Title

Impact of COVID-19 lockdown on South Korean citizens' behavioral changes: An online survey between the first waves of the pandemic

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Keywords

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Abstract

This study analyzed the behavioral changes in individuals in South Korea due to restrictions on going out during the COVID-19 pandemic and examined the state of the psychological changes. We examined attributes such as age and gender, place of residence, characteristics of the residential environment, and of the communities they came into contact with, which are considered to be the factors responsible for psychological changes in individuals. The results of the analysis of the psychological changes showed that the differences were more significant for attributes such as age and gender than for spatial characteristics such as residential area and type of residence. In addition, depression was found to be greater in specific gender and age groups. In particular, those in their 20s were found to be more depressed than those in their 30s and 40s, even though they are less prone to getting infected with COVID-19 as compared to older adults. Through the findings of this study, we have obtained materials and factors that should be taken into account while preparing policies to counteract future waves of COVID-19.

1. Introduction

Due to the prolonged duration of the COVID-19 pandemic, the number of people who are under psychological stress is increasing (1), especially among younger people living alone, older adults, and people living in households that could easily become isolated.
The scale of the spread of the infection in East Asia is relatively small compared to Europe and the United States, despite the fact that Taiwan, Japan, and South Korea have similar forms of governance, comparable levels of economic development, and are classified as high-income countries. South Korea and Japan are managing the virus by requesting the public to follow administrative guidelines such as staying at home and social distancing, while being compatible with economic activities. In these countries, it is necessary to continue social distancing to control the spread of the infection.
Among these countries, South Korea has taken strong social distancing measures and its policies have been effective to some extent. At the time of writing (early 2022), the number of infected people was still increasing but mortality rates were low. However, it has also been pointed out that citizens have become fatigued due to long-term social distancing protocols. Therefore, psychological care of citizens, while taking measures against the pandemic through social distancing has become an important topic.

According to an early-stage survey in Japan (conducted from March 26–28, 2020) (2), a large proportion of women and older adults refrained from going out, whereas unmarried men in their 20s, groups with a low annual income, and groups with high extroversion did not change their behavior significantly in terms of going out. In addition, a study on topic modeling using big data on media coverage of COVID-19 measures in South Korea (1) used SNS data and divided each period into "concern," "caution," "alarm," and "seriousness" (3).
Existing studies on the impact on citizens during COVID-19 have provided an overview of the current status and details of behavioral changes and factors that could be considered. However, the distinction of behavior changes between people who are likely to show self-restraint and those who are not, is not clear.
Although research focusing on behavioral change has been accumulating, there has not been sufficient consideration of the psychological changes individuals experience as a result of behavioral change. Therefore, the purpose of this study is to examine the behavioral and psychological changes in individuals who refrained from going out as a counterpart measure to COVID-19. The following factors were considered as possible

causes for the psychological changes: personal attributes, place of residence, characteristics of the residential environment, and characteristics of the community with which one is in contact. Based on the results of this study, we propose methods on how to promote social distancing and strategies that would be effective during a prolonged pandemic. The research questions for this study are as follows:

1. What kind of psychological changes did people experience as a result of refraining from going out during the spread of COVID-19?
2. What are the possible causes of these psychological changes? How do the possible factors differ according to personal attributes, the characteristics of the place of residence and living environment, and the characteristics of the communities they come into contact with?

2. Literature Review

In this study, we reviewed relevant works on urban changes and citizens' lives under COVID-19 conditions in South Korea. As a result, it can be said that there is still a lack of research results on the psychological impact and changes caused by COVID-19 in South Korea, taking into account individual and regional characteristics.

In the early stages of the pandemic, epidemiological studies were conducted and published, mainly in *The Lancet*, focusing on the analysis of the spread of the disease in China, where the infection first appeared. (4,5). In the second half of 2020, various studies on the specific social impact of COVID-19, regional differences, and cultures began to appear.

COVID-19 is said to exhibit a completely different trend compared to previous infectious diseases (6), and its impact is global, with environmental influences such as climate and population density in different countries (7, 8), and differences in the spread of the disease due to social background and countermeasures (9). Therefore, it is necessary to consider the measures taken in each region in detail. A study (10) that examined the development of the South Korean strategy to control the spread of COVID-19, with a particular focus on ethical issues and the politicization of public communication, found that the communication of information related to the pandemic, which should be done by the medical community, was either politicized or politicized by religious exclusivity. It was evident that this kind of communication significantly impacted society as a whole. In this regard, there was a collapse of social support structures and the stigmatization of patients, with far-reaching and long-term health and social consequences. Some papers also analyzed the relationship between coping with

COVID-19 and well-being, and were concerned about the pandemic's prolonged duration (11).

According to the results of a study on the psychological crisis situation in the early stages of the pandemic in Japan (7), suicides rates attributable to COVID-19 were higher among women than men as of September 2020, and about 20%–30% higher than in previous years. Among other things, this could be ascribed to an employment unbalanced resulting in a larger number of female non-regular workers, but this study was not able to extract these factors (12). Detailed discussions were also conducted on how the suicide rate changed depending on these attributes. A study on suicide rates and the psychological effects of the pandemic in Japan found a greater wariness toward foreigners with respect to individual differences and values (7). For variables directly related to COVID-19, while there were gender differences, there were no differences by generation or location of residence.

An early study on COVID-19 in South Korea (13) analyzed changes in the psychological and behavioral effects of the virus by using the data of 937 people in an internet survey. The results showed a causal relationship between psychological impact and behavioral change due to the spread of COVID-19 (3).

A study that explored the impact of COVID-19 on mental illness in multiple regions in South Korea (1), examined various health aspects and their relationship with the local environment.

Further, the results of a survey conducted among 1,500 South Korean citizens on the psychological stress caused by COVID-19 showed that the effects differed by gender. Men were more worried about the economic aspects of their lives, while women were more worried about their daily lives. Thus, it can be seen that the anxiety caused by the pandemic differs by gender. Furthermore, the study (14) pointed out that the South Korean government's response to the COVID-19 pandemic was very effective, although it was very difficult to maintain mental health due to the strict regulations. The study (14) also pointed out that the different situations among men and women in South Korea make the relatively vulnerable female population even more vulnerable to psychological impact. The study also found differences by age, with younger people being more depressed than older people. Household characteristics were also found, with two-person households without children such as DINKs (double income, no kids) and couples, experiencing less stress and psychological impact than single-person households and family households with children. The results of these studies suggest that it is necessary to analyze the psychological effects of stress in more detail.

3. Methods

3.1 Target area: Spread of infection in South Korea

South Korea was one of the first countries in the world to confirm cases of COVID-19. Government-led social distancing measures were introduced at an early stage and raised to Level 2 [1] after the first infected person was found in late January 2020. In February 2020, following the spread of the infection, mainly in Daegu City, strong social distancing measures were introduced for about a month from mid-March. This was followed by a gradual relaxation from May to June. In this way, the strength of the social distancing measures was adjusted according to the spread of the infection, and citizens who had to adapt to these changes became exhausted.

The evolution of COVID-19 cases and related fatalities in South Korea is presented in Fig. 1 for the period between the first infection until the beginning of the vaccination campaign, which was a departure from the prevailing measure against COVID-19. Fig. 2 illustrates the so-called "constringency index," which is a measure created to evaluate the strictness of COVID-19 counterpart measures enforced in a country. It is based on nine response indicators including school closures, workplace closures, and travel bans. The minimum is set to 0 (no restrictions), which corresponding to the pre-pandemic scenario, and the maximum to 100, representing the strictest policies.

Fig. 1: Evolution of the confirmed COVID-19 cases (blue) and related deaths (red) in South Korea. Curves are smoothed to improve visualization and the data collection period is highlighted in yellow.

Fig. 2: Constringency index for South Korea from the first confirmed COVID-19 case until the start of the vaccination campaign. Data collection period is highlighted in yellow.

3.2 Outline of the study

In this study, we investigated changes in going-out behavior and psychological conditions during August 2020, when the spread of infection had settled down. We conducted a questionnaire survey among men and women living in South Korea, aged 20–69 years.

[1] Level 2 of social distancing in South Korea entailed three main guidelines: (1) banning public gatherings, including private/public face-to-face gatherings of 50 or more people indoors and 100 or more people outdoors; (2) gatherings in 12 types of high-risk facilities including clubs, singing rooms, and buffet restaurants were banned; and (3) national and public indoor facilities run by the government, local governments, and the offices of education and affiliated agencies were closed.

The survey was conducted in collaboration with the Macromill Embrain, an Internet survey company with 1,324,315 potential survey participants, all with individual identification numbers. For this study, a sample of 535 participants were randomly selected by age and region. The survey yielded 535 responses. Table 1 provides an overview of the survey items analyzed in this study.

Table 1: Outline of the survey items analyzed in this study

Fields	Questions	Indicator
Respondent demographics	Age, sex, education, occupation, place of residence, residential attributes	Single Answer
Psychological change	Life satisfaction, stress, and change in mood between the time of response and the time before the spread of COVID-19	7-point scale and 5-point scale
Number of outings in a week	Frequency of going out in a week in each of the three periods (before the spread of infection, in the midst of the first wave of infections, and now): "Never," "1–2 times a week," "3–4 times a week," "Once every two days," "About once a day," "Several times a day."	6-point scale

3.3 Analysis method

We used the survey data to calculate and compare psychological indicators using IBM SPSS Statistics 27. In addition, we conducted cross-tabulations on individual characteristics such as age and gender, spatial characteristics, and the size of the community with which participants maintained contact, and confirmed through t-tests whether the psychological changes of a particular group were large or not. T-tests are used to compare averages between two groups based on t-distributions. The t-test is a type of parametric test. It is also a common test to find a statistically significant difference between two groups.

4. Results

4.1 Changes in going-out behavior

In this survey, behavioral changes were examined at three points in time, and psychological changes (happiness and stress) were examined at two points in time.

The three time points were defined as “before the spread of the infection,” “during the spread of the infection,” and “now.” This is based on the first wave of COVID-19 in Daegu at the end of February 2020. After this point, we defined “before the spread of the infection” as the time before February 2020, and “during the spread of infection” as the time when the infection started to spread in Daegu in February 2020. “Now” refers to the time of survey, August 2020. The two time points, “before the spread of infection” and “now,” are illustrated in Appendix 1.

The calculation method is as follows.

$X1 = Xt - Xt\text{-}1$

> “At the time of the spread of infection” selection number − “Before the spread of infection” selection number = change from before the spread of infection to the time of the spread of infection
>
> “Now” selection number − “At the time of spread” selection number = change from the time of spread to August 2020
>
> “Now” selection number − “Before” selection number = change from before the spread of infection to August

Fig. 3 shows the frequency of going out a week before the spread of the infection, at the time of the spread of the infection (around the end of February), and at the time of the survey (early August).

Fig 3. Frequency of going out in the week before the spread of the infection, at the time of the spread of the infection (around the end of February), and at the time of the survey (early August).

In terms of the number of times respondents said they went out a week before the spread of infection, the most common response was “once a day,” followed by “1–2 times a week.” When the epidemic started, the overall trend shifted toward going out less frequently. At the time, the government passed a law restricting people from going out,

so it was only natural that people went out less. In August, the number of people going out increased more than when the infection had spread. However, there were fewer people than before February. This indicates that there was indeed a large decrease in outings from before the spread of the infection to the time of the spread of the infection, but there was an increase in outings from that time to August.

Only those who had increased their outings between the time of the spread of the infection and August were asked to respond to the importance of their outings (Table 2). Approximately 29% of the respondents answered that it would have been inconvenient to live without going out even if they increased their outings for work. In the case of non-work-related outings, 6% said it was inconvenient, but 84% increased their outings even though the importance of such activities was not that high. In other words, there was some loosening of people's attitude toward going out in August.

Table 2 Importance of going out for respondents with increased outing behavior: Work and non-work purposes

Changes in importance	Going out for work		Going out for non-work	
Refraining from going out doesn't change that.	47	(25%)	69	(37%)
Not going out and making life somewhat inconvenient for yourself and others	54	(29%)	90	(48%)
Not going out and doing great damage to your own and others' lives	36	(19%)	18	(10%)
Getting out and about makes it difficult to maintain your own and others' lives	49	(26%)	9	(5%)
If you don't go out, your own life and the lives of others will be in jeopardy	3	(2%)	3	(2%)

3.2 Psychological Changes

We examined the most recent psychological changes caused by the stay-at-home order. Participants were also asked to respond to changes in mood before and after the spread of the infection.

In terms of life satisfaction, the ratio of "Very dissatisfied," "Moderately dissatisfied," and "Slightly dissatisfied" responses increased overall from before to after the spread of infection. Regarding changes in stress levels, as in the case of life satisfaction, respondents were more stressed during the spread of infection than before it (Table 3).

Table 3. Changes in life satisfaction and stress before and after the spread of infection: number of answers (upper) and percentage of respondents (lower)

Life Satisfaction	Before spread	After spread	Stress	Before spread	After spread
Very dissatisfied	8	37	very stressful	11	63
	1%	7%		2%	12%
Moderately dissatisfied	14	64	moderately stressful	32	112
	3%	12%		6%	21%
Slightly dissatisfied	48	145	slightly stressful	88	137
	9%	27%		16%	26%
Neutral	170	159	neutral	160	130
	32%	30%		30%	24%
Slightly satisfied	174	88	slightly good	136	59
	33%	16%		25%	11%
Moderately satisfied	96	36	moderately good	88	28
	18%	7%		16%	5%
Very satisfied	25	6	Very good	20	6
	5%	1%		4%	1%

In other words, when comparing the values before and after the spread of the infection, life satisfaction decreased after the spread of the infection, and the number of people who were stressed increased. We also asked the respondents to indicate how their normal mood had changed from before the spread of the infection. The most common answer was “No change,” followed by “Got Worse.” The latter accounted for 41% of the total (Fig. 4).

Fig 4. Change in mood (n=535)

Next, we analyzed whether the psychological changes before and after infection were positive or negative. Appendix 2 shows an example of a questionnaire on psychological changes.

In the case of the changes in life satisfaction and stress levels, the change was defined as a negative change if it worsens, no change if it is the same, and a positive change if it improves. In the case of change in mood, negative change was defined as “much worse” or “worse,” unchanged as “same,” and positive change as “better” or “much better.”
In terms of the change in life satisfaction, 61% of the respondents answered negatively, 35% answered that it had not changed much, and 4% answered positively. Similarly, 62%

of the respondents answered negatively in terms of changes in stress. In terms of the change in mood, 45% of the respondents answered negatively. (Fig. 5)

Fig 5. Increase/decrease in emotional changes (%): change in happiness/life satisfaction (left), change in stress level (center), and change in mood (right) (n=535)

The survey also asked the respondents about their recent feelings at the time of the survey. Looking at Table 4, we can see that negative factors such as “fatigue,” “helplessness,” “boredom,” “anxiety,” and “depression/sadness” occupied the top positions. This indicates that fatigue, helplessness, and boredom are among the most common feelings among citizens as of August.

Table 4 The feelings of respondents at the time of the survey

Emotions	Number of responses	Emotions	Number of responses	Emotions	Number of responses
Fatigue	342	Indifference	127	Confused	42
Helplessness	236	Fretfulness	92	Full of vitality	41
Boring	205	Restraint feeling	77	Impatient	40
Anxiety	183	Active	72	Feeling love with dear one	38
Melancholy, sadness	170	Calm	72	Interesting	30
Enough rest	142	There are ups and downs of emotions	65	Freshness	29
Hollowness	137	Scary	62	Open	26
Loneliness	136	Energetic, happy, joy	56	Full of imaginatio n	16
				Others	4

4. Analysis of Factors Affecting Psychological Change

4.1 Differences in Psychological Change by Respondents’

Attributes

In this section, we analyzed the differences in psychological change by respondent attributes and tabulated the factors related to psychological change.

4.1.1 Differences in psychological change by age

According to the results, the percentage of respondents in their 20s whose life satisfaction levels worsened was not so large, but was larger than that of other age groups. In terms of changes in stress levels, there was a tendency for stress levels to increase with age, generally starting in the 30s. In terms of changes in mood, the percentage of worsening was highest among those in their 40s, while it was relatively low among those in their 20s and 30s.

- Change in life satisfaction

There was a significant difference in life satisfaction levels between participants in their 20s and 30s, 30s and 50s, and 30s and 60s; there was a slight difference between those in their 20s and 40s, and those in their 40s and 60s. (Fig 6)

Fig 6. Difference of changes in life satisfaction by age

- Differences in stress level by age

There was a significant difference in stress levels between participants in their 30s and 50s, and between the 30s and 60s. There was a slight difference between those in their 40s and 50s, and those in their 40s and 60s. (Fig. 7)

Fig 7. Differences of change in stress by age

- Change in mood by age

There was a significant difference between mood changes between those in their 20s and 40s; there was a slight difference between those in their 30s and 40s, and between participants in their 40s and 60s (Fig. 8).

Fig 8. Differences of change in mood with age

- Differences in psychological changes by gender

As for the differences by gender, the percentage decrease in all three items of psychological change was significantly greater in women. Table 5 shows that the

psychological impact was greater among respondents in their 20s and 30s, and that the psychological change experienced by women was greater than for men. Therefore, women in their 20s and 30s were more severely impacted by the pandemic situation than others. The results of the t-test showed a significant difference by gender, indicating that women experienced more negative psychological changes than men ($t(533) = 2.60$, $p < .05$).

Table 5 Mean, variance, and t-value of emotional changes by gender

	Male		Female			
	Mean	Variance	Mean	Variance	t-value	
Life satisfaction	-0.88	1.67	-1.17	1.70	2.60	*
Stress	-0.95	1.81	-1.31	2.06	3.01	*
Mood	3.34	0.43	3.53	0.44	-3.36	*

- Differences in psychological changes between those who live alone and those who do not

When analyzing the difference in psychological change between those who live alone and those who live with others, it was found that there was no significant difference in psychological change between the two groups. However, there was a tendency for all psychological change items to worsen for those who live alone.

4.2. Differences in psychological changes according to the characteristics of respondents' residential areas

4.2.1 Differences by region of residence

The differences in psychological changes between participants living in the Seoul metropolitan area and those living in other regions showed that changes in life satisfaction, stress, and mood were worse for those living in the Seoul metropolitan area. However, a significant difference was only seen in levels of life satisfaction (Table 6).

Table 6 Mean, variance, and t-value of emotional changes with region of residence

	Seoul metropolitan area			Other areas			
	Mean	Variance		Mean	Variance	t-value	
Life	-1.11	1.67		-0.89778	1.726111	-1.88	*

satisfaction							
Stress	-1.17	1.85		-1.07	2.12	-0.80	n.s.
Mood	3.45	0.49		3.41	0.39	0.61	n.s.
* $p < .05$							

Furthermore, the three areas that constitute the Seoul metropolitan area: Seoul City, Incheon City, and Gyeonggi Province were compared. Gyeonggi Province showed the greatest deterioration in all of the psychological items (life satisfaction, stress level, and mood); however, statistically significant differences were only found in the "Life satisfaction" category in the central area of Seoul and the other suburban metropolitan regions, and the three prefectures within the urban area.

4.2.2 Type of residence

In terms of changes in life satisfaction levels, those living in detached houses (stand-alone residences that do not share walls with other buildings) experienced the least deterioration in life satisfaction (Fig. 9). There were also differences in stress levels and changes in mood, but these differences were not significant in the t-test (Figs. 10 and 11).

Fig 9. Difference of change in life satisfaction with the type of residence
Fig 10. Difference of change in stress with the type of residence
Fig 11. Difference of change in mood with the type of residence

4.2.3 Size of the community

We found that psychological changes did not change linearly with community size. In the case of changes in the level of life satisfaction, there was a slight deterioration in small, medium, and large communities. Further, in terms of the level of life satisfaction, the percentage of worsening was the largest. (Fig. 12). The deterioration in terms of stress level was larger in small, medium, and large communities, compared to the decrease in their life satisfaction. However, the percentage decrease was the smallest, compared to the change in their life satisfaction (Fig. 13). Last, with regard to the changes in mood, the deterioration was the smallest in medium and large communities (Fig. 14).

Fig 12. Difference of change in life satisfaction with the size of community
Fig 13. Difference of change in stress with the size of community

Fig 14. Difference of change in mood with the size of community

5. Discussion

In Section 4, psychological depression was observed before and after the infection spread in South Korea, and depression was also greater among women and respondents in their 20s. With regard to gender, the proportional deterioration was significantly higher among women across all three categories. With regard to age, the deterioration was generally high in participants in their 30s to 60s in terms of life satisfaction and stress levels. The study also found that psychological changes tended to worsen more in those who lived alone than in those who lived with others

In this section, we analyzed how psychological changes differed, and which attributes were more significant, such as age and gender. However, we could not find significance for spatial characteristics such as region and type of residence.

The results of this study showed that the increase and decrease in going-out behavior was generally in line with the stay-at-home order measures issued by the South Korean government. This suggests that the South Korean government's policy of preventing people from going out was relatively effective at the time of the initial spread of the infection. However, in terms of psychological changes before and after the spread of the infection, a large percentage of respondents reported a deterioration in life satisfaction and stress levels and mood changes, with more negative emotions across all categories. The results showed that many citizens underwent negative psychological changes after the spread of COVID-19 (Tables 7 and 8).

Table 7. Psychological changes by categorization of outgoing changes

	Average Change in Mood Between before and after COVID-19	**Average Stress level Change Between before and after COVID-19**	**Average Change in Happiness and Life Satisfaction Between before and after COVID-19**
Decrease in outings	-0.54	-1.32	-1.23
No change	-0.29	-0.74	-0.62
Increase in outings	-0.08	-0.43	0.14
Total	**-0.43**	**-1.13**	**-1.02**

Table 8 Analysis results of ANOVA

		Sum of squares	Degrees of freedom	Mean square	F-value	P-value
Change in mood	Inter-groups	20.096	9	2.233	5.345	0.000
	Intra-group	219.299	525	0.418		
	Total	239.394	534			
Stress level change	Inter-groups	159.039	9	17.671	10.435	0.000
	Intra-group	889.062	525	1.693		
	Total	1048.101	534			
Change in happiness and satisfaction	Inter-groups	145.880	9	16.209	11.170	0.000
	Intra-group	761.851	525	1.451		
	Total	907.731	534			

There were also significant differences in the spatial characteristics. For example, there was a significant difference in the level of life satisfaction between those living in Seoul city, which is the central area in Seoul metropolitan area, and those living in Gyeonggi Province, which is a suburban area in the Seoul metropolitan area. In addition, there were differences between those living in condominiums and those living in detached houses. However, spatial characteristics did not have as great an impact on psychological changes under the spread of COVID-19 as personal attributes.

6. Conclusion

The purpose of this study was to examine long-term countermeasures against COVID-19 based on psychological changes and their factors during the spread of COVID-19. For this purpose, we analyzed psychological changes, emotions, and related personal attributes and spatial characteristics. Psychological depression was observed before and after the spread of infection in South Korea, and depression was also greater among women and those in their 20s.

Based on the results of this study, it can be seen that the increase and decrease in outing behavior is generally in line with the stay-at-home order measures issued by the South Korean government. This suggests that the South Korean government's policy of

restricting people from going out was relatively effective at the time of the initial spread of the infection. However, in terms of psychological changes before and after the spread of the infection, a large percentage of respondents reported a worsening of life satisfaction and stress levels and mood changes, with more negative emotions being selected in all categories. The results showed that many citizens underwent negative psychological changes after the spread of COVID-19.

Furthermore, the results of the analysis of psychological changes showed that the differences were more significant for attributes such as age and gender than for spatial characteristics such as region and type of residence.

With regards to age, the percentage deterioration was generally higher in participants in their 30s to 60s in terms of life satisfaction and stress levels. The study also found that psychological changes tended to worsen more in those who lived alone than in those who lived with others.

We also found differences in the spatial characteristics such as location on living between suburb area and central area in Seoul metropolitan area. Furthermore, we found differences between resident style. Regarding to gender, the percentage of worsening was significantly higher among women in the other categories.

The purpose of this study was to examine the behavioral and psychological changes in individuals who refrained from going out as a counterpart measure to COVID-19. In summary, the study indicates that psychological depression was greater among women and people in their 20s. In particular, those in their 20s were more depressed than those in their 30s and 40s, despite the fact they are less susceptible to the COVID-19 than those older than them.

In the future, additional research could focus on clarifying these factors and analyzing them in order to propose concrete solutions.

Acknowledgments

Author Contributions

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Appendix 1: Sample of question and answer about behavioral changes

<Question>

Please select the number of days you go out of the house per week before the spread of infection (before February 2020) and at the time of the spread of infection (at the end of February).

1. Before the spread of infection (before February 2020)
1. never went out at all 2. 1-2 times a week 3. 3-4 times a week 4. once every two days 5. about once a day 6. several times a day

At the time of infection spread (end of February 2020)
1. not out at all 2. 1-2 times a week 3. 3-4 times a week 4. once every 2 days 5. about once a day 6. several times a day

3. now
1. not at all 2. 1-2 times a week 3. 3-4 times a week 4. once every two days 5. about once a day 6. several times a day

Appendix 2: Sample of question and answer about behavioral changes

<Question>

1. Please select about your satisfaction before and after the spread of infection.

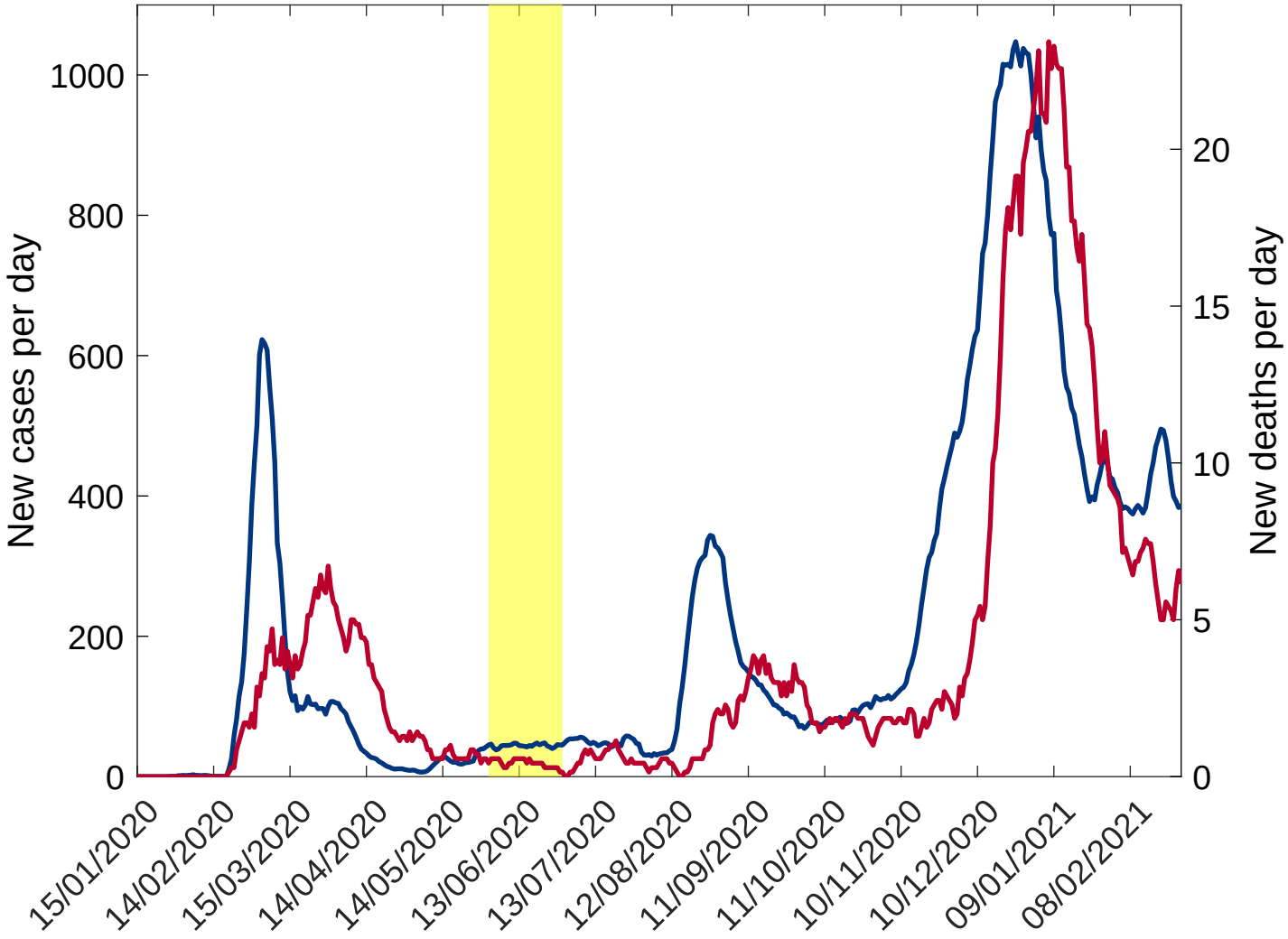
Before COVID-19 1. Very dissatisfied 2 3 4 5 6 7. Very satisfied
After COVID-19 1. Very dissatisfied 2 3 4 5 6 7. Very satisfied

2. Please select about your stress before and after the spread of infection.

Before COVID-19 1.Very stressed 2 3 4 5 6 7.Very calm
After COVID-19 1.Very stressed 2 3 4 5 6 7. Very calm

3. Please select a mood change in the last few weeks compared to before the infection spread.

1. Became very good
2. Better
3. Does not change
4. Got worse
5. Became very bad


New cases per day
New deaths per day
0
200
400
600
800
1000
0
5
10
15
20
15/01/2020
14/02/2020
15/03/2020
14/04/2020
14/05/2020
13/06/2020
13/07/2020
12/08/2020
11/09/2020
11/10/2020
10/11/2020
10/12/2020
09/01/2021
08/02/2021

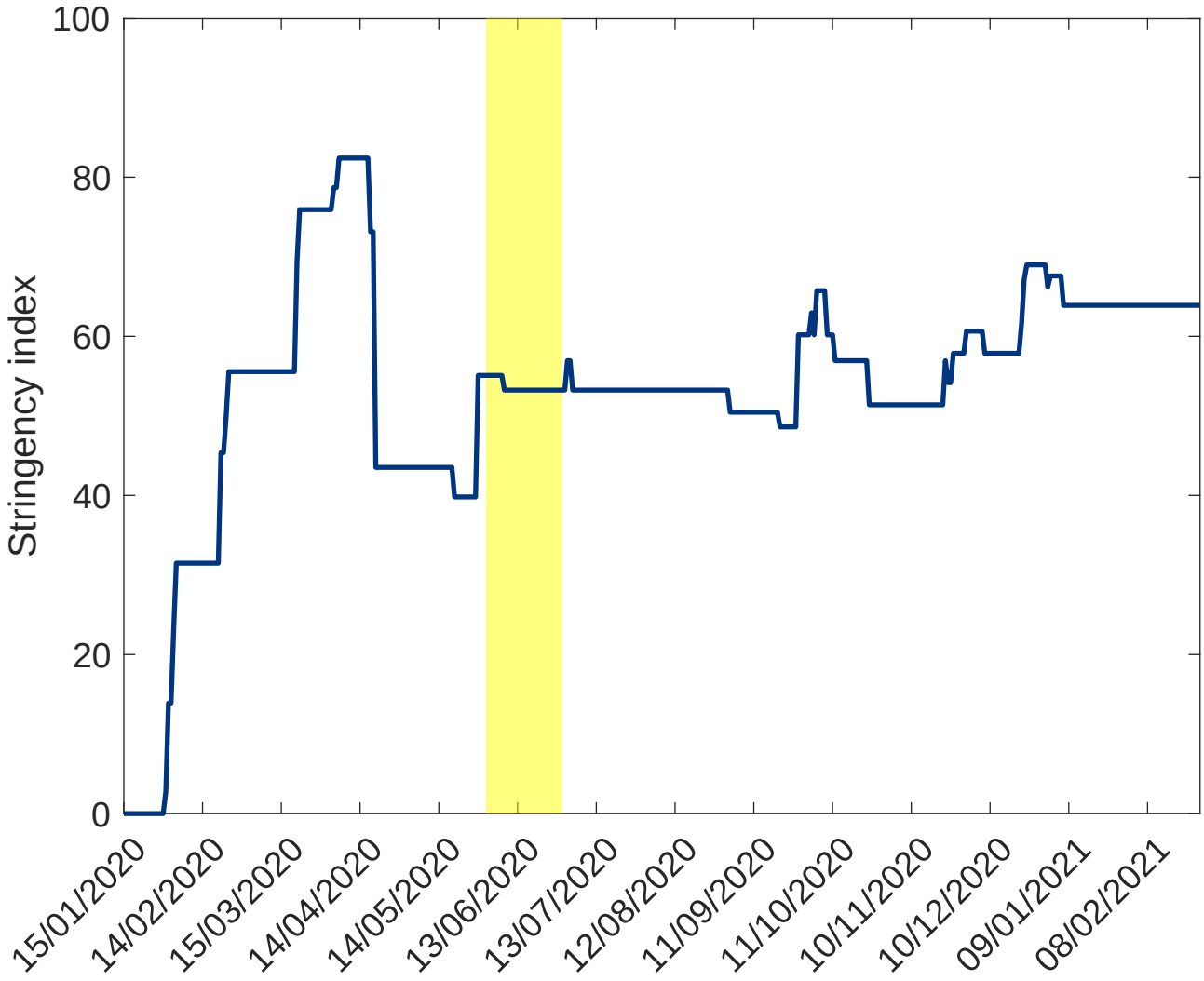

Stringency index
100
80
60
40
20
0
15/01/2020
14/02/2020
15/03/2020
14/04/2020
14/05/2020
13/06/2020
13/07/2020
12/08/2020
11/09/2020
11/10/2020
10/11/2020
10/12/2020
09/01/2021
08/02/2021

Fig 3

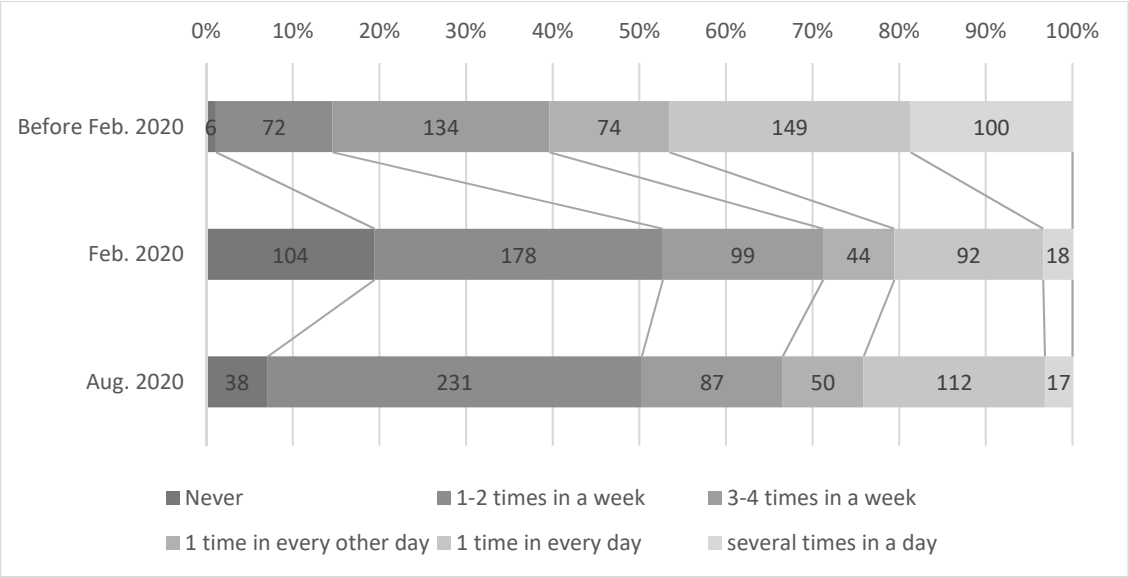

0%
10%
20%
30%
40%
50%
60%
70%
80%
90%
100%
Before Feb. 2020
6
72
134
74
149
100
Feb. 2020
104
178
99
44
92
18
Aug. 2020
38
231
87
50
112
17
Never
1-2 times in a week
3-4 times in a week
1 time in every other day
1 time in every day
several times in a day

Fig 4

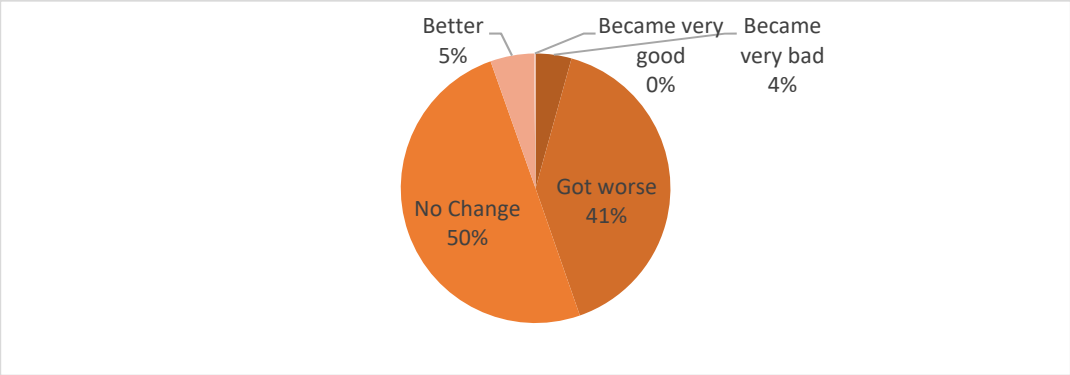

Better
5%
Became very
good
0%
Became
very bad
4%
Got worse
41%
No Change
50%

Fig 5

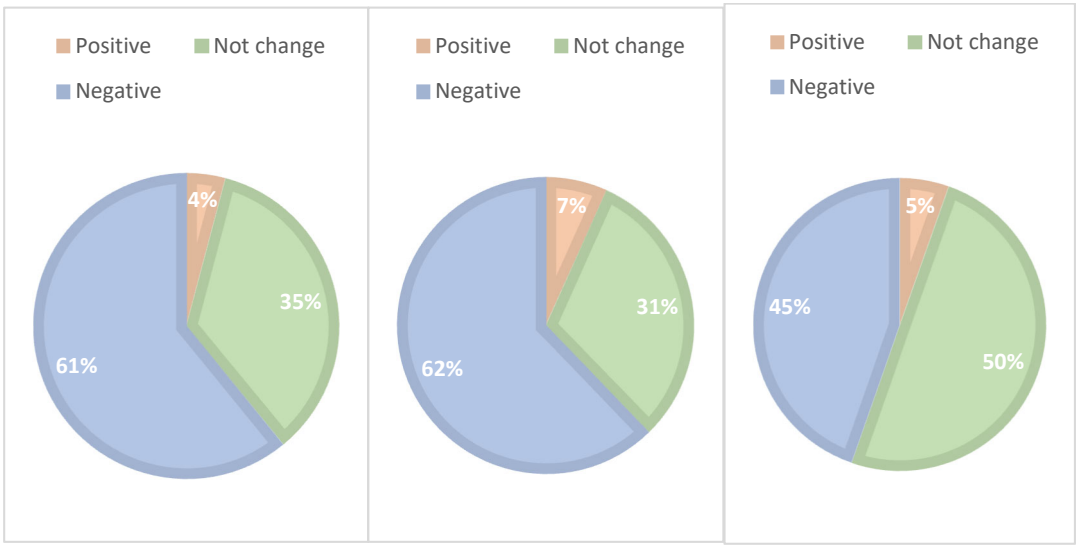

Positive
Not change
Negative
4%
35%
61%
Positive
Not change
Negative
7%
31%
62%
Positive
Not change
Negative
5%
45%
50%

Fig 6

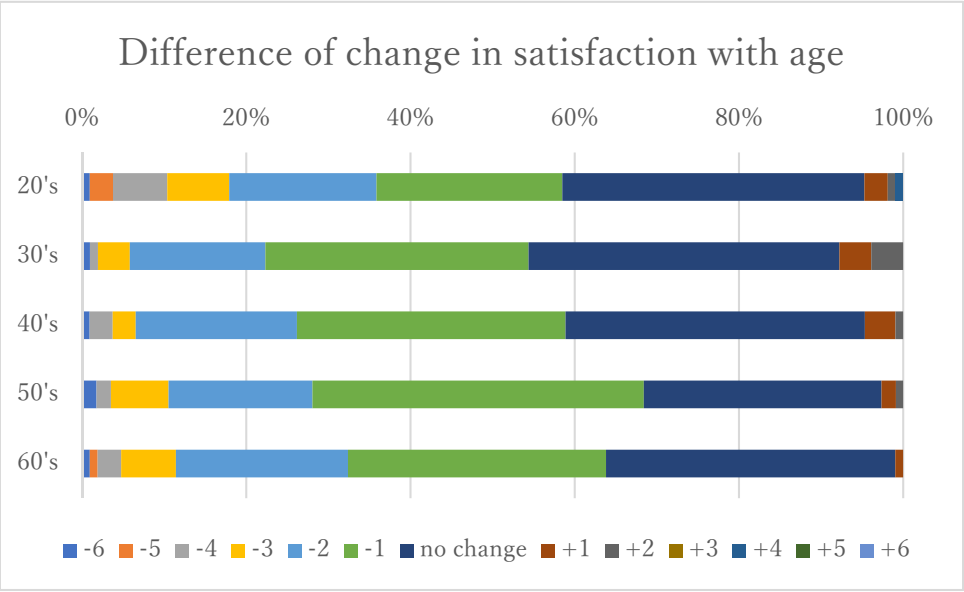

Difference of change in satisfaction with age
0%
20%
40%
60%
80%
100%
20's
30's
40's
50's
60's
-6
-5
-4
-3
-2
-1
no change
+1
+2
+3
+4
+5
+6

Fig 7

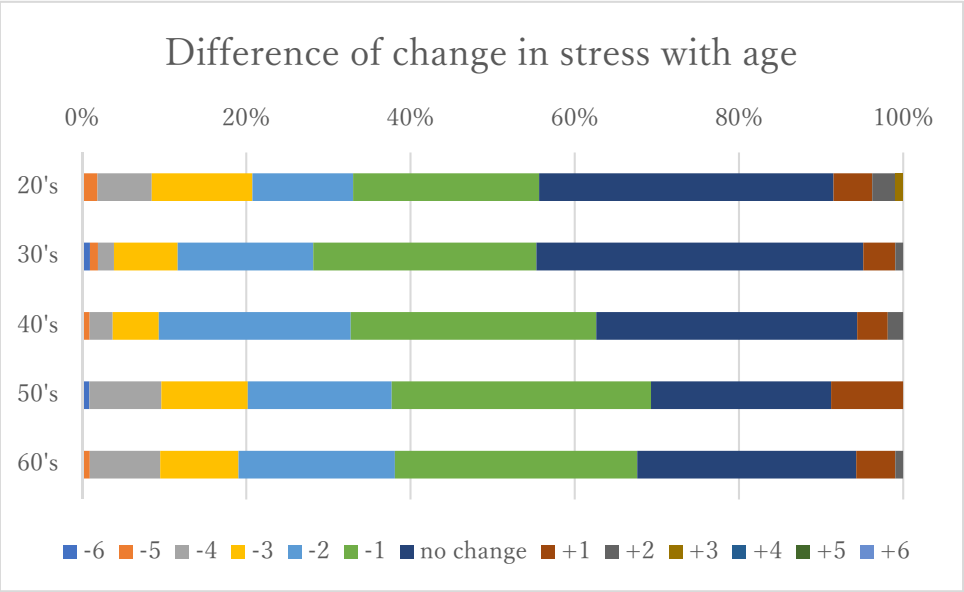

Difference of change in stress with age
0%
20%
40%
60%
80%
100%
20's
30's
40's
50's
60's
-6
-5
-4
-3
-2
-1
no change
+1
+2
+3
+4
+5
+6

Fig 8

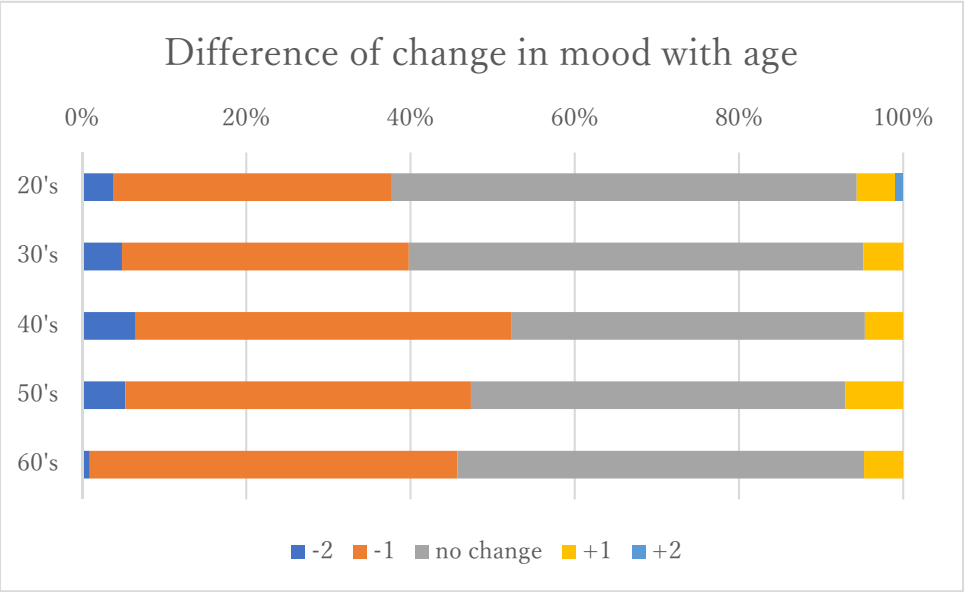

Difference of change in mood with age
0%
20%
40%
60%
80%
100%
20's
30's
40's
50's
60's
-2
-1
no change
+1
+2

Fig 9 Difference of satisfaction with type of residence

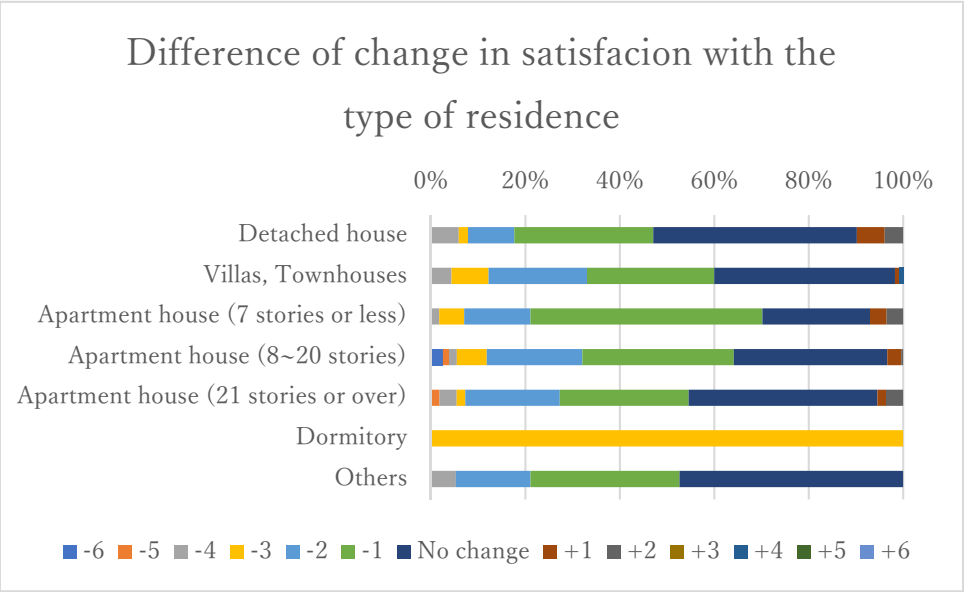


Fig 10 Difference of change in stress with the type of residence

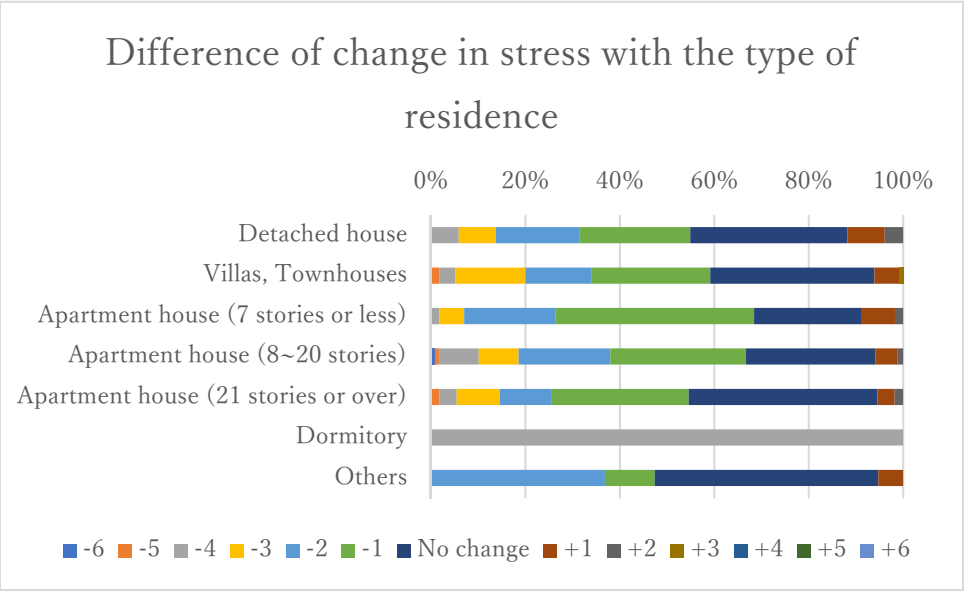


Fig 11 Difference of change in mood with the type of residence

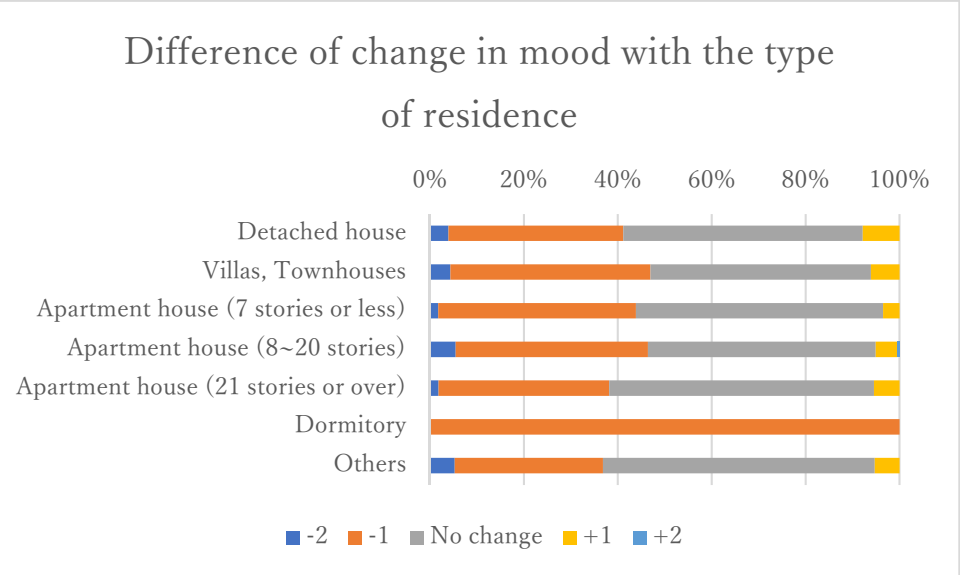


Fig 12 Difference of change in satisfaction with the size of community

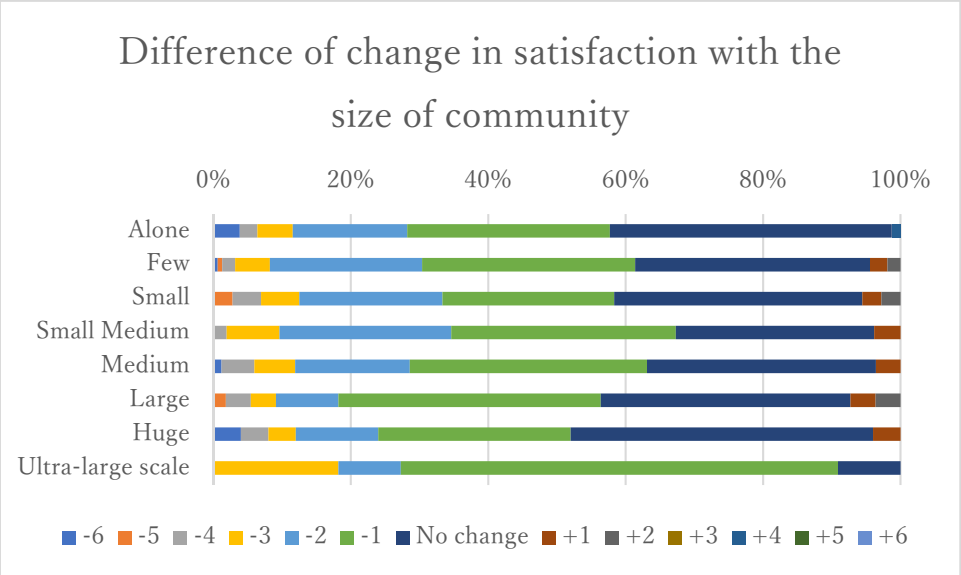


Fig 13 Difference of change in stress with the size of community

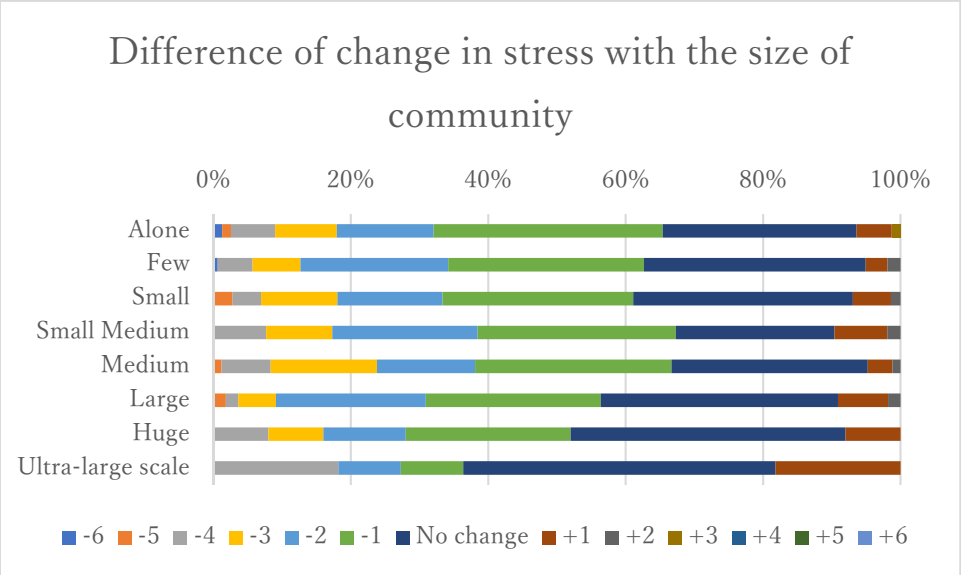


Fig 14 Difference of change in mood with the size of community