

# The Purpose of Internet Use and Face-to-Face Communication with Friends and Acquaintances among Older Adults: A JAGES Longitudinal Study

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## Research Article

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# Abstract

## Background

Whether and what type of internet use increases face-to-face communication (FFC) remains unclear. We aimed to investigate the mode of internet use that increases the FFC among older adults after three years.

## Methods

The participants were 8,734 adults aged 65 years or older who responded to the Japan Gerontological Evaluation Study (JAGES) surveys in 2016 and 2019. The exposures were the seven purposes of internet use in 2016, including communication, information search, and financial services. The outcome was the frequency of FFC with friends or acquaintances, more than once per week in 2019. The confounders included 13 variables, including demographic, socioeconomic, and psychological factors. We performed modified Poisson regression analyses to evaluate the association between the purposes of internet use in 2016 and meeting friends or acquaintances more than once per week in 2019. We also analyzed after stratification by the frequency of meeting friends or acquaintances in 2016. We evaluated the number of meetings with friends and acquaintances in the sensitivity analysis.

## Results

Internet use for communication was associated with an increased probability of meeting friends or acquaintances more than once a week in 2019 (Cumulative Incidence Ratio:1.08; 95% Confidence Interval = [1.01–1.16];  $P = .029$ ). This trend was more noticeable if the frequency of meeting friends or acquaintances was less than once per week in 2016. Internet use for communication is also associated with an increased number of meeting friends or acquaintances.

## Conclusions

Internet use for communication in 2016 increased FFC in 2019, especially in the lower frequency of FFC in 2016.

## Background

Social isolation, the objective state of having few social relationships or infrequent social contact with others, has become a serious public health issue. Life transitions and events in old age (e.g., retirement; loss of spouse, partner, or friends; migration to or from children; disability; or loss of mobility) are likely to affect older adults and are important risk factors for social isolation [1]. The prevalence of social isolation is high worldwide, at 24% in the USA [2], 10–43% in North America [3], and 20% in the United Nations Loneliness around the world: Age, gender, and cultural differences in loneliness [4]. In Japan, the

prevalence of social isolation has increased from 21% before the Coronavirus-induced disease 2019 (COVID-19) pandemic to 28% after the pandemic [5]. With increasing longevity and aging populations worldwide, social isolation among older adults is expected to increase further. Social isolation is associated with increased mortality [6], cognitive decline [7, 8], cardiovascular disease [9], abuse [10], and depression [11]. Given the negative impact of social isolation on health and well-being, several countries, including the United Kingdom and Japan, have implemented policies for the prevention and action against isolation and loneliness and appointed a Minister for Loneliness. Tackling social isolation and loneliness is considered a primary strategy for promoting global health and well-being.

Social interaction with friends is an important component of social isolation [12]. Social interactions can be classified into face-to-face communication (FFC) and non-face-to-face communication (non-FFC), such as the use of letters, telephone, e-mail, and social networking services (SNS). In a cross-sectional study, non-FFC achieved the same level of communication effectiveness as the FFC. [13]. In another cross-sectional study, FFC had a moderating effect on loneliness and happiness, similar to non-FFC [14]. In a longitudinal study, FFC and non-FFC individuals had a lower risk of mental health decline than non-FFC individuals alone [15]. In another longitudinal study, FFC and/or non-FFC individuals with friends, neighbors, and workmates had a lower risk of new long-term care insurance certification than those who did not interact [16]. An interventional study suggested that FFC with acquaintances is related to better well-being in older adults [17].

With technological advances in the past 10–15 years, there has been growing interest in internet-based interventions in social interactions [18–21]. According to a survey by the Ministry of Internal Affairs and Communications in 2021 in Japan, approximately 60% of older adults in their 70s and 28% of older adults aged 80 and over used the internet [22]. Some interventional studies suggest that the use of the internet for communication may increase the frequency of FFC with friends or acquaintances [23, 24]. Some of the possible mechanisms are as follows: Internet use may strengthen social support networks by crossing social and spatial barriers [25], increase social contact and reduce loneliness [26], and enrich and complement telephone and face-to-face social participation [27].

There are some inconclusive aspects of the relationship between internet use and FFC. First, the FFC and non-FFC groups were not adequately differentiated. For example, although internet use for communication, including social media, has increased social contact, the definition of social contact includes FFC and non-FFC, and the two are not distinguished. Second, the purpose of internet use is expected to affect people's behavior, health, and well-being differently. Although internet use for communication has been associated with increased social networks [26, 28, 29], higher psychological well-being [30], and lower levels of social isolation [31], problematic SNS use can also increase social isolation and negatively impact relationships [28, 32]. Although internet use for informational purposes has been associated with higher well-being [30, 33] or reduced loneliness [29], it may undermine existing social networks and further increase loneliness [29]. Internet use for instrumental purposes has been associated with increased well-being [33] and better Quality of Life (QOL) among older male adults [34].

Whether and what type of internet use increases FFC remains unclear. Therefore, we conducted a longitudinal study assessing the association between the purpose of internet use in 2016 and the frequency and number of FFCs among older adults aged 65 years and over in 2019. We hypothesized that internet use for communication increases the frequency of FFC.

## Methods

### Sample

We used data from the 2016 and 2019 waves of JAGES. The JAGES is a repeated nationwide population-based gerontological cohort study in Japan that focuses on the social determinants of health and functional disabilities. The JAGES is a self-administered questionnaire survey of adults aged 65 years or older who are independent of both physical and cognitive functions and who are not certified for eligibility for the benefit of the long-term care insurance system [35, 36]. A census was conducted for all residents in municipalities with fewer than 5,000 eligible residents, while random sampling was used in large municipalities with 5,000 or more eligible residents. The 2016 survey consisted of a common set of questions and eight modules, and the participants were randomly assigned to one of the eight modules. One of the eight modules included a section on the purpose of internet use. Figure 1 shows a flowchart of participant inclusion and exclusion. Among the 22,295 participants in 34 municipalities (response rate 70.2%) who responded to the module, which included questions on the purpose of internet use, 12,656 participants were untraceable because they were certified for eligibility for the benefit of the long-term care insurance system, dead, did not respond to, or did not consent to the 2019 survey. Among 9,600 participants who responded to the 2019 survey, 866 were excluded because of gender discrepancies, age discrepancies, reduced activities of daily living (ADL), and missing values of ADL. Finally, 8,734 participants (47.6% male, mean age 73.1 years) were included in the study.

### Measurements

#### The Frequency and Number of FFC with Friends or Acquaintances

In response to the question, 'How often do you meet with your friends or acquaintances?', participants selected one of the following options: "almost every day," "twice or three times a week," "once a week," "once or twice a month," "several times a year," and "not participate at all." We created binary variables by integrating them into "more than once a week" and "less than once a week" based on a previous study [37]. As a sensitivity analysis, we assessed the number of friends or acquaintances. In response to the question, 'How many friends or acquaintances have you met in the past month? Count the number of times you met the same person as one,' participants selected one of the following: 'one–two,' 'three–five,' 'six–nine' and 'ten or more.' We classified them to "one or more," "three or more," "six or more" or "ten or more," as binary variables of "yes" or "no."

#### The Frequency and Purpose of Internet Use

First, we asked participants how often they had used the internet in the past year. Participants selected one of the following: “almost every day,” “two or three times a week,” “several times a month or less,” or “do not use at all.” The respondents who selected “almost every day,” “two or three times a week,” and “several times a month or less” were further asked about the purpose of their internet use: “communicating with friends and family,” “LINE (Messaging application widely used in Japan, Taiwan, Thailand, and Indonesia), Facebook and Twitter,” “searching for information other than health or medical care,” “searching for information on health and medical care,” “searching maps and traffic information,” “purchasing products and services,” and “bank transactions, stock and securities trading.” Participants could select more than one purpose when they were engaged in them. Each category was analyzed as a binary variable: “yes” or “no.” Participants who answered “No” included both those who had never used the internet and those who had used the internet but not for relevant purposes.

## Control Variables

We adjusted for a series of demographic, physical, psychological, and social factors in 2016. Age and sex were included as demographic factors [38]. The relationship between social isolation and gender is slightly more noticeable among males than females of all ages [21]. There is also a gender gap in internet use [39], and the frequency of internet use decreases with age [40]. We analyzed age as a continuous variable and sex as a binary variable: male and female. Decreased physical function and comorbidities are risk factors for decreased social interactions [38]. Older adults with limited activity and comorbidities due to physical problems may have barriers to accessing the internet [41]. Conversely, older adults with physical problems may use the internet to seek information or communicate with others. We adopted a 5-item self-report measure of instrumental activities of daily living (IADL-5) as an indicator of IADL (score range:0–5) [42]. We created a binary variable of no decline (5 points) and decline (0–4 points). The comorbidity question consisted of 17 diseases related to atherosclerotic diseases and major medical diseases, including cancer, dementia, musculoskeletal diseases, and sensory system diseases. Participants were considered to have comorbidities if they had any of them. We created a binary variable for comorbidity: the absence or presence of comorbidities. Depression is associated with decreased social interaction [43]. Depression may also be associated with decreased internet use [44]. We assessed depressive symptoms using the Geriatric Depression Scale (GDS), which consists of 15 questions, with higher scores indicating more depressive symptoms [45]. Participants with a GDS of 5 or higher were considered to have depression [46]. Self-rated health (SRH) is a subjective measure of health status. SRH has been associated with increased social interaction [47] and internet use [48, 49]. We also created a binary variable for SRH. Participants responded to the question, “How is your current health status?”. (1) “Excellent” or (2) “good” was considered good, while (3) “fair” or (4) “poor” was considered poor.” Socioeconomic status, marital status, and living arrangements contributed to social interactions [38] and were also associated with poor access to the internet [40]. Therefore, we created binary variables: educational attainment (less than 9 years or more than 10 years), occupational status (currently employed or unemployed), equalized household income (less than 2 million yen or more than 2 million yen), marital status (married or unmarried), and living arrangement (living alone or not). Social interaction at baseline was also related to social interactions at the follow-up. The frequency of meeting friends or

acquaintances in 2016 may be related to the frequency of interactions in 2019. Social interaction is associated with internet use [50]. We created the binary variables “more than once a week” and “less than once a week.” Low social support is associated with higher social isolation [51]. Receiving Emotional support is expected to promote internet use among older adults [44]. Internet use may not only promote emotional support, but also maintain and strengthen existing relationships with geographically distant friends or acquaintances [52]. We asked participants, ‘Do you have someone who listens to your problems and frustrations?’ We created a binary variable of “yes” and “no” for this question.

## Statistical Analysis

Since the incidence of outcomes was more than 10% in our analysis, the odds ratio could not be accurately estimated by logistic regression analysis [53]. We used modified Poisson regression models to calculate the cumulative incidence ratio (CIR) and 95% confidence interval (CI) for meeting friends or acquaintances more than once a week. The purposes of internet use were simultaneously included in the modified Poisson regression model.

As internet use is interrelated with FFC [26, 50, 54, 55], we hypothesized that the frequency of FFC in 2016 would influence the association between internet use and FFC frequency in 2019. We created product terms for the frequency of meeting friends or acquaintances in 2016 and the purpose of internet use. The product terms were added to a modified Poisson regression analysis along with the CIR and 95% CI. The purpose of internet use was simultaneously included in the modified Poisson regression model.

Two sensitivity analyses were conducted. First, we assumed that some older adults met only a few friends and acquaintances frequently. We replaced the outcome with a binary variable of the number of friends or acquaintances who met in a month. We asked, “How many friends or acquaintances have you met in the past month? Count the number of times you met the same person as one.” The number of friends or acquaintances in 2019 was categorized as “1 or more,” “3 or more,” “6 or more,” or “10 or more,” as a binary variable of “yes” or “no.” We analyzed the data in two ways: with and without a decrease in the number of friends or acquaintances who met in a month. First, we tested the probability of increasing the number of friends or acquaintances from zero to one or more, two or less to three or more, five or less to six or more, and nine or less to ten or more between 2016 and 2019, respectively. Second, we tested the probability of maintaining more than one, three, six, and ten friends or acquaintances between 2016 and 2019. We conducted a modified Poisson regression analysis and calculated the CIR, 95% CI, and *P* value. Second, we modified the statistical analysis methods to verify their robustness. We conducted a multiple regression analysis with the frequency of meeting friends or acquaintances as continuous values in the following order: “almost every day,” “a few times a week,” “once a week,” “once or twice a month,” “a few times a year,” and “not attending at all.” We calculated the coefficients, 95% CI, and *P* values.

We conducted multiple imputation using the multivariate normal method, assuming that all the data were missing at random. Data were missing in 1.8% for the variables of the purpose of internet use in 2016, 16.8% of income in 2016, 14.3% for GDS in 2016, and 14.1% for employment status in 2016. The missing

data for the other variables were less than 10%. We created 20 imputed datasets and combined the effect estimates using Rubin's rule [56].

All data were analyzed using STATA 17.0 software (STATA Corp. LLC, College Station, TX, USA). Continuous variables are expressed as mean (standard deviation [*SD*]), and categorical variables are reported as percentages.

## Results

Compared to internet non-users, older adults who used the internet tended to be younger, female, without comorbidity, had less IADL decline, had higher equivalized household incomes, had higher educational attainment, had better SRH and better GDS, were married, and lived with someone. The most common purpose of internet use was communicating with friends and family (71.0%), while only 13.8% of internet users used SNS (Table 1).

Table 2 shows the characteristics of older adults who used the internet for each purpose in Japan in 2016. Internet use for communication and SNS was more common among females or those with a higher frequency of meeting friends or acquaintances in 2016. Internet use for communication was more common among those with a low income or who lived alone. SNS was more common among those who were single, currently employed, or who received emotional support than other purposes. Health information was more common in those who did not have comorbidities than for other purposes. Banking, stocks, and securities trading were more common among males, who had a lower frequency of meeting friends or acquaintances in 2016, higher incomes, higher education levels, and lived with someone for other purposes.

The modified Poisson regression models showed that internet use for communication with friends, friends, or acquaintances in 2016 was associated with an increased probability of meeting friends or acquaintances more than once a week in 2019 (CIR:1.08; 95% CI = [1.01–1.16],  $P = .029$ , Reference: Internet non-users or older adults who did not use the internet for the relevant purposes), while any other purpose, including SNS, in 2016 was not associated with an increased probability of meeting friends or acquaintances more than once a week in 2019 (Table 3).

We created interaction terms because the frequency of meeting friends or acquaintances in 2016 may have interacted with the purposes of internet use and the control variables and in 2016. A statistically significant association was found only in the product term of internet use for communication and the frequency of interaction with friends or acquaintances in 2016 (Supplementary table 1).

Table 4 shows the association between the purpose of internet use and the frequency of meeting friends or acquaintances in 2019, stratified by the frequency of meeting friends or acquaintances in 2016 (modified Poisson regression model). Among those who met friends or acquaintances less than once a week in 2016, internet use for communication was associated with a statistically significant increase in meeting friends or acquaintances more than once a week in 2019 (CIR:1.20, 95%CI [1.04–1.39],  $P = .014$ ,

Reference: older adults who did not use the internet for communication). Among those who met friends or acquaintances more than once a week in 2016, internet use for communication was not associated with a statistically significant increase in meeting friends or acquaintances more than once a week in 2019 (CIR:1.05, 95%CI [0.97–1.13],  $P=.237$ ).

In a sensitivity analysis of the association between internet use purposes and the number of FFCs with friends or acquaintances in a month, while there was no association with an increase in the number of FFCs from 0 to more than 1  $\geq$  in 2019 (CIR:1.20, 95% CI [0.89–1.60],  $P=0.227$ , Reference: older adults who did not use the internet for communication), internet use for communication was associated with an increase in the number FFC from less than 2 to more than 3 in 2019 (CIR:1.25, 95% CI [1.06–1.49],  $P=0.009$ ), from less than 5 to more than 6 (CIR:1.31, 95% CI [1.13–1.52],  $P<0.001$ ), and from less than 9 to more than 10 (CIR:1.40, 95% CI [1.20–1.64],  $P<0.001$ ). Similarly, although there was no association with the retained number of FFCs in 2019 more than 1 in 2019 (CIR:1.03, 95% CI [0.98–1.08],  $P=0.321$ ; Reference: older adults who did not use the internet for communication), it was associated with retained number FFC in 2019 more than 3 (CIR:1.06, 95% CI [1.00–1.13],  $P=0.040$ ), more than 6 (CIR:1.11, 95% CI [1.03–1.20],  $P=0.010$ ), and more than 10 (CIR:1.11, 95% CI [1.00–1.22],  $P=0.047$ ) (Supplementary Table 2). Another sensitivity analysis of the linear regression model showed a positive association between internet use for communication in 2016 and the frequency of FFC with friends and acquaintances in 2019 ( $\beta:0.13$ ; 95% CI = [0.07–0.19],  $P\leq 0.001$ ) (Supplementary Table 3).

## Discussion

In 2016, internet use for communication with friends or family increased the frequency and number of FFCs with friends or acquaintances in 2019, especially among those whose frequency and the number of FFCs with friends or acquaintances decreased in 2016. These results are consistent with previous studies showing that internet use for communication is associated with improved social relationships [18, 33, 57]. The findings of this study are valuable because non-FFC through internet use for communication may increase FFC in a longitudinal study in Asian countries.

In our study, internet use for communication with friends or family members was associated with increased FFC with friends and acquaintances in 2019. Several previous studies have found that internet use for communication may increase social relationships and interactions. In a qualitative study, online content facilitates communication and enriches social engagement and FFC [27]. Internet communication enhances existing social relationships, complements, induces, and facilitates FFC [28, 58, 59], and makes it easier to meet new people [57]. Older adults use the internet to maintain and strengthen existing social relationships with family and friends and to enhance social support [60]. In an observational study, internet use for communication was associated with increased social contact [26]. Our results are consistent with those of the previous studies. Similar results are not expected for other purposes of internet use, such as SNS, informational usage, and instrumental usage.



The findings of our study suggest that internet use for communication may increase FFC with friends or acquaintances, particularly among older adults who had less frequent FFC with friends or acquaintances in 2016. When older adults have fewer social relationships, they subjectively interpret the differences and discrepancies among them and feel lonely, which negatively affects network building, unrealistic desires, high expectations of relationships, difficulty in coping with stress, and consequently intensifying the dilution of social relationships [61]. In short, they became trapped in a vicious cycle of diluted social relationships and loneliness. Internet use enables individuals to overcome social and spatial barriers [25]. Internet use also reduces social isolation among older adults by connecting with the outside world, receiving social support, participating in activities of interest, and increasing self-confidence [62]. Consequently, the vicious cycle of loneliness and diluted social relationships can be halted. We thought these to be a part of the mechanisms that contribute to promoting social relationships, especially among those with less frequent FFC.

Our study showed that SNS use was not associated with increased FFC with friends or acquaintances. Some possible reasons for this may be as follows. First, only 13.8% of internet users used SNS in our study, which may have resulted in insufficient statistical power. Second, internet use for communication and SNS overlap and cannot be completely separated. Third, existing SNS applications such as Facebook and Twitter mainly target the younger generation and do not take into account the needs of older adults [20]. Fourth, the impact of SNS on FFC was debatable; in an observational study, problematic SNS use was associated with increased perceptions of social isolation among older adults [32]. SNS use for more than one hour per day was associated with reduced health among older adults [63]. In a review assessing the impact of communication technologies on social interaction, some studies reported that SNS increased social interaction, while others did not [23]

Our study had several limitations. First, we were unable to identify the causality of these relationships fully. Although we addressed reverse causality by stratifying the frequency of FFC at baseline and adjusting for a series of potential confounders, unmeasured confounders might still exist. Second, the type of online communication used was not identified. Some may talk online, others may send an e-mail or message, and others may use the chat function of SNS. It remains unclear whether specific types of online communication can be used to increase the frequency of FFC. Third, the questions on SNS referred to the name of the application and did not refer to the content of the services. Understanding the usage rate and content of SNS applications in each country is also essential. The most common SNS application used in Japan is LINE [64], primarily used for chatting and telephone/video calls. However, a cross-sectional survey conducted in Japan in 2016 [65] showed that only 23.8% of older adults in their 60s used LINE and that the usage rate is expected to decline with increasing age; this should not significantly affect our conclusions.

## Conclusions

We used three years of longitudinal data from many municipalities across Japan to investigate the relationships between the purpose of internet use and the frequency and number of FFCs with friends or

acquaintances more than once a week. The results showed that internet use for communication with family and friends increased FFC with friends or acquaintances, especially among those whose frequency and number of FFC with friends or acquaintances were lower in 2016. Similar findings were not observed for other purposes of internet use, including SNS. The results suggest that internet-based non-FFC may be useful in promoting FFC and preventing social isolation among older adults who are less likely to interact with others.

## Abbreviations

<b>ADL</b>	<b>Activities of daily living</b>
<b>CI</b>	<b>Confidence interval</b>
<b>CIR</b>	<b>Cumulative incidence ratio</b>
<b>FFC</b>	<b>Face communication</b>
<b>GDS</b>	<b>Geriatric Depression Scale</b>
<b>IADL</b>	<b>Instrumental activities of daily living</b>
<b>JAGES</b>	<b>Japan Gerontological Evaluation Study</b>
<b>QOL</b>	<b>Quality of Life</b>
<b>SNS</b>	<b>Social networking services</b>
<b>SRH</b>	<b>Self-rated health</b>

## Declarations

### **Ethics approval and consent to participate**

The study was reviewed and approved by the Ethics Committees of the National Center for Geriatrics and Longevity Sciences (Approval number: 992) and Chiba University (Approval number: 2493). JAGES participants were informed that participation in the study was voluntary and that completing and returning the questionnaire via mail (with checking a checkbox for some participants) indicated their consent to participate in the study. With this procedure, informed consent was obtained from all the participants involved in the study. All methods were conducted in accordance with Ministry of Health, Labour and Welfare guidelines (Ethical Guidelines for Medical and Health Research Involving Human Subjects).

### **Consent for publication**

Not applicable.

## Availability of data and materials

Data are from the JAGES study. All enquiries are to be addressed at the data management committee via e-mail: [dataadmin.ml@jages.net](mailto:dataadmin.ml@jages.net). All JAGES datasets have ethical or legal restrictions for public deposition due to inclusion of sensitive information from the human participants.

## Competing interests

The authors have no conflicts of interest relevant to this article to disclose.

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## Author's contributions

**I.C.** contributed to data curation, formal analysis, visualization, writing – original draft. **All authors** contributed to conceptualization, visualization, writing – review & editing. **M.S.** and **K.K.** contributed to supervision. **KK:** contributed to project administration, funding acquisition.

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## Tables

Tables 1-4 is available in the Supplementary Files section.

## Figures

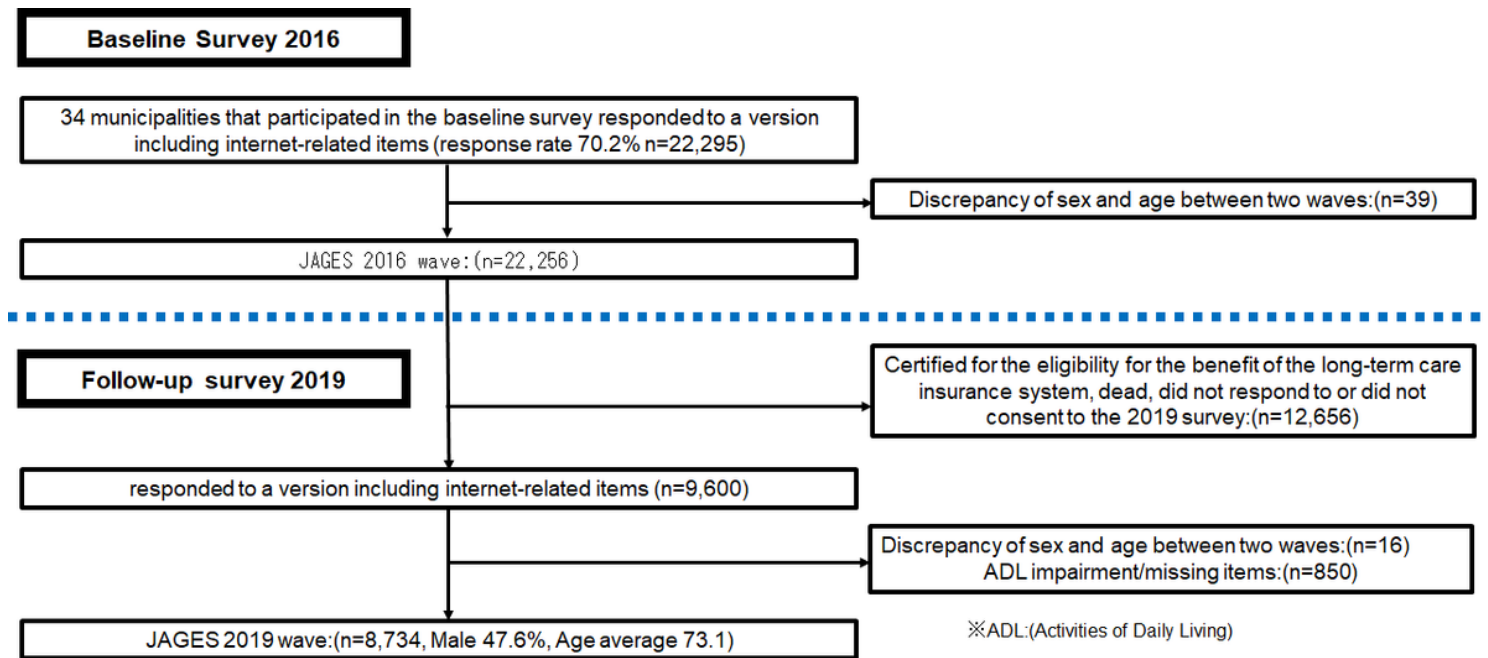


Figure 1

Flow chart of the participants and inclusion/exclusion criteria.

## Supplementary Files

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- [SupplementaryTable3.xlsx](#)