



Title	Older rural people's perception of connectedness through a communication application : A qualitative descriptive study
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Title

Older Rural People's Perception of Connectedness through a Communication

Application: A Qualitative Descriptive Study

Abstract

Connectedness among older people is essential for healthy communities, especially among rural populations where limited social interaction and associated health effects may be cause for concern. In this qualitative descriptive study, we explored older rural people's perception of connectedness through a communication application. The study assessed 10 participants (mean age = 76.2 years) living in rural Japan who regularly participated in a senior citizens' club. From July 2019 to January 2020, the participants used a social media application developed by our research team to meet the needs of older people. Semi-structured interviews were conducted. Six themes representing older rural people's perception of connectedness were identified: (1) thoughtful consideration for members strengthened even without them meeting face-to-face, (2) encouragement received from familiar members, (3) joy in sharing daily routine with neighbors, (4) courage to advance through face-to-face interaction, (5) willingness to continue club membership, and (6) fear of disrupting club's harmony. Participants who used the application felt compensated for the lack of social interaction opportunities in rural settings and strengthened their existing relationships.

Key Words

information technology, Japan, older people, rural population, social interaction, qualitative research

Key Points

- Older rural people who participated in this study recognized that their day-to-day relationships became more robust through the specially designed communication application.
- For older rural people, a sense of belonging was the basis for commitment.
- The use of a communication application along with social activities could be a strategy to achieve improved health of older rural people.

Introduction

Connectedness is essential when considering the health of older people. Connectedness has been defined as “the opposite of loneliness, a subjective evaluation of the extent to which one has meaningful, close, and constructive relationships with others” (O’Rourke & Sidani, 2017, p. 43). Connectedness is related to self-rated health (Kawasaki et al., 2018), objective health status (Cherry et al., 2013), and mortality risk (Holt-Lunstad et al., 2010), all of which are important determinants of health. In recent years, the importance of connectedness to health has been increasingly understood from a scientific perspective, and research on connectedness among older people has constantly been growing.

However, the literature on connectedness among older rural people is still in its infancy. In the few studies that have been conducted, connectedness among older people is exemplified by contact with family, friends, and social groups (Buys et al., 2015) or relationships with family, friends, community, and God (Letvak, 1997). Additionally, the consequences of connectedness are focused on psychosocial health, such as purpose of life (Welsh et al., 2012) and mental health and well-being (Collins et al., 2017). It has been proposed that connectedness has a significant impact on psychosocial health through people’s perceptions. Although evidence on the connectedness of older rural people is still insufficient, it has been understood as contributing to a fulfilling life in terms of their relationships in the community (e.g., their independence and community engagement; Buys et al., 2015), and active aging (Carver et al., 2018).

Additionally, the importance of connectedness among older rural people has been discussed in light of the unique obstacles encountered in rural environments. Such discussions include, for example, projected population decline (United Nations, 2018),

geographical distance (Berg et al., 2017), and lack of opportunities for social activities (Vogelsang, 2016). Human, environmental, and situational limitations make it more challenging for older people in rural areas to connect with others than those in urban areas. Furthermore, the health impacts associated with this challenge may be greater in rural areas because of inadequate social resources compared with urban areas (Verma & Taegen, 2019). Public health professionals have an urgent mission to address these issues of connectedness among older rural people.

Social activities are one of the most effective strategies to maintain connectedness (O'Rourke et al., 2018). Older rural people experience connectedness through participation in various community groups (Buys et al., 2015). Neville et al. (2018) stress the importance of direct interactions with friends and neighbors, along with maintaining social networks. The use of information and communication technologies (ICTs) has been found to have positive health effects (Chen & Schulz, 2016). The use of ICTs by older people helps reduce their loneliness and improves the quantity and quality of communication (Cotten et al., 2013). Additionally, several smartphone applications have demonstrated the possibility of addressing the issue of older people's isolation during the COVID-19 pandemic (Banskota et al., 2020). A smartphone is expected to have a positive effect on connectedness.

The importance of connectedness (Buys et al., 2015; Carver et al., 2018) and ICT use (Banskota et al., 2020; Cotten et al., 2013) among older people has been reported in previous studies. However, there have been insufficient reports on research that combine social activities and ICT use. Furthermore, it is unclear how connectedness is recognized in this context. Therefore, we explored older rural people's perception of connectedness through the use of a communication application specially designed for them.

This study is expected to contribute significantly to supporting healthy, independent living in rural communities, where it is increasingly difficult to connect socially. Moreover, as Japanese older people were the participants of this study, exploring preventive approaches to older people's health in Japan, a rapidly aging society, may bring similar suggestions for all countries with aging populations.

Methods

Research Design

A qualitative descriptive design was used in this study, underpinned by the philosophical position of naturalistic inquiry (Sandelowski, 2000). Qualitative descriptive studies aim to summarize comprehensive events in daily life (Sandelowski, 2000). Direct descriptions are appropriate for gaining insight into phenomena that are important to healthcare professionals but not fully understood.

This study adopted the triangulation method, which involves the use of both qualitative and quantitative approaches to measure the same variable to ensure confirmation and completeness of data (Halcomb & Andrew, 2005). In this study, the phenomenon of connectedness identified through the interviews was reviewed using a survey on the use of the application and a questionnaire regarding connectedness.

Participants

Senior citizens' clubs are informal organizations run by older people. Such clubs are found throughout Japan; they provide a setting for the social activities of older people, which are mainly based on community relations. However, the clubs are not managed by the government, and the number of clubs differs by region. The town selected for this study was Town A, which is in Hokkaido, northern Japan. It has a population of

about 6,000 people, and there are three clubs, one in each of its three districts.

Of Town A's population, as of 2015, 29.3% were aged 65 and above. The selected club, led by four men, was established less than 10 years ago. There is no strict age policy, but most members are over 75 years old.

Twenty-five residents of Town A are registered as members of the senior citizen's club, and 19 members join in the monthly activities held once a month. Initially, 19 members were asked to cooperate in this research, and 15 of them gave their consent. Before the study began, we investigated the barriers to using this application, namely (1) cognitive impairment, (2) paralysis, and (3) significant visual or hearing impairment. The participants were confirmed to be free of these barriers.

The study explored insider perspective on connectedness through the use of the application. It would have been difficult to understand fully the participants' perspective on connectedness if they had not used the application for a significant number of days. Therefore, we set the exclusion criterion at less than 120 days of posts/pedometer views during the study period (180 days). A day was defined as one on which posts or pedometer recordings were viewed at least once. During the 180-day study period, five participants (two voluntarily withdrew, and three met this exclusion criterion) were excluded from the study, leaving 10 final study participants.

The study was conducted from June 2019 to February 2020. During the study period, the application was used for six months from July 2019 to January 2020, followed by interviews in January to February 2020. Figure 1 provides an overview of the study.

Communication Application

The research team had previously investigated the ICT needs of older people, based on

which it developed a communication application called Kikoeru, specially designed to be user-friendly for older people (Abe et al., 2021; Figure 2).

Kikoeru users interact by voice and photos (Figure 2-1), and the application includes a pedometer (Figure 2-2). The application has three activity features that differentiate it from a telephone: (1) participation at users' own pace anytime and anywhere, (2) group interaction instead of one-on-one interaction, and (3) sharing the daily step count.

From July 2019, the participants were provided with a smartphone installed with Kikoeru. The research team paid all the costs related to these smartphones. The researchers conducted participatory observations on the application during the study period.

Data Collection

Individual interviews were conducted from January to February 2020, six months after beginning the use of the application. All individual sessions were conducted face-to-face. The interviews were conducted at the participants' homes or in a private room of a public facility. The first author individually interviewed all participants.

In qualitative studies, the researcher is the primary instrument for data collection, which influences how the data are collected and analyzed (Baillie 2015). The first author, a research team member involved in research administration, had to consider the possibility of influencing the participants' responses. With this in mind, the interviewer applied various techniques to maintain objectivity during the interviews such as: (1) promoting participants to speak freely by making every effort to show respect and empathy (e.g., eye contact, leaning forward, and open body language; Moser et al., 2018), (2) providing participants an opportunity to express their

experiences and perceptions freely through semi-structured interviews, and (3) avoiding leading questions by using open-ended questions throughout the interview and ensuring that participants are free to talk about their perceptions.

The interviewer asked questions based on an interview guide (see Table 1) and probing questions (Polit & Beck, 2017). The interviews lasted an average of 60 minutes. The interviews were recorded on a digital voice recorder with the participant's consent.

Data Analysis

The first author transcribed all the interviews, after which the first and last authors independently and carefully read all transcriptions verbatim to familiarize themselves with the data. In the first phase, they read all cases and focused on the context in which “connectedness” could be detected and translated into codes. Afterward, the final codes were extracted from all cases by examining the relationship between the codes. In the second phase, similar final codes were aggregated, and subthemes were extracted. After each case was examined, subthemes were extracted from six cases; no new subthemes were identified from four cases, and the subthemes were integrated into those already extracted. In the third phase, commonalities between subthemes were examined, aggregating similar subthemes to generate themes with a higher level of abstraction. In generating the themes and subthemes, we performed continuous comparative analysis and checked for any gaps or discrepancies in the interpretation of the data and returned to the data and codes for verification. This series of processes was conducted by the first and last authors. The first author shared the analysis and modified it until it was approved by the last author. After a consensus was reached, the themes and subthemes were confirmed by all authors. Once the final consensus was reached, the subthemes and themes were established.

The first author is a qualified nurse and a post-graduate student of Public Health Nursing. Before data collection could begin, this author trained in qualitative descriptive study under the supervision of the last author, conducting pre-interview and detailed data analysis with an older rural woman. The first author also participated in club activity and built relationships with the participants. The last author is a university researcher with experience in conducting qualitative research as well as a public health nurse with practical experience in healthcare.

Rigor and Trustworthiness

Different strategies were adopted throughout the research process to ensure rigor and trustworthiness. The data were thoroughly reviewed with the co-authors during the analysis (for confirmability and dependability). Additionally, member-checking and method triangulation were conducted (for credibility). Member-checking was done with approval of the theme from the nine participants, and some expressions with comments were modified. This study followed the COREQ checklist criteria for reporting qualitative research (Tong et al., 2007).

The method triangulation process is shown in Table 2. First, we conducted a survey on the use of the application to demonstrate that the connectedness reflected in the qualitative data was indeed made through its use. Second, we conducted a questionnaire survey on connectedness. Connectedness among older people is defined as the opposite of loneliness (O'Rourke & Sidani, 2017). With this in mind, we investigated loneliness among older people before and after they used the application to ensure that the connectedness reflected in the qualitative data was also secured by the quantitative data.

Ethical Considerations

This study was approved by the Ethics Review Committee of the Faculty of Health Sciences, Hokkaido University (approval number: 19-8). In June 2019, the authors held a 60-minute interactive communication application experience session to explain the operation of the application and responded to questions about the operation method while using the application. This way, the authors tried to minimize the burden on the participants.

Results

The participants comprised four males and six females, with a mean age of 76.2 ± 7.0 years. All the men lived with their family, while the women lived alone; all of them lived in their own homes. Seven out of ten had never used a smartphone before this study. Furthermore, all of them had never used social media such as LINE or Facebook. Table 3 provides an overview of the participants.

Six themes, with 17 subthemes, were extracted through the qualitative analysis. The themes and subthemes are listed in Table 4. The study participants are referred to as “members,” defined as senior citizens’ club participants who used the application.

1) Thoughtful consideration for members strengthened even without them meeting face-to-face

The members reported doing well without face-to-face contact. Through these new opportunities, they experienced peace of mind. Additionally, because of their previous involvement, they were able to imagine what was going on with the members and were concerned about their condition. As a member said:

We only have the club once a month. I am sure that members who live close

to each other can see how everyone is doing, but in my case, we live far apart. That makes it even more difficult to know. So, if members walk around or post about their flowerbeds and flowers... I'll know that members are doing well using Kikoeru. (C)

From the number of steps, the members were able to determine the status of other members in a timely manner. This also meant that members were concerned about the health condition of other members who had not taken many steps:

When I looked at the pedometer and Ms. E hadn't walked, or it was 400 or 500 steps, I wondered if she had caught a cold, or if she wasn't feeling well. (G)

2) Encouragement received from familiar members

The members received inspiration that they had never had previously. The appearance of the members' faces on the application gave them a different sense of urgency from the pedometers they worked on alone. Sometimes they felt that they did not want to fall behind:

Some days it's a big deal. Well... but if I look at the pedometer, I see that members are walking so much. I thought, "I have to join in and work hard. I can't be doing this. That's what encouraged me. (G)

However, it was not all about the desire to compete. As the members worked hard, they experienced a positive feeling of wanting to do the same:

It's just like anything else, but I have the impression that because they are doing it, I want to do it too. (A)

Members had previously built mutual relationships. Therefore, they received support from members who knew their past. Through their posts, they were touched by their

compassion. It gave them strength to face their own regrets and move forward:

I found out last spring that my husband had a disease. After that, we thought it would be hard to grow orchids, so I uprooted them, but only the yellow orchids remained. At that time, Mr. D shared a post, so... I picked up the yellow orchids yesterday and watered them again. I felt like I should try it. Um... I feel like he gave me strength. I am going to work hard to make them bloom again. (H)

3) Joy in sharing daily routine with neighbors

Through the application, they realized that they did not know much about how the members lived, even though they had known them for a long time. For some of them, even after knowing each other for 40 years, they were discovering new aspects of their lives and enjoying themselves:

Even if we wanted to know how members are doing, there was no way to know that before [using Kikoeru]. I think it is fun to listen to the stories because I can see it in each person. (F)

Members recognized the function of posting messages and photos in the application as a means to share information, which, previously, had not been possible. They often posted photos of landscapes and flowers that reminded them of the beauty of their hometown, which they had taken for granted and had never noticed before. They were moved by it. By looking at the members' posts, they shared the joys of everyday life with the members:

I was reminded of something I had never seen before, even though we were in the same place. The morning and night, the sound of the birds... They showed me many things. It was really wonderful to be able to see those

things. (H)

4) Courage to advance through face-to-face interaction

Members were able to see new aspects of how the others lived, and that increased their interest. They talked about memorable postings upon meeting each other, and the topics shared on the application were used as conversation starters. Additionally, by having a common topic, they were able to overcome the communication barrier with senior members, with whom they had had little opportunity to talk to before:

I've never really talked to Ms. F. We have a big age difference. However, I met her when I was taking a morning walk. We could talk about how she had been working hard on her pedometer. Then, the conversation got really exciting. (J)

5) Willingness to continue club membership

For members, participating in the application meant staying in the group. Using the application was a new challenge particularly for the senior members, as they were coming to terms with their own aging. They thought it was more important to use the pedometer every day than to record more steps. They walked as much as they could without straining themselves. Further, even if they were not able to contribute, they made sure to see the postings every day:

Anyway, even if I can't walk as much as I would like, I know... it's important to participate every day. (G)

I don't post or do anything. But, you know, I always look at Kikoeru. (E)

The members are working hard, so I must be able to do it as a member, too.

I believe that if I don't feel like following [the] members, it's the end. (F)

6) Fear of disrupting club's harmony

All members are not only enrolled in the club but are also long-time residents of the area. Hence, they were aware of the link between their daily lives and those who are on the application. They were always aware of being watched by other members. Because of the shame and guilt of deviating from the “normal,” they felt compelled to participate as much as they could. They also chose to behave in a considerate manner so as not to disrupt the harmony of the group. They thought that the unwritten rules of socializing in daily life, which had been implicitly understood and shared, were extended to the application:

I've always heard that Ms. A walks with a goal of 3,000 steps. Then, I looked at the pedometer; it was around 4,000 steps. When I saw that, hmmm... it seemed like I was slacking off. I was not walking even though my feet didn't hurt. (G)

Findings from the Quantitative Data on Social Connections

An assessment of the application usage revealed that the average number of times the participants viewed their pedometers was 11.7 ± 16.9 times per day, and that of posts was 13.9 ± 17.0 times per day.

We also conducted a questionnaire survey on social connections before and after the use of the application. Before using the application, nine participants had an AOKLS score of 0 points and one participant had a score of 1 point. The mean score was 0.1 ± 0.3 points. Six months after using the application, there were eight

participants with 0 points and two participants with 1 point. After six months, loneliness was reduced in one participant, maintained in seven, and increased in two. There was no statistically significant difference in loneliness before and after the use of the application ($P=1.000$).

Discussion

In this study, six themes were derived regarding connectedness. Previous studies have not thoroughly examined the use of a communication application as a supplementary tool in social activities and did not explore how connectedness is recognized. We show that older rural people can recognize connectedness within their activities in various ways.

Participants expressed that “thoughtful consideration for members strengthened even without them meeting face-to-face.” ICTs help friends connect with each other (Cotten et al., 2013; Sims et al., 2017) and further strengthen existing connectedness (Bruggencate et al., 2019). The Kikoeru application featured sharing status through posts and pedometers. For participants who have only had the opportunity to meet at the club once a month, the application seemed to have created a mutual sense of security and consideration regardless of environmental and circumstantial factors.

Additionally, “encouragement received from familiar members” helped the members’ sense of self. For rural individuals, friendships are predictors of physical activity (Clarke et al., 2017) and increase the likelihood of meeting physical activity recommendations (Parks et al., 2003). Members recounted the experience of being inspired to walk by viewing others’ steps. It can be inferred that such experiences of older rural people, as in previous studies, were generated in their interactions with the application. Furthermore, all six female participants lived alone. Saito et al. (2004) find

that a lack of participation in social activities and of contact with friends and neighbors causes a functional capacity decline in older Japanese people living alone in rural areas. Especially among women, support from neighbors contributes to the maintenance of daily activities (Saito et al., 2005). In this study, the messages received from members triggered a symbolic act of acceptance of bereavement for their spouses, and further encouraged them to continue living despite the sorrowful circumstances. The creation of daily engagement through the application could lead to maintaining, or even regaining motivation for, their activities through interaction with others.

Participants experienced the “joy in sharing daily routine with neighbors.” They also recognized an interest in the way of life that they had never experienced. Bruggencate et al. (2019) state that older people using social technology enjoy sharing their lives with friends and imagining what their distant friends—especially those with whom communication had been difficult—were doing through photographs or videos. The application allowed the participants to share photos easily, using the posting function. The photos posted were mainly of local scenery or snippets of one’s own life. The participants experienced interest in the senders, and both senders and receivers experienced the pleasure of sharing. These results are similar to those of previous studies. “The lack of opportunities to share feelings and experiences with others who had similar personal social and cultural experiences” was noted among rural older women (Harvey, 2007, p. 6). Using the application provided reliable triggers to share interests and experiences with members. The geographical distance from friends and the lack of opportunities for interaction faced by older rural people were likely to be newly complemented.

Members also gained “courage to advance through face-to-face interaction.” This, too, differs from previous ICT studies where older people were reluctant to

replace virtual interactions with real ones (Bruggencate et al., 2019). The members had already established a kindred relationship. Hence, online and offline interactions may have been linked without divergence. When used in existing groups, as in our study, it suggests the potential to counteract the negative aspects of ICT specific to older rural people, such as infrequent use (Sum et al., 2009), and help them develop their existing connections.

Connectedness through the application is also explained by the ambivalence of the members' sense of belonging. First, "willingness to continue club membership" reflects a positive aspect of belongingness. The participants used the application as much as possible, even though they could not use all of its functions. A positive sense of responsibility to remain committed to the group was expressed. This is similar to other studies where online activities were found to increase the sense of belongingness (Shapira et al., 2007). At the same time, a sense of belonging to a group implies a perception of having an important position or role in the group (O'Rourke & Sidani, 2017). A sense of belonging among older people entails a responsibility to do what they can for the group; even with the application, the experience was similar.

However, "fear of disrupting club's harmony" reflects a negative aspect of belongingness. As in previous studies, participants considered relationships with their neighbors meaningful (Neville et al., 2018), but they also desired to maintain a reasonable distance. For rural older women, "while the sense that 'everybody knows everybody' can facilitate a sense of belongingness, the visibility of daily life, and conformity to an accepted rural identity, can marginalize and exclude women who do not share this persona" (Harvey, 2007, p. 7). Even though the study participants were not exclusively female, the sense of belongingness may have provided wisdom and ingenuity to avoid exclusion. Furthermore, the use of new devices has been found to

make people prone to exclusion (Kilpeläinen & Seppänen, 2014). Participants may have avoided exclusion by participating, motivated by negative feelings of obligation. It can be argued that a consideration similar to a kind of bondage perceived in daily life was experienced differently on the application and determined the members' behaviors.

Based on data from the application, each member viewed the pedometer and postings more than ten times per day. This result suggests that they were using it and interacting with each other sufficiently on regular days, apart from the monthly club activities. Additionally, 180 days after using the application, eight participants did not feel lonely. There was no significant change in loneliness before or after using the application, but when combined with a mean score of 0.2 ± 0.4 points for loneliness after six months, it can be said that the participants remained loneliness-free. This means that a state of connectedness was manifest throughout the period they used the application, which supports the qualitative findings of this study that previous daily interactions were maintained.

Limitations

The limitations of this study deserve mention. First, the participants had been involved in social activities and had already built some relationships when they participated in this study. Perceptions of social connections may be influenced by culture and group relationships. In this sense, transferability to other contexts might be limited. However, transferability was facilitated by providing comprehensive descriptions of the data and the findings. Second, all participants were physically able to use their smartphones. We did not consider participants with visual or hearing impairments. Further verification is needed to clarify the scope of this application and refine its design. Third, the researchers conducted participatory observations, which may have influenced the

content posted. Finally, the researchers did not seek to identify any possible harm from the use of the communication application. As “consideration” was extracted in the results, it is possible that the participants refrained from using negative expressions, and the possibility of the existence of negative connections cannot be denied.

Conclusions

By using a specially designed communication application, older rural people gained a sense of security and their social relationships became stronger through daily interactions. The practice also provided mutual sympathy for the members, as previous lack of interaction opportunities was compensated. In addition, the sense of belonging, which was the basis for commitment, strengthened. The positive impacts are expected to prevent various adverse health effects associated with social disconnection among older rural people and support healthy living in such communities.

Relevance for Clinical Practice

Based on the results of this study, to maintain connectedness, we propose a preventive approach suitable for older rural people, especially those who are concerned about attenuated connections and the associated health effects. This study used a specially designed communication application that considered the usability for and needs of older people. Despite their advanced age and little to no experience of using smartphones (Table 3), the participants learned to use smartphones and stayed connected with other members daily. ICTs are not generally understood by older people because of design flaws related to visual stimuli and multifunction buttons; in other words, because ICTs were designed by young people for young people, not for older people (Wandke et al., 2012). However, even older people with no experience of using smartphones can fully

utilize a communication application if it is specifically designed for them.

First, Kikoeru's simple design and familiar features made it more accessible and comfortable for members to interact with each other daily. Second, Kikoeru enabled members to interact even though the club was closed. Furthermore, the participants strengthened and supplemented their existing relationships. When formulating strategies to stay connected, it is essential to design applications for older people. Public health professionals can help sustain the effects of connectedness by using such applications in conjunction with existing social activity participation.

In addition, ICT use is expected to be promoted further by the early acquisition of ICT-based communication by older people. In the interview, Ms. F, who is in her 80s, explained, *"Kikoeru is a wonderful thing isn't it? I wish it had come out a little earlier, a little earlier in our youth."* Factors that inhibit older adults' understanding of ICT include slower processing speed associated with aging and reduced ability to recognize relevant and irrelevant stimuli (Wandke, 2012). Older people have a reduced ability to learn new things. As such, it is crucial not only to design ICT but also to create an environment in which ICT can be learned at an early stage.

The use of ICTs could become an effective way of maintaining connectedness among older rural people, even when engaging in social activities is difficult because of the COVID-19 pandemic. In the future, it is necessary to conduct follow-up surveys to determine whether relationships among group members have been further strengthened. Additional research on other regions or isolated people is also recommended to accumulate evidence. In the future, it is vital to consider different ways of supporting connections that contribute to the health of community-dwelling older people.

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Table 1. Interview guide and probing questions

Q1.	How did you experience connectedness with the group members?	
	1-1.	When did you perceive connectedness?
	1-2.	What did the experience of connectedness bring you?
	1-3.	In reference to questions 1-2, what do you think of the feeling that you had?
Q2.	What changes have you experienced regarding your connectedness with the group members?	
	2-1.	If you have not experienced any change, how do you currently interact with the group members in your daily life?
	2-2.	If you have experienced some changes, how have you changed?
Probing Questions ^a	1	What does this mean to you?
	2	Can you give me an example?
	3	Could you elaborate on that?

^a We included general probing questions (Polit & Beck, 2017) to elicit further depth from participants' responses.

Table 2. Details of the triangulation method

	(i) Survey of the use of the application	(ii) Questionnaire survey on connectedness
Period of data collection	From June 2019 to February 2020	1) June 2019 2) January–February 2020
Method of data collection	Log data were collected by the server	1) Self-administered questionnaire with a group survey 2) The same questionnaire was used and conducted before the start of the interviews
Survey variable	1) Number of days of use 2) Number of post views 3) Number of pedometer views	Ando, Osada, and Kodama Loneliness Scale (AOKLS; Ando et al., 2000) ^a
Data analysis	Descriptive statistics were gathered on the daily usage for each survey item	Descriptive statistics were gathered. Afterward, pre- and post-comparison checks were conducted using Wilcoxon signed-rank test after using the application. The statistics used the Monte Carlo estimate. IBM SPSS Statistics (version 26.0, IBM SPSS Inc., Chicago, USA) was used, and the significance level was set at 5%.

^aBecause this scale measures loneliness with a focus on relationships, it was considered to reflect perceptions of connectedness. The questionnaire comprises ten items (e.g., “Do you have people around you with whom you have a good rapport?”). Responses were rated on a 2-point scale, ranging from 0 to 1, with 1 indicating loneliness. The score range was 0–10, with higher scores indicating a greater sense of loneliness.

The study included 1,276 Japanese middle-aged and older adults. As a result of factor analysis, the selection criterion for the items was a factor loading of 0.60 or higher. The scale created consisted of 10 items. Cronbach’s α for the scale was 0.836.

Table 3. Overview of the study participants

ID	Gender	Age	Family structure	Residence	Club participation	Social activities	Smartphone experience	Main medium of contact
A	Male	70s	Two or three generations	≥ 41 years	≥ 7 years	Local community activities, religious organizations	< 1 years	Phone, smartphones
B	Male	70s	Only couple	< 31 years	≥ 7 years	Local community activities, religious organizations	5 years	Phone, smartphones for seniors
C	Male	70s	Two or three generations	≥ 41 years	≥ 7 years	Local community activities, volunteer groups	None	Phone, mobile phone
D	Male	60s	Only couple	≥ 41 years	< 3 years	Local community activities, volunteer groups	< 1 years	Phone, smartphones
E	Female	80s	Single	≥ 41 years	≥ 7 years	Local community activities, hobby groups	None	Phone, mobile phone
F	Female	80s	Single	< 41 years	≥ 7 years	Local community activities	None	Phone
G	Female	80s	Single	< 21 years	≥ 7 years	Local	None	Phone

				years	years	community activities		
H	Female	70s	Single	≥ 41 years	< 1 years	Local community activities, hobby groups	None	Phone, mobile phone
I	Female	70s	Single	≥ 41 years	≥ 7 years	Local community activities, hobby groups	None	Phone, mobile phone
J	Female	60s	Single	< 21 years	< 1 years	Local community activities, hobby groups	None	Phone, mobile phone

Table 4. Themes and subthemes

Themes	Subthemes
Thoughtful consideration for members strengthened even without them meeting face-to-face	Peace of mind online
	Knowing other members' activities
	Consideration for members' probable condition
	Showing appreciation to members who participate
Encouragement received from familiar members	Self-encouragement to keep walking
	Continue living despite sorrowful circumstances
Joy in sharing daily routine with neighbors	Discovery of previously unknown experiences
	Posting daily pleasures
	Share and appreciate what is usually taken for granted
Courage to advance through face-to-face interaction	Opportunities for lively conversation
	Cheering on the members by taking pictures
Willingness to continue club membership	Learn and continue practicing new techniques
	Willingness to participate as much as possible
	Personal efforts to avoid dropouts
Fear of disrupting club's harmony	Feeling ashamed because of inability to do what others can
	Extend local considerate manner even in the application
	Filtering behavior to maintain harmony

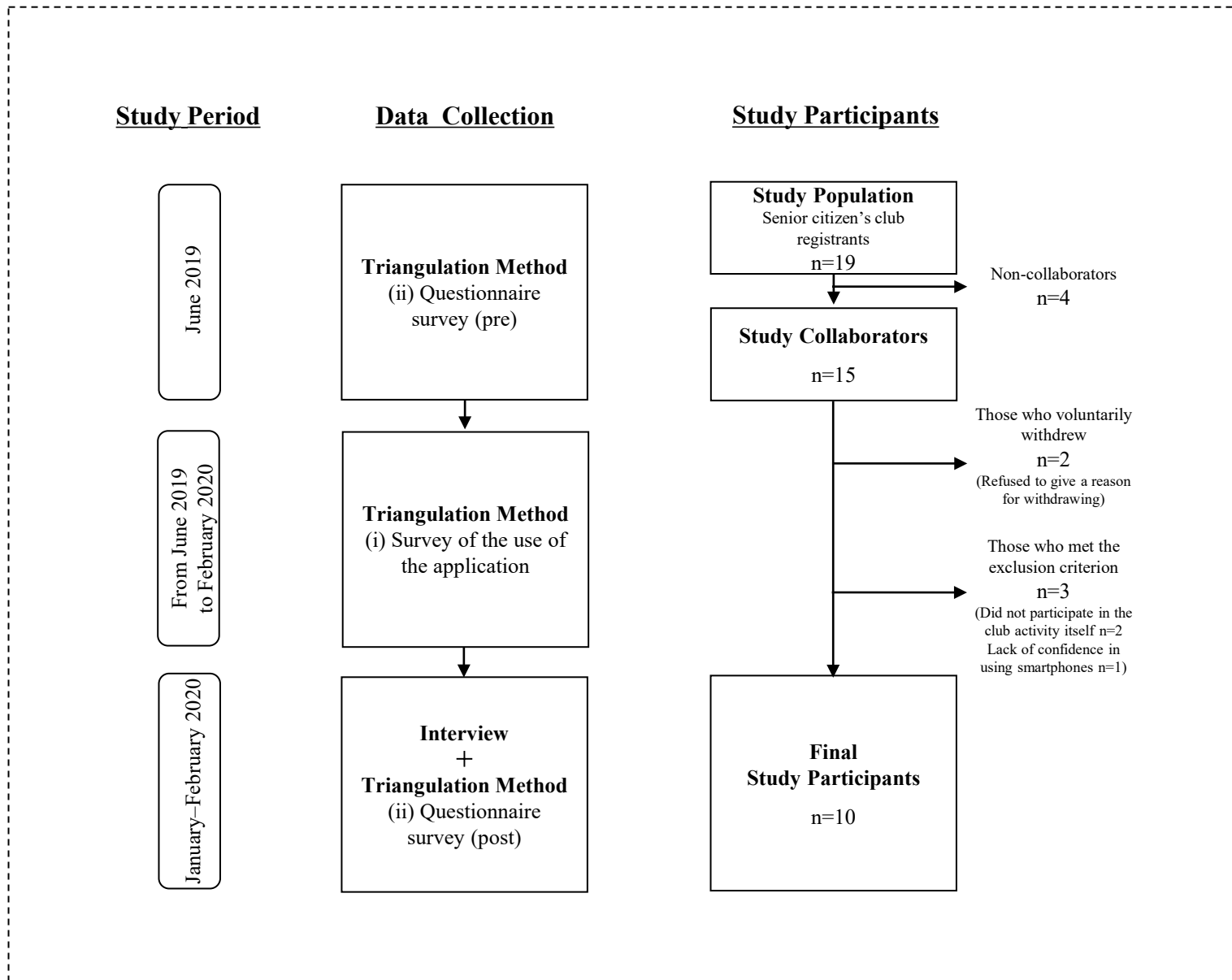


Figure 1. Study period, data collection, and participants

Figure 2: Communication application screen

Figure 2-1. Chat window

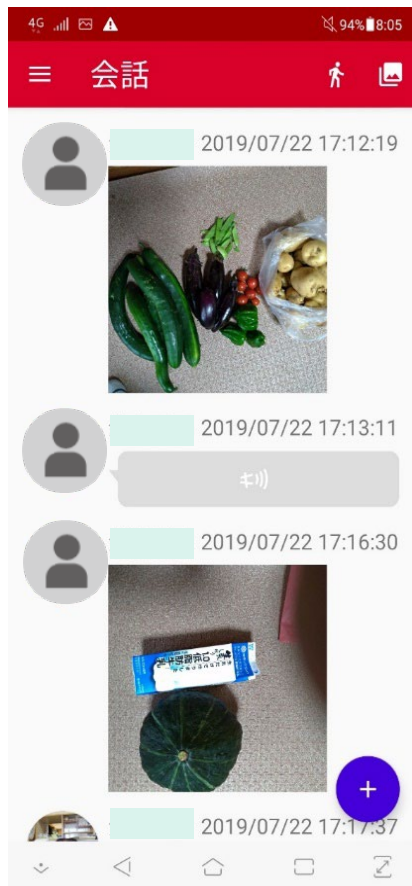
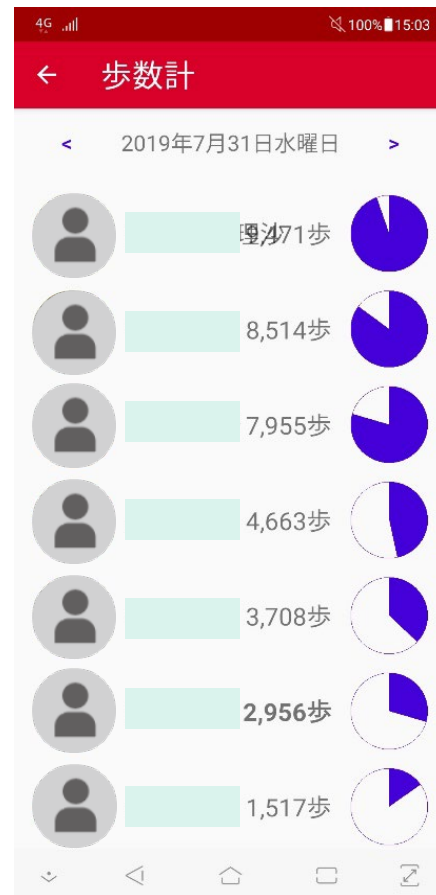


Figure 2-2. Pedometer window



Kikoeru has three features: voice recording, photography, and a pedometer. It incorporates a simple, user-friendly design that excludes operational complexity, such as live-streaming or video functions. It is also designed to be elderly-friendly since it does not require any text input but allows users to post voice and photo messages (Figure 2-1). Users record voice messages or take photos of daily events or even sounds from nature, such as birds singing or a river rushing. All these can be posted on the application. Users enjoy listening to, watching, and reacting to other members' posts. The application also has a pedometer function (Figure 2-2) that allows users to track not only their own steps but also those of other users ranked in order of performance.