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Testing a Frailty Prevention Program for Older Men During COVID-19: A Two-Year

Mixed-Methods Pilot Study

Running title: FRAILITY IN OLDER MEN DURING COVID-19

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Consent for publication

Not applicable.

Availability of data

The data that support the findings of this study are available on request from the corresponding author. The data are not publicly available due to privacy or ethical restrictions.

Ethical approval and consent to participate

This study was approved by the Ethics Committee of Hokkaido University (approval number 19-36). The study participants were informed of the study verbally and in writing, and consent to the study was obtained in writing.

Declaration of conflicts of interest

This study received grants from Nihon Unisys, Ltd. (Currently known as BIPROGY). A researcher from Nihon Unisys, Ltd. (Currently known as BIPROGY) was involved in the development of the communication application and the implementation of Frail Prevention Programs Focusing on Social Aspects. This work was supported by JSPS KAKENHI (Grant Number: 18H03103). We also received unrestricted research grants from Nihon Unisys, Ltd. (Currently known as BIPROGY). The former had no role in the study design, data collection and analysis, decision to publish, or manuscript preparation.

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Authors' Contributions

HM, TR, OR and SK for the study design. HM conducted interviews and was responsible for data analysis and writing the manuscript. TR and OR conducted interviews. TR, OR, AH and SK contributed to the data analysis and interpretation. All authors read, edited, and approved the final manuscript.

Testing a Frailty Prevention Program for Older Men During COVID-19: A Two-Year Mixed-Methods Pilot Study

Abstract

Introduction

Frailty is a syndrome related to declining functioning attributed to aging. This study aimed to evaluate a frailty prevention program for older men comprising face-to-face meetings and an original social mobile application. We also examined the effect of COVID-19-associated social isolation on the implementation of this program.

Methods

We conducted a mixed-methods pilot study featuring a single group before and after comparison of 11 man participants, ≥ 65 years, living in Japanese cities with a spouse or relatives. Program outcome measures included frailty, loneliness, grip strength, step count, and mental health status. Process evaluation considered the experience of participants through a semi-structured interview.

Results

The intervention period included an interval of self-isolation owing to the spread of COVID-19. Among the outcomes, grip strength decreased after intervention. No significant negative changes were observed in other items. Themes emerging from participant experiences with the program included “Cooperation with researchers and contributing to research,” “Greater awareness of health,” “Interest in and experience of ‘newness’,” “Hesitation over active engagement,” “Casualties with members,” and “Relationships that do not breach personal boundaries.”

Conclusions

Although the COVID-19 pandemic overlapped with the intervention, participants maintained their mental health. The program was a novel, stimulating experience for older men, and demonstrated the usefulness of information and communication technology in supporting their social activities.

Keywords: COVID-19, older men, mental health, grip strength, step count, frailty, loneliness

SUMMARY STATEMENT OF IMPLICATIONS FOR PRACTICE

What does this research add to existing knowledge in gerontology?

- During periods of government-enforced restricted mobility due to COVID-19, interventions that combined face-to-face meetings and social mobile application-driven interactions helped older men preserve their psychophysiological status.
- Online interactions on social mobile applications alone are insufficient to deepen connections among older men.

What are the implications of this new knowledge for nursing care with older people?

- A combination of face-to-face meetings and a social mobile application may address the social aspects of frailty in older men.
- Routine use of mobile applications that allow sharing of step counts may motivate older men to continue physical exercise.

How could the findings be used to influence policy or practice or research or education?

- For older men living in the community, activities stimulating “greater awareness of health” and “interest in and experience of ‘newness’” may impact social aspects of frailty.
- Group interaction for older men should account for the characteristics of the participants, encourage interaction among members, and gradually deepen relationships.

Introduction

The aging population is increasing worldwide. Frailty, whose prevalence increases with age, occurs in 4%–59% of community-dwelling older populations (Rohrmann, 2020). As a reversible, often improved condition, preventive measures for frailty can be effective.

Frailty is a syndrome characterized by reduced stress tolerance due to functional decline in older people (Rohrmann, 2020), comprising physical, psychological, and social domains. It is defined as “a continuum of being at risk of losing, or having lost, social and general resources, activities, or abilities that are important for fulfilling one or more basic social needs during the life span” (Bunt et al., 2017). A 4-year follow-up longitudinal cohort study of 1226 non-physically frail older adults reported that participants classified as social frail at baseline had a 3.93-fold increased risk of developing physical frailty, suggesting that social frailty precedes physical frailty and may lead to its onset (Makizako et al., 2018).

Social activities, roles, and engagement are indicators of social frailty (Makizako et al., 2015). Of these, higher participation in social activities is significantly associated with improved cognitive function (Bae, 2020), instrumental activities of daily living (Tomioka et al., 2016), reduced loneliness (Zhao & Wu, 2022) and isolation (Ejiri et al., 2019), and overall improvement in frail older adults (Jang et al., 2021). However, there are gender differences (Saito et al., 2015), with men being less likely to participate in social activities (Nurmi et al., 2018). Given that the association between frailty and mortality is stronger in older men (Langholz et al., 2018), engaging them in social activities is important.

In 2020–2021, countries adopted lockdowns and social distancing measures to manage the coronavirus disease pandemic (COVID-19). In Japan, the government issued a request to refrain from leaving home unnecessarily and suspended various activities. This self-isolation

impacted older people, observable as increased depression, frailty (Okamura et al., 2021), and loneliness (van Tilburg et al., 2021). Additionally, physical activity levels decreased (Yamada et al., 2020), potentially leading to further health problems.

Considering the lifestyle changes made during COVID-19, involving extensive Internet use for work and social interactions, social activities to prevent frailty using information and communication technology (ICT) are essential to curtailing face-to-face interactions in older adults. This two-year pilot study aimed to evaluate a frailty prevention program for older men, focusing on the social aspects, comprising face-to-face meetings and an original social mobile application (smApp).

Research Questions

We evaluated a Frailty Prevention Program Focusing on Social Aspects (FPSA) using a logic model comprising five elements: objectives, inputs, activities, outputs, and outcomes (Melle, 2016). The conceptual framework of the study is shown in Figure 1, where the inputs are FPSA and the activities are the face-to-face meetings and smApp. The outputs are the number of face-to-face meetings attended and smApp views. Based on prior studies, outcomes were defined as frailty and loneliness (Jang et al., 2021; Zhao & Wu, 2022).

Since the implementation period coincided with COVID-19 for approximately one year, its effects on the measured outcomes needed to be considered. COVID-19 has been associated with increased depression (Okamura et al., 2021) and decreased physical activity (Yamada et al., 2020). Therefore, additional outcomes were examined from the collected data, including number of steps, body mass index (BMI) and grip strength as physical activity indicators, alongside mental health state and subjective well-being.

Accordingly, we evaluated FPSA with the following research questions:

RQ1: Does FPSA contribute to maintaining and improving the physical and mental condition of the participants? (Outcome evaluation)

RQ2: What is the experience of participants engaging in FPSA? (Process evaluation)

[Figure 1 around here]

Methods

Design

This pilot study featured a single group before and after comparison and a mixed-methods design.

Sample and Setting

The participants were men aged ≥ 65 years living in Japanese cities. Recruitment was through newspaper advertisements and from health or cooking classes, resulting in two and fourteen applicants, respectively. Five participants withdrew from the study owing to ill health, schedules, and program needs, leaving 11 participants, who took part for the entire two-year study period.

The study was conducted in the fourth most populous city, located in the north of Japan; of the approximately 2 million population, 27% are over 65 years. Snow falls from December–March, with temperatures ranging from -12°C – 3°C .

Intervention

FPSA was conducted from October 2019–October 2021 (Figure 2). The program content devised by the research team comprised a two-hour monthly interaction in a community center, alongside exchanges using the smApp “Kikoeru” (Japanese term for “be heard”; hereafter, Kikoeru). Content was based on the values attributed by older men to different social

activities, such as “health as a resource and reward for social activities” and “finding interests through interactions” (Takashima et al., 2020a); it included the following: A. information on disease prevention and health maintenance and promotion (30 minutes); B. thematic discussions (30 minutes); C. group activities (40 minutes); and D. setting individual goals that can be achieved in one month (10 minutes). A and B, and A and D were linked (Appendix 1). The content for A and B were provided monthly in rotation by the first, third, and fifth authors, with experience practicing as public health nursing, and the second author, with experience practicing as an occupational therapist. C and D were assigned to the second author. In the meetings, researchers facilitated interactions between members, when appropriate, to foster connection and among participants. The meetings were suspended for eight months owing to the spread of COVID-19.

[Figure 2 around here]

Kikoeru was developed considering the abilities and needs of older people. The mobile application is designed to share voice, photos, and step counts with all members, and has a simple, easy-to-use design (Abe et al., 2021). A photo of the participant’s face and their name are displayed on the screen. The posting screen and step count screen make it easy to check the interactions and activities of the participants (Figure 3).

[Figure 3 around here]

Research participants were lent smartphones with Kikoeru pre-installed. Before the intervention, participants were taught how to use Kikoeru using manuals and demonstrations; further support was provided over a dedicated phone number. The use of Kikoeru was voluntary, and one participant chose not to use it. The first three authors participated in and observed the interactions on Kikoeru during the research period.

Measures

FPSA appraisal comprised an outcome and process evaluation (Figure 1). Outcome assessment involved collecting quantitative data on the participants' psychophysiological state. Frailty was measured using the simple five-item "FRAIL" questionnaire (Morley et al., 2013; Appendix 2), with a score of 3 or more indicating frail, 1 or 2, pre-frail, and 0, robust. Ando et al.'s (2000) Loneliness Scale comprising ten items measured on a two-point Likert scale was used (e.g., "Are there people around you with whom you share a good rapport?"). The Cronbach's alpha for this scale was previously determined as 0.836.

Grip strength was measured using a digital Smedley grip strength meter, and adjusted such that the second joint of the index finger was at 90°, holding the meter in the straight strength posture. Measurements were taken twice, alternating between left and right hands, and the better record from each side was averaged.

Mental health status was calculated using the simplified Japanese version of WHO-Five well-being index (S-WHO-5-J; Inagaki et al., 2013), comprising five items measured on a four-point Likert scale (e.g., "I have felt cheerful in good spirits."). Subjective well-being was measured by a single item, rated from 0–10, "How happy are you right now?"

Data on the number of steps were collected from the Kikoeru log, and other items were surveyed in October 2019 and October 2020, using a questionnaire.

Process evaluation used qualitative accounts of the participants' experience in FPSA, collected during October–November 2021 through face-to-face, semi-structured individual interviews. Interview items were as follows: "Looking back on FPSA so far, what was fun, what was difficult, etc.? Please tell us your impressions"; "Have you noticed any changes in your health during the process of FPSA? What kind of changes?"; "While participating in the FPSA,

did you notice any changes in your thoughts and relationships with the participants? What kind of changes?"; and "What was FPSA like for you? Please tell us your honest thoughts." The interviews were conducted by the first three authors and audio recorded with the participants' consent. Additionally, the number of views was collected from the log to check the usage of Kikoeru.

Data Analysis

IBM SPSS Statistics Version 25.0 Exact Test was used for statistical processing, and G power 3.1 was used to calculate effect sizes. The significance level was set at 5%. Wilcoxon signed-rank test was used to compare before and after intervention data for BMI, grip strength, subjective psychological well-being, subjective well-being, and loneliness. Fisher's exact test was used for frailty. The number of steps and average number of views were divided into six-month intervals: Phase 1 (October 2019– March 2020), Phase 2 (April 2020 –September 2020), Phase 3 (October 2020–March 2021), and Phase 4 (April 2021–October 2021). Friedman test was used for the number of steps. We analyzed the significance probability using the Monte Carlo method, which enables the analyses of small samples. The 99% confidence interval of significance probability by the Monte Carlo method was calculated for the items, except for frailty, and the effect size was further calculated for the same.

Interview data were analyzed through a qualitative descriptive design. The first author coded the data of all 11 participants, constructing subcategories and categories. Caution was taken to ensure that the categories were based on the data, by constructing them using ongoing comparative analysis and revisiting data, codes, and subcategories. To ensure truthfulness, we used descriptive validity, interpretive validity, and generalizability (Maxwell, 1992). We examined descriptive validity by checking subcategories and categories with the participants and

confirmed interpretive validity with six participants. Internal generalizability could not be examined because all participants cooperated in the interview process. Therefore, only external generalizability was examined in the consideration of other communities and groups.

Results

Table 1 shows the participants' individual characteristics. Their mean age was 77.3 ± 4.4 years, and all lived with a spouse or relatives. The average number of participants in all 17 face-to-face meetings was 14.6 ± 2.2 , with one person attending 10 meetings (58.8%) and the others attending more than 70%. The average number of views per day on Kikoeru in each six-month interval was 8.7 in Phase 1, 7.3 in Phase 2, 5.5 in Phase 3, and 5.7 in Phase 4.

[Table 1 around here]

Comparison of Psychophysiological Conditions Before and After Intervention

Psychophysiological measures before and after the intervention are shown in Table 2. Although grip strength was significantly lower after intervention ($P = 0.017$), no other significant differences were observed ($P = 0.837$ – 1.000). The mean number of steps per six months showed no significant difference ($P = 0.733$).

[Insert Table 2 around here]

Experience of Participants in FPSA

Six categories were constructed from the participants' experiences in FPSA. Categories, subcategories, and representative narratives are shown in Table 3.

[Insert Table 3 around here]

Cooperation with Researchers and Contributing to Research

Most participants met each other for the first time, and always wore masks and practiced social distancing to prevent COVID-19 infection. This led to limited conversations among the members during the face-to-face meetings, and most of the breaks were spent in silence. Nevertheless, participants continued to engage in FPSA because they wanted to cooperate with the research and provide data. They were also interested in how the data they provided were finally compiled.

Greater Awareness of Health

The health information shared as part of FPSA provided a valuable learning opportunity and motivated the participants to understand and take charge of their health. Some showed considerable interest in acquiring new knowledge about health.

Participants used Kikoeru to track their steps. Those with post-stroke sequelae aimed to post their voices every day as part of their rehabilitation. All participants set goals considering their physical condition and used Kikoeru as a health management tool.

Interest in and Experience of “Newness”

Through the program, participants perceived a diverse world by interacting with others. It was a rare and enjoyable experience for them to hear stories from people they had never met before. Some participants used smartphones and mobile applications for the first time and often admired those who shared information through Kikoeru.

Hesitation Over Active Engagement

In the face-to-face meetings, participants were hesitant to express their opinions and actively participate. Posting on Kikoeru also required determination, and if participants felt they had nothing good to post, they delayed communicating. They did not want to bother everyone with random posts, but they felt guilty for not posting.

Casual Ties with Members

Through FPSA, the participants gradually developed an attachment to other members, representing the beginning of a relationship. Soon after, the meetings had to be suspended due to COVID-19. When face-to-face interaction was curtailed, the participants managed to stay connected through Kikoeru.

Kikoeru provided a rudimentary connection and participants felt close to each other by seeing “familiar faces” on the app. In addition, Kikoeru inspired them to walk by displaying the number of steps and posts of other members. Participants who were treated for illnesses that affected their participation were viewed with sympathy by the others.

Relationships That Do Not Breach Personal Boundaries

FPSA did not facilitate interactions around the participants’ private life, and it was not possible to introduce these topics during casual conversations. Kikoeru’s posts were mainly for transmission, and there were few two-way exchanges, which some members found unsatisfactory. Participants sensed that the relationships were contrived and did not deepen.

Discussion

Verification of FPSA by Output and Outcome Evaluation

Face-to-face meetings were intermittently suspended due to the spread of COVID-19, but 10 of the 11 participants attended at least 70% of the sessions. The average number of daily views of Kikoeru was at least five, varying slightly by phase. There were no dropouts, suggesting that the program may be acceptable to older men.

COVID-19 distressed older people by limiting their social and personal lives (Takashima et al., 2020b). Nevertheless, the participants maintained their psychophysiological status. In addition to providing information on disease prevention and health promotion, the

FPSA meetings encouraged members to interact and build relationships through group discussions and activities. The experiences of “Greater awareness of health” and “Casual ties with members” may have contributed to maintaining the mental health status quo. Additionally, FPSA used Kikoeru to ensure interaction between members in the absence of meetings. Internet use among older adults helps them connect with friends and family, improves the quality of their communication with others, and reduces feelings of isolation (Cotten et al., 2013). ICT utilization further contributes to their well-being through improved health, life satisfaction, participation in civic activities, and meaningfulness (Ronzi et al., 2018). Posting and sharing on Kikoeru may have contributed to maintaining the participants’ mental health, addressing the social aspects of frailty.

Participants had “Relationships that did not breach personal boundaries” through their exchanges on Kikoeru. Some felt unsatisfied with the superficial interactions. Online virtual interactions do not replace face-to-face meetings and increase loneliness among older adults (Choi et al., 2022). Thus, it may be effective to use face-to-face exchanges to complement online exchanges in older men.

Conversely, the frailty score decreased from robust to pre-frail in one subject post-intervention, and grip strength decreased significantly in all participants. Low grip strength is a clinical indicator of poor mobility (Lauretani et al., 2003), and physical activity in older people had decreased during COVID-19 (Yamada et al., 2020). However, because the participants maintained their step count, decreased grip strength cannot be attributed to decreased physical activity.

Japanese men’s grip strength peaks at 50 years and declines thereafter, with an average grip strength of 35.2 ± 5.58 for 75–79 year-olds (Japan Sports Agency, 2021). The pre-

intervention grip strength of participants was 35.9 ± 4.2 , and five participants were in their 80s. Therefore, the decreased grip strength post-intervention is likely due to aging. Moreover, FPSA focuses on the social aspects of frailty rather than physical frailty, including strength maintenance. Therefore, we consider the frailty score and grip strength, which evaluate the physical aspects of frailty, were not maintained or improved post-intervention.

Validation of FPSA Intervention Method Based on Process Evaluation

International studies examining interactions among older adults and non-family members are lacking (Fu et al., 2018; Perkins et al., 2008; Katayama et al., 2021). However, FPSA maintained interaction between participants by employing ICT, even during COVID-19. Therefore, it provided an opportunity for older people to socialize.

The value attributed to social activities by older men includes “health as a resource and reward for social activities” and “finding interest through interactions” (Takashima et al., 2020a). The contents of FPSA were devised based on these values. Indeed, participants experienced “Greater awareness of health” and “Interest in and experience of ‘newness’”, suggesting that the content of the FPSA intervention satisfied the social activity needs of older men. Furthermore, Kikoeru reflects the needs of older people, such as “wanting to live a healthy life with healthy friends” and “wanting to stay mobile and have personal connections with my friends” (Abe et al., 2021). Through the FPSA, participants experienced “Greater awareness of health” and “Casual ties with members.”

Contrastingly, the negative experiences of participants included “Relationships that do not breach personal boundaries” and “Hesitation over active engagement.” The meetings were suspended due to COVID-19 and communication was hampered by social distancing. This situation made it difficult for participants to gradually deepen relationships with other members.

Moreover, men are less likely to participate in groups and meetings, and interact with friends and acquaintances (Saito et al., 2015). It is possible that these man characteristics presented as a negative attitude toward FPSA. Contrarily, the temporary nature of “Relationships that do not breach personal boundaries” may have allowed them to continue participating in FPSA for two years. In the future, a detailed survey of how older men interact and build relationships is indicated, with the results reflecting on programs like FPSA.

Toward the Development of a Frailty Prevention Program Focusing on the Social Aspects of Frailty in Community Health Nursing

Although the study period corresponded with COVID-19, steps counts were maintained during winter and the period of government-restrained mobility. The older men may have developed an awareness of their health through the program. Furthermore, since Kikoeru motivated them to exercise and helped them with health management, we believe ICT is useful in self-care for older people.

As a community health nursing initiative for older people, we propose activities that combine group and online support. Frailty prevention programs for older men must contain content that stimulates their interests, such as “health” and “newness.” Providing group support in residential areas may aid in building relationships based on familiarity and proximity. Furthermore, decreased social roles and cognitive activity are associated with the development of instrumental activities of daily living disorders (Fujiwara et al., 2003). Therefore, we believe creating opportunities for older people to play an active social role through various activities is important for frailty prevention programs.

Combining online exchanges with face-to-face meetings may enable the development of preventive interventions focusing on the social aspects of frailty. Thus, it is necessary to provide

continuous support regarding the use of smartphones and mobile applications for older people. Moreover, older men may be able to maintain social ties simply by participating in online groups without actively posting. In the case of Kikoeru, a connection was created by carrying a smartphone as a pedometer and displaying the step count on the group screen. Participants' average number of steps was maintained throughout the two years and in each phase without a large decrease, even during periods of severe snowfall and limited activity due to COVID-19. We believe such an online interaction system that allows participants to passively participate is effective among older people.

Notably, the participants experienced “Cooperation with researchers and contribution to research.” They recognized that their data would be used for research, and by participating, they would contribute to possible preventive measures. The value of social activities among older men included “Feeling I am still useful” (Takashima et al., 2020a). Therefore, it is possible that the participants recognized research cooperation itself as a value of social activity. When implementing FPSA in the community without the research element, older men may have different thoughts. Therefore, when developing FPSA for general use, it must incorporate elements that help older men recognize their social contributions.

Furthermore, when implementing FPSA as a high-risk approach to social frailty prevention, attention should be paid to the method of recruiting participants. In this study, participants were recruited through newspaper advertisements and health classes, wherein it was difficult to identify those at high risk of social frailty and link them to the FPSA. It is necessary to utilize the network of local health and welfare professionals to identify older people who are isolated, and incorporate supportive measures until they are linked to FPSA.

Study Limitations

This study had a small sample size, limitations in statistical analysis, and confounding factors that could not be controlled. Particularly, BMI, subjective well-being, and loneliness had small effect sizes. Additionally, because the study design involved a before and after comparison in a single group, it was not possible to clarify the causal relationships and mechanisms linking FPSA and psychophysiological conditions, or FPSA and social and physical frailty. Further verification through randomized controlled trials with a larger sample is necessary.

Most participants lived with their spouses and children, whose support may have contributed to the prevention of frailty. Moreover, the participants may have been a low-risk group for social frailty because of their participation in FPSA. Being a pilot study with no control group, we were unable to adjust results for individual attributes. Furthermore, the participants were cooperative older men living in urban areas. Many participants were financially comfortable and highly educated. People with health risks, isolation, high frailty risk, and lower socioeconomic backgrounds, may have different needs for social activities. Therefore, FPSA needs to be revised according to those targets.

Finally, due to COVID-19 corresponding with the intervention period, face-to-face meetings were interrupted and activities were restricted. In this study, the intervention evaluation was based on a logic model. In the future, it would be useful to use a model that accounts for several factors, such as a precede-proceed model.

References

- Abe, H., Kamishima, T., Ojima, R., Onishi, R., & Hirano, M. (2021). Social and physical effects of a pedometer and communication application among older men: A mixed-methods, pre/post pilot study. *Information, Communication and Society*, 26(3), 1–20.
<https://doi.org/10.1080/1369118X.2021.1954231>.

- Ando, T., Osada, H., & Kodama, Y. (2003). Construction of a new loneliness scale and correlates of loneliness among middle aged and aged. *Bulletin of College of Education and Human Sciences. Yokohama National University*, 3, 19–27.
- Bae, S. M. (2020). The association between health-related factors, physical and mental diseases, social activities, and cognitive function in elderly Koreans: A population-based cross-sectional study. *Psychogeriatrics*, 20(5), 654–662. <https://doi.org/10.1111/psyg.12561>.
- Bunt, S., Steverink, N., Olthof, J., van der Schans, C. P., & Hobbelen, J. S. M. (2017). Social frailty in older adults: A scoping review. *European Journal of Ageing*, 14(3), 323–334. <https://doi.org/10.1007/s10433-017-0414-7>.
- Choi, N. G., Hammaker, S., DiNitto, D. M., & Marti, C. N. (2022). COVID-19 and loneliness among older adults: Associations with mode of family/friend contacts and social participation. *Clinical Gerontologist*, 45(2), 390–402. <https://doi.org/10.1080/07317115.2021.2013383>.
- Cotten, S. R., Anderson, W. A., & McCullough, B. M. (2013). Impact of internet use on loneliness and contact with others among older adults: Cross-sectional analysis. *Journal of Medical Internet Research*, 15(2), e39. <https://doi.org/10.2196/jmir.2306>.
- Ejiri, M., Kawai, H., Fujiwara, Y., Ihara, K., Watanabe, Y., Hirano, H., Kim, H. K., Ishii, K., Oka, K., & Obuchi, S. (2019). Social participation reduces isolation among Japanese older people in urban area: A 3-year longitudinal study. *PLOS ONE*, 14(9), e0222887. <https://doi.org/10.1371/journal.pone.0222887>
- Fu, C., Li, Z., & Mao, Z. (2018). Association between social activities and cognitive function among the elderly in China: A cross-sectional study. *International Journal of*

Environmental Research and Public Health, 15(2), 231.

<https://doi.org/10.3390/ijerph15020231>.

Fujiwara, Y., Shinkai, S., Kumagai, S., Amano, H., Yoshida, Y., Yoshida, H., Kim, H., Suzuki, T., Ishizaki, T., Haga, H., & Watanabe, S., & Shibata, H. (2003). Longitudinal changes in higher-level functional capacity of an older population living in a Japanese urban community. *Archives of Gerontology and Geriatrics*, 36(2), 141–153.

[https://doi.org/10.1016/s0167-4943\(02\)00081-x](https://doi.org/10.1016/s0167-4943(02)00081-x).

Inagaki, H., Ito, K., Sakuma, N., Sugiyama, M., Okamura, T., & Awata, S. (2013). Reliability and validity of the simplified Japanese version of the WHO-Five Well-being Index (S-WHO-5-J). *Japanese Journal of Public Health [Nihon Koshu Eisei Xasshi]*, 60(5), 294–301.

Jang, A. R., Won, C. W., Sagong, H., Bae, E., Park, H., & Yoon, J. Y. (2021). Social factors predicting improvement of frailty in community-dwelling older adults: Korean Frailty and Aging Cohort Study. *Geriatrics and Gerontology International*, 21(6), 465–471.

<https://doi.org/10.1111/ggi.14160>.

Japan sports agency. (2021). *Survey report on physical activity and athletic performance*.

https://www.mext.go.jp/sports/content/20210927-spt_kensport01-000018161_6.pdf

Katayama, O., Lee, S., Bae, S., Makino, K., Chiba, I., Harada, K., Shinkai, Y., & Shimada, H. (2021). Participation in social activities and relationship between walking habits and disability incidence. *Journal of Clinical Medicine*, 10(9), 1895.

<https://doi.org/10.3390/jcm10091895>.

Langholz, P. L., Strand, B. H., Cook, S., & Hopstock, L. A. (2018). Frailty phenotype and its association with all-cause mortality in community-dwelling Norwegian women and men

- aged 70 years and older: The Tromsø Study 2001-2016. *Geriatrics and Gerontology International*, 18(8), 1200–1205. <https://doi.org/10.1111/ggi.13447>.
- Lauretani, F., Russo, C. R., Bandinelli, S., Bartali, B., Cavazzini, C., Di Iorio, A., Corsi, A. M., Rantanen, T., Guralnik, J. M., & Ferrucci, L. (2003). Age-associated changes in skeletal muscles and their effect on mobility: An operational diagnosis of sarcopenia. *Journal of Applied Physiology*, 95(5), 1851–1860. <https://doi.org/10.1152/jappphysiol.00246.2003>.
- Makizako, H., Shimada, H., Doi, T., Tsutsumimoto, K., Hotta, R., Nakakubo, S., Makino, K., & Lee, S. (2018). Social frailty leads to the development of physical frailty among physically non-frail adults: A four-year follow-up longitudinal cohort study. *International Journal of Environmental Research and Public Health*, 15(3), 490. <https://doi.org/10.3390/ijerph15030490>.
- Makizako, H., Shimada, H., Doi, T., Tsutsumimoto, K., Lee, S., Doi, T., Nakakubo, S., Makino, H., Hotta, R., & Suzuki, T. (2015). Social frailty in community-dwelling older adults as a risk factor for disability. *Journal of the American Medical Directors Association*, 16(11), 1003.e7–1003.e11. <https://doi.org/10.1016/j.jamda.2015.08.023>
- Maxwell, J. A. (1992). Understanding and validity in qualitative research. *Harvard Educational Review*, 62(3), 279–300. <https://doi.org/10.17763/haer.62.3.8323320856251826>
- Melle, E. V. (2016). Using a logic model to assist in the planning, implementation, and evaluation of educational programs. *Academic Medicine*, 91(10), 1464. <https://doi.org/10.1097/ACM.0000000000001282>
- Morley, J. E., Vellas, B., van Kan, G. A., Anker, S. D., Bauer, J. M., Bernabei, R., Cesari, M., Chumlea, W. C., Doehner, W., Evans, J., Fried, L. P., Guralnik, J. M., Katz, P. R., Malmstrom, T. K., McCarter, R. J., Gutierrez Robledo, L. M., Rockwood, K., von

- Haehling, S., Vandewoude, M. F., & Walston, J. (2013). Frailty consensus: A call to action. *Journal of the American Medical Directors Association* 14(6), 392–397.
<https://doi.org/10.1016/j.jamda.2013.03.022>.
- Nurmi, M. A., Mackenzie, C. S., Roger, K., Reynolds, K., & Urquhart, J. (2018). Older men's perceptions of the need for and access to male-focused community programmes such as Men's Sheds. *Ageing and Society*, 38(4), 794–816.
<https://doi.org/10.1017/S0144686X16001331>.
- Okamura, T., Sugiyama, M., Inagaki, H., Miyamae, F., Ura, C., Sakuma, N., Edahiro, A., Taga, T., Tsuda, S., & Awata, S. (2021). Depressed mood and frailty among older people in Tokyo during the COVID-19 pandemic. *Psychogeriatrics*, 21(6), 892–901.
<https://doi.org/10.1111/psyg.12764>.
- Perkins, J. M., Multhaup, K. S., Perkins, H. W., & Barton, C. (2008). Self-efficacy and participation in physical and social activity among older adults in Spain and the United States. *Gerontologist*, 48(1), 51–58. <https://doi.org/10.1093/geront/48.1.51>.
- Rohrmann, S. (2020). Epidemiology of frailty in older people. *Advances in Experimental Medicine and Biology*, 1216, 21–27. https://doi.org/10.1007/978-3-030-33330-0_3.
- Ronzi, S., Orton, L., Pope, D., Valtorta, N. K., & Bruce, N. G. (2018). What is the impact on health and wellbeing of interventions that foster respect and social inclusion in community-residing older adults? A systematic review of quantitative and qualitative studies. *Systematic Reviews*, 7(1), 26. <https://doi.org/10.1186/s13643-018-0680-2>.
- Saito, T., Kondo, K., Murata, C., Jeong, S., Suzuki, K., & Kondo, N., & JAGES Group. (2015). Gender and regional differences in going-out, social, and leisure activities among older

- adults. Findings from the JAGES Project. *Japanese Journal of Public Health [Nihon Koshu Eisei Zasshi]*, 62(10), 596–608. https://doi.org/10.11236/jph.62.10_596.
- Takashima, R., Onishi, R., Saeki, K., & Hirano, M. (2020a). The values and meanings of social activities for older urban men after retirement. *PLOS ONE*, 15(11), e0242859. <https://doi.org/10.1371/journal.pone.0242859>.
- Takashima, R., Onishi, R., Saeki, K., & Hirano, M. (2020b). Perception of COVID-19 restrictions on daily life among Japanese older adults: A qualitative focus group study. *Healthcare*, 8(4), 450. <https://doi.org/10.3390/healthcare8040450>.
- Tomioka, K., Kurumatani, N., & Hosoi, H. (2016). Association between social participation and instrumental activities of daily living among community-dwelling older adults. *Journal of Epidemiology*, 26, 553–561. <https://doi.org/10.2188/jea.JE20150253>.
- van Tilburg, T. G., Steinmetz, S., Stolte, E., van der Roest, H., & de Vries, D. H. (2021). Loneliness and mental health during the COVID-19 pandemic: A study among Dutch older adults. *Journals of Gerontology. Series B, Psychological Sciences and Social Sciences*, 76(7), e249–e255. <https://doi.org/10.1093/geronb/gbaa111>.
- Yamada, M., Kimura, Y., Ishiyama, D., Otobe, Y., Suzuki, M., Koyama, S., Kikuchi, T., Kusumi, H., & Arai, H. (2020). Effect of the COVID-19 epidemic on physical activity in community-dwelling older adults in Japan: A cross-sectional online survey. *The Journal of Nutrition, Health and Aging*, 24(9), 948–950. <https://doi.org/10.1007/s12603-020-1424-2>.
- Zhao, L., & Wu, L. (2022). The association between social participation and loneliness of the Chinese older adults over time-The mediating effect of social support. *International*

Journal of Environmental Research and Public Health, 19(2), 815.

<https://doi.org/10.3390/ijerph19020815>.

Table 1. Demographic characteristics of participants

N=11

ID	Age in years	Living arrangements	Residence years	Final education	Economic situation	Frail score	Number of face-to-face meetings attended ^a	Average number of steps per day Number of views of Kikoeru per day			
								October 2019–March 2020	April 2020–September 2020	October 2020–March 2021	April 2021–September 2021
A	70s	with spouse	≥ 31	High school	Not slightly worried	Pre-frail	13	-	-	-	-
B	70s	with spouse and child, etc.	11–20	Junior college or University	Slightly worried	Robust	17	3650.9 6.8	4053.5 5.4	2820.9 1.9	3549.4 2.2
C	80s	with spouse	≥ 31	High school	Not slightly worried	Robust	14	2409 8.6	4436.4 9.7	5207.8 6.7	2709.2 7.1
D	80s	with spouse	≤ 10	High school	Not slightly worried	Robust	17	15188.2 6.2	17004.8 4.0	17886.8 2.9	13182.7 2.6
E	70s	with spouse	21–30	High school	Not slightly worried	Robust	15	2032 1.8	3615.5 2.6	5343.5 3.3	5291.1 2.7
F	70s	with spouse	21–30	Junior college or University	Not slightly worried	Robust	16	4599.2 1.0	5689 0.9	3998.2 0.3	4589.7 0.3
G	80s	with spouse and child, etc.	11–20	Junior high school	Slightly worried	Pre-frail	14	3256.5 3.3	2663.5 3.3	1216.4 1.4	2154.1 1.7
H	80s	with spouse and child, etc.	≥ 31	Junior college or University	Not slightly worried	Robust	13	3462 6.4	2498.9 4.3	4819.5 4.7	5826 4.9
I	80s	with spouse	≥ 31	Junior high school	Not slightly worried	Pre-frail	14	562.3 5.6	947.2 12.6	650.1 7.1	830.2 10.6
J	70s	with spouse	≥ 31	Junior high school	Not slightly worried	Pre-frail	15	4669.4 8.1	2079.1 2.8	1422.6 1.8	461.3 1.7
K	70s	with spouse and child, etc.	21–30	Junior college or University	Slightly worried	Robust	10	10669 39.0	10210.1 30.3	9769.6 24.5	10460 22.8

Note. Baseline data were used for age, living arrangements, residence years, final education, economic situation, and frail score.

^aMonthly face-to-face meetings were planned for a total of 25 sessions, but suspended 8 times due to COVID-19. Finally, 17 sessions were conducted.

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Table 2. Comparison of pre- and post-intervention psychophysiological functioning

N=11						
Variables	Pre-test score Mean $\pm$ SD (Median) (Min-Max)	Post-test score Mean $\pm$ SD (Median) (Min-Max)	<i>p</i>		Significance probability in Monte Carlo methods: 99% confidence interval	<i>Z</i> Power
BMI	26.7 $\pm$ 3.9 (26.3) (21.8-35.6)	26.8 $\pm$ 3.6 (26.4) (22.0-32.8)	0.837		0.83-0.85	-0.237 0.05
Grip strength	35.9 $\pm$ 4.2 (34.3) (31.0-43.4)	32.5 $\pm$ 5.4 (33.8) (23.2-40.1)	0.017		0.14-0.21	-2.313 0.70
Subjective psychological well-being	10.8 $\pm$ 2.0 (11.0) (7-14)	9.7 $\pm$ 1.3 (10.0) (7-12)	0.107		0.01-0.12	-1.632 0.36
Subjective well-being	7.3 $\pm$ 1.8 (7.0) (4-10)	7.2 $\pm$ 1.4 (7.0) (5-9)	1.000		1.00-1.00	-0.106 0.05
Loneliness	1.0 $\pm$ 1.2 (1.0) (0-4)	0.8 $\pm$ 1.3 (0.0) (0-4)	0.749		0.74-0.76	-0.557 0.07
Frail score	n	n				Cramer's <i>V</i>
Robust	7	6	0.388			0.48
Pre-frail	4	5				
Frail	0	0				

	October 2019– March 2020	April 2020– September 2020	October 2020– March 2021	April 2021– September 2021	<i>p</i>	Significance probability in Monte Carlo methods: 99% confidence interval
	Mean ± SD (Median)	Mean ± SD (Median)	Mean ± SD (Median)	Mean ± SD (Median)		
Number of steps	5049.9 ± 4455.0 (3556.5)	5319.8 ± 4836.4 (3834.5)	5313.5 ± 5162.0 (4408.9)	4905.4 ± 4096.8 (4069.6)	0.733	0.72-0.74

Note. Wilcoxon signed-rank test was used for BMI, grip strength, subjective psychological well-being, subjective well-being, and loneliness. Fisher's exact test was used for the frail score. Friedman's test was used for number of steps.

Table 3. Participants' experience in the Frailty Prevention Program Focusing on Social Aspects

Theme	Subtheme	Representative Quote
Cooperation with Researchers and Contributing to Research	Contribution to research as a research participant	Even if your name isn't mentioned, data can be used as statistical material, and I think that it will lead to such materials as presentations at academic conferences. That is why I'm thinking that I might be able to contribute in some way. (ID G)
	Interest in turning own data into research results	I wonder how you will organize and utilize the information from Kikoeru. I am also interested in how to organize the information. I wonder what kind of information I should provide in my social interactions there. (ID F)
Greater Awareness of Health	Curiosity about new health information	In providing information, I listened to various stories and thought that it wouldn't do to sit quietly at home. Hearing that it is useless unless you interact with various people, these days, when I meet people while walking, I say hello. (ID D)
	Active healthcare for self	My goal was to complete 3,000 steps every day, and if I only did neighborhood association activities, I would only walk a little more than 1,000 steps at most... I knew that if I did not walk like everyone else, I would never reach 3,000 steps. I would leave my house at 5:45 a.m. at the latest, walk to the end of the neighborhood association, and then zigzag back and forth through the association. (ID I)
Interest in and Experience of "Newness"	Increasing interest in information obtained from Kikoeru Experience a previously unknown world	Looking at everyone's photos, I think that various people have various hobbies. It is a world I've never experienced before. It is as though I went on a trip to a foreign country or something. (ID G)

		I get to hear from researchers once a month, and I get to hear from members about their lives and activities as well as their opinions (it's good). It's a little different from my world. They have a different way of thinking about things and a different way of life. I enjoyed the experience because I was able to incorporate certain aspects of it and it was very helpful for my own thinking. (ID H)
Hesitation Over Active Engagement	Reluctance to actively participate	When I listen to the posts of people who can put things together well, I feel like I too should do it well. But I don't think that's the way it should be. I think it would be nice if I could send a message, but I cannot help but set it up a little. (ID E) Everyone has so many topics to talk about, so I don't want someone like me, who is not very good at posting, to cause trouble. I also don't want to press an unwanted button and cause the machine (smartphone) to stop working. (ID D)
Casual Ties with Members	Growing affection for members Persistent loose ties in Kikoeru Compassion for members with symptoms Inspired by Kikoeru for activities	Even after taking a break from the meetings, I feel like they still remember my name. After all, I think that becoming familiar with such faces will lead to connections. (ID K) That is why he enjoys posting about flowers that other people have bloomed at home, and flowers that have bloomed somewhere else. That is what inspired him to post photos of the cacti at J's house and the flowers blooming outside. (ID J Wife) I feel sorry for the members whose voices are hoarse. I feel sorry for them when they come to a meeting and I notice they can't speak. (ID C)
Relationships that Do Not Breach	Psychological barriers to posting against being seen	Kikoeru probably will not have conversations about things at home. After all, I think that people do not want others to know much about the inside of their own house. I wonder if everyone

Personal
Boundaries

Unsatisfied with
superficial interaction

thinks it's bad to have a complicated story, so there's a part of them that refrains from posting on Kikoeru. (ID B)

A relationship that
maintains a distance
without stepping into
private life

I have a feeling that if we had a chance to have lunch or dinner together, our relationship would change drastically, but at the moment, although everyone is so defensive that they have not taken the first step out of the FPSA relationship. (ID E)

I don't see any conversation among the members at the meeting. I've been watching and listening to Kikoeru's postings and they all seem knowledgeable and I was wondering if there is anyone wanted to talk more. (ID C)

Figure caption

Figure 1: Conceptual framework in this study

Figure 2: Research process

Figure 3: Communication mobile application “Kikoeru” screen. **1-1** Chat window. **1-2** Pedometer window.

Note. The icon is a photograph of the member’s face, listed along with their name. The chat window is designed to allow users to post messages with voice and pictures without the need for typing. Posts are uploaded in chronological order. The content of the voice posts are as follows:

a) Hello everyone, my name is G. The photo I posted is of a sea bream, which was caught in Hokkaido. Fish that are normally caught in Honshu are also caught in Hokkaido because the water temperature is high. That is why it is so cheap. You can eat sea bream, which usually costs more than 10,000 yen, for about half the price. Today, I am planning to make sashimi with half of it; I’m still wondering what to do with the rest of it.

b) Hi everyone, I’m B. Today’s weather is a bit muggy, but it is comfortable when the wind blows. E, there is a farm in the city where you can pick cherries. The cherries you ate while looking at the wonderful scenery must have been delicious. G, that is a splendid sea bream! It is really wonderful. I want to see your knife handling skills. Yesterday, I went to a nearby river to see the sunset. The air wasn’t very clear, so I could not see the beautiful sunset, but I’ll post two pictures.

The Pedometer window displays a record of the user’s steps and the steps of other members in rank format.

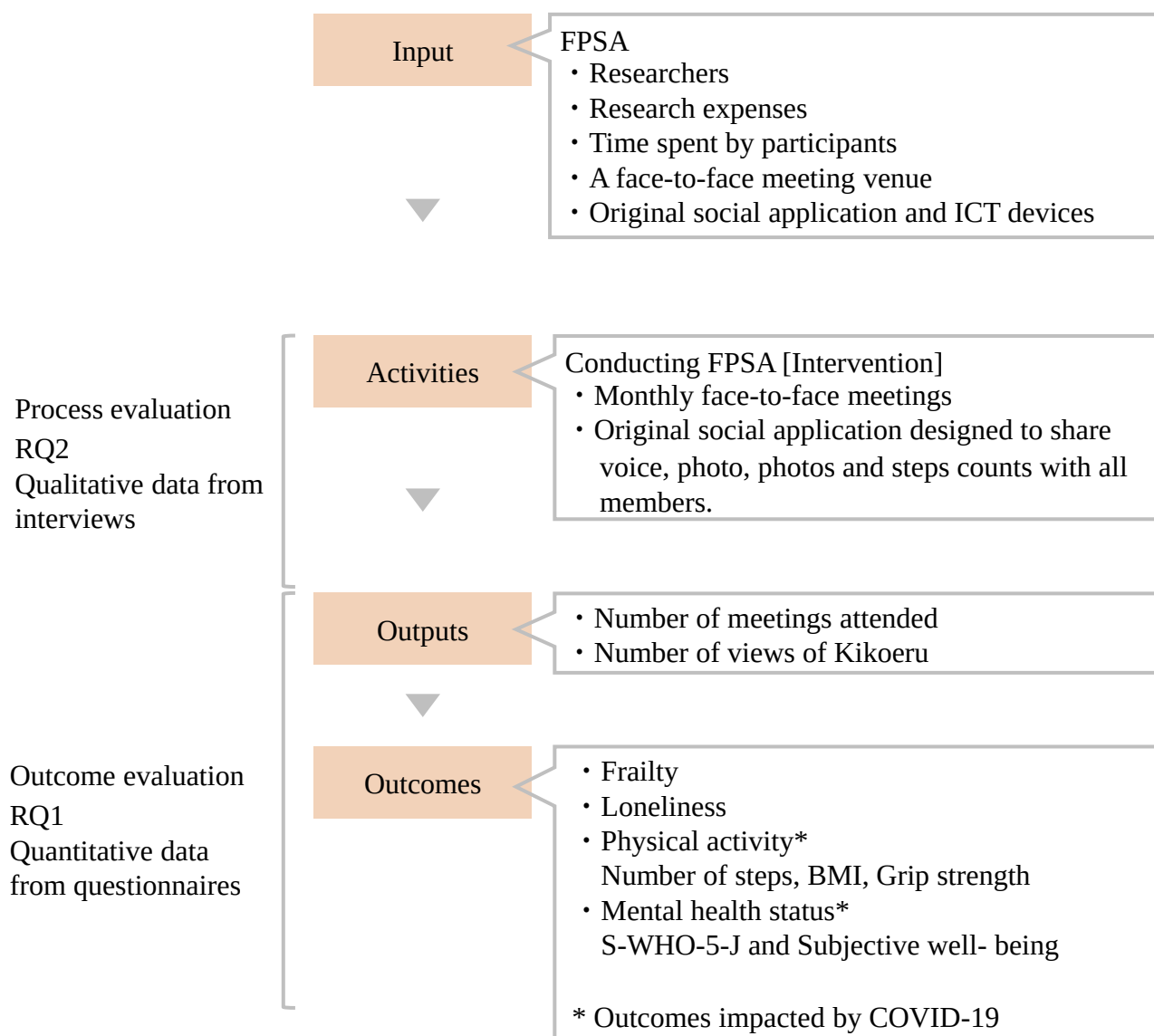
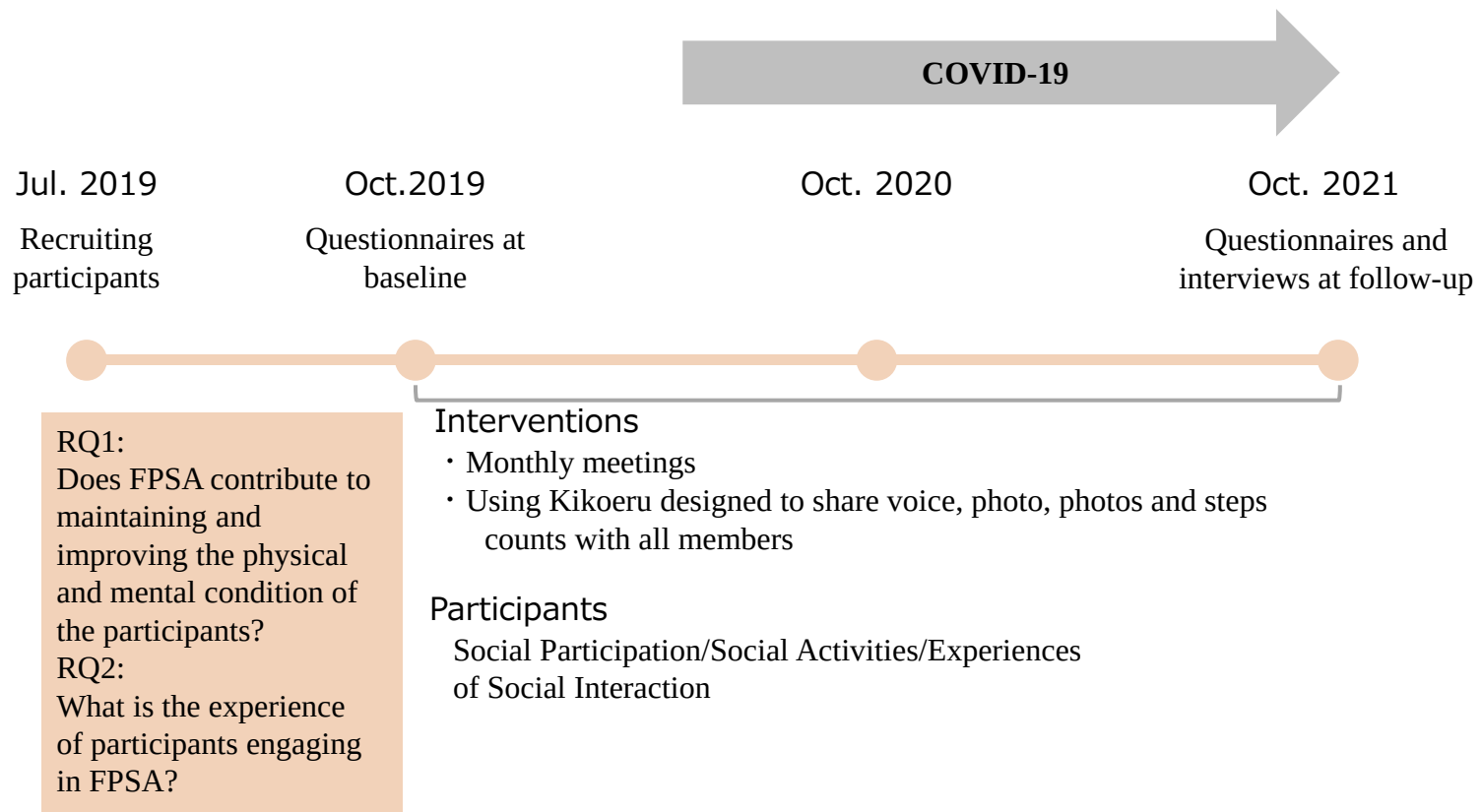


Figure 1 Conceptual framework in this study



Note: Meetings were cancelled in the following months due to activity restrictions during the COVID-19 pandemic: Mar, Apr, May 2020; Nov, Dec 2020; May, Jun 2021; Sep 2021.

Figure 2 Research process

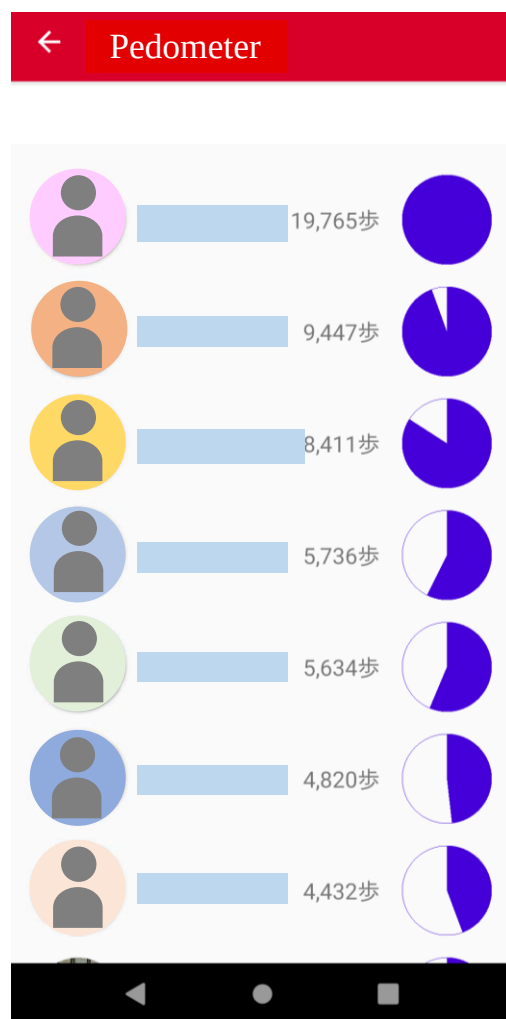
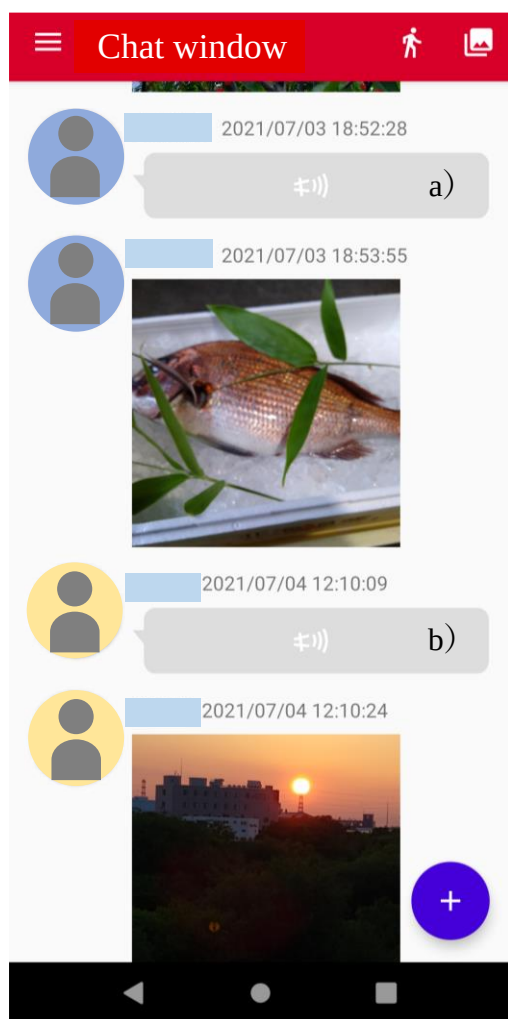


Figure 3. Communication application “Kikoeru” screen. 1-1 Chat window. 1-2 Pedometer window.

A. Providing information related to health

For example: The importance of social activities for older people in Japan's aging society

B. Discussions based on themes

For example: Reflecting on the activities you do on a daily basis and the hard work you do.

C. Joint activities

For example: Egg holder*

* This activity requires teams to use straws, newspapers, rubber bands, and other materials to create a device that would hold a raw egg and prevent it from cracking when dropped from a high place.

D. Setting individual goals that can be achieved in one month

The Importance of Social Activities for the Older People in Japan's Aging Society

2019.11.20



PERSONAL GOAL SETTING! SOCIAL ACTIVITIES

Please take today's content and think about your personalized goals regarding social activities. The goals should be as specific as possible and achievable in the past month.

(e.g.) Have the opportunity to go out once a week.
Comment once on someone's post on Kikoeru. etc.



Appendix 2. The Simple “FRAIL” Questionnaire Screening Tool

Scores of 1 or 2: prefrail; 3 or greater: frail

Fatigue: Are you fatigued?

Resistance: Cannot walk up 1 flight of stairs?

Aerobic: Cannot walk 1 block?

Illnesses: Do you have more than 5 illnesses?

Loss of weight: Have you lost more than 5% of your weight in the past 6 months?

Original version.

Morley, J. E., Vellas, B., van Kan, G. A., Anker, S. D., Bauer, J. M., Bernabei, R., Cesari, M., Chumlea, W. C., Doehner, W., Evans, J., Fried, L. P., Guralnik, J. M., Katz, P. R., Malmstrom, T. K., McCarter, R. J., Gutierrez Robledo, L. M., Rockwood, K., von Haehling, S., Vandewoude, M. F., & Walston, J. (2013). Frailty consensus: A call to action. *Journal of the American Medical Directors Association* 14, 392–397.
<https://doi.org/10.1016/j.jamda.2013.03.022>.

Do you feel tired for no reason (in the last two weeks)?	1. Yes	0. No
Can you climb a flight of stairs from the first to the second floor?	0. Yes	1. No
Can you walk 400m (1 block)?	0. Yes	1. No
Do you have more than 5 illnesses?	1. More than 5	0. Less than 5
Have you lost more than 2-3 kg (>5%) in the past 6 months?	1. Yes	0. No

Scores of 1 or 2: prefrail; 3 or greater: frail

Japanese version.

Yamada, Y., & Yamada, M. (2016). Sources of sarcopenia research and problems in determining sarcopenia, roles and issues in sarcopenia and frailty assessment: An introduction to Rapid Geriatric Assessment Japanese version. *Kaigohukusi/Kenkoudukuri*, 3, 11–18. (in Japanese)

Note: Survey items and response options are translated by Hirano.