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Research Article

The Impact of Fear of Needles and Self-Efficacy for Injections on COVID-19 Vaccination Behavior

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Background

The COVID-19 pandemic highlighted the need for rapid vaccination; however, fear of needles and low self-efficacy for injections may have hindered vaccine uptake. Although fear of needles is common in Japan, its influence on actual vaccination behavior remains unclear.

Objective

This longitudinal study investigates the effects of fear of needles and self-efficacy for injection on vaccination behavior.

Methods

Data were collected at three time points (late June to early July 2021, late September to early October 2021, and late December 2021 to early January 2022) through longitudinal surveys conducted online. Of all the responses, 1,059 valid entries from 1,750 participants aged 15 years or older living in Japan, who provided information on their COVID-19 vaccination date, were analyzed. Survival analysis was conducted to investigate the impact of fear of needles and self-efficacy for injections on vaccination behavior.

Results

Results from the Kaplan–Meier estimator revealed that those with a high fear of needles or low self-efficacy for injections tended to postpone their vaccinations. Cox proportional hazards regression analysis revealed that those with higher direct fear and avoidance had lower vaccination rates. Therefore, fear of needles and self-efficacy for injections influenced vaccination behavior.

Conclusion

Given that both are interventional factors, approaches to reduce fear of needles and increase self-efficacy for injections may be effective in increasing vaccination coverage and promoting vaccinations. Healthcare providers should consider the possibility that patients may be fearful of injections.

1. INTRODUCTION

The COVID-19 pandemic has significantly disrupted daily life, prompting global vaccination efforts. Rapid distribution of vaccines is necessary to increase herd immunity, especially during a pandemic. In Japan, vaccinations for older adults began in April 2021.[1] However, vaccine hesitancy emerged as a barrier to widespread immunization, thereby becoming a public health concern.

Fear of needles, an important psychological factor that prevents vaccination, refers to anxiety associated with needles and fear of situations where injections are administered.[2] It was also a psychological disincentive for vaccination against COVID-19.[3] A survey reported that 26.2% of respondents had a fear of needles and were twice as likely to be hesitant to receive the COVID-19 vaccine as those who did not have this fear.[4] Furthermore, a study reported that 38% of Japanese university students feared needles.[5] Hence,

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this fear may have influenced COVID-19 vaccination in Japan. However, research on the relationship between fear of needles and vaccination behavior during the pandemic is scarce.

In contrast to fear of needles, self-efficacy for injections may serve as a motivational factor that facilitates vaccination. It is defined as one's confidence in managing injection-related procedures.[6-8] Higher self-efficacy is associated with greater engagement in health behaviors;[7] however, its role in COVID-19 vaccination behavior remains underexplored.

Although studies have examined COVID-19 vaccination efforts, most have focused on vaccination intention and hesitancy. Thus, knowledge of vaccination behavior is lacking. Furthermore, many studies were cross-sectional in nature and did not consider the time of vaccination. Therefore, this longitudinal study aims to clarify how fear of needles and self-efficacy for injections influenced vaccination behaviors. Specifically, we examined the trends in vaccination coverage over time in relation to fear of needles and self-efficacy for injections. Furthermore, we identified the factors that influenced vaccination behavior from the subscale of fear of needles. These factors included direct and indirect fear—the fear felt by oneself when exposed to a fearful situation and by witnessing others experiencing fear, respectively—as well as physiological reactions, which are internal responses to fear, and avoidance, an external response to fear.[5] Clarifying the elements of fear of needles that influence vaccination behavior would help consider intervention approaches. Accordingly, we investigated the following two hypotheses: first, a high level of fear of needles and low self-efficacy for injections are associated with delayed vaccination behavior. Second, among the components of fear of needles, direct fear and avoidance show the strongest associations with vaccination behavior, which is the outcome variable in this study. This hypothesis is based on the notion that direct fear reflects the immediate emotional response experienced when receiving an injection, which can strongly discourage individuals from vaccination, leading to avoidance.[2,4] Furthermore, among the various fears, the fear experienced during the actual injection (direct fear) is considered most likely to be evoked.

2. METHODS

2.1. PARTICIPANTS

The survey was administered to 1,750 individuals aged 15 years and older who resided in Japan at 3 time points (from late June to early July 2021, late September to early October 2021, and late December 2021 to early January 2022). Participants lost to follow-up or provided invalid responses to specific items were excluded from the analysis. Subsequently, 1,059 individuals were included in the final analysis (valid response rate = 60.5%; 567 males; mean age = 48.3 years, standard deviation = 16.2). The age breakdown is as follows: 40 individuals in their teens (3.78%), 129 in their 20s (12.18%), 130 in their 30s (12.28%), 233 individuals in their 40s (22.00%), 252 individuals in their 50s (23.80%), 158 individuals in their 60s (14.92%), 103 individuals in their 70s (9.73%), 13 individuals in their 80s (1.23%), and 1 individual in their 90s (0.09%).

2.2. MEASUREMENTS

2.2.1. FEAR OF NEEDLES

The multidimensional fear-of-injection scale was used to assess fear of needles. It comprises 16 items rated on a five-point Likert scale, ranging from 1 (not at all applicable) to 5 (very applicable).[5] It has a four-factor structure: direct fear, indirect fear, physiological response, and avoidance. Higher scores correspond to a higher fear of needles. The cutoff value for a subjective fear of needles, which determined whether a person was afraid of needles, was 35 points.

2.2.2. SELF-EFFICACY FOR INJECTION

The self-efficacy scale for schoolchildren for receiving injections and blood sampling[8] was used to assess self-efficacy. It comprises 15 items rated on a four-point Likert scale. This scale consists of items assessing preparedness and perceived capability during injection, such as "I am ready for the needle" and "I can stay still during the injection," and if they executed the required actions during the procedure. Internationally, the Visual Analog Scale has been used to measure adults' self-efficacy for blood donation,[9] assessing their degree of confidence in donating blood (e.g., "I can do it as soon as I decide to donate blood"). The self-efficacy scale for magnetic resonance imaging (MRI)[10] measures an individual's degree of confidence in a series of behaviors during an MRI (e.g., "I can remain motionless" and "I can communicate with the radiologist"), which was consistent with Bandura's theory. Although Emoto's[8] scale is intended for elementary school students, its reliability and validity have been confirmed. Furthermore, the questions are similar to those of Li *et al.*'s[9] scale. In addition, similar to the scale by Powell *et al.*,[10] Emoto's[8] self-efficacy scale for injections and blood sampling was used to measure self-efficacy for injections, as it comprises items consistent with the self-efficacy theory.

2.2.3. VACCINATION BEHAVIOR

The date of participants' COVID-19 vaccination was self-reported at the second and third time points. To minimize recall bias, the survey schedule was aligned with Japan's nationwide vaccination plan, allowing most participants to report their vaccination status shortly after receiving the vaccine.

2.3. PROCEDURE

A longitudinal survey was administered at 3 time points using Freeasy (iBRDGE, Japan), an online survey platform. Recruitment was additionally conducted during university lectures. Follow-up surveys were administered 3 and 6 months after baseline. To contextualize the vaccination environment in Japan during the survey period, vaccination of healthcare workers began on February 17, 2021, followed by rollout to adults aged 65 years and older on April 12, 2021. By baseline, vaccinations in workplaces, such as companies and universities, began sequentially from June 21, 2021, on a workplace-by-workplace basis, including educational institutions. Eligibility broadened, and COVID-19 vaccines became widely available to the public. By the third time point, a third (booster) dose had been introduced for individuals aged 18 years and older.[11] It is important to note that in Japan, COVID-19 vaccination is not mandatory but rather voluntary, based on individual decision-making.[12]

2.4. STATISTICAL ANALYSIS

Survival functions were calculated for fear of needles and self-efficacy for injections using the Kaplan–Meier estimation method to examine trends in vaccination coverage over time. In addition, Cox proportional hazards regression analysis was conducted to determine how fear-of-needles subscales influenced vaccination. We also set a start date for each participant. February 17 and April 12, 2021, were set as the start dates for healthcare workers and those aged 65 years and older, respectively. For all others, the start date was June 21, 2021. Regarding vaccination behavior, vaccination was defined as the date an individual reported receiving the first vaccine. This reported date was used as the event date. Participants lost to follow-up or unvaccinated by the end of the third survey were right-censored. EZR version 1.41[13] was used for analysis.

2.5. ETHICAL CONSIDERATIONS

This study was approved by the Ethical Review Committee of the Graduate School of Human and Social Sciences at Hiroshima University (approval number: 202105). All data collection was completed within the valid approval period. Participants were asked to indicate whether they agreed to participate after reading the ethical and social considerations and explanations. Responses were obtained from those who provided informed consent.

3. RESULTS

Kaplan–Meier methods were used to estimate time to vaccination, stratified by fear-of-needles score (above vs. below the cut-off) and self-efficacy for injection (groups were divided into high and low based on the median). Figures 1 and 2 illustrate the Kaplan–Meier curves. The Y-axis represents the probability of remaining unvaccinated (survival probability), and the X-axis represents days since baseline.

For fear of needles, the median time to vaccination was 70 days (95% confidence interval [CI]: 67–74) in the below-cut-off group and 82.5 days (95% CI: 76–89) in the above-cut-off group, indicating a significant difference between groups ($p<0.001$; Figure 1).

Subsequently, self-efficacy for injections was categorized into two groups based on the median value. Furthermore, we calculated the Kaplan–Meier analysis of time to vaccination. The median survival times for the groups with low and high self-efficacy for injections were 79.5 days (95% CI: 74–84) and 69 days (95% CI: 64–73), respectively, showing a significant difference ($p < 0.001$; Figure 2).

In addition, Cox proportional hazards regression models were used to calculate the hazard ratios for the subfactor of fear of needles and examine the effects on vaccination behavior in further detail (Table 1). The likelihood ratio, Wald, and score (log-rank) tests confirmed the overall model's usefulness ($p<0.01$). The proportional hazards assumption was violated, as no variables were significant. Regarding hazard ratios, significant differences were observed for direct fear and avoidance, with hazard ratios of 0.79 (95% CI: 0.66–0.95, $p<0.05$) and 0.78 (95% CI: 0.64–0.96, $p<0.05$), respectively.

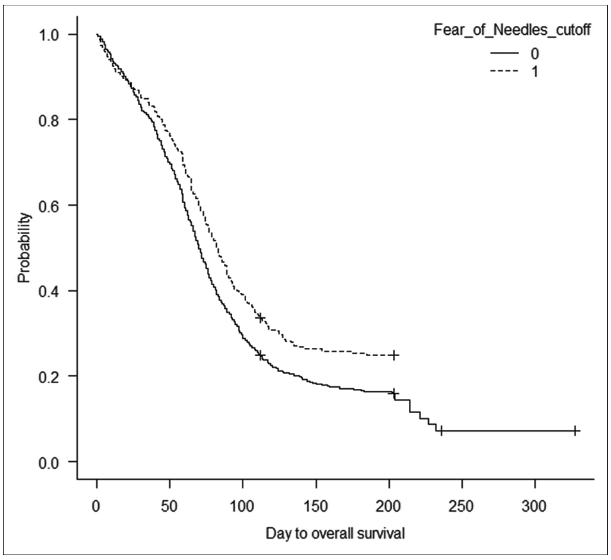

Figure 1. Results of the survival analysis of fear of needles.

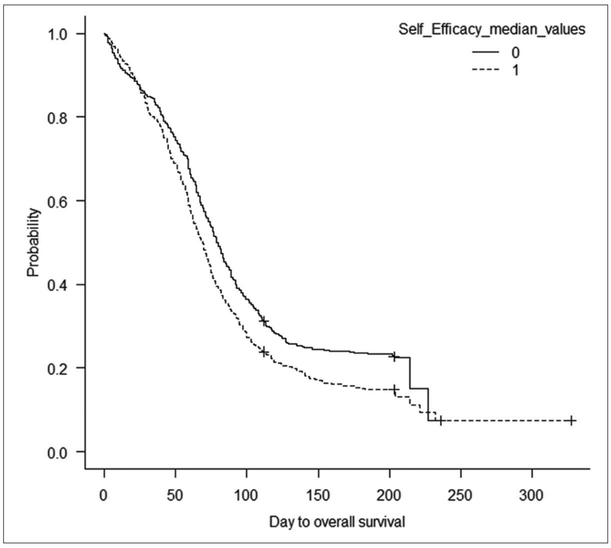

Figure 2. Results of the survival analysis of self-efficacy for injection.

Table 1. Results of the Cox proportional-hazards regression model

Variable	Hazard ratio	95% confidence interval	p-value
Direct fear	0.79	0.66–0.95	0.01
Indirect fear	1.00	0.82–1.23	0.98
Physiological response	1.09	0.92–1.30	0.32
Avoidance	0.78	0.64–0.96	0.02

4. DISCUSSION

This study examined the effects of fear of needles and self-efficacy for injections on COVID-19 vaccination behaviors. Survival analysis revealed that those who exceeded the cutoff value for fear of needles tended to delay vaccination more frequently than those who did not. Similarly, individuals with low self-efficacy for injections tended to postpone their vaccination more frequently than those with high self-efficacy. Furthermore, the Cox proportional-hazards regression model results revealed that higher direct fear and higher avoidance were associated with a lower hazard of vaccination (hazard ratios = 0.79 and 0.78, respectively) compared to the low fear/avoidance group. Therefore, regarding fear of needles, those with high direct fear and avoidance had lower vaccination rates than those who did not. These results suggest that fear of needles and low self-efficacy postpone vaccination.

Freeman *et al*.[4] established that COVID-19 was associated with hesitation to be vaccinated and focused on the fear of needles. In addition, they established that those with a fear of needles were more likely to be hesitant to vaccination than those without (odds ratio = 2.18, 95% CI: 1.97–2.40). Most previous studies considered vaccination hesitancy as an outcome. In contrast, this study considered vaccination behavior as an outcome, enabling us to examine the factors that directly influenced it. Furthermore, unlike many previous studies, which focused on vaccination intention or hesitancy using cross-sectional designs, the longitudinal design of this study allowed us to track actual vaccination behavior over time. This approach enabled us to capture how these factors translated into actual behavior throughout the vaccination period. Moreover, the use of survival analysis allowed us to model the timing of vaccination, providing a more dynamic and behavior-grounded perspective.

The results of the Cox proportional-hazards regression model revealed that among the components of the fear of needles, direct fear (the fear felt when receiving an injection) and avoidance (an external response to fear) significantly influenced vaccination behavior. Therefore, approaches that reduce avoidance and improve coping with injections are required to increase vaccination rates. Furthermore, self-efficacy for injections influenced vaccination behavior, suggesting that approaches that increased self-efficacy for injections might also be effective in promoting vaccination behavior. Verbal persuasion is an effective means of increasing self-efficacy.[6] Hence, explaining and helping people understand the need for vaccines may help increase self-efficacy.

4.1. LIMITATIONS

This study has some limitations. First, vaccination dates were self-reported by the participants. Hence, the data were not completely reliable. Future studies could consider incorporating verification methods, such as requesting participants to upload vaccination certificates, to enhance data accuracy. Second, the use of the self-efficacy scale for schoolchildren for receiving injections and blood sampling[8] might have affected our results. A scale for adults that inquired about efficacy in similar procedural situations has been used internationally. The item content of that scale was used as a reference and was found to be generally similar for adaptation. However, the scale that we used is essentially designed for schoolchildren and comprises items that are not appropriate for adults, such as “I can keep myself from crying” during injection procedures. This might have influenced the results, and the effect of self-efficacy for injections might have been underestimated. Therefore, developing a self-efficacy scale for injections for adults that can be used in Japan is desirable. Third, whether the effects of fear of needles and self-efficacy for injections on vaccination behavior were specific to the COVID-19 vaccine remains unclear. COVID-19 vaccines were rapidly developed to combat the virus and its various strains. Therefore, compared with other vaccines, many uncertainties exist regarding their efficacy, especially in the early stages of vaccination.[14] Kishikawa[15] established that the group that avoided vaccination had additional doubts and concerns regarding its efficacy and adverse reactions. These evoked concerns and fears regarding safety, which might have affected vaccination behavior and self-efficacy for injections. Therefore, further investigation is needed to determine whether these findings can be applied to other injection procedures. Furthermore, cultural and social backgrounds may influence fear of needles, self-efficacy, and vaccination behavior.[16,17] Therefore, further investigation is needed to determine how individual attitudes toward vaccination and healthcare, as well as cultural and social contexts, affect fear and vaccination behavior.

Another limitation is that the age distribution of our sample was skewed, with relatively few participants in the youngest and oldest groups. Future studies should adopt a more balanced sample design to enable a detailed and reliable investigation of age-related influences on vaccination behavior and psychological responses.

4.2. IMPLICATIONS

This study has some clinical implications. Fear of needles is acquired through negative experiences with injection procedures.[18] Since many people have undergone injections (a medical procedure), healthcare providers should be sensitive to individuals’ fear of needles and provide safe and secure procedures. In addition, since successful experiences can enhance self-efficacy,[7] healthcare providers should utilize methods that enable patients to feel a sense of efficacy during and after the injection procedure. Moreover, when implementing policies related to public health, such as vaccination, advertisements that consider the fear of needles and provide information on their treatment may be effective.

5. CONCLUSION

Our results indicate that fear of needles and self-efficacy for injections can influence vaccination behavior. While previous studies measured vaccination intention, this study identified the factors that influenced behavior. However, several studies have indicated that the fear of needles and self-efficacy for injections affect injection procedures; psychological support for people who are afraid of needles and undergo injection procedures is insufficient. Future studies should develop approaches to transform the identified factors and verify their effectiveness. Hopefully, the results of this study will contribute to the development and dissemination of psychological support for individuals who receive injections.

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CONFLICT OF INTEREST

The authors declare no conflicts of interest.

AUTHOR CONTRIBUTIONS

Conceptualization: Suzuka Hako, Akiko Ogata
Data curation: Suzuka Hako
Formal analysis: Suzuka Hako, Kohei Kambara
Writing–original draft: Suzuka Hako, Akiko Ogata
Writing–review & editing: All authors

ETHICS APPROVAL AND CONSENT TO PARTICIPATE

This study was approved by the Ethical Review Committee of the Graduate School of Human and Social Sciences at Hiroshima University (approval number: 202105). Written informed consent to participate in the study was obtained from all participants.

CONSENT FOR PUBLICATION

The data were fully anonymized, and written informed consent for the use and publication of the anonymized data was obtained from all participants.

DATA AVAILABILITY STATEMENT

The datasets of the present study are available from the corresponding author on reasonable request.

ADDITIONAL DISCLOSURE

This study is a partial revision of a doctoral dissertation (https://hiroshima.repo.nii.ac.jp/records/2002234) submitted by the first author to the Graduate School of Human and Social Sciences, Hiroshima University, in 2023.

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