hypothesis that by participating in the novel check-up, older people receive positive feedback on activities of daily living (ADL), social well-being, physical activity, and body composition (e.g., BMI) and are more proactive in engaging in activities that promote physical health, such as those of the body and brain, as well as mental health, in addition to daily living functions, including health activities that are not praising in the novel check-up. We also form the hypothesis that comparing participants in the novel check-up with non-participants, participants are more proactive in health activities. We conducted a questionnaire on both those who received the novel check-up and those who did not. This study analyzes whether participation in this check-

up tends to be more proactive in engaging in health maintenance activities. This study conducts analysis using the following equation (1).

$$\Pr(Healthy\_Activities_i=1|Positive\_Feedback_i, Sex_i, Age_i, Working_i, Doctor_i, Ill_i, Family_i) = \Phi(\beta_0+\beta_1 Positive\_Feedback_i + \beta_2 Sex_i+\beta_3 Age_i+\beta_4 Working_i+\beta_5 Doctor_i+\beta_6 Ill_i+\beta_7 Famlily_i) \quad (1)$$

This study analyzes using a general probit model. In addition, we analyze an extended probit model with instrumental variables as a robustness check considering the endogeneity of the novel check-up. In equation (1), *i* is each district longevity association member. *Healthy_Activities* is the dependent variable, that is, behavior that promotes healthy activities among older adults.[5] Specifically, for each activity that leads to improved health in the body, brain, mental, and eating habits (*Mild Exercise*, *Active Exercise*, *Meal*, *Brain-Intensive Work*, *Regular Check-Ups*, *Enough Rest*, *Stress-Free*, *Sobriety*, *Not Smoking*), dummy variables are created, with a value of 1 if the activity is engaged in and 0 if the activity is not engaged in. We create regression equations for each and perform the analysis.

Positive Feedback in equation (1) is receiving positive feedback by participating in the novel check-up (a dummy variable set to 1 if at least one participation and 0 if non-participation) as a main independent variable. In other words, if the member has participated in the novel check-up at least once, the value of the *Positive Feedback* is 1, and if the member has never participated before, the value is 0. The hypothesis of this study is that positive feedback would increase participants' motivation to engage in health-promoting behaviors, through SDT (Ryan and Deci, 2000) calls "intrinsic motivation" or "(sufficiently internalized) extrinsic motivation." Additionally, according to the HBM, verbal persuasion may increase self-efficacy and lead to behavioral motivation (Bandura, 1977; Rosenstock et al., 1988). Therefore, this study thinks that *Positive Feedback* has a significant positive effect.

Sex is a sex dummy (1 for men and 0 for women). Women tend to live longer and have wider social networks than men, following the HBM, and may be more likely to engage in health-promoting behaviors through vicarious experiences of self-efficacy (Bandura, 1977; Rosenstock et al., 1988). Therefore, this study thinks that *Sex* has a significant negative effect. *Age* is the respondent's age as of 2023, *Working* is a working dummy (1 for employed and 0 for unemployed). Younger people and those with jobs could move their bodies well. Following the HBM, they may be more likely to engage in health-promoting behaviors through performance accomplishments of self-efficacy (Bandura, 1977; Rosenstock et al., 1988). This study thinks that *Age* has a significant negative and *Working* has a significant positive effect. *Doctor* is a frequency of visits to the family doctor.[6] Moreover, *Ill* is a dummy for having a serious illness (1 if the respondent has a serious illness and 0 if not). In this study, we expect *Doctor* and *Ill* have a significant positive effect because they may help people understand the effectiveness of health-promoting behavior and potentially motivate us to engage in

[5] They are variables related to health habits that are determined using a part of Breslow's Health Practice Index (Belloc and Breslow, 1972; Breslow and Enstrom, 1980) and novel variables added by research members.

[6] The value increases as the frequency of medical visits by a family doctor increases, with "never visiting a doctor" being 1, "about once every six months" being 2, "once every two to three months" being 3, "once a month" being 4, "once every two weeks" being 5, and "once a week or more" being 6.

Table 1: Descriptive statistics

Variables	Observation	Mean	Standard Deviation	Minimum	Maximum
Mild Exercise	446	0.552	0.498	0	1
Active Exercise	446	0.056	0.230	0	1
Meal	446	0.426	0.495	0	1
Brain-Intensive Work	446	0.177	0.382	0	1
Regular Check-Ups	446	0.348	0.477	0	1
Enough Rest	446	0.330	0.471	0	1
Stress-Free	446	0.296	0.457	0	1
Sobriety	446	0.390	0.488	0	1
Not Smoking	446	0.392	0.489	0	1
Positive Feedback	446	0.278	0.449	0	1
Sex	446	0.502	0.501	0	1
Age	446	74.825	6.901	64	95
Working	446	0.285	0.452	0	1
Doctor	446	3.363	1.139	1	6
Ill	446	0.765	0.425	0	1
Family	446	0.848	0.360	0	1

health-promoting behaviors (Bandura, 1977; Rosenstock et al., 1988). *Family* is a dummy for having family members living with them (1 if the respondent lives with others and 0 if the respondent is single). Having family members living together may contribute to the goal of maintaining good health. Due to this and Holahan and Suzuki (2006), we expect *Family* to be significantly positive.

Moreover, we use instrumental variables that relate to participation in the local longevity association when analyzing by an extended probit model of robustness check of the endogeneity of the main independent variable (*Positive Feedback*). For the variables (including instrumental variables) used in the extended probit model analysis and the analysis results, we are shown in Appendix, Tables A1 and A2.

Table 1 shows the descriptive statistics for each variable used in the analysis. Looking at the health-promoting behaviors used as the dependent variable, mild exercise was performed by about 55.2%, the most common behavior, while *Active Exercise* is only about 5.6%, the least common behavior. The other variables of health-promoting behaviors are distributed in the range of just under 20% to just over 40%. In addition, the mean for *Not Smoking* is 0.392. This means that over 60% of members did not answer that they were paying attention to quitting smoking.[7]

4. Empirical Results

From the result in Table 2, *Mild Exercise* shows significantly positive values. In addition, receiving positive feedback from attending the novel check-up significantly increases the marginal effect of *Mild Exercise* by 0.097 points, which effect is relatively high. Moreover, *Active Exercise* also has significantly positive values, receiving positive feedback on promoting active exercise by 0.046 points. Therefore, participating in the novel check-up may influence older people to engage in both moderate and active exercise, especially in moderate exercise. Receiving positive feedback has no significant effect on paying attention to their meals

[7] This value is much higher than the smoking rate in Japan (According to the Ministry of Health, Labour and Welfare of Japan (2024), the smoking rate in 2023 of 60-69 is about 17.3%, and that of 70 and older is about 7.3%), but it suggests that many members are paying attention to quitting smoking without being particularly conscious of it, and thereby may not have answered that they were paying attention to quitting smoking.

Table 2: Relationship between receiving positive feedback by the novel check-ups and health activity promotion variables using a probit model

	(1)		(2)		(3)	
Dependent variables	Mild Exercise		Active Exercise		Meal	
	Marginal Effects	Standard Errors	Marginal Effects	Standard Errors	Marginal Effects	Standard Errors
Positive Feedback	0.097*	0.141	0.046**	0.213	0.073	0.139
Sex	0.006	0.124	-0.003	0.201	-0.172***	0.126
Age	-0.002	0.010	-0.002	0.020	0.001	0.010
Working	-0.132**	0.148	0.004	0.239	0.001	0.150
Doctor	0.025	0.055	0.007	0.095	0.047**	0.056
Ill	-0.103*	0.145	0.009	0.235	0.042	0.146
Family	0.063	0.168	-0.021	0.256	-0.077	0.172
Constant		0.809		1.639		0.811
Observation	446		446		446	
Log pseudolikelihood	-298.421		-92.739		-291.270	

	(4)		(5)		(6)	
Dependent variables	Brain-Intensive Work		Regular Check-Ups		Enough Rest	
	Marginal Effects	Standard Errors	Marginal Effects	Standard Errors	Marginal Effects	Standard Errors
Positive Feedback	0.091**	0.160	0.097*	0.140	0.023	0.143
Sex	-0.033	0.150	-0.048	0.129	-0.133***	0.128
Age	0.005*	0.012	-0.004	0.010	0.002	0.010
Working	0.131***	0.172	0.096*	0.151	-0.041	0.157
Doctor	-0.024	0.067	0.040**	0.054	0.023	0.059
Ill	0.078*	0.177	0.065	0.149	0.073	0.149
Family	-0.043	0.193	-0.043	0.169	0.035	0.176
Constant		0.957		0.803		0.821
Observation	446		446		446	
Log pseudolikelihood	-198.264		-280.406		-274.666	

	(7)		(8)		(9)	
Dependent variables	Stress-Free		Sobriety		Not Smoking	
	Marginal Effects	Standard Errors	Marginal Effects	Standard Errors	Marginal Effects	Standard Errors
Positive Feedback	0.082*	0.142	0.121**	0.141	0.087	0.139
Sex	-0.114***	0.130	0.172***	0.127	0.065	0.125
Age	0.0001	0.011	0.003	0.010	0.0004	0.010
Working	0.030	0.156	0.069	0.151	0.064	0.149
Doctor	-0.008	0.060	0.012	0.057	-0.001	0.055
Ill	0.100**	0.151	0.039	0.146	0.002	0.144
Family	-0.047	0.172	0.108*	0.174	-0.005	0.167
Constant	-	0.845		0.826		0.806
Observation	446		446		446	
Log pseudolikelihood	-263.468		-286.773		-295.789	

Notes: 1. *, **, *** indicate that they are significant at 10%, 5%, and 1% level, respectively. To correct for heteroskedasticity, we use the robust standard error.

2. All models in this table correspond to the sample sizes in Table A2.

(*Meal*). Moreover, feedback from the novel check-up does not have a significant effect on changes in smoking behavior (*Not Smoking*). From the above, it is highly likely that undergoing the novel check-up does not affect older people to improve their dietary habits, or their smoking habits. However, praising feedback from this novel check-up has a significantly positive effect on drinking alcohol behavior (*Sobriety*). The marginal effect is the highest of all activities at 0.121, indicating that positive feedback is effective in encouraging appropriate drinking or abstinence.

On the other hand, since receiving the novel check-up has a significantly positive effect on *Brain-Intensive Work*, receiving positive feedback may promote activities that activate the brains of older people. The coefficient value is also relatively high at 0.091. Participating in the novel check-up, which is a health check that praises people, also has a positively significant effect on regular attendance of health check-ups (*Regular Check-Ups*). However, *Enough Rest* is not promoted by taking the novel check-up. Not getting stressed out (*Stress-Free*) is significantly positive, but this is at the 10% level. From this result, receiving positive feedback may not also promote mental health activities. To summarize the results, the marginal effects are highest for drinking alcohol behavior (*Sobriety*), second highest for *Mild Exercise* and *Regular Check-Ups*, following *Brain-Intensive Work*, *Stress-Free*, and *Active Exercise* in that order.

Next, we detail the influence of variables other than receiving positive feedback on health promotion activities. *Sex* is significantly negative for mental health activities (*Enough Rest, Stress-Free*) and careful about meals (*Meal*). However, *Sex* is significantly positive for drinking habits (*Sobriety*). This result suggests that men are less attentive to mental health activities and diet habits than women, but in drinking habits, men pay more attention than women. Additionally, people who work (*Working*) tend to be more enthusiastic about *Brain-Intensive Work* but less enthusiastic about *Mild Exercise*. People with a high frequency of family doctor visits (*Doctor*) tend to have more frequent health check-ups (*Regular Check-Up*s) and also pay more attention to their diet (*Meal*). Presence illness dummy (*Ill*) increases *Stress-Free*, which means people with an illness, have a statistically significant tendency to try not to accumulate stress.

Table A2 shows regression analysis results using an extended probit model using instrumental variables to check robustness and address the endogeneity. In Table A2, the endogeneity test is not significant at the 10% level. This result suggests that the variable suspected to be an endogenous variable, positive feedback, is not an endogenous variable. In this analysis, it is considered desirable to prioritize the results of the (general) probit model shown in Table 2 over the results of the extended probit model shown in Table A2. Based on the results in Table 3, the effect of *Positive Feedback* on health promotion activities is not significant in *Active Exercise* and *Stress-Free*, which are statistically significant in Table 2.

5. Conclusion

According to our results, receiving positive feedback by participating in the novel check-up promotes the practice of healthy habits that stimulate the body and brain, and moderate alcohol or not drinking habits. However, positive feedback does not have much affect healthy activities that stabilize mentally. In addition, this check-up has no significant effect on improving dietary habits, and smoking habits. This result indicates that participation in the novel check-up leads to a certain degree of improvement in some physical and brain habits in addition to daily living functions, the hypothesis is valid to a certain extent. Additionally, this result suggests that the purpose of this novel check-up is to improve the health of older adults by praising their daily habits,

increasing their motivation to engage in health-promoting behavior, and making it easier for them to set goals for maintaining their health, may have been some achieved.

However, there are several points to remember when interpreting these results and making policy recommendations. First, the analysis result suggests that in addition to the content of the feedback obtained through the novel check-up, the act of positive feedback itself is likely to promote healthy behavior. This novel check-up with positive feedback includes cases without feedback about drinking habits. Receiving the novel check-up has a significantly positive effect on drinking habits, and the marginal effect is relatively high. Second, in the case of health promotion activities related to dietary habits and mental health, some measures will be needed to encourage men to actively participate in these health promotion activities, especially since men tend not to participate in these activities.

From the above, this result suggests that the experience of receiving positive feedback has the effect of increasing health promotion activities among older adults through the incentive of praising. On the other hand, there are also problems, such as the result that it does not have a sufficient effect on eating habits or behaviors that promote mental stability. Additionally, it may be necessary to pay attention to encouraging health promotion activities through the effect of receiving positive feedback itself, rather than the content of the novel check-up. Although there are several points to keep in mind and points for improvement, this study indicates that receiving positive feedback from this novel check-up improves the health of older adults and contributes to increasing life satisfaction. As healthy life expectancy increases worldwide, the findings of this study may contribute to improving the quality of life so that people can live longer and more meaningfully. Therefore, this study suggests that positive feedback could help resolve social problems that arise in an aging society, such as the problem of the increasing number of older people living unhealthy lifestyles.

In conclusion, first, this study indicates that receiving positive feedback itself increases moderate alcohol drinking or not drinking, although one does not receive direct praise in the feedback about drinking. Second, this study could not provide any theoretical refutation to the research that denies the effects of positive feedback or feedback skills themselves, such as that shown in Dohrenwend (2002), Parks et al. (2013), and Ramani et al. (2019), although empirical evidence provided. In future research, we would like to further demonstrate the effectiveness of positive feedback skills, thereby improving health-promoting behaviors among older people.

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Appendix. Robustness Check Using an Extended Probit Model

This study uses instrumental variables that relate to participation in the local longevity association when analyzed by an extended probit model of robustness check of the endogeneity of the *Positive Feedback*. Specifically, instrumental variables are the attitude toward participating in the Maenosho district longevity association (*LA Participation*), stance toward activities about district longevity association (*Activeness*), and respondent's residential small area (*Distance*) as instrumental variables for the novel check-up.[8] The descriptive statistics are shown in Table A1. The sample size is the same as the descriptive statistics for the probit model in Table 1, thereby the descriptive statistics other than the instrumental variables not in the probit model are consistent with Table 1.

In addition, we conduct an endogeneity test with the null hypothesis that "*Positive Feedback* is an exogenous variable" by testing the correlation between the error term of the equation estimated using the dependent variables and instrumental variable and the error term when estimated without taking endogeneity into account and including the dependent variables. Moreover, we also conduct an over-identification test. In this analysis by an extended probit model, the number of variables suspected of endogeneity (*Positive Feedback*) is one but the number of instrumental variables is three, thereby an over-identification model. Therefore, we perform a likelihood ratio test with a just-identified case (that is the case of the instrumental variable is only *LA Participation*), the null hypothesis that the instrumental variables, that are included in the over-identification model but not in the just-identification model, are uncorrelated with the error term. Moreover, it is necessary to consider the possibility of weak instrumental variables, that is, the possibility that the instrumental variables are not correlated with *Positive Feedback*. Therefore, we make a weak instrumental variable test based on the null hypothesis that the coefficients of all variables are 0 in the first-stage regression, using the p-value of F-statistics. The analysis and testing results are shown in Table A2. As shown in Table A2, the p-values for the endogeneity tests in all regression equations are not significant at the 10% level, this study determines that there is no endogeneity in *Positive Feedback* and uses the results of the probit model shown in Table 2.

[8] The instrumental variables are selected from the perspective that they affect *Positive Feedback* (attending the novel check-up) but do not directly affect the dependent variables (implementing health promotion activities). *LA Participation* is used as an instrumental variable because older adults who actively participate in the Longevity Association also tend to participate in local events, including the novel check-up, but this does not directly affect health promotion activities. *Distance* is used because it affects attendance at the novel check-up but does not directly affect the implementation of health promotion activities. Alternative variable that indicates the distance (access) from the residence of each member of the longevity association to the novel check-up site. Shinjo and Konokusa, which are far from the site and have different names for the section of the village, are set to 1, and other areas (Oka, Matsunomoto, Saegusa, Honjo, Toyooka, and Nakajima) are set to 0.

Table A1: Descriptive statistics (using an extended probit model)

Variables	Observation	Mean	Standard Deviation	Minimum	Maximum
Mild Exercise	446	0.552	0.498	0	1
Active Exercise	446	0.056	0.230	0	1
Meal	446	0.426	0.495	0	1
Brain-Intensive Work	446	0.177	0.382	0	1
Regular Check-Ups	446	0.348	0.477	0	1
Enough Rest	446	0.330	0.471	0	1
Stress-Free	446	0.296	0.457	0	1
Sobriety	446	0.390	0.488	0	1
Not Smoking	446	0.392	0.489	0	1
Positive Feedback	446	0.278	0.449	0	1
Sex	446	0.502	0.501	0	1
Age	446	74.825	6.901	64	95
Working	446	0.285	0.452	0	1
Doctor	446	3.363	1.139	1	6
Ill	446	0.765	0.425	0	1
Family	446	0.848	0.360	0	1
LA Participation	446	2.276	0.809	1	3
Activeness	446	0.363	0.481	0	1
Distance	446	0.377	0.485	0	1

Table A2: Relationship between receiving positive feedback by the novel check-ups and health activity promotion variables using an extended probit model

	(1)		(2)		(3)	
Dependent variables	Mild Exercise		Active Exercise		Meal	
	Marginal Effects	Standard Errors	Marginal Effects	Standard Errors	Marginal Effects	Standard Errors
Positive Feedback	0.199*	0.301	0.017	0.438	0.108	0.318
Sex	0.007	0.123	-0.003	0.200	-0.171***	0.126
Age	-0.002	0.010	-0.002	0.019	0.001	0.010
Working	-0.132**	0.148	0.005	0.236	0.001	0.150
Doctor	0.024	0.055	0.007	0.095	0.047**	0.056
Ill	-0.101*	0.144	0.009	0.232	0.043	0.146
Family	0.061	0.167	-0.021	0.255	-0.078	0.172
Constant		0.800		1.590		0.814
Observation	446		446		446	
Log pseudolikelihood	-522.773		-313.598		-515.435	
Endogeneity test (p-value)	0.158		0.556		0.512	
Over-identification test (p-value)	0.147		0.108		0.113	
Weak instrumental variable test (p-value)	0.000		0.000		0.000	

	(4)		(5)		(6)	
Dependent variables	Brain-Intensive Work		Regular Check-Ups		Enough Rest	
	Marginal Effects	Standard Errors	Marginal Effects	Standard Errors	Marginal Effects	Standard Errors
Positive Feedback	0.170**	0.327	0.231**	0.284	0.128	0.279
Sex	-0.032	0.147	-0.046	0.127	-0.132***	0.127
Age	0.005*	0.012	-0.004	0.010	0.002	0.010
Working	0.131***	0.170	0.095*	0.148	-0.039	0.155
Doctor	-0.024	0.065	0.039**	0.053	0.022	0.058
Ill	0.082*	0.173	0.070	0.146	0.077	0.147
Family	-0.043	0.191	-0.044	-0.167	0.035	0.174
Constant		0.969		0.797		0.818
Observation	446		446		446	
Log pseudolikelihood	-421.462		-502.357		-497.355	
Endogeneity test (p-value)	0.276		0.170		0.136	
Over-identification test (p-value)	0.085		0.079		0.128	
Weak instrumental variable test (p-value)	0.000		0.000		0.000	

	(7)		(8)		(9)	
Dependent variables	Stress-Free		Sobriety		Not Smoking	
	Marginal Effects	Standard Errors	Marginal Effects	Standard Errors	Marginal Effects	Standard Errors
Positive Feedback	0.082	0.300	0.208**	0.275	0.087	0.300
Sex	-0.114***	0.129	0.172***	0.126	0.065	0.125
Age	0.0002	0.011	0.003	0.010	0.0004	0.010
Working	0.030	0.155	0.070	0.150	0.064	0.149
Doctor	-0.008	0.059	0.012	0.056	-0.001	0.055
Ill	0.100*	0.150	0.041	0.145	0.002	0.144
Family	-0.047	0.172	0.106*	0.173	-0.005	0.167
Constant		0.837		0.824		0.808
Observation	446		446		446	
Log pseudolikelihood	-485.289		-510.632		-519.644	
Endogeneity test (p-value)	0.435		0.397		0.979	
Over-identification test (p-value)	0.101		0.088		0.109	
Weak instrumental variable test (p-value)	0.000		0.000		0.000	

Notes: 1. An example of how to read the table is presented in Table 2.

2. In this analysis, *Positive Feedback* is used as the variable treated as an endogenous variable, and variables related to participation and stance in the local longevity association (*LA Participation*, *Activeness*) and respondent's access from the residence to the novel check-up site (*Distance*) are used as the instrumental variable.

3. All models in this table correspond to the sample sizes in Table 2.