Understanding the Role of Internet Access on Health and Health Equity toward Healthy Ageing in the Western Pacific Region

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Understanding the Role of Internet Access on Health and Health Equity toward Healthy Ageing in the Western Pacific Region

Edited by
Naoki Kondo, Chie Koga and Yuiko Nagamine

Contents

ABBREVIATIONS AND GLOSSARY

Abbreviation	
ADL	Activities of Daily Living
BMI	Body Mass Index
GDS	Geriatric Depression Scale
IADL	Instrumental Activities of Daily Living
SDOH	Social Determinants of Health
SES	Socio-economic Status
SRH	Self-rated health

Glossary	
Abbreviated Mental Test score (AMTS)	A 10-point test for detecting dementia in older patients. A score of 6 or less suggests possible delirium or dementia.
Cohort	A study population to be followed up with in epidemiological studies.
Continuous variable	A factor that can take on an unlimited number of measured values; for example: height and time.
Covariates	Factors used to adjust estimates, aiming to minimize bias.
Cross-sectional study	A type of observational study that analyses data collected at one given point in time.
Dependent variable	A variable whose change of status is explained/determined by another variable i.e., by an independent variable.
Difference in differences	A quasi-experimental analytical approach that repeatedly compares the changes in outcome of a population enrolled in a programme (=the treatment group) and a population that is not (=the comparison group) over time.
Dose-response relationship	The measurement of a causal relationship between exposure (to a stimulus or stressor) and the response (outcome). Typically, increasing the exposure leads to an increase in the outcome.
Explanatory variable	Also known as an independent or predictor variable. It explains changes in the dependent variable.
Fixed effect model	A statistical approach, which assumes that effects of all individuals on the outcome are the same (i.e., averaged effect).
Hypertension	A physical condition marked by high blood pressure, indicated by systolic blood pressure (artery being most tensed) >=140 mmHg and diastolic blood pressure (artery being most relaxed) >=90 mmHg.
Incidence Rate Ratio (IRR)	A ratio between incidence rates of events occurring at any given point in time.
Income	In this report, income refers to the summed-up household income divided by the square root of the number of household members. This standardised income is also called as 'equivalised' income.
Independent variable	Also called as explanatory/predicting variable. See Explanatory variable.
Linear regression analysis	A statistical analysis method to closely portray, i.e. 'regress', all data points between independent and dependent variables in a straight line, allowing a

	change in the dependent variable to be explained by a change in the independent/explanatory variable.
Longitudinal data	Data collected at multiple observation points, e.g. baseline, 1 month later, 1 year later etc.
Multinomial logistic regression	A type of regression analysis, i.e. examining associations between explanatory factors and outcomes; it can be used when the outcome variable is categorical, e.g. healthy, becoming ill, recovered, stayed ill.
Multivariable analysis	A statistical technique that uses more than one explanatory/independent variable to explore the associations with the dependent/outcome variable.
Panel data	Also referred to as longitudinal data. See Longitudinal data.
Poisson regression analysis	A type of regression analysis performed when the outcome/dependent variable represents count data, for example, events.
Population density	It indicates the concentration of human habitation in a unit of habitable land area. In our report, for each municipality, we divided the population by the habitable land area and calculated the number of residents per km² of unit area. According to the population density of the habitable area, we classified each municipality into four categories: metropolitan (≥4,000/km²), urban (1,500-3,999/km²), semi-urban (1,000- 1,499/km²), and rural (< 1,000 /km²).
Population proportionate random sampling	Random sampling is defined as a sampling technique wherein every item in the population has an even chance and likelihood of being selected for the sample. In population proportionate random sampling, the probability of selection is directly proportional to the item's population size within the target population.
Prevalence ratio	A probability to indicate how large is the prevalence of the occurrence of an event/outcome in one group of subjects/individuals in reference to another group (i.e., reference group).
Relative risk ratio	A probability belonging to a certain category of the outcome in comparison to the reference category. It is an estimate used in multinomial logistic regression.
Standard errors	Averaged deviations (= standardised) between the expected and actual data points.
Statistical significance/statistically significant	Used as a decision point to claim that a result is not attributable to chance alone but has occurred due to a specific cause.
Subjective socio-economic status	A person's perception of his/her socio-economic standing in society.
Wealth	In our study, wealth refers to the total household wealth divided by the square root of the number of household members.
Wealth index	A measurement of the living standard of a household, i.e. household economic situation. Calculated based on the ownership of total number of TVs, air conditioners, cars, etc. (note: 17 items for this report) in ratios. The score is classified into three categories (i.e., poorest 40%, middle class 40%, and richest 20%). (Filmer and Pritchett, 2001).
95% confidence interval	A confidence interval is the range of values within which the true value is expected to fall. A 95% confidence level indicates that one can be 95% certain that the true value lies within the obtained range. A wider range is associated with more uncertainty.

EXECUTIVE SUMMARY

Digital technology is gaining great importance as a health tool in today's world, especially in the wake of the COVID-19 pandemic. The lockdowns during the pandemic have highlighted how important access to online services is for vulnerable populations, especially older people. Thus, it is crucial to examine the level of digital access enjoyed by older people from different socio-economic groups and provide robust evidence on the issue. Often, it has been said that older people are likely to have limited access to digital devices and the Internet because of their biological (e.g. impaired mobility, eyesight, cognitive function, and mental health) and social (e.g. low income, isolation, and social exclusion) disadvantages. Since Japan leads the world in longevity and growing older population, we are in a position to provide the required evidence.

Using cross-sectional (data at a specific point in time) and longitudinal (follow-up data) data from 40 municipalities in nationwide Japan and two local regions in Myanmar, this report finds evidence of a strong association between frequent Internet use and good health and well-being, mainly low depression risk, high self-rated health, greater capability for activities of daily living (ADL), and well-connected social relationships. Notably, these associations were not affected by income, educational attainment, or other socio-economic factors. We would like to emphasise that such associations were present in both Japan and Myanmar.

We provide clear evidence of the digital divide among older people belonging to different socio-economic groups and residential regions in Japan and Myanmar. In Japan, the Internet was used by half of the older population. However, older people with higher income and more educational attainments were more likely to be frequent Internet users (Figure 1).

Internet users were found to be more socially active compared to non-users (Figure 2). Those who used the Internet almost daily used it for shopping and banking, indicating that Internet use helps older people perform these two essential activities in their daily lives. Additionally, Internet use lowered the risk of depression by about 40% among those who were at a high risk for developing depression due to their socially disadvantaged background. (Figure 3)

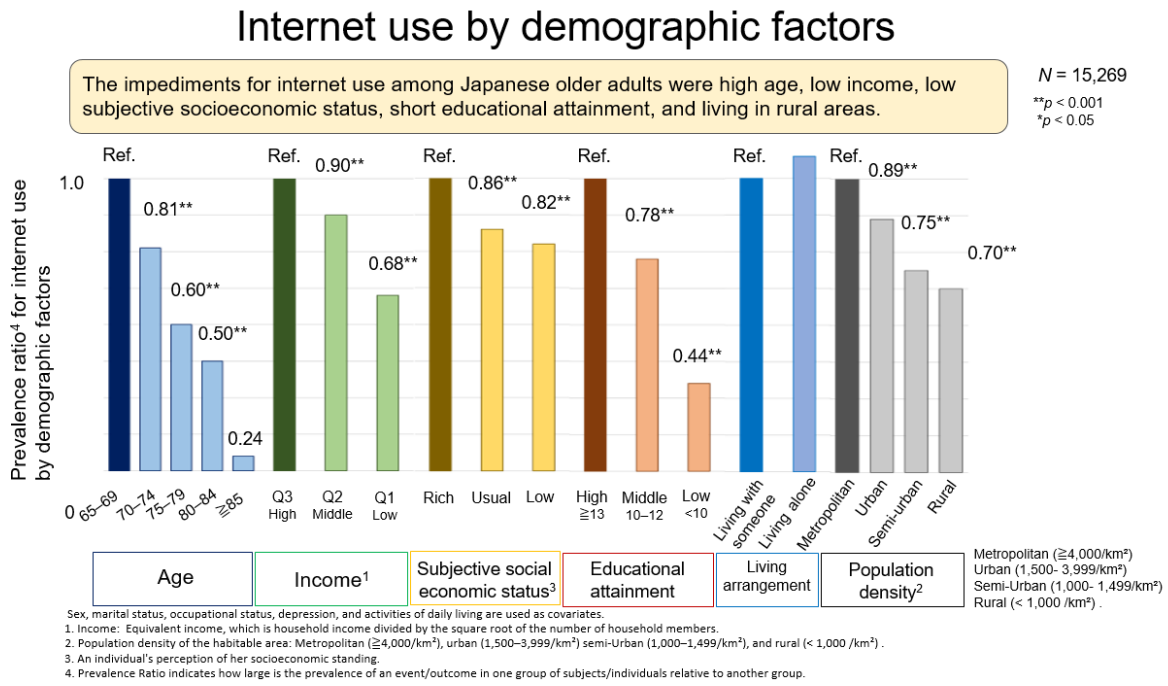

Figure 1. Characteristics of Internet access among Japanese older people (page 51)

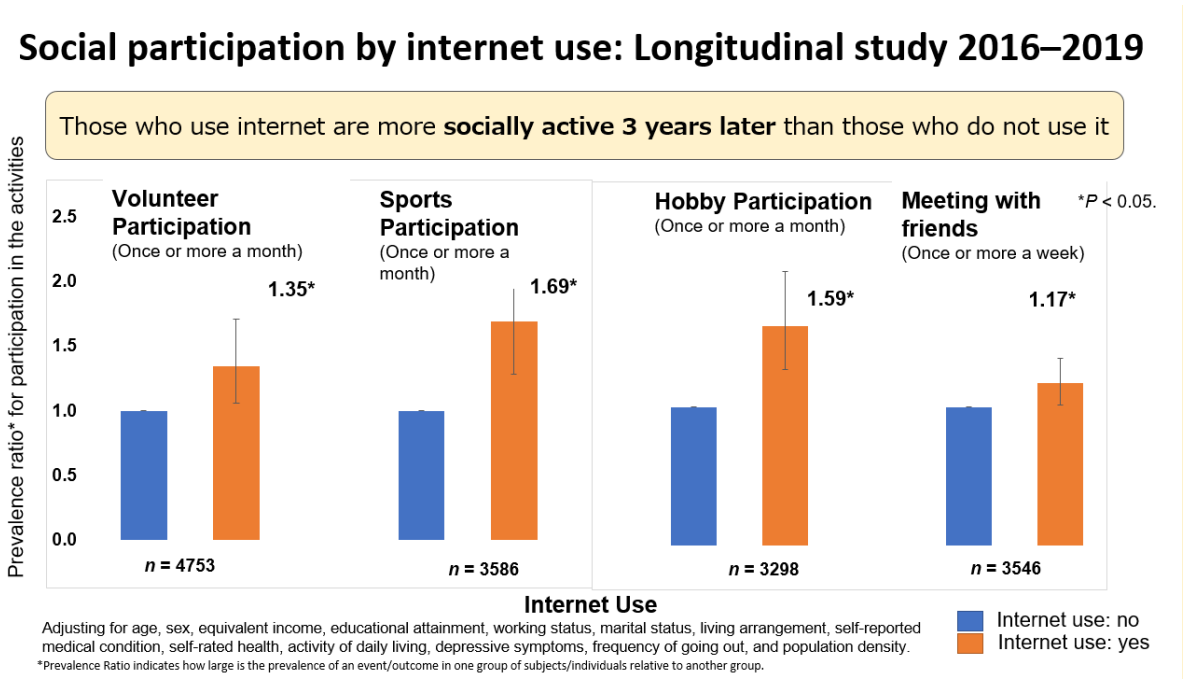

Figure 2. The association between Internet use and social participation after 3 years (page 43)

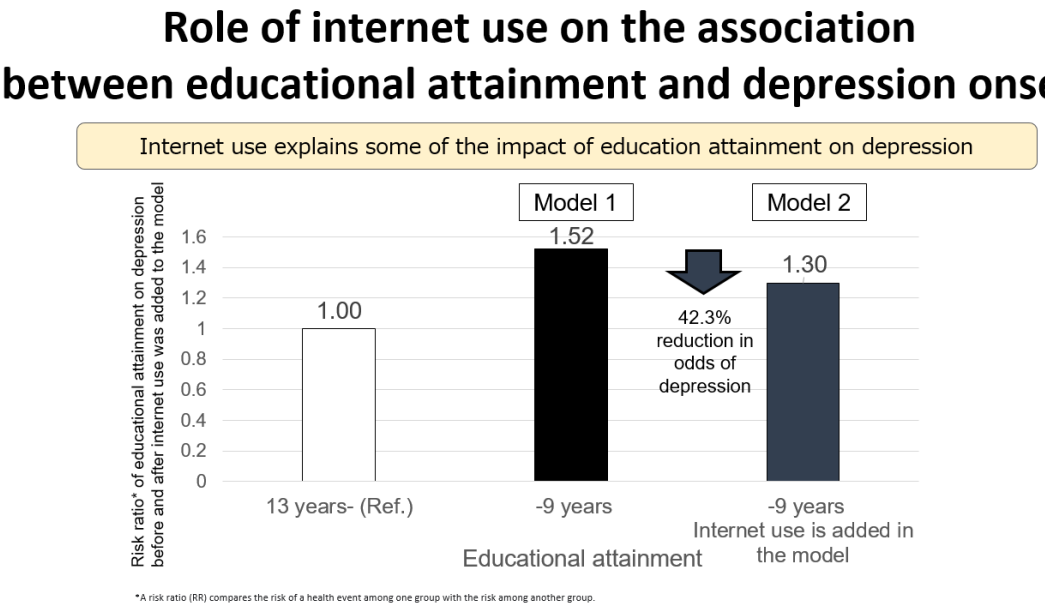

Figure 3. Internet use explained the associations between educational attainment and depression onset by 42% (page 54)

Evidence from a city (Yangon) and a rural area (Bago) in Myanmar shows trends of a digital divide similar to those seen in Japan: good socio-economic conditions were linked to Internet access and Internet users had better health. Moreover, a huge gap in Internet access was observed between the urban and rural population in Myanmar.

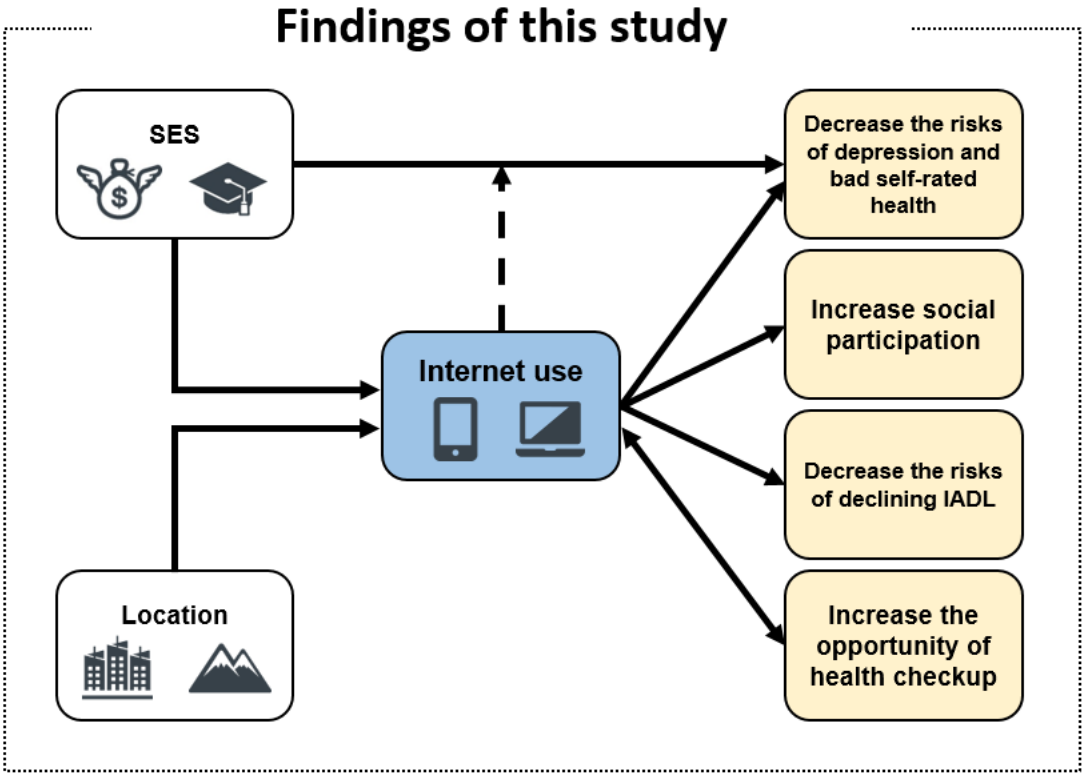

Figure 4. Findings of this study (page 85)

In the face of compelling evidence on the existence of a digital divide in the older population in both countries, bridging this divide should be a priority of policymakers. Our findings confirm that reducing the digital divide can contribute to fostering health equity among older adults. This report is only the first small step in unravelling the complex picture of the digital divide among older people, and we hope that future studies will be able to find the mechanism linking Internet access, socio-economic status, and health and well-being among older adults residing in the Western Pacific Region. (Figure 4)

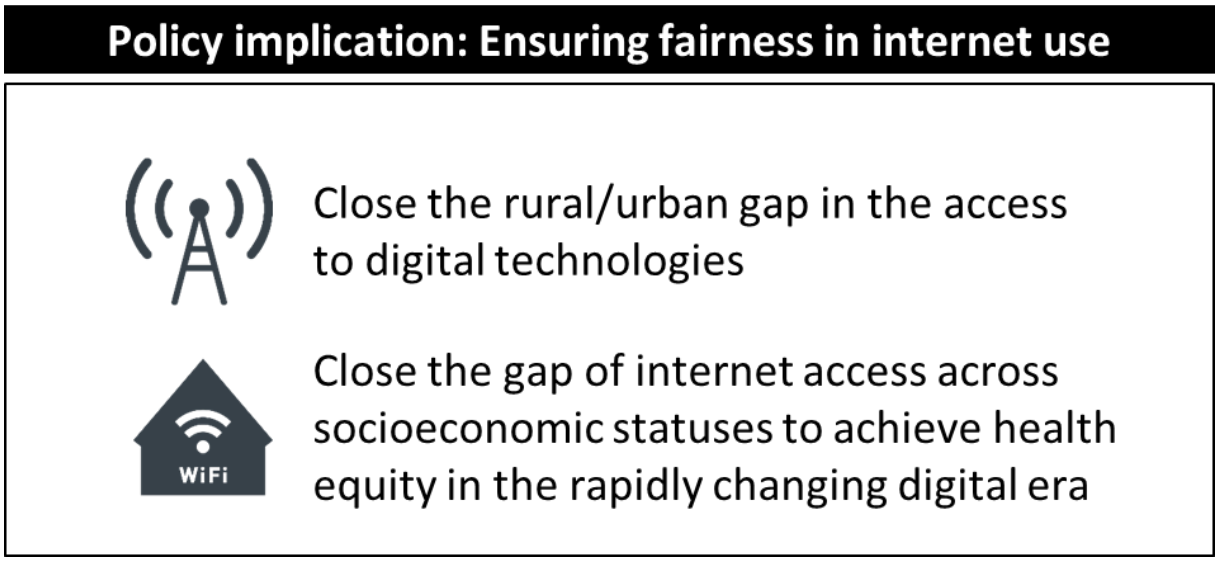

Figure 5. Policy implications (Page 87)

Further, we encourage future studies to apply more advanced causal inference models along with rich and high-quality data from Japan, Myanmar, and other countries to ascertain the causal role of Internet use in the health and well-being of older people. We urge other researchers to study the effect of Internet use on various health outcomes as well as mortality and onset of medically diagnosed diseases using data from official health reports, while also taking into account various social factors affecting health. We also urge them to investigate links between Internet use, socio-economic status (SES), and healthcare systems to understand the complex picture of Internet use and older people's health and well-being. Such comprehensive understanding of the issue would help design effective interventions, such as providing resources to older people or improving their digital literacy, so that all older people, irrespective of socio-economic status, can enjoy the health benefits resulting from Internet use.

Our society is rapidly transitioning to a digital world and this transition was accelerated by the global COVID-19 pandemic. As Internet use becomes more and more essential in our day-to-day lives, people left behind in the digital wave are likely to face many disadvantages, physically, mentally, and socially. The evidence we provide of the divide in digital technologies and health among older people is a stepping-stone for future studies to investigate public health problems emerging from the aftermath of the current pandemic at local, national, and global levels.

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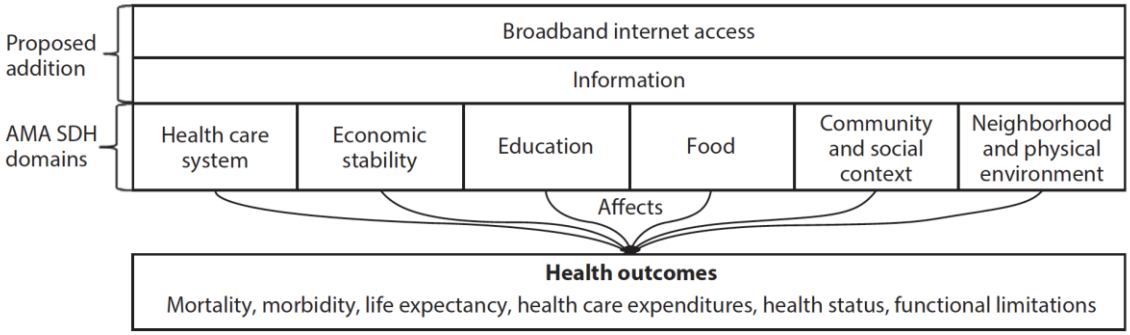
1. INTRODUCTION

1-1. Background

Digital technology is an increasingly important tool for improving health. The Internet enables access to unlimited health information and a variety of health services. It serves as a platform for wellness tools to collect data about users' health and support them in living a healthy lifestyle. Digital technologies can also indirectly contribute to health by empowering individuals to circumvent socio-economic and psychosocial barriers to health. Using communication technologies, such as video sharing and video calling, health professionals disseminate a tremendous amount of health information and even conduct online seminars and workshops for a global audience. In this way, the Internet is facilitating social connection, health activities, and equity in access to health information. Creating digital accessibility for older people will enable leapfrogging across barriers to healthy ageing and transcending limitations posed by the physical world, such as geographic location.

While COVID-19 has highlighted the importance of digital access for vulnerable populations such as older people, robust evidence on the actual status of distribution of digital access across various socio-demographic classes is lacking. Specifically, older people are likely to have limited access to digital devices and the Internet because of their biological (e.g. impaired mobility, eyesight, cognitive function, and mental health) and social (e.g. low income, isolation, and social exclusion) disadvantages.



Source. American Medical Association (AMA).[2]

*SDOH: Social determinants of health are non-medical factors that influence health outcomes

Figure 1. Model of social determinants of health extended to include broadband Internet access and information as proposed by Benda et al. (2020).

With particular attention to social interactions, mental health, and activities of daily living (ADL), in this study we sought to contribute to the knowledge on social determinants of health perspectives by building on Benda et al.'s (2020) model. Our specific aim is to shed light on the importance of addressing the digital divide among older people.

As health and society become increasingly reliant on technology, as reflected in Japan's Society 5.0 initiative, digitally marginalised populations such as older people are at the risk of being left behind. Digital access is a cornerstone of the Healthy Ageing Unit's vision of societies in the future, with digital tools becoming mediators for community integrated care services and vectors for personalised medicine and social support for older people. Without drastic improvements in digital access, further innovation risks exacerbating the inequalities among older people. The goal of this work is to develop a foundation for the collection of

evidence on the relationship between digital access and health, which will ultimately contribute to the Healthy Ageing Unit's guidance for the promotion of digital access for older people in the Western Pacific Region.

1-2. Literature Review

The relationship between Internet access and health status has been reported in both intervention/programme evaluations and observational studies. The following is a brief overview of some of these studies.

The Widening Digital Participation programme (2013–2016), delivered by the United Kingdom National Health Service (NHS) in partnership with the Good Things Foundation, aimed to increase the digital literacy of vulnerable groups, with a specific focus on health, through local community networks. According to their findings (Tinder Foundation, 2016), 52% of learners reported feeling less lonely, whereas 62% stated they felt happier because of increased social contact. The results also showed that the intervention led to lower utilization of frontline health services as 54% of learners needing non-urgent medical advice reported that they visited the NHS Choices website first and 21% made fewer calls or visits to their primary care physician as their issues were resolved over the Internet. The evaluation suggested potential annual savings of £6 million in saved primary and emergency department visits, with a return on investment of £6.40 for every £1 invested in the last year of the program. A 2011/2012 analysis of the social outcomes of a digital skills programme called Get IT Together aimed at older people and residents of remote areas in the UK (BT, 2014) found that 25% of older learners reported a reduction in social isolation, 57% were enjoying a more meaningful use of their time, and 60% reported improved confidence.

A study based on the Scottish Household Survey found that Internet use was correlated with better mental health and wellbeing and with greater feelings of social connection (although more weakly correlated) even after controlling for other factors. Household working status, highest educational qualification of the responding adult in the household, and the age of the highest income recipient were strong predictors of household Internet access. Families without cars, living in socially rented accommodation, and low-income families without children were less likely to have Internet access. Urban-rural indicators and the gender of the highest income recipient, among other factors, did not emerge as predictors of Internet access. The analysis showed that between 33% and 52% of the variation in Internet access can be explained by demographic factors. The analysis further found that four indicators of social inclusion (active living, transport, mental health, and socially connectedness) had clear associations with Internet access, controlling for age and household type. It also showed that those without Internet access were more likely to have visited a doctor once a month or more, a result that aligns with the findings of the NHS intervention evaluation. This suggests that the relationship between Internet use and health service utilisation is unclear.

A recent study by Li et al. (2020) used three rounds of data from the China Family Panel Studies (2014, 2016, and 2018) to investigate whether Internet use had a positive impact on health outcomes of rural individuals over the age of 16. The results showed a strong positive impact on health outcomes via three pathways: information access, social interactions, and exercise. People over 60 were found to receive the smallest impact of general Internet use on health outcomes. The authors suggested that this could be related to the lower digital literacy of older people in rural China, which would have affected their ability to benefit from online

resources. Further, the study found a significant impact on people with less education, that is, primary school education or lower. To explain this finding, the authors discussed that as rural residents with more education had higher socio-economic status, they have more opportunities to access to health care providers and were less reliant on the Internet for health resources.

Kearns and Whitley (2019) assessed the association between Internet use and social integration, well-being, and physical activity among adults in deprived communities through a household survey. Internet use was correlated with a lower likelihood of loneliness, higher mental well-being, and physical activity. Internet use was also correlated with a higher frequency of contact with neighbours, financial social support, and greater use of social amenities (such as sports and leisure facilities and libraries) and shops. Some of the positive impacts were particularly high among older people. Bessière et al. (2010) found that health-related Internet use such as communicating with friends and family or gaining health information was correlated with a small increase in depression, while its use for communication was associated with a small decrease in depression. No associations were found with changes in general health. However, it is worth noting that the data used for this study were from a survey conducted between 2000 and 2002, which may not hold strong relevance anymore given the rapid advancements in digital tools and services.

Considering studies that specifically focused on older adults (above the age of 50), Cotton et al. (2011) applied regression and propensity score methods to a large sample of retired older, non-working people in the US and demonstrated that Internet use had a positive impact on well-being. Internet use was estimated to reduce depression categorisation by approximately 20%–28%. Szulc (2020) used a telephone-based survey of a sample of 1,000 people over the age of 50 in Poland. Logistic regression analysis showed that Internet use was associated with better self-reported health status and a lower prevalence of chronic conditions after controlling for age and socio-economic status. Tavares (2020) analysed the Survey of Health, Ageing, and Retirement (SHARE) data and found that Internet use correlated with better reported health status for older Europeans when controlling for individual characteristics. Interestingly, this association was found to be stronger in less eHealth-developed countries, which was hypothesised to be due to the diminishing returns of Internet access, that is, the effects of Internet use on health were getting weaker in proportion to the development of eHealth services.

These studies have shown that, overall, digital access has a positive effect on the health of older adults. However, it is not clear how much of the impact of Internet access is accounted for by existing social determinants of health (SDOH), such as income and educational attainment. Moreover, it has not been examined whether the use of digital information technology can counteract the negative effects of SDOH on health.

1-3. Purpose of This Report

Given the knowledge gap discussed above, the purpose of this study was to uncover the relationship between access to the Internet—the primary digital infrastructure of information technology—and health outcomes in older people and to evaluate whether Internet access has comparable effects on health with known social determinants of health such as income and educational attainment. Furthermore, it aimed to evaluate whether Internet access mediate or mitigate the social determinants of health. This study aimed to develop the foundation for gathering evidence of the relationship between digital access and health that will ultimately contribute to the WHO Healthy Ageing Unit's guidance for the promotion of digital access for older people in the Western Pacific Region. To achieve this, we set three main goals.

First, we evaluated the relationship between Internet access and health, accounting for the effects of confounding variables, such as socio-economic status and geographical location. Health status, such as (but not limited to) physical and functional status, and psychological health, as well as intermediate health outcomes such as the capacity to perform daily living activities, were considered. Second, we elucidated the relationship between Internet access and health across socio-economic classes and evaluated how much access to the Internet explains health inequality across socio-economic groups. Lastly, we developed key insight summaries and a comprehensive report to synthesise the results obtained and created suggestions on potentially useful interventions to mitigate the potential detrimental impacts of the digital divide among older adults on their health and health equity. Finally, we gathered thoughts on further research agenda (**Figure 2**).

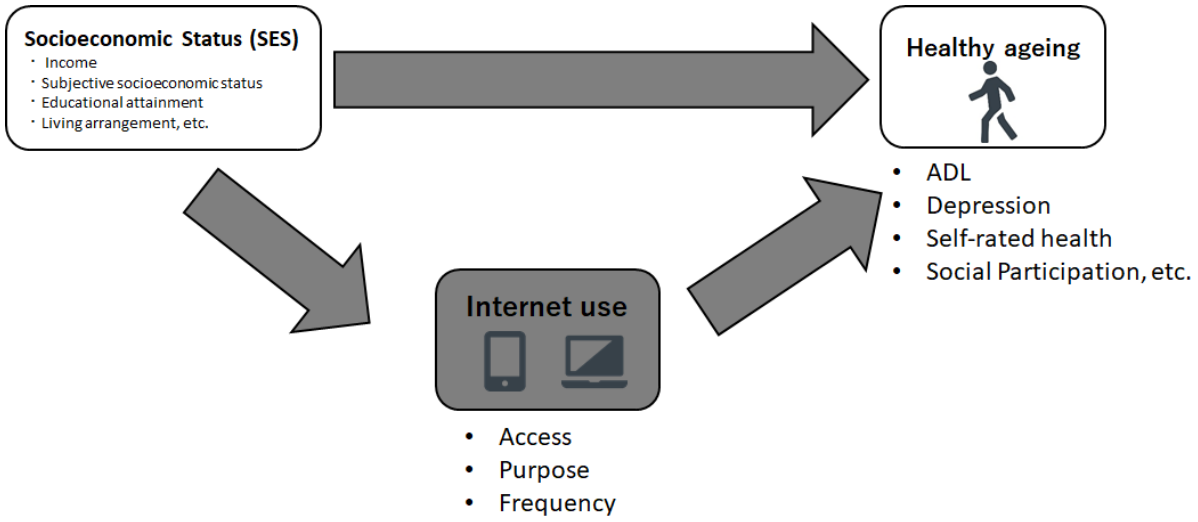


Figure 2. Basic conceptual models on the associations between socio-economic status, Internet use, and older adults' health in this study

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2. METHODS

2-1. Participants and Settings of Cross-Sectional Data in 2016

We used cross-sectional data from the Japan Gerontological Evaluation Study (JAGES), a population-based study of independent older adults aged ≥65 years who did not have physical or cognitive disabilities and were not eligible for receiving public long-term care insurance benefits. The data were collected in 2016, and we conducted a descriptive analysis of Internet use. The municipalities included urban, suburban, and rural communities from the northernmost to the southernmost prefectures of Japan. The municipalities participating in the 2016 JAGES survey are shown in **Figure 3**.

Excluding participants whose sex, age, and Internet usage information was missing, data of 17,947 participants were used for analysis. The average age of the participants was 73.6±6.0.

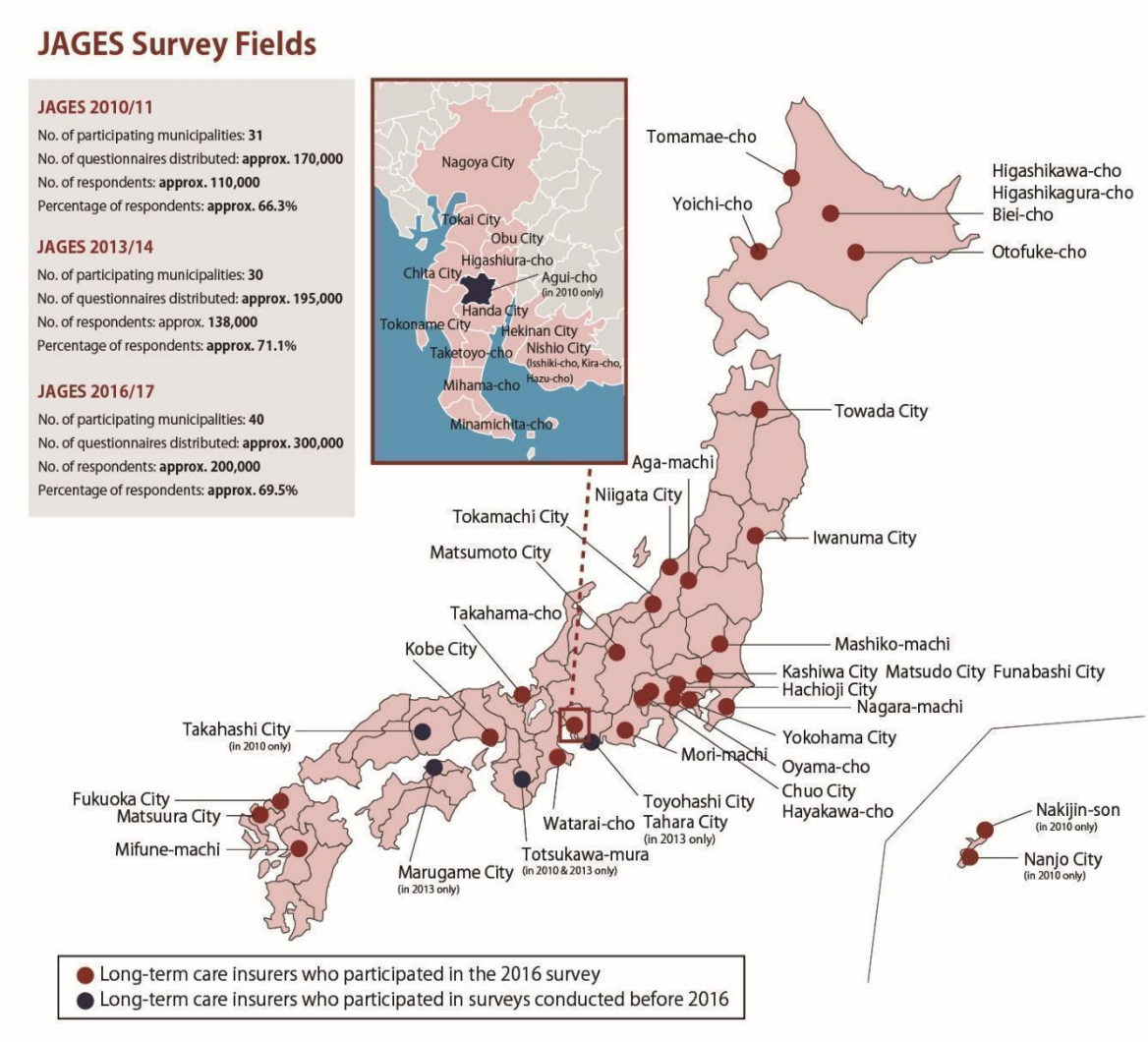


Figure 3. Municipalities that participated in JAGES in 2016

2-2. Participants and Setting of Longitudinal Data in 2016–2019

We used longitudinal data from JAGES. This study used panel data from two longitudinal surveys. The baseline survey was conducted between August 2016 and January 2017, and self-reported questionnaires were mailed to 34,571 community-dwelling independent individuals aged 65 years and older. A total of 24,313 people responded (response rate: 70.3%). We excluded 2,018 responses because those respondents were already certified as having functional disability, which is defined by medical certification for long-term care insurance. Overall, 22,925 people participated in the JAGES 2016 survey.

A follow-up survey was conducted between November 2019 and February 2020. Of the 22,295 baseline respondents, 14,218 people were excluded at follow-up because they did not respond or no longer met the requirements for participation in the study, or were either deceased, relocated (e.g. to a municipality whose local government could not co-operate with us), or required long-term care. We excluded 27 responses for the following reasons: (ⅰ) the age difference between the baseline and follow-up surveys was not within 2–4 years (n=26); and (ⅱ) sex mismatch between baseline and follow-up surveys (n=1). The final number of participants in this analysis was 8,050. A flowchart of the selection of participants is shown in **Figure 4**.

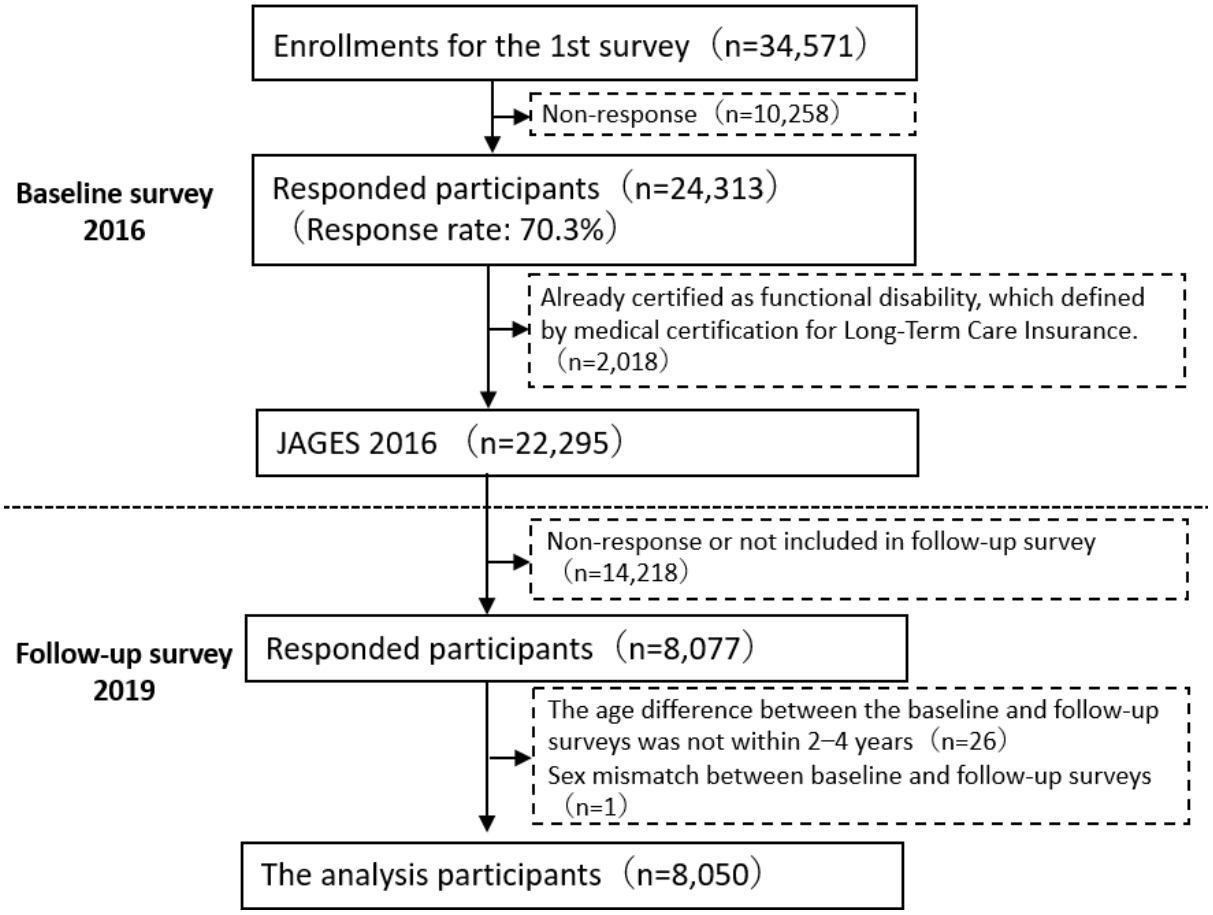


Figure 4. Flow chart of participant selection (analytical sample)

2-3. Variables

There were four categories of variables: demographic biological, behavioural, psychosocial and social, and environmental factors. Missing data were categorised into missing groups for each variable, except sex and age.

Variables of Internet use

All questions related to digital devices are shown in **Appendix 1**. The question about the use of digital devices was: *Have you used the Internet or e-mail in the past year? If yes, please indicate how often*. The response items were: *1. No, 2. Yes (less than a few times per month), 3. Yes (2–3 times per week), and 4. Yes (almost every day)*. The distribution of Internet use was as follows: daily users - 4,355; 2-3 times per week - 2,310; less than once per week - 2,573; no internet use - 8,709. Next, the purpose of Internet use was assessed: *If you chose '2', '3', or '4' above, please answer the questions 2) to 4). For what purposes do you use the Internet or e-mail? Circle all that apply. 1. To find and collect medical and health-related information, 2. To find and collect information other than medical and health-related information, 3. To communicate with my family and friends, 4. To access maps and traffic information, 5. To purchase commodities and services, 6. For online banking or trading of securities and bonds, 7. For social networking services (LINE, Facebook, Twitter, etc.), and 8. For other reasons*. We also collected information on the types of devices used: *What devices do you use to access the Internet or e-mail? Circle all that apply. 1. Personal computer, 2. Mobile phone, 3. Smartphone, 4. Tablet PC, and 5. Others*. The history of using Internet devices was enquired about: *When did you start using the Internet or e-mail? Circle the one answer that applies the best. 1. More than 10 years ago, 2. More than 5 years ago, 3. Three to four years ago, 4. One to two years ago and 5. Less than 1 year ago.*

Demographic and biological factors

Variables used for the descriptive analysis and multivariable analysis are shown in this section. We used activities of daily living (ADL), sex, age, body mass index (BMI), self-reported medical conditions (hypertension, diabetes mellitus, stroke, cardiac diseases, cancer, and respiratory diseases), diseases under treatment, marital status, household equalised income (million yen), subjective socio-economic status, educational attainment, employment status, occupational position for the longest job served, living arrangement, instrumental self-maintenance subscale, intellectual activity subscale, and social role subscale as demographic and biological factors. For self-reported medical conditions and diseases under treatment, participants were asked to '*Circle the numbers of all diseases for which you are currently receiving treatment or whose after-effects you are experiencing*'. Those who answered '*None*' were categorised as the no illness group in self-reported medical conditions. Those who answered '*Yes*' to a disease were categorised as under treatment. Equalized income (million yen) was classified as: Less than 500,000 yen; 500,000 to less than 1 million yen; 1 to less than 1.5 million yen; 1.5 to less than 2 million yen; 2 to less than 2.5 million yen; 2.5 to less than 3 million yen; 3 to less than 4 million yen; 4 to less than 5 million yen; 5 to less than 6 million yen; 6 to less than 7 million yen; 7 to less than 8 million yen; 8 to less than 9 million yen; 9 to less than 10 million yen; 10 to less than 12 million yen; and, more than 12 million yen. Then, we categorised them as low, middle, or high. Subjective socio-economic status was assessed by asking '*Which of the following best describes your current financial situation in light of*

general economics'. The responses were categorised as poor, average, and rich. Other variables were categorised as follows: marital status (married, widowed, divorced, never-married, and others), educational attainment (low [<10 years], middle [10–12 years], high [≥13 years], and others), employment status (employed, retired/not employed, and never employed), longest job (professional, manager/clerical, manual/service, sales/service, skilled labour, agriculture, forestry or fisheries, self-employed, other, and unemployed), and living arrangement (living alone, with only spouse, two households with son or daughter, and other [including 3 households]).

Health and health behavioural factors

For behavioural factors, we considered: medical examination, frequency of meat and fish intake, frequency of fruit and vegetable intake, smoking, drinking status, walking time (in minutes per day), frequency of going outdoors, time spent in physical labour and intense sports, time spent sitting, and time spent walking or standing. These variables were categorised as: medical examination (examined within 1 year and others), frequency of meat and fish intake (>=once/day, and <once /day), frequency of fruit and vegetable intake (>=once /day and <once /day), smoking (never smoked, past smoker, current smoker), drinking status (never drank, past drinker, current drinker), walking time (in minutes per day: >90 min, 60–90 min, 30–60 min, and <30 min), frequency of going outdoors (>=4 times/week, 1–3 times/week, and =< once/month), physical labour and intense sports (>=1 hour/day, <1 hour/day, none), time spent sitting (>=8 hours/day, 3–8 hours/day, <3 hours/day), and time spent walking or standing (>=3 hours/day, 1–3 hours/day, and <1 hour/day). Participants' instrumental ability of daily living (IADL) was assessed in 2016 and 2019 using five questions asking about the ability to use public transport, do daily shopping, prepare a meal, pay bills, and manage one's own bank account. The presence of each ability was scored 1; the range of the total score was 0 to 5. One analysis in the report used a continuous variable while the other used binary variables as follows. The total score was cut off at 5, with those who had all abilities represented by 1 and those who did not have any of the abilities represented by 0.

Psychosocial factors

We used the following psychosocial factors: self-rated health, depression, general trust in the community, norms of reciprocity, attachment to the neighbourhood, receiving emotional support, receiving instrumental support, providing instrumental support, frequency of meeting friends, number of friends met, interaction with neighbours, participation in sports groups, participation in hobby groups, and participation in volunteer groups. Self-rated health was categorised as either very good, good, poor, or very poor. We used the 15-item Geriatric Depression Scale (GDS) which defines mild depression as >5 points and severe depression as >10 points. To utilise the data fully, we included individuals whose responses contained up to two missing items. We replaced the missing values by applying the mean of the respondents' answers to the items. Social support (including emotional and instrumental support) was assessed by asking the following four questions: 1) *Do you listen to someone else's concerns and complaints?* (giving emotional support), 2) *Do you have someone who listens to your concerns and complaints*? (receiving emotional social support), 3) *Do you take care of someone who is sick*? (giving instrumental support), and 4) *Do you have someone who takes care of you when you are sick?*' (receiving instrumental support).

Environmental factors

As environmental factors, we used population density, access to parks or sidewalks, and access to shops from the place of residence. The variables were categorised as follows: population density (metropolitan, urban, semi-urban), parks or sidewalks (no, yes), and access to shops from house (no, yes).

2-4. Participants and Settings of Myanmar Survey

A study titled 'Healthy and Active Aging in Myanmar (JAGES in Myanmar 2018)' constituted the baseline survey for a longitudinal study. Community-dwelling older adults aged 60 years and above were recruited from two regions of Myanmar—Yangon and Bago. The Republic of the Union of Myanmar consists of seven regions and seven states. This survey was conducted only in the Yangon and Bago regions and is not representative of older people throughout Myanmar. However, a quarter of older people aged 60 live in Yangon or Bago according to the 2014 census. Yangon is representative of urban areas, whereas Bago is representative of rural areas. There are 34 townships in the Yangon region and 28 townships in the Bago region. From each region, six townships were randomly selected based on population proportionate sampling (**Figure 5**).

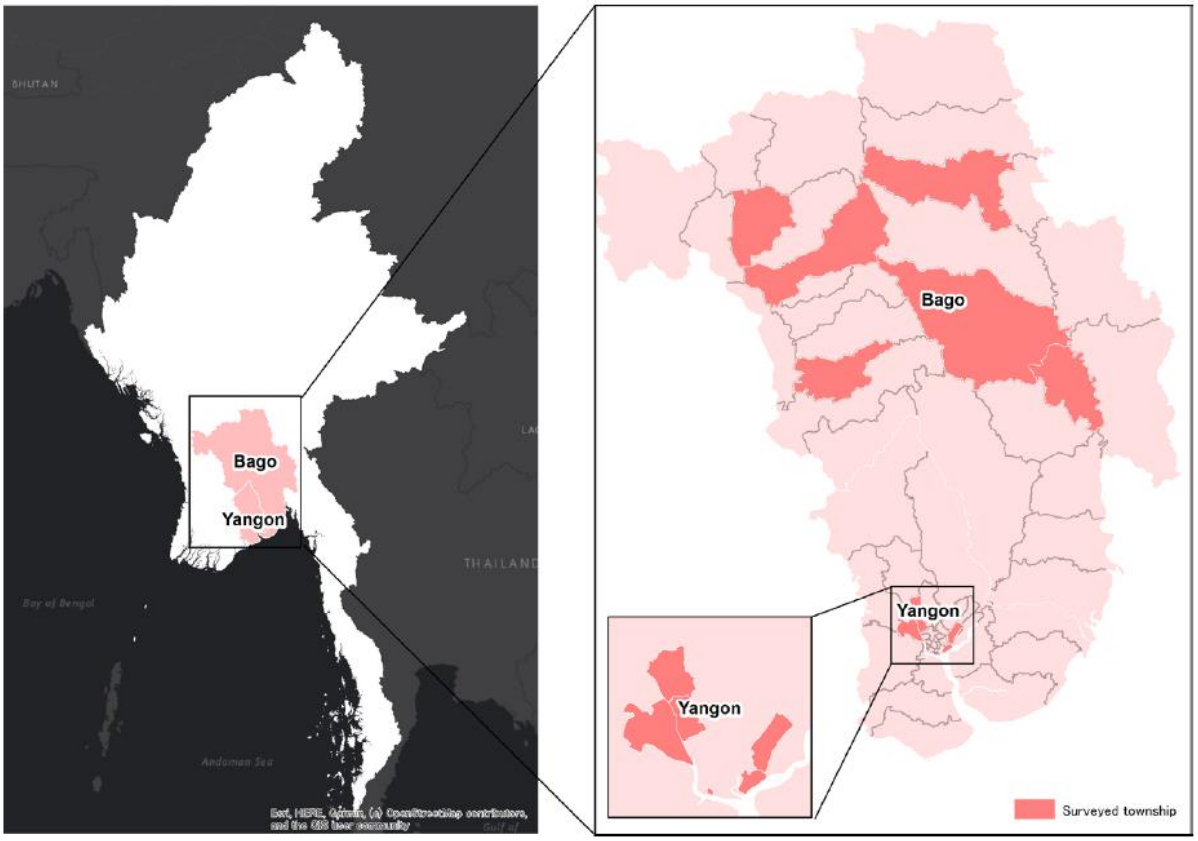


Figure 5. Areas that participated in JAGES in the Myanmar survey of 2018

3. RESULTS OF THE STUDY IN JAPAN

3-1. Relationship between Internet Access and Health

To elucidate the relationship between Internet access and health, we conducted both descriptive observations and multivariate analyses controlling for potential confounding factors using both cross-sectional and longitudinal data.

3-1-1. Descriptive observations of the variables

The results of cross tabulation with the frequency of Internet use and individual and demographic factors are presented in **Table 1**. We used sex, age, marital status, income (million yen)*, subjective socio-economic status, educational attainment, employment status, longest job, and living arrangement as demographic factors.

In men, 45.7% did not use the Internet at all and 25.1% used the Internet almost every day. Among women, 47.1% did not use the Internet and 17.6% used it almost every day. As age increased, the percentage of those who did not use Internet increased. Likewise, the percentage of people using the Internet almost daily decreased as age increased. As income increased, the percentage of Internet non-users decreased. The same tendency was observed for subjective socio-economic status. Regarding educational attainment, among those who were categorised as low (less than 10 years), 64.1% did not use the Internet and the number decreased as the number of years of education increased. In terms of employment status, participants who used the Internet almost every day were the highest among current workers (29.0%) followed by the categories of retired/not working (21.7%) and never working (11.8%). In the longest job, 60.9% of participants did not use the Internet, and 11.4% from the unemployed category used it almost every day. In living arrangements, daily Internet users were the highest in the category of living with a spouse only (24.6%).

*Income: In our study, income indicates household income divided by the square root of the number of household members. The reason behind this is that even with the same household income, the standard of living of the household varies depending on the number of people in the household.

Table 1. Individual and demographic factors

Demographic and biological factors		Total n=22,252	No Internet use n=10,331		Less than a few times a month n=2,827		2-3/week n=2,506		Almost every day n=4,677		Missing n=1,911	
		n	n	%	n	%	n	%	n	%	n	%
Sex	Male	10,121	4,621	45.7	1,232	12.2	993	9.8	2,537	25.1	738	7.3
	Female	12,131	5,710	47.1	1,595	13.1	1,513	12.5	2,140	17.6	1,173	9.7
Age （years）	65–69	6,612	1,988	30.1	1,012	15.3	1,058	16.0	2,186	33.1	368	5.6
	70–74	5,895	2,494	42.3	867	14.7	748	12.7	1,363	23.1	423	7.2
	75–79	5,051	2,769	54.8	605	12.0	455	9.0	722	14.3	500	9.9
	80–84	3,165	1,973	62.3	269	8.5	203	6.4	332	10.5	388	12.3
	≥85	1,529	1,107	72.4	74	4.8	42	2.7	74	4.8	232	15.2
Marital status	Married	15,744	6,838	43.4	2,142	13.6	1,883	12.0	3,716	23.6	1,165	7.4
	Widowed	4,376	2,420	55.3	465	10.6	414	9.5	599	13.7	478	10.9
	Divorced	927	421	45.4	118	12.7	122	13.2	194	20.9	72	7.8
	Never married	654	356	54.4	67	10.2	63	9.6	130	19.9	38	5.8
	Others	178	97	54.5	16	9.0	11	6.2	21	11.8	33	18.5
	Missing	373	199	53.4	19	5.1	13	3.5	17	4.6	125	33.5
Income (3 percentile)	Q1(Low)	6,326	3,551	56.1	746	11.8	609	9.6	847	13.4	573	9.1
	Q2(Middle)	5,490	2,201	40.1	840	15.3	759	13.8	1,372	25.0	318	5.8
	Q3(High)	5,476	1,862	34.0	717	13.1	747	13.6	1,883	34.4	267	4.9
	Missing	4,960	2,717	54.8	524	10.6	391	7.9	575	11.6	753	15.2
	Poor	6,430	3,374	52.5	786	12.2	648	10.1	1,047	16.3	575	8.9

Subjective socio-economic status*	Average	12,695	5,860	46.2	1,638	12.9	1,502	11.8	2,616	20.6	1,079	8.5
	Rich	2,899	996	34.4	388	13.4	351	12.1	997	34.4	167	5.8
	Missing	228	101	44.3	15	6.6	5	2.2	17	7.5	90	39.5
Educational attainment (years)	Low(<10)	7,318	4,691	64.1	684	9.3	465	6.4	570	7.8	908	12.4
	Middle(10–12)	9,013	3,830	42.5	1,347	14.9	1,267	14.1	1,949	21.6	620	6.9
	High(≥13)	5,548	1,620	29.2	769	13.9	758	13.7	2,113	38.1	288	5.2
	Others	121	61	50.4	13	10.7	5	4.1	20	16.5	22	18.2
	Missing	252	129	51.2	14	5.6	11	4.4	25	9.9	73	29.0
Employment status	Working	5,159	1,939	37.6	683	13.2	689	13.4	1,496	29.0	352	6.8
	Retired/not working	11,570	5,378	46.5	1,612	13.9	1,388	12.0	2,510	21.7	682	5.9
	Never working	1,352	810	59.9	131	9.7	118	8.7	160	11.8	133	9.8
	Missing	4,171	2,204	52.8	401	9.6	311	7.5	511	12.3	744	17.8
Longest job	Professional	3,565	1,354	38.0	511	14.3	409	11.5	1,060	29.7	231	6.5
	Manager/Clerk	5,195	1,681	32.4	791	15.2	818	15.7	1,643	31.6	262	5.0
	Manual/service	7,370	3,993	54.2	902	12.2	740	10.0	1,130	15.3	605	8.2
	Other	1,842	1,036	56.2	208	11.3	172	9.3	245	13.3	181	9.8
	Unemployed	1,288	785	60.9	121	9.4	115	8.9	147	11.4	120	9.3
	Missing	2,992	1,482	49.5	294	9.8	252	8.4	452	15.1	512	17.1
Living arrangement	Living alone	3,400	1,709	50.3	404	11.9	364	10.7	594	17.5	329	9.7
	Only spouse	10,825	4,488	41.5	1,537	14.2	1,326	12.2	2,667	24.6	807	7.5

	Two households with sons or daughters	4,535	2,415	53.3	487	10.7	432	9.5	798	17.6	403	8.9
	Other (including 3 households)	2,129	976	45.8	275	12.9	275	12.9	465	21.8	138	6.5
	Missing	1,363	743	54.5	124	9.1	109	8.0	153	11.2	234	17.2

*An individual's perception of her socio-economic standing.

Table 2 shows the results of cross tabulation of the frequency of Internet use and health and health behavioural factors. It shows that 22.4% of participants were functionally independent using the internet almost daily while 44.8% did not use the Internet. As for self-rated health, daily users were the highest among those who described their health status as very good (30.6%), followed by those whose health was good (21.3%), poor (12.7%), and very poor (9.8%). Regarding depression status, the least number of Internet non-users were found in the no depression category (43.2%), followed by mild depression (55.7%) and severe depression (61.7%). Among participants who had taken a medical examination within the last one year, 24.4% used the Internet almost daily while 42.1% did not use the Internet.

Among participants with medical conditions, 47.7% did not use the Internet, while 20.2% were daily Internet users. A similar trend can be observed among participants undergoing treatment for diseases. Internet non-users had a higher percentage of having diseases than daily users.

Among those who ate meat and fish less than once a day, 50.8% did not use the Internet while 16.9% were daily users. A similar trend was observed for the frequency of fruit and vegetable intake. Next, 48.7% of current smokers did not use the Internet while 20.6% used it daily. Regarding drinking status, current drinkers had the highest proportion (27.6%) of daily Internet users. Those who walked less than 30 min per day had the highest proportion (53.4%) of Internet non-users. In terms of frequency of going outdoors, participants who used the Internet almost daily were the highest in the four times or more per week category (24.2%), followed by those who went out 1–3 times per week (14.8%) and less than once per month (5.7%). Further, the proportion of daily Internet users was higher among those who engaged in physical activity (physical labour or intense sports) for less than 1 h (27.3%) than those who exercised for an hour or more (21.6%).

Table 2 Health behaviour and lifestyle factors

Health and health behavioural factors		Total n=22,252	No Internet use n=10,331		Less than a few times a month n=2,827		2-3 times/week n=2,506		Almost every day n=4,677		Missing n=1,911	
		n	n	%	n	%	n	%	n	%	n	%
Activities of Daily Living	Independent	19,422	8,709	44.8	2,573	13.2	2,310	11.9	4,355	22.4	1,475	7.6
	In need of care but not receiving it	1,041	728	69.9	72	6.9	50	4.8	58	5.6	133	12.8
	Receiving care	239	147	61.5	18	7.5	17	7.1	40	16.7	17	7.1
	Missing	1,550	747	48.2	164	10.6	129	8.3	224	14.5	286	18.5
The Instrumental Self-Maintenance subscale	No decline(5 points)	19,305	8,484	43.9	2,595	13.4	2,325	12.0	4,373	22.7	1,528	7.9
	Decline (4points)	2,173	1,438	66.2	164	7.5	124	5.7	224	10.3	223	10.3
	Missing	774	409	52.8	68	8.8	57	7.4	80	10.3	160	20.7
The Intellectual Activity subscale	No decline(4 points)	14,250	5,822	40.9	1,984	13.9	1,819	12.8	3,597	25.2	1,028	7.2
	Decline (3 points)	6,966	3,943	56.6	759	10.9	615	8.8	984	14.1	665	9.5
	Missing	1,036	566	54.6	84	8.1	72	6.9	96	9.3	218	21.0
The Social Role subscale	No decline(4 points)	10,494	4,311	41.1	1,392	13.3	1,364	13.0	2,593	24.7	834	7.9
	Decline (3 points)	10,497	5,369	51.1	1,305	12.4	1,044	9.9	1,946	18.5	833	7.9
	Missing	1,261	651	51.6	130	10.3	98	7.8	138	10.9	244	19.3
Body Mass Index (Kg/cm^2)	<18.5	1,597	810	50.7	217	13.6	149	9.3	260	16.3	161	10.1
	18.5–24.9	15,086	6,764	44.8	2,011	13.3	1,823	12.1	3,305	21.9	1,183	7.8
	≥25.0	4,921	2,384	48.4	563	11.4	500	10.2	1,055	21.4	419	8.5

	Missing	648	373	57.6	36	5.6	34	5.2	57	8.8	148	22.8
Self–rated health	Very good	2,990	1106	37.0	380	12.7	367	12.3	914	30.6	223	7.5
	Good	15,321	6976	45.5	2,022	13.2	1,806	11.8	3,269	21.3	1,248	8.1
	Poor	2,876	1679	58.4	304	10.6	241	8.4	364	12.7	288	10.0
	Very poor	437	267	61.1	49	11.2	37	8.5	43	9.8	41	9.4
	Missing	628	303	48.2	72	11.5	55	8.8	87	13.9	111	17.7
Depression	No	16,069	6936	43.2	2,147	13.4	1,917	11.9	3,887	24.2	1,182	7.4
	Mild	3,742	2086	55.7	412	11.0	365	9.8	521	13.9	358	9.6
	Mild to severe	1,115	688	61.7	128	11.5	94	8.4	96	8.6	109	9.8
	Missing	1,326	621	46.8	140	10.6	130	9.8	173	13.0	262	19.8
Medical examination	Examined within 1 year	13,039	5485	42.1	1,795	13.8	1,625	12.5	3,185	24.4	949	7.3
	Others	8,541	4486	52.5	968	11.3	835	9.8	1437	16.8	815	9.5
	Missing	672	360	53.6	64	9.5	46	6.8	55	8.2	147	21.9
Self-reported medical conditions	No illness	3,984	1,629	40.9	554	13.9	459	11.5	1,015	25.5	327	8.2
	Illness	17,174	8,189	47.7	2,145	12.5	1,937	11.3	3,467	20.2	1,436	8.4
	Missing	1,094	513	46.9	128	11.7	110	10.1	195	17.8	148	13.5
Diseases under treatment	Hypertension	9,352	4,613	49.3	1,142	12.2	1,006	10.8	1,767	18.9	824	8.8
	Diabetes mellitus	2,931	1,438	49.1	347	11.8	310	10.6	587	20.0	249	8.5
	Stroke	635	358	56.4	64	10.1	65	10.2	93	14.6	55	8.7
	Cardiac diseases	2,119	1,047	49.4	253	11.9	207	9.8	443	20.9	169	8.0
	Cancer	938	405	43.2	157	16.7	110	11.7	206	22.0	60	6.4

	Respiratory diseases	1,116	552	49.5	149	13.4	117	10.5	198	17.7	100	9.0
Frequency of meat and fish intake	≥once /day	10,871	4,555	41.9	1,456	13.4	1,283	11.8	2,767	25.5	810	7.5
	<once /day	10,881	5,531	50.8	1,321	12.1	1,176	10.8	1,838	16.9	1,015	9.3
	Missing	500	245	49.0	50	10.0	47	9.4	72	14.4	86	17.2
Frequency of fruit and vegetable intake	≥once /day	17,287	7,695	44.5	2,236	12.9	2,0351 1.8	3,937	22.8	1,384	8.0	
	<once /day	4,573	2,453	53.6	548	12.0	432	9.4	691	15.1	449	9.8
	Missing	392	183	46.7	43	11.0	39	9.9	49	12.5	78	19.9
Smoking	Never smoked	13,220	6,255	47.3	1,681	12.7	1,574	11.9	2,531	19.1	1,179	8.9
	Past smoker	6,224	2,724	43.8	806	12.9	644	10.3	1,618	26.0	432	6.9
	Current smoker	2,309	1,125	48.7	289	12.5	246	10.7	476	20.6	173	7.5
	Missing	499	227	45.5	51	10.2	42	8.4	52	10.4	127	25.5
Drinking status	Never drank	11,179	5,604	50.1	1,382	12.4	1,230	11.0	1,950	17.4	1,013	9.1
	Past drinker	2,383	1,229	51.6	307	12.9	210	8.8	430	18.0	207	8.7
	Current drinker	7,949	3160	39.8	1,056	13.3	997	12.5	2,194	27.6	542	6.8
	Missing	741	338	45.6	82	11.1	69	9.3	103	13.9	149	20.1
Walking duration (per day)	>90 min	4,010	1,846	46.0	536	13.4	444	11.1	871	21.7	313	7.8
	60–90 min	3,654	1,543	42.2	499	13.7	438	12.0	899	24.6	275	7.5
	30–60 min	7,836	3,380	43.1	1,040	13.3	994	12.7	1,807	23.1	615	7.8
	<30 min	5,998	3,200	53.4	680	11.3	576	9.6	999	16.7	543	9.1
	Missing	754	362	48.0	72	9.5	54	7.2	101	13.4	165	21.9
	>4 times/week	15,786	6,747	42.7	2,105	13.3	1,924	12.2	3,813	24.2	1,197	7.6

Frequency of going outdoors	1-3 times/week	5,164	2,765	53.5	621	12.0	508	9.8	764	14.8	506	9.8
	≤ 1 time/month	942	656	69.6	64	6.8	41	4.4	54	5.7	127	13.5
	Missing	360	163	45.3	37	10.3	33	9.2	46	12.8	81	22.5
Times for physical labour and intense sports	≥1 h/day	6,797	2,984	43.9	937	13.8	852	12.5	1,467	21.6	557	8.2
	<1 h/day	4,314	1,682	39.0	627	14.5	521	12.1	1,178	27.3	306	7.1
	None	10,022	5,069	50.6	1,184	11.8	1,068	10.7	1,942	19.4	759	7.6
	Missing	1,119	596	53.3	79	7.1	65	5.8	90	8.0	289	25.8
Time spent sitting	≥8 h/day	1,553	825	53.1	171	11.0	117	7.5	334	21.5	1066.8	
	3–8 h/day	12,541	5,588	44.6	1,661	13.2	1,518	12.1	2,845	22.7	929	7.4
	<3 h/day	7,511	3,579	47.7	963	12.8	835	11.1	1,451	19.3	683	9.1
	Missing	647	339	52.4	32	4.9	36	5.6	47	7.3	193	29.8
Time spent walking or standing	≥3 h/day	10,366	4,582	44.2	1,370	13.2	1,307	12.6	2,277	22.0	830	8.0
	1–3 h/day	8,477	3,838	45.3	1,128	13.3	941	11.1	1,900	22.4	670	7.9
	<1 h/day	2,971	1,684	56.7	306	10.3	245	8.2	479	16.1	257	8.7
	Missing	438	227	51.8	23	5.3	13	3.0	21	4.8	154	35.2

Table 3 shows the results of cross-tabulation of the frequency of Internet use and social factors. In general trust in the community, daily users were higher in the yes group (22.9%) than in the no group (17.4%). A similar trend can be seen in norms of reciprocity, attachment to the neighbourhood, receiving emotional support, providing emotional support, receiving instrumental support, and providing instrumental support. In terms of frequency of meeting friends, daily users were the highest in the four times or more per week group (27.0%), followed by 1–3 times per week (22.4%), and less than once in a month (18.8%). As the number of friends met increased, the percentage of Internet non-users decreased. That is, the percentage of Internet non-users was highest among participants who met 0 friends and lowest among those who met 6–9 friends. Among people who participated in sports groups, hobby groups, or volunteer groups more than once a week, the proportion of Internet non-users was higher than that of daily users.

Table 3. Social factors

Social factors		Total n=22,252	No Internet use n=10,331		Less than few times a month n=2,827		2–3 times/week n=2,506		Almost every day n=4,677		Missing n=1,911	
		n	n	%	n	%	n	%	n	%	n	%
General trust	No	6,805	3,433	50.4	815	12.0	815	12.0	1,186	17.4	655	9.6
	Yes	14,909	6,639	44.5	1,969	13.2	1,969	13.2	3,419	22.9	1,139	7.6
	Missing	538	259	48.1	43	8.0	43	8.0	72	13.4	117	21.7
Norms of reciprocity	No	10,158	4,885	48.1	1,283	12.6	1,283	12.6	1,999	19.7	859	8.5
	Yes	11,384	5,125	45.0	1,482	13.0	1,482	13.0	2,589	22.7	875	7.7
	Missing	710	321	45.2	62	8.7	62	8.7	89	12.5	177	24.9
Attachment to the neighborhood	No	4,719	2,290	48.5	555	11.8	555	11.8	907	19.2	455	9.6
	Yes	17,062	7,829	45.9	2,233	13.1	2,233	13.1	3,706	21.7	1,349	7.9
	Missing	471	212	45.0	39	8.3	39	8.3	64	13.6	107	22.7
Receiving emotional support	No	1,106	608	55.0	119	10.8	80	7.2	190	17.2	109	9.9
	Yes	20,631	9,475	45.9	2,675	13.0	2,395	11.6	4,424	21.4	1,662	8.1
	Missing	515	248	48.2	33	6.4	31	6.0	63	12.2	140	27.2
Providing emotional support	No	1,405	881	62.7	124	8.8	85	6.0	158	11.2	157	11.2
	Yes	20,205	9,137	45.2	2,662	13.2	2,385	11.8	4,452	22.0	1,569	7.8
	Missing	642	313	48.8	41	6.4	36	5.6	67	10.4	185	28.8
Receiving instrumental support	No	1,077	563	52.3	144	13.4	83	7.7	184	17.1	103	9.6
	Yes	20,720	9,554	46.1	2,653	12.8	2,374	11.5	4,436	21.4	1,703	8.2
	Missing	455	214	47.0	30	6.6	49	10.8	57	12.5	105	23.1

Providing instrumental support	No	3,207	1,765	55.0	367	11.4	237	7.4	529	16.5	309	9.6
	Yes	17,971	8,010	44.6	2,376	13.2	2,186	12.2	4,056	22.6	1,343	7.5
	Missing	1074	556	51.8	84	7.8	83	7.7	92	8.6	259	24.1
Frequency of meeting friends	>4 times/week	3,531	1,492	42.3	406	11.5	402	11.4	953	27.0	278	7.9
	1–3 times/week	7,046	3,003	42.6	951	13.5	903	12.8	1,579	22.4	610	8.7
	≤ once/month	10,970	5,475	49.9	1416	12.9	1,153	10.5	2,066	18.8	860	7.8
	Missing	705	361	51.2	54	7.7	48	6.8	79	11.2	163	23.1
Number of friends met	0	1,906	1,166	61.2	196	10.3	104	5.5	294	15.4	146	7.7
	1–2	4,064	2,240	55.1	463	11.4	384	9.4	596	14.7	381	9.4
	3–5	5,381	2,597	48.3	727	13.5	633	11.8	925	17.2	499	9.3
	6–9	2,915	1,277	43.8	394	13.5	391	13.4	630	21.6	223	7.7
	≥10	7,214	2,645	36.7	989	13.7	956	13.3	2156	29.9	468	6.5
	Missing	772	406	52.6	58	7.5	38	4.9	76	9.8	194	25.1
Interactions with neighbours	Cooperating in daily life	3,639	1,700	46.7	471	12.9	401	11.0	715	19.6	352	9.7
	Standing and chatting frequently	12,050	5,573	46.2	1,580	13.1	1,459	12.1	2,460	20.4	978	8.1
	No more than an exchange of greetings/none	6,153	2,870	46.6	748	12.2	604	9.8	1,448	23.5	483	7.8
	Missing	410	188	45.9	28	6.8	42	10.2	54	13.2	98	23.9
	No	13,989	6,881	49.2	1,791	12.8	1,489	10.6	2,939	21.0	889	6.4

Participation in a sports group	Yes (>once/week)	4,185	1,324	31.6	683	16.3	636	15.2	1,250	29.9	292	7.0
	Missing	4078	2126	52.1	353	8.7	381	9.3	488	12.0	730	17.9
Participation in a hobby group	No	14,665	7,053	48.1	1,887	12.9	1,635	11.1	3,140	21.4	950	6.5
	Yes (>once/week)	4,437	1,522	34.3	687	15.5	665	15.0	1231	27.7	332	7.5
	Missing	3150	1,756	55.7	253	8.0	206	6.5	306	9.7	629	20.0
Participation in a volunteer group	No	17,533	8,137	46.4	2,354	13.4	2,046	11.7	3,834	21.9	1,162	6.6
	Yes (>once/week)	1,389	465	33.5	177	12.7	178	12.8	462	33.3	107	7.7
	Missing	3,330	1,729	51.9	296	8.9	282	8.5	381	11.4	642	19.3

Table 4 presents the results of cross-tabulation of the frequency of Internet use and environmental factors. It shows that in relation to the factor of population density, most of the daily Internet users (27.5%) were residents of metropolitan areas, followed by urban areas (21.9%), semi-urban areas (16.0%), and rural areas (13.3%).

Table 4. Environmental factors

Environmental factors		Total n=22,252	No Internet use n=10,331		Less than a few times a month n=2,827		2–3 times/week n=2,506		Almost every day n=4,677		Missing n=1,911	
		n	n	%	n	%	n	%	n	%	n	%
Population density*	Metropolitan	8,292	3,302	39.8	1,129	13.6	1,106	13.3	2,279	27.5	476	5.7
	Urban	5,273	2,378	45.1	695	13.2	594	11.3	1,154	21.9	452	8.6
	Semi-urban	3,281	1,667	50.8	426	13.0	335	10.2	526	16.0	327	10.0
	Rural	5,406	2,984	55.2	577	10.7	471	8.7	718	13.3	656	12.1
Parks or sidewalks	No	4,564	2,446	53.6	563	12.3	396	8.7	696	15.2	463	10.1
	Yes	1,7140	7,613	44.4	2,228	13.0	2,065	12.0	3,920	22.9	1,314	7.7
	Missing	548	272	49.6	36	6.6	45	8.2	61	11.1	134	24.5
Access to shops	No	4,391	2,238	51.0	522	11.9	447	10.2	767	17.5	417	9.5
	Yes	17,379	7,855	45.2	2,279	13.1	2,015	11.6	3,847	22.1	1,383	8.0
	Missing	482	238	49.4	26	5.4	44	9.1	63	13.1	111	23.0

* Population density: For each municipality, we divided the population by habitable land area and calculated the number of residents per km² of unit area. According to the population density of the habitable area, we classified each municipality into the following four categories: metropolitan (≥ 4,000/km²), urban (1,500–3,999/km²), semi-urban (1,000–1,499/km²), and rural (< 1,000 /km²).

The cross-tabulation of the association between the purpose of Internet use and frequency of Internet use is shown in **Table 5**. Communication with friends/family was the least common purpose (46.4%) of using the Internet among those used it almost daily and the most common purpose (26.7%) in the 2–3 times/week group and the less than a few times in a month group (26.9%). On the other hand, social network services, bank transactions and purchase of goods and services were frequent purpose for those who use Internet almost every day or 2–3 times/week. Other major reasons were checking traffic information, banking, and other areas closely related to their lives. The digital divide is highly apparent from the difference in the percentages seen in the 'Almost every day' column and the columns of the other two groups.

Table 5. The purpose of Internet use

Purpose of Internet use	Total	Less than a few times a month		2–3 times/week		Almost everyday	
	n	n	%	n	%	n	%
Gathering health and medical information	2,116	344	16.3	361	17.1	1,411	66.7
Gathering non-health and medical information	3,484	531	15.2	648	18.6	2,305	66.2
Communication with friends/family	6,967	1,875	26.9	1,859	26.7	3,233	46.4
Map and traffic information guide	3,693	684	18.5	689	18.7	2,320	62.8
Purchase of goods and services	1,964	252	12.8	274	14.0	1,438	73.2
Bank transactions, trading of stocks, securities, etc	1,130	115	10.2	108	9.6	907	80.3
LINE*, Facebook, Twitter	1,268	123	9.7	173	13.6	972	76.7
Others	835	138	16.5	148	17.7	549	65.7

*LINE is a free messaging app

The results on types of devices used in relation to the frequency of Internet use are shown in **Table 6.** Most almost-daily users used a tablet (68.3%), followed by a smartphone (66.4%). Of those who used the Internet 2–3 times/week, 29.8% used a mobile phone, and 18.3% used a personal computer. Participants who used the Internet less than a few times a month used a mobile phone (32.7%) or personal computer (19.0%).

Table 6. Types of Internet-using devices

Internet-using devices	Total	Less than a few times a month		2–3 times/week		Almost everyday	
	n	n	%	n	%	n	%
Personal computer	4,728	896	19.0	867	18.3	2,965	62.7
Mobile Phone	5,869	1,922	32.7	1,747	29.8	2,200	37.5
Smartphone	2,055	323	15.7	368	17.9	1,364	66.4
Tablet	950	148	15.6	153	16.1	649	68.3
Others	21	11	52.4	2	9.5	8	38.1

Table 7 presents the cross tabulation of the history and frequency of Internet use. It shows that 6,430 participants started using the Internet or email more than 10 years ago. Further, 56.5% of the participants used the Internet almost daily. However, 156 participants had begun using the Internet within the last 1 year, and 52.2% of them were using it less than a few times a month.

Table 7. History of Internet use

History of Internet use	Total	Less than a few times a month		2–3 times/week		Almost everyday	
	n	n	%	n	%	n	%
More than 10 years ago	6,430	1,343	20.9	1,457	22.7	3,630	56.5
More than 5 years ago	2,130	799	37.5	660	31.0	671	31.5
3-4 years ago	767	331	43.2	223	29.1	213	27.8
1-2 years ago	338	183	54.1	82	24.3	73	21.6
Within the last 1 year	159	83	52.2	33	20.8	43	27.0

3-1-2. The association between Internet use and health, health care service use, and behaviour: Cross-sectional study

The Relationship between Internet use and social participation among older adults in Japan: A cross-sectional study of JAGES 2016

In this analysis, the relationship between Internet use and social participation among older people in Japan was investigated. Social participation was measured by four aspects: 1) volunteering, 2) sports participation, 3) hobby group participation, and 4) number of meetings with friends. Those who participated more than once a month were categorised as 'socially active' and the others were 'not socially active'. The frequency of Internet use was used as an Internet use variable; those who used Internet more than once a month were categorised as 'Internet users' and the others were categorised as 'Internet non-users'. Age, sex, education, marital status, living arrangement, income, working status, comorbidity, activities of daily living, self-rated health, geriatric depression scale, frequency of meeting friends, and population density were added as covariates. Poisson regression analysis was conducted for this analysis.

Result: Those who use Internet are more socially active than those who do not use it.
Those who used the Internet were attending social groups and meeting friends more than those who did not use the Internet. Impediments to social participation among Japanese older adults were: being male, having a low income, low educational attainment, being divorced or separated, not being employed, having comorbidities, having a low subjective view of health, having depression, and going out less than once a week.

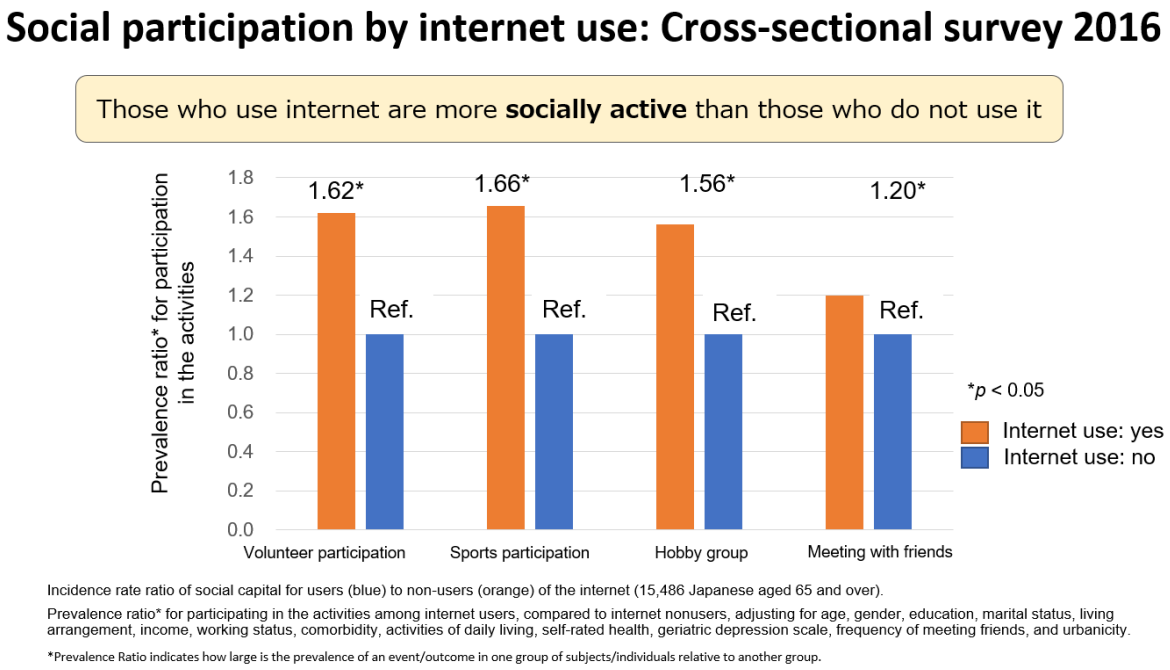


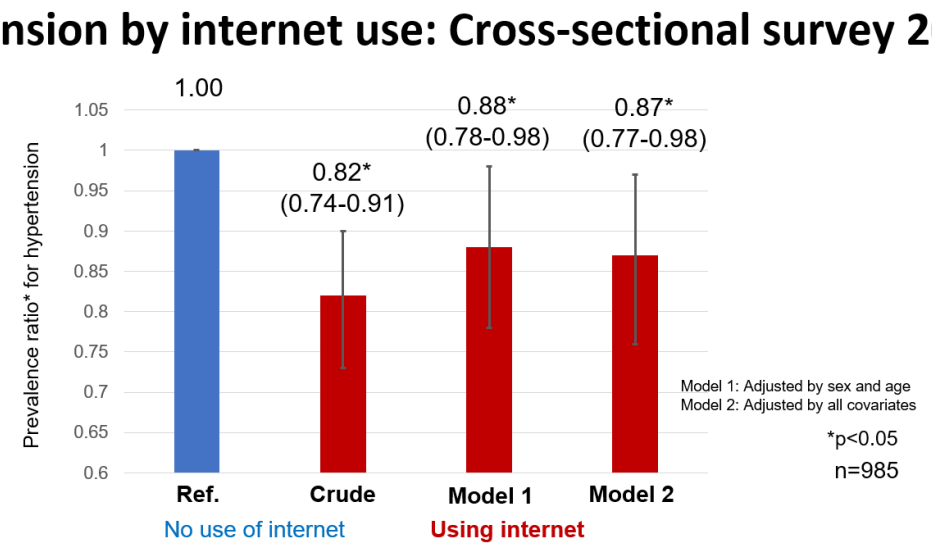
Figure 6. The relationship between Internet use and social participation

The association between Internet use and biomarkers taken during the municipal medical check-up among Japanese older people

In this analysis, the association between Internet use and biomarkers measured during medical check-ups was investigated. For the biomarkers, we used the prevalence of hypertension and diabetes. Health check-up data provided by local municipalities were linked to the JAGES data. Blood pressure and blood sugar levels were measured at community health centres and registered hospitals. The prevalence of hypertension was defined as systolic blood pressure ≥140 mmHg, diastolic blood pressure≥ 90 mmHg, or self-reported treatment information. The prevalence of diabetes was defined as fasting blood sugar ≥126 mmHg, HbA1c ≥6.5%, or self-reported treatment information. The frequency of Internet use was used as an explanatory variable. Those who used the Internet more than once a month were categorised as 'Internet users' and the others were 'Internet non-users'. We defined people who use the Internet at least several times a year as Internet users. Sex, age, income, education, employment status, residential status, marital status, presence of diabetes or hypertension, presence of stroke, presence of heart disease, score on the Geriatric Depression Scale, subjective health perception, body mass index (BMI), ADL, frequency of going out, and participation in horizontal organisations were added as covariates. The 'presence of diabetes' was adjusted when the outcome was hypertension. When the outcome was diabetes, the 'presence of hypertension' was included as a covariate. Poisson regression analysis was conducted for this analysis.

Result: Those who use the Internet are less likely to have hypertension than those who do not use the Internet.

Using cross-sectional data, we examined whether the prevalence of hypertension/diabetes was lower among older people who used the Internet and e-mail than among those who did not. The results showed that those who used digital devices had a significantly lower prevalence of hypertension, but no statistically significant results were obtained for diabetes.



Crude: A model that does not consider variables other than the use of the Internet
Model 1: Adjusted by sex and age
Model 2: Adjusted by all covariates (Sex, age, equivalent income, education, employment status, residential status, marital status, presence of diabetes/hypertension, presence of stroke, presence of heart disease, Geriatric Depression Scale, subjective health perception, BMI, ADL, frequency of going out, and participation in horizontal organizations)
*Prevalence Ratio indicates how large is the prevalence of an event/outcome in one group of subjects/individuals relative to another group.

Figure 7. Prevalence ratio and 95% confidence interval with hypertension incidence

The association between Internet usage and taking municipal medical check-up services among Japanese older people

In this analysis, the association between Internet use and annual medical check-up services provided by residential municipalities was investigated. The outcome was defined as NOT receiving a medical check-up. Internet use was defined by the frequency of Internet use, i.e. those who used it more than once a week were categorised as frequent users and the others were categorised as infrequent users. Age, sex, income, educational attainment, longest job, marital status, and the number of people met in a recent month were added as covariates. Poisson regression analysis was conducted for this analysis.

Result: Infrequent Internet are less likely to have health check-ups than frequent Internet users.

The prevalence of NOT having an annual health check-up was 1.36 times higher in infrequent Internet users than in frequent Internet users (95% Confidence Interval: 1.28-1.45, Model 1 in **Figure 8**). Even after adjusting for socio-economic status (PR: 1.28 [95% CI: 1.20-1.37], Model 2) and the number of friends met in a recent month, the association remained (PR: 1.22 [95% CI: 1.14-1.30], Model 3).

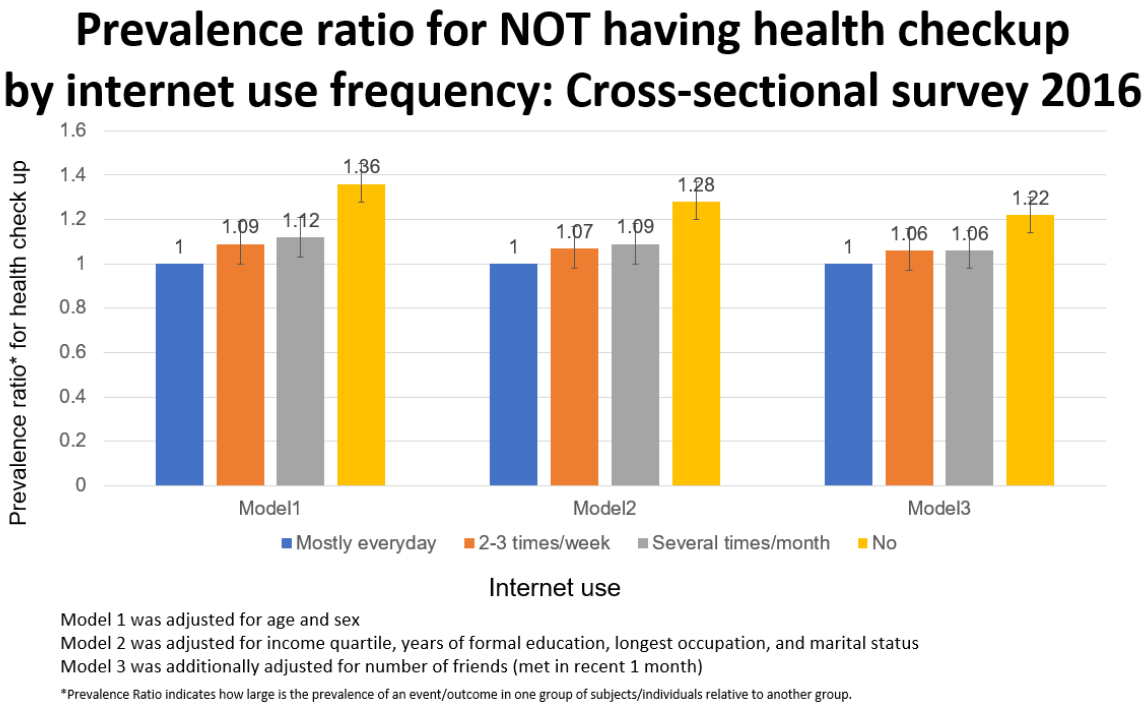


Figure 8. Results of risk ratios for not having health checkup by Internet use frequency

Table 8. Prevalence ratios (95% confidence intervals) of NOT having health check-up by Internet use frequency			
	Model 1	**Model 2**	**Model 3**
Internet usage (frequency)			
No	**1.36 (1.28–1.45)**	**1.28 (1.20–1.37)**	**1.22 (1.14–1.30)**
Several times/month	**1.12 (1.03–1.21)**	**1.09 (1.00–1.18)**	1.06 (0.98–1.15)
2–3 times/week	**1.09 (1.00–1.19)**	1.07 (0.98–1.17)	1.06 (0.97–1.16)
Mostly everyday	1 (reference)	1 (reference)	1 (reference)

Model 1 was adjusted for age and sex.
Model 2 was adjusted for income quartile, years of formal education, longest job, and marital status.
Model 3 was additionally adjusted for number of friends (met in the last one month).

3-1-3. The association between baseline Internet use and health, health care service use, and behaviour after three years: longitudinal studies

The association between Internet use and social participation among Japanese older adults: JAGES longitudinal study

In this analysis, the association between Internet use and social participation in older adults was investigated. Social participation in 2016 was measured by frequency and number of meetings with friends and social participation (sports groups, volunteer groups, hobby groups) in 2019. The frequency of Internet use in 2016 was used as an Internet use variable. Those who used the Internet more than once a month were categorised as Internet users, and the others were categorised as Internet non-users. Sex, age, SES (equalised income, education), working status, marital status, self-reported medical conditions, self-rated health, activities of daily living, frequency of going out, population density, living with family members, and depression (GDS score) were added as covariates. Poisson regression analysis was conducted for this analysis. Participants in the analysis were limited to those who did not have an outcome at baseline.

Result: Those who used the Internet were more socially active 3 years later than who did not use it.

Internet users were about 1.4 times more likely to have participated in volunteer groups at least once a month during the three years (2016–2019) than non-users did. Internet users were about 1.7 times more likely than non-users to have participated in sports groups at least once a month in three years (**Figure 9**). Internet users were about 1.6 times more likely to have participated in hobby groups at least once a month in three years than those who did not use the Internet. Internet users were about 1.2 times more likely to have met with friends at least once a week in three years than non-users did. These results suggest that Internet users increased their social participation and frequency of meeting with friends three years later. Thus, it is possible that social networks are enriched by Internet use.

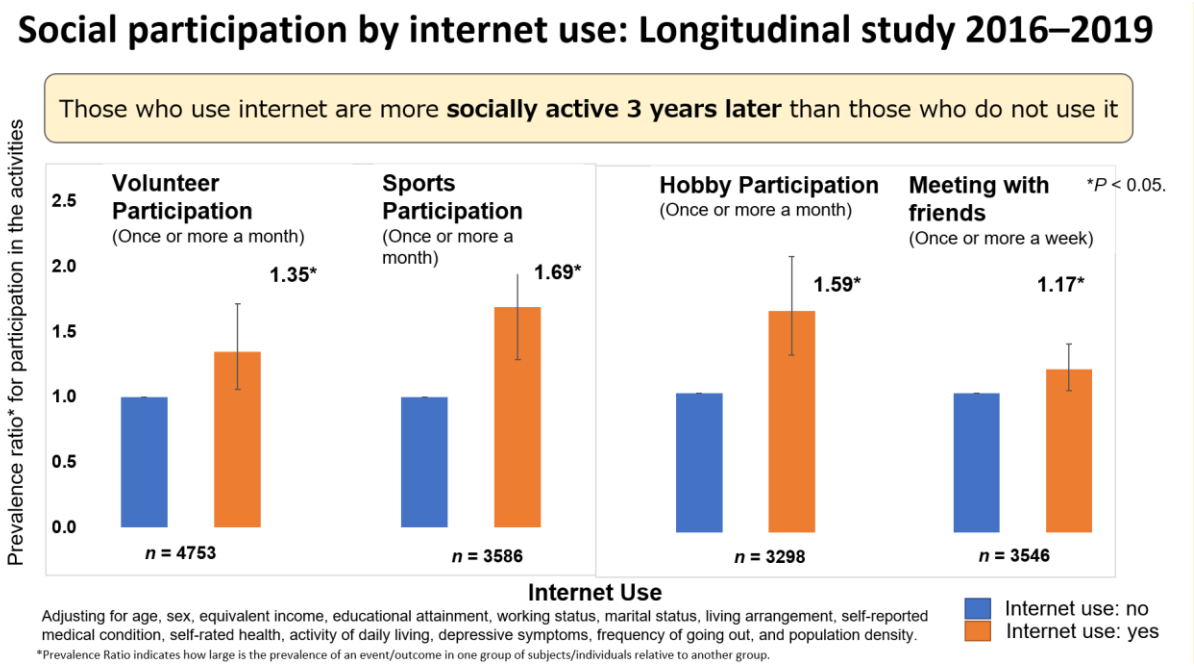


Figure 9. The association between Internet use and social participation after 3 years

The impact of a contextual environment on the relationship between individual Internet use and changes in instrumental activities of daily living (IADL) among older people in Japan: A longitudinal study (verified on 12 June)

Japan is known to be a world leader in longevity and has small socio-economic gradients in health. In this analysis, the changes (remained low, declined, improved, stayed high) in instrumental ADL (IADL) status from 2016 to 2019 were determined based on income (tertiled) and education (not receiving university education vs. receiving university level education). Participants' Instrumental Ability of Daily Living (IADL) was assessed in 2016 and 2019, using the five questions asking the presence of competency and capabilities of using public transport, daily shopping, preparing a meal, paying bills, and managing own bank account. The presence of each ability is scored 1, ranging a total score of 0 to 5. The total score was cut off at 5, treating those who have all abilities as 1 as opposed to those who did not as 0. Then, all responses from two time points were grouped into 4 groups: constantly low, declined, improved and constantly high.

We also evaluated whether this association was attenuated by Internet use. We further explored the role of prefecture-level Internet access (in %), obtained from the Cabinet Office survey in 2016, and the size of friend networks. Sex, age, partnership status, and activities of daily living (ADL) were included in the model for adjustment. There are no area differences in the interests of the associations; multinomial logistic regression, which is used to assess associations between causal factors and categorised outcomes, was applied to examine the research questions.

Result: Not the prefecture-level Internet access, but individuals' frequent Internet use, possibly driven by communication with friends, was the main determinant of changes in IADL status over 3 years.

The findings showed that education played a significant role in determining the changes in the IADL among older people in Japan, while income did not have any significant impact at all (Education: relative risk ratio: RRR 0.75, 95% CI=0.56–0.99 vs High income: RRR=0.89, 95%CI: 0.64–1.22 for those who are in the group as 'stayed low' . Note: RRR is the probability that belongs to a certain category of the outcome compared to the reference). Nevertheless, the impact of education was relatively small and found only in the group whose IADL capability was 'stayed low', which was completely attenuated by the participants' Internet use (**Table 9**). Not using the Internet was closely associated with changes in IADL, especially among those whose IADL was in the group of 'stayed low' (RRR= 2.88, 95%CI = 2.07-4.03).

The prefecture-level Internet use was similar across the groups, at approximately 85%. The results showed that area-level Internet use had no significant effect on the outcome (**Table 10**). Exploring the role of social network size, this factor partially attenuated the negative impact of not using the Internet on the changes in IADL (**Table 11**). Social network size was negatively associated with the 'stayed low' group in comparison to the 'stayed high' group, meaning not having friends was more common in this group.

Overall, the results showed the importance of Internet use in maintaining IADL among older people in Japan, suggesting that using the Internet can possibly reduce social inequalities in healthy ageing.

Table 9. Results of multinomial logistic regression between Internet use, education, and

changes in IADL status (N=6,941)

	Stayed low, % (n=263)	Declined, % (n=253)	Improved, % (n=162)	Stayed high, % (n=5159)
Education	0.92(0.70–1.22)	0.91(0.69–1.19)	0.87(0.62–1.24)	Reference
Internet use:				
none	2.89(2.07–4.02)	2.02(1.46–2.79)	2.27(1.51–3.41)	Reference
2–3 times/month	0.94(0.58–1.52)	1.06(0.69–1.63)	1.57(0.96–2.57)	Reference
2–3 times/week	1.16(0.71–1.87)	0.94(0.59–1.50)	1.04(0.58–1.89)	Reference
Almost daily	Reference	Reference	Reference	Reference

Table 10. Results of multinomial logistic regression in examining the associations between Internet use, area-level Internet use, and changes in IADL among Japanese older people (N=6,941)

	Stayed low (n=263)	Declined (n=253)	Improved (n=162)	Stayed high (n=5159)
Education	0.92(0.70–1.21)	0.91(0.69–1.19)	0.88(0.62–1.23)	Reference
Internet use: none	2.87(2.05–4.00)	2.01(1.45–2.76)	2.25(1.49–3.38)	Reference
2–3 times/month	0.94(0.58–1.52)	1.05(0.69–1.62)	1.56(0.95–2.56)	Reference
2–3 times/week	1.16(0.71–1.87)	0.94(0.59–1.50)	1.05(0.58–1.90)	Reference
Almost daily	Reference	Reference	Reference	Reference
Area level Internet use	0.99(0.96–1.02)	0.99(0.96–1.02)	0.98(0.95–1.03)	Reference

Table 11. Results of multinomial logistic regression in examining the associations between Internet use, area based Internet use, social network size, and changes in IADL status (N=6,941)

	Stayed low (n=263)	Decline (n=253)	Improved (n=162)	Stayed high (n=5,159)
Education	0.92(0.69–1.22)	0.93(0.70–1.22)	0.88(0.62–1.24)	Reference
Internet use:				
None	2.61(1.86–3.66)	1.81(1.31–2.51)	2.06(1.37–3.11)	Reference
2–3 times/month	0.93(0.57–1.50)	1.00(0.65–1.54)	1.51(0.92–2.47)	Reference
2–3 times/week	1.15(0.71–1.88)	0.91(0.57–1.46)	1.05(0.58–1.90)	Reference
Almost daily	Reference	Reference	Reference	Reference
Area based Internet use	0.99(0.96–1.02)	0.99(0.96–1.02)	0.98(0.95–1.02)	Reference
Social network size:				
0	Reference	Reference	Reference	Reference
1-2	0.55(0.38–0.82)	0.86(0.57–1.30)	0.66(0.40–1.08)	Reference
3-5	0.48(0.33–0.70)	0.75(0.50–1.13)	0.48(0.29–0.80)	Reference
6-9	0.44(0.28–0.69)	0.73(0.46–1.16)	0.70(0.41–1.19)	Reference
10+	0.39(0.27–0.86)	0.48(0.31–0.72)	0.45(0.28–0.72)	Reference

Note: All estimates were adjusted for sex, age, partnership status, and ADL

Associations of the Internet use/frequency of Internet use/purposes of Internet use with health outcomes (depression, self-rate health, hypertension, and diabetes)

In this analysis, associations of Internet use/frequency of Internet use/purposes of Internet use with health outcomes (depression [Geriatric Depression Scale-15≥5 or diagnosed depression), self-rated health ['Very good' or 'good'], hypertension [self-reported], diabetes [self-reported]) was examined. Internet use/frequency of internet use/purposes of internet use were used to measure internet use statuses. Age, sex, income, educational attainment, working status, living arrangement, pre-existing diseases (hypertension, diabetes, cardiovascular disease, stroke, cancer, and respiratory diseases), self-rated health, ADL, depression, and population density were added as covariates. Logistic regression with standard errors (estimating the nature of the population from the sample and expressing the variability) clustered at Kcode (regional code) was performed.

Result: Those who use the Internet have less risk of each health outcome than those who do not use it.

Internet use, defined as usage a few times or more a month, was significantly associated with the onset of depression, worsening self-rated health, and diabetes onset. Internet use was marginally significantly associated with the onset of hypertension. Clear dose-response relationship (i.e. the health effects increased with increased exposure) were found between frequency of Internet use and depression development and worsening self-rated health.

Among the purposes of Internet use, information searching (general purposes) and communication with friends/family were associated with the onset of depression and worsening self-rated health.

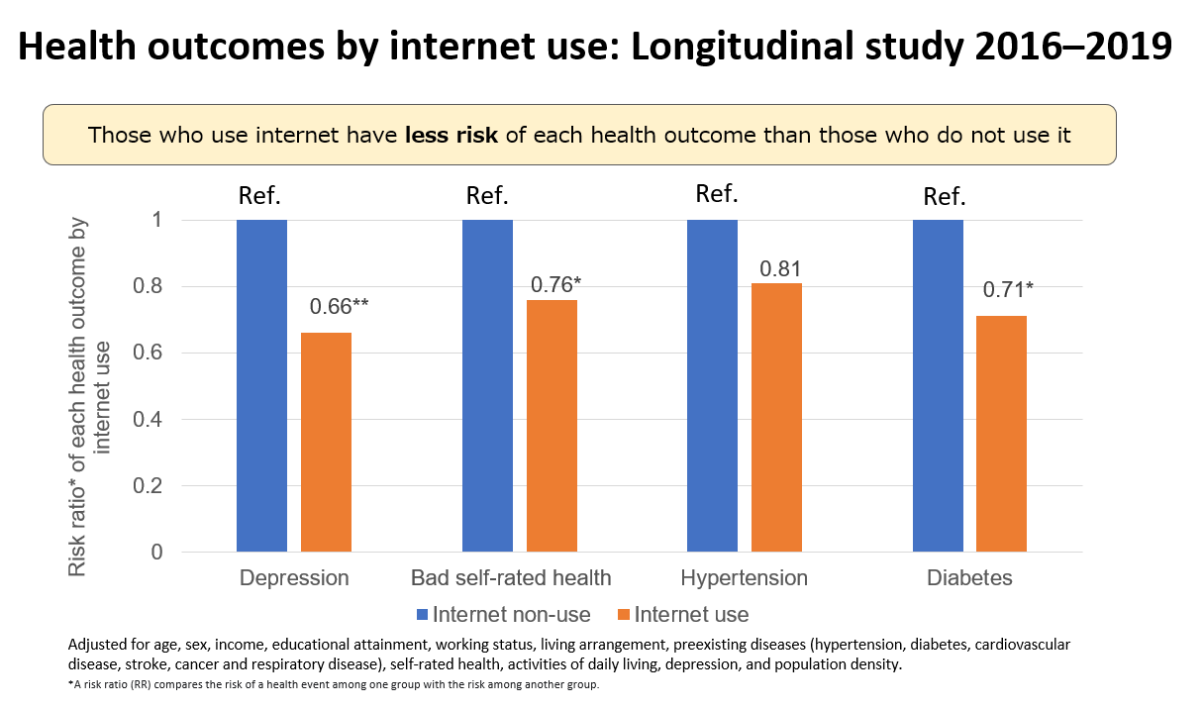


Figure 9. Associations between Internet use and health outcomes

Table 12. Associations between health outcomes and Internet use

		Outcomes							
		Depression (n = 5631)		Self-rated health (n = 6427)		Hypertension (n = 3842)		Diabetes (n = 5879)	
		OR [95%CI]	P	OR [95%CI]	P	OR [95%CI]	P	OR [95%CI]	P
Internet use	No	Ref.		Ref.		Ref.		Ref.	
	Yes (few times or more a month)	0.66 [0.55, 0.79]	0.00	0.76 [0.62, 0.92]	0.01	0.81 [0.65, 1.01]	0.06	0.71 [0.51, 0.99]	0.04

Table 13. Associations between health outcomes and frequency of Internet use

		Outcomes							
		Depression (n = 5631)		Self-rated health (n = 6427)		Hypertension (n = 3842)		Diabetes (n = 5879)	
		OR [95%CI]	P	OR [95%CI]	P	OR [95%CI]	P value	OR [95%CI]	P
Internet use	No	Ref.		Ref.		Ref.		Ref.	
	Yes: few times a month	0.77 [0.61, 0.97]	0.03	0.8 [0.63, 1.02]	0.08	0.8 [0.56, 1.13]	0.21	0.61 [0.37, 1.01]	0.05
	Yes: few times a week	0.66 [0.53, 0.83]	0.00	0.76 [0.58, 1]	0.05	0.92 [0.7, 1.2]	0.53	0.66 [0.42, 1.03]	0.07
	Yes: almost every day	0.58 [0.46, 0.74]	0.00	0.72 [0.57, 0.93]	0.01	0.76 [0.6, 0.96]	0.02	0.81 [0.57, 1.17]	0.27

The relationship between physical activity and use of the Internet in Japanese older adults

In this analysis, the relationship between physical activity and Internet use was examined. The outcome variable was total energy expenditure (TEE) (kcal/day) in 2019 as a continuous variable, and the explanatory variable was Internet use in 2016. Internet usage was defined by Internet use frequency; that is, those who use the Internet more than once a month were categorised as 'Internet users' and the others were 'Internet non-users'. A linear regression analysis was conducted to estimate the relationship. Covariates were age, sex, income (Japanese Yen), years of education, employment status, longest job, subjective economic status, marital status, living arrangement, GDS, IADL, and predicted TEE in 2016.

We included in our analysis 6,957 individuals who had responded to the 2016 survey about whether or not they used the Internet and who answered the three questions about physical activity in the 2019 survey. The estimated total energy expenditure (TEE) was used as a reference index of physical activity based on the answers to the questionnaire on physical activity. Average METs were calculated using the formula of Fujii et al. (2011), estimated basal metabolic rate (BMR) using the formula of Ganpule et al. (Eur J Clin Nutr, 2007), and estimated TEE based on the estimated BMR method. Furthermore, the physical activity level (PAL) of each participant was determined using the formula (= TEE/BMR) for determining PAL given in the Dietary Intake Standards for Japanese (2015 version) by the Ministry of Health, Labour and Welfare. For continuous adjustment variables, those with missing values were excluded from the analysis.

*An analysis method in which the objective variable is represented by a straight line or a value close to it concerning the explanatory variable (also called the dependent variable or independent variable).

Result: An association between Internet use and physical activity has not been observed.
The presence or absence of Internet use alone does not seem to affect the amount of physical activity performed three years later. However, it is feared that the amount of physical activity will decrease due to Internet use and dependence. However, Internet use may increase interest in social participation through access to information, which may result in increased opportunities for social participation and increased physical activity. As a future research topic, it is necessary to investigate the relationship between Internet use and access to information on social participation and physical activity.

3-2. The Relationship between Internet Access and Health in Relation to Social Determinants of Health.

To elucidate the relationship between Internet access and health in relation to other social determinants of health, we conducted multivariable analyses using both cross-sectional and longitudinal data.

The results of multivariable analyses using cross-sectional data from 2016 are shown in 3-2-1. In this analysis, associations between age, socio-economic status, living arrangement, population density, and Internet use, and associations between living arrangement, family structure, and Internet use were evaluated. The results of the multivariable analyses using longitudinal data from to 2016–2019 are shown in 3-2-2. Using longitudinal data, we investigated how socio-economic status modified the associations between Internet use and depression, self-rated health, hypertension, diabetes and instrumental activities of daily living (IADL) among Japanese older people. Whether the respondents were socially isolated or not was considered in the analysis. Detailed tables of each analysis are presented in **Appendix 2**.

3-2-1. The association between social determinants of health and Internet use in 2016: Cross-sectional study

Associations between Internet use and age, socio-economic status, living arrangement, and population density

In this analysis, the associations between age, socio-economic strata, living arrangement, population density, and Internet use was examined. Internet use variables were categorised as at least once a month and at least once a week. Sex, marital status, occupational status, depression, and activities of daily living were used as covariates. Poisson regression analysis was performed to examine the prevalence ratios.

Result: There were associations between demographic factors and Internet use.

We conducted an analysis to identify the individual predictors of digital access (e.g. specific age groups, socio-economic status, family structure, etc.) to inform potential intervention strategies to promote Internet access. The impediments for Internet use among the Japanese older adults were high age, low income, low subjective socio-economic status, less educational attainment, and living in rural areas. Compared to older people who lived with someone, older people who lived alone used the Internet more. Among the factors examined in this study, age 80 years and older and less than 10 years of education were strong inhibitors of Internet access (**Figure 10**).

The inhibitors for Internet use among Japanese older adults were high age, low income, low subjective socio-economic status, less education, and living in rural areas.

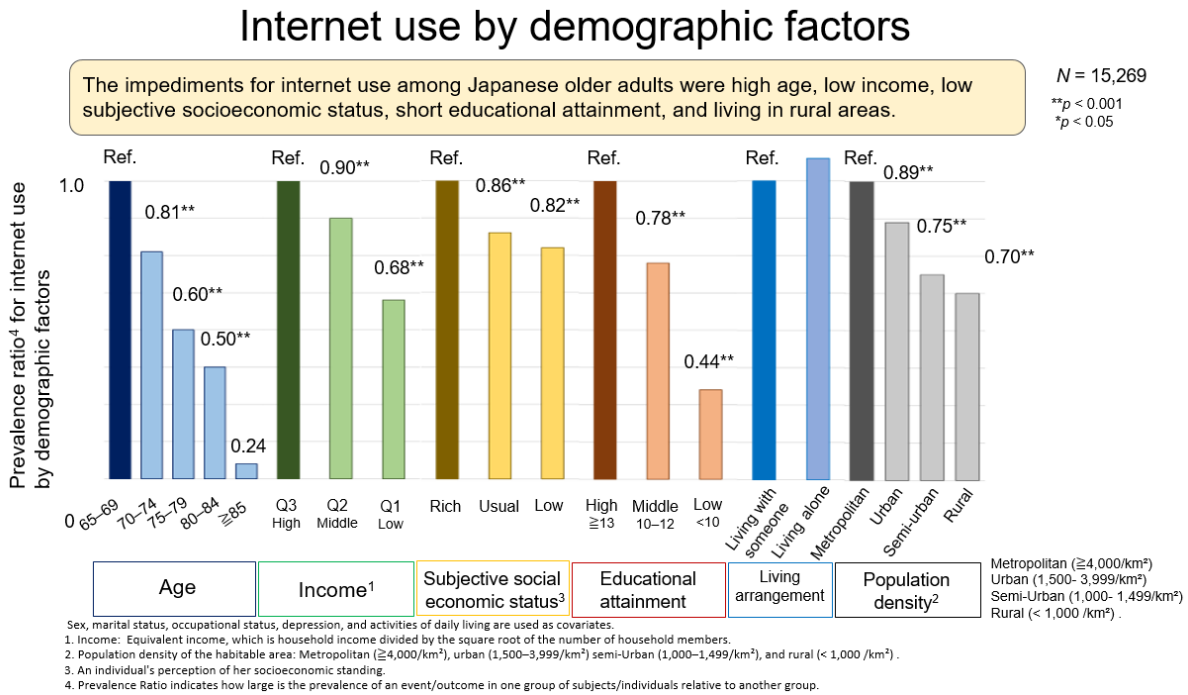
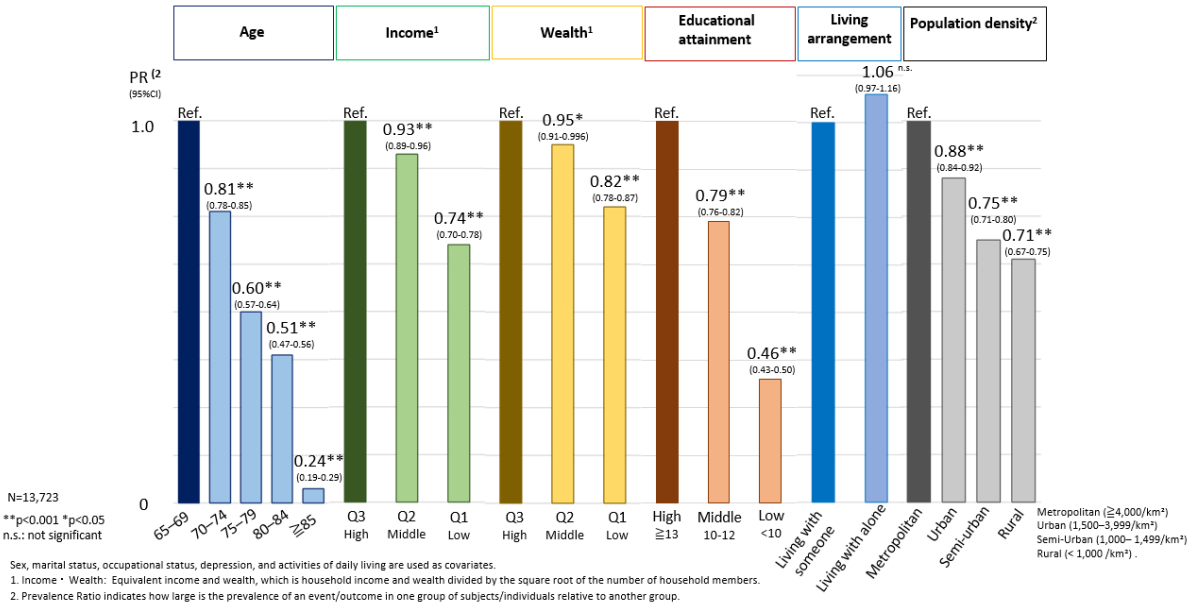


Figure 10. Characteristics of Internet access among Japanese older people

Additional analysis building on previous analysis wherein wealth had been included as an influencing factor was performed because for older adults, wealth may affect how much they benefit from access to the Internet. The dependent variable was Internet use (at least once a week), and the independent variables were age, income, wealth, educational attainment, living arrangement, and population density. We considered sex, marital status, occupational status, depression, and activity activities of daily living as covariates. The results show that those who are in the low or middle group of wealth use less Internet compared to the high group. After considering wealth, the relationship between Internet use and other demographic factors remained the same (**Figure 11**).

Internet use by demographic factors including wealth



Sex, marital status, occupational status, depression, and activities of daily living are used as covariates.
1. Income・Wealth: Equivalent income and wealth, which is household income and wealth divided by the square root of the number of household members.
2. Prevalence Ratio indicates how large is the prevalence of an event/outcome in one group of subjects/individuals relative to another group.

Figure 11. Characteristics of Internet access among Japanese older people considering the influence of wealth

Associations between Internet use and living arrangement and family structure

In this analysis, the associations between living arrangements, family structure, and Internet use were examined. Internet use variables were categorised as use at least once a month and at least once a week. Age, income, educational attainment, living arrangement, employment status, depression, population density, and ADL were used as covariates. After stratification by sex, Poisson regression analysis was performed to calculate the multivariate-adjusted prevalence ratios.

Result: Men who lived alone used the Internet less, while women who lived alone used the Internet more. These relationships were similar in any family structure.

Among the factors related to digital access examined in Analysis 1, we conducted a detailed analysis focusing on living arrangements. Since the interactive effect of sex and living arrangement on Internet use was statistically significant, the analysis was stratified by sex. Men who lived alone used the Internet less than those who live with someone else, while women who lived alone used the Internet more than those who live with someone else. These relationships were similar for all family structures shown at the bottom of **Figure 12**. The interactive effect of sex and living arrangements on Internet use was statistically significant. Men who lived alone used the Internet less, while women who lived alone used the Internet more. These relationships were not changed depends on who they live with.

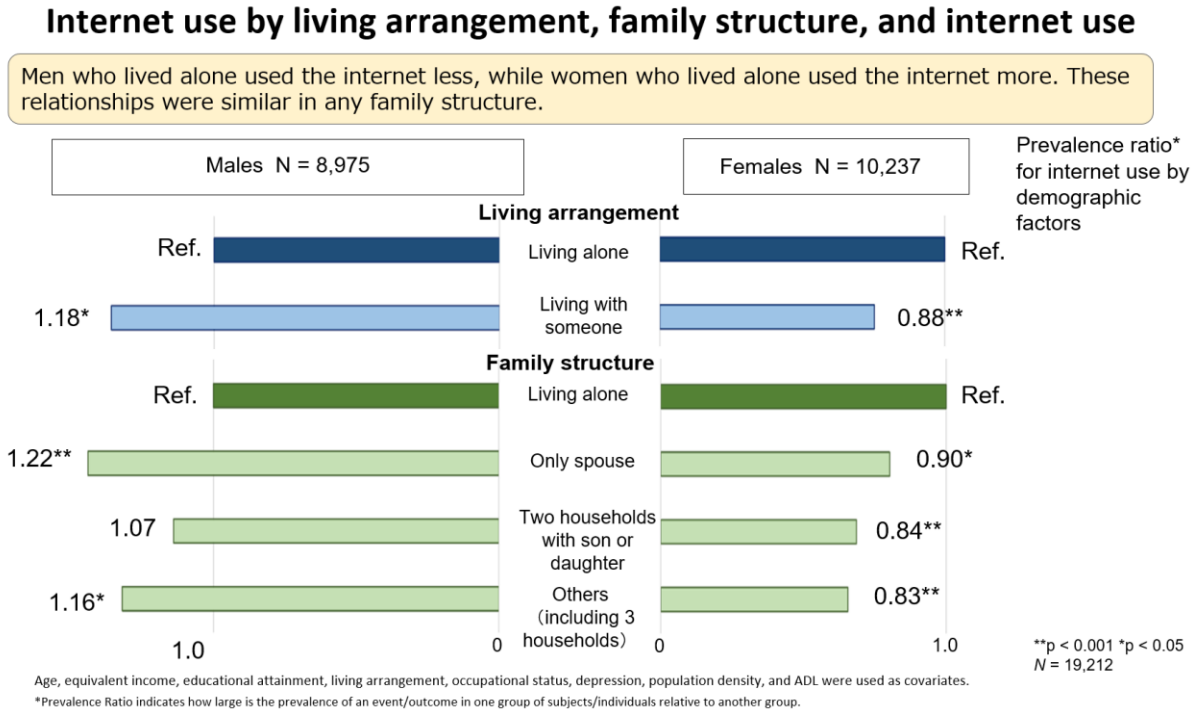


Figure 12. Characteristics of Internet access among Japanese older people

Poisson regression analysis （forced entry methods）
Dependent Variable: Internet use （at least once a week）
Independent Variables: Living arrangement and family structure
Covariates: Age, income, educational attainment, occupational status, depression, activitiy of daily living, and population density

3-2-2. Is the Internet powerful enough to mitigate the detrimental effects of social determinants of health?

Impact of Internet use on the associations between socio-economic status and subsequent onset of depression, poor self-rated health, hypertension, and diabetes

In this longitudinal analysis (follow-up data), the effect of Internet use on the associations between socio-economic status and depression, self-rated health, hypertension, and diabetes were examined. Dependent variables (the outcome variable) consisted of the development of depression, self-rated health worsening, hypertension, and diabetes. Independent variables (exposures) were income, educational attainment, and working status. Internet use (in model 2 only), age, sex, living arrangement, pre-existing diseases (hypertension, diabetes, cardiovascular disease, stroke, cancer, and respiratory diseases), self-rated health, ADL, depression, and population density were used as covariates. Logistic regression with standard errors clustered at the kcode (regional code) was performed.

Result: Internet use explains some of the impact of educational attainment on depression. Low educational attainment was associated with a greater onset of depression. This association was attenuated by the addition of Internet use in the model. Low income was associated with a greater worsening of self-rated health. This association was slightly attenuated by the addition of Internet use in the model. Low educational attainment and low income were associated with a greater onset of hypertension. These associations were slightly attenuated by the addition of Internet use in the model (**Figure 13**).

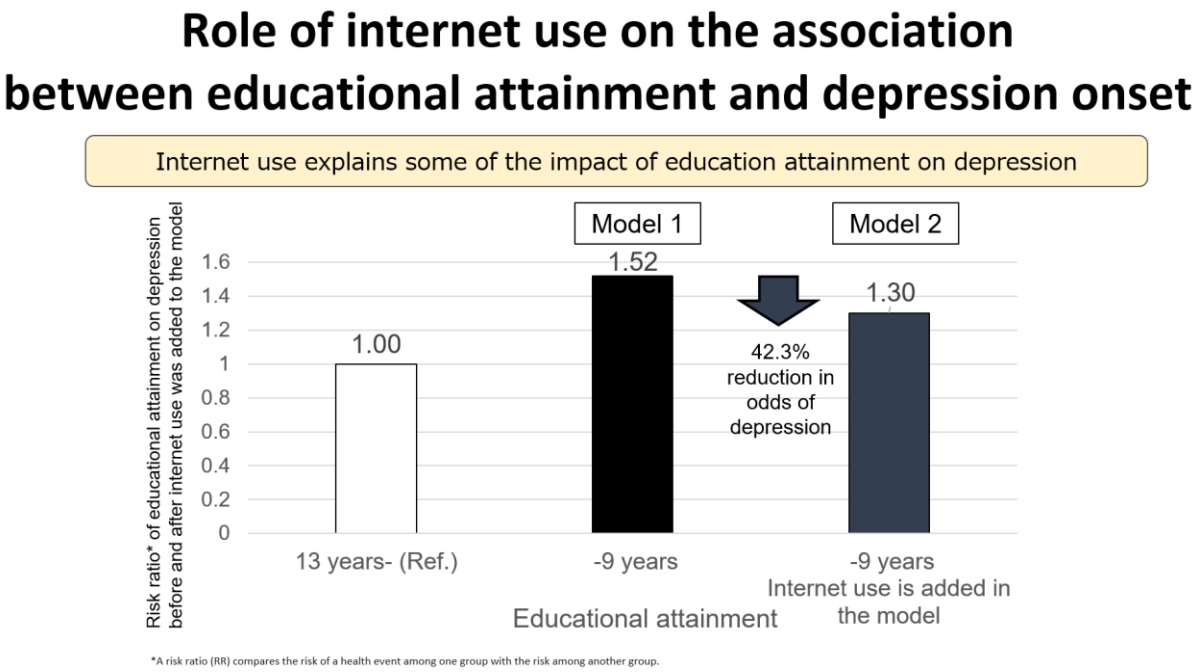


Figure 13. Internet use explained the associations between educational attainment and depression onset by 42%

Internet access and subsequent risks for the decline in instrumental and higher-level Activities of Daily Living (ADL) among Japanese older people: Association with socio-economic conditions

In this analysis, the impact of Internet access on higher-level activities of daily living (ADL) among older Japanese people was examined. We excluded participants who were functionally dependent at baseline (2016). For outcomes, higher-level ADL, instrumental self-maintenance, intellectual activity, and social role subscales were used. Independent variables (exposures), Internet use, subjective socio-economic status, and income were used. Sex, age, body mass index, marital status, educational attainment, employment status, living arrangement, diseases being treated, activities of daily living, self-rated health, depression, receiving emotional support, receiving instrumental support, frequency of meeting friends, and population density were used as covariates. Poisson regression analysis was performed to examine the incidence rate ratio (IRR)*.

* Relative difference measure used to compare the incidence rates of events occurring at any given point in time.

Result: Those who use the Internet are less likely to have declined IADL than those who do not use the Internet.

Internet use inhibited the decline in higher-level ADL, instrumental independence, intellectual independence, and social roles of older adults after three years. The effect of Internet use on reducing the decline in 'higher-level ADL,' 'instrumental independence,' 'intellectual independence,' and 'social roles' was slightly higher among those with higher incomes and those who felt more financially comfortable, but this effect was not statistically significant **(Figure 14)**.

The results adjusted for subjective socio-economic status were more effective in deterring 'higher-level ADL (overall)' and other levels of independence than when adjusted for income (quintile). Throughout the analysis, women showed a higher and significant deterrent effect of Internet use on higher-level ADL decline. There was a deterrent effect on the decline in higher-level ADL (overall) in obese people. Solitary aged persons showed a higher and significant deterrent effect of Internet use on instrumental independence decline.

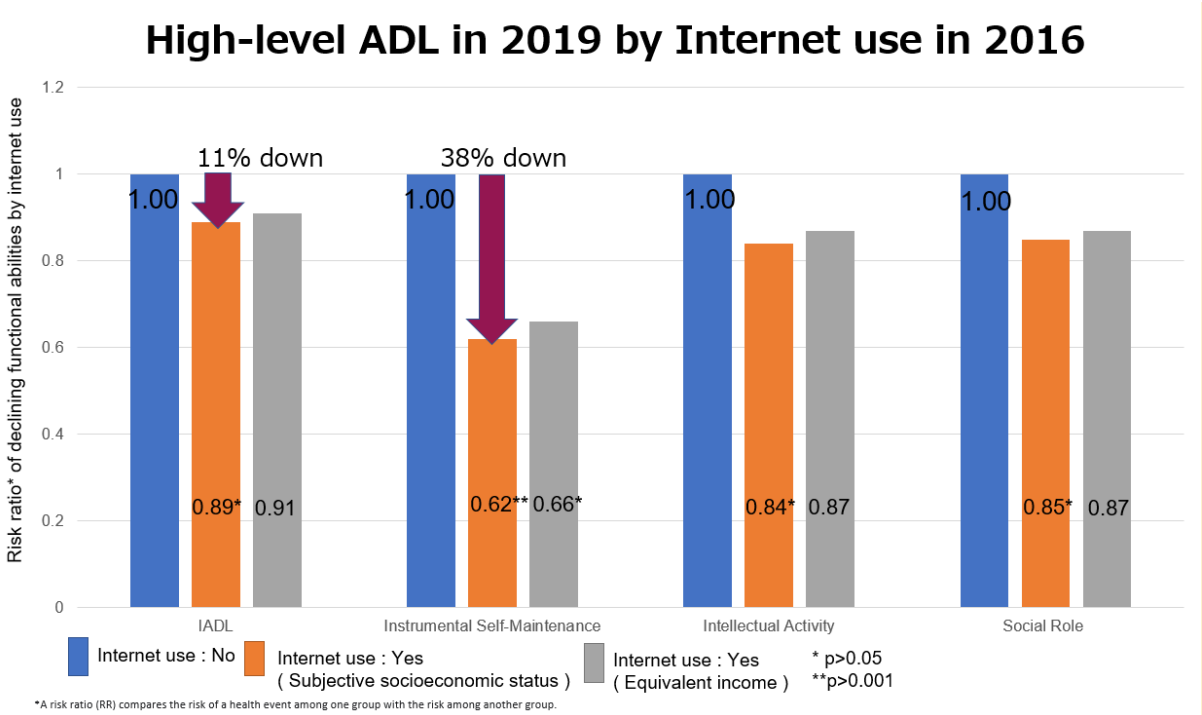


Figure 14. Incident rate ratio for high-level ADL decline by Internet access while controlling for socio-economic status variables

Impact of Internet use frequency on higher-level ADL change among Japanese older adults: Difference in differences analysis using JAGES three-year panel data

In this analysis, the impact of Internet access on higher-level ADL among older Japanese people was examined. The main difference from the previous analysis is the research question and analytical methods. The research question in this analysis was whether the higher-level ADL decline was prevented by Internet use. To answer this question, the difference in differences* method was applied. For outcomes, higher-level ADL, instrumental self-maintenance, intellectual activity, and social role subscales were used. Internet use frequency was used as an independent variable (exposure). Those who used Internet once a week or more were categorised as "Frequent users" and the others were categorised as "Infrequent users". Sex, age, income, educational attainment, employment status, marital status, and frequency of meeting friends were used as covariates. Differences in difference analysis with linear regression analysis** was performed.

*A quasi-experimental approach that compares the changes in outcomes over time between a population enrolled in a programme (the treatment group) and a population that is not (the comparison group).
**An analysis method in which the objective variable is represented by a straight line or a value close to it concerning the explanatory variable (also called the dependent variable or independent variable).

Result: IADL decline was more gradual in Internet users than in those who did not use the Internet.

Higher-level ADL points of frequent Internet users were 0.05 points less than those of rare Internet users ($p = 0.001$) in three years (Model 3 in **Figure 15**). The estimated effect was not significantly attenuated by income, educational attainment, employment status, or marital status. The association also did not change after adjusting for the frequency of meeting people.

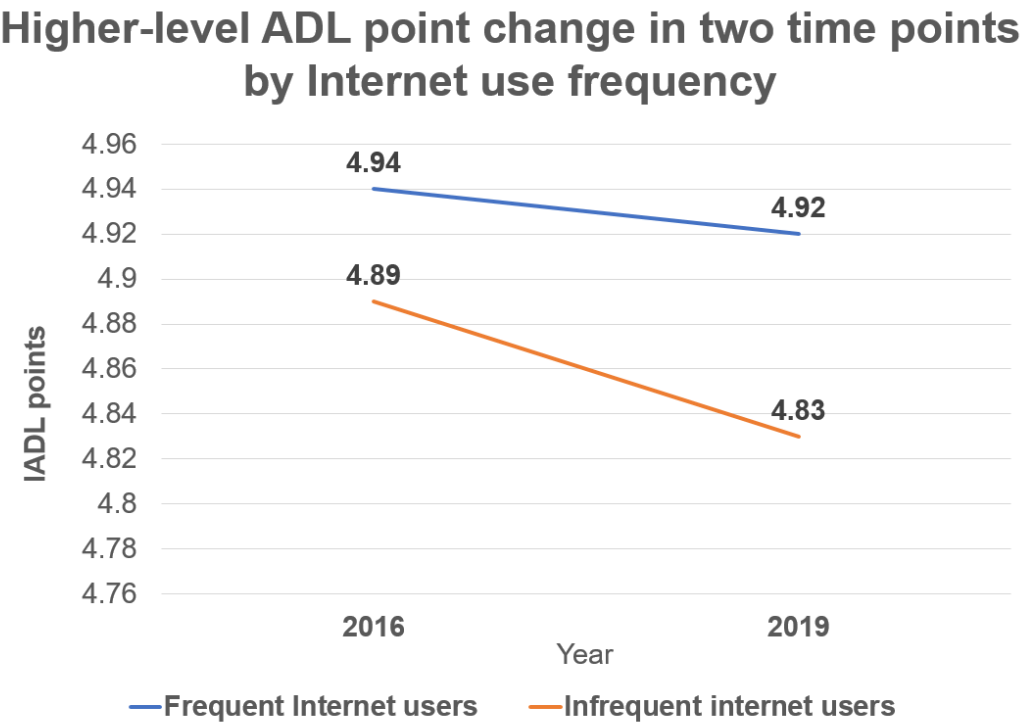


Figure 15. Higher-level ADL points change in two time points by Internet use frequency. Treated means using the Internet and control means not using it.

4. RESULTS OF THE STUDY IN MYANMAR

4-1. Background and Participants

For the study in Myanmar, 1200 individuals aged ≥60 years who were not bedridden and did not have severe dementia (indicated by an Abbreviated Mental Test score ≤6) were recruited from Yangon (urban) and Bago (rural) in 2018. The Abbreviated Mental Test (AMTS) score is a 10-point test for rapidly assessing older patients for the possibility of dementia, developed and validated by Hodgkinson in 1972. A score of six or less suggests delirium or dementia, although further tests are necessary to confirm the diagnosis. A population-proportionate random-sampling method in which the sample size of each subgroup matches its proportion in the target population, was used for recruitment. The JAGES study in Japan used self-administered questionnaires by mail. In Myanmar, face-to-face interviews were used for data collection.

In Yangon, interviewers visited 1,083 older adults, of whom 610 were at home. Ten patients were excluded because they were unable to provide informed consent because theyhad severe dementia (n=6) or were bedridden (n=4); thus, the response rate was 98.4% in Yangon. In Bago, interviewers visited 1044 older adults, of which 694 were at home. Ninety-four people were excluded from the study because they had severe dementia or were bedridden, bringing the response rate to 86.5% in Bago. In this study, 600 older adults from the Yangon region (222 men and 378 women) and 600 from the Bago region (261 men and 339 women) were examined. We further excluded 2 people who left the wealth-related fields blank in the questionnaires, resulting in a total sample of 1,198.

In this analysis, we asked questions such as, 'Do you have a mobile phone?' and 'Do you have Internet'. We could categorize three groups: (1) does not have a mobile phone, (2) has a mobile phone but does not have Internet access, and (3) has a mobile phone and Internet access. None of the participants categorized as no phone and have access to the Internet.

4-2. Descriptive Analysis

Table 14 shows comparisons of socio-demographic characteristics across three groups (classified according to mobile ownership and Internet access) that were identified above. In both Yangon and Bago, education, wealth score, and living alone were significantly different across the three groups. People who did not have a mobile phone were likely to be poorly educated or scored poorer in the wealth score. In contrast, people who had access to the Internet were likely to be well educated and in the richer group.

The Wealth Index is a measurement of the living standard of a household and represents the household's economic situation. The index is calculated as per the ownership of the total number of radios, TVs, air conditioners, cars, etc., and the score is categorised into three categories (i.e. poorest 40%, middle 40%, and richest 20%) (Filmer and Pritchett, 2001). In this study, we took account of 17 household items for the wealth index. Having mobile phones or having the Internet was not included in the items.

In Japan, daily Internet users were highly educated and had high incomes, while those who were not using the Internet were likely to be living alone. Similar to the findings of the Japanese data regarding socio-economic status and Internet use, the socio-economic status of Internet users was higher than that of Internet non-users in Yangon.

JAGES in Japan excluded those who required long-term care (i.e. receipt of the certificate for long-term care) due to functional disabilities or dementia. In Myanmar, there are no schemes for nursing care. Regarding ADL, we used the question, 'Do you need any nursing

care or assistance?' The response categories were: no need, partially needed, or receiving nursing care or assistance. We then included the ADL in our model as a covariate.

In Japan, BMI has been reported to be not associated with socio-economic status in many studies. In Myanmar, there was a positive correlation between BMI and the wealth score: more underweight people in the low-income group with no mobile phone, and overweight people in the higher income group with Internet access. The proportion of underweight respondents (BMI<18.5) was 15.0%, while it was 37.9% for the overweight respondents (BMI ≥ 25) in Yangon. In Bago, the proportions of underweight and overweight respondents were 41.4% and 12.4%, respectively.

Regarding the frequency of meeting friends, 74.8% of respondents in Bago and only 44.7% of respondents in Yangon said they met their friends more than two or three times a week. Comparing those who reported having 'no phone' and those who had a phone, the frequency of meeting friends was higher in the latter group in Bago. On comparing the 'phone only' and 'phone and Internet' groups in Yangon, it was found that the latter group met their friends less frequently. At this moment, we are unable to elaborate on this complex observation; therefore, further studies are needed.

When the participants were asked, 'Do you have any hobbies?' quite a few in both Yangon (54.2% in no phone) and Bago (36.4% in no phone) replied 'no hobbies'. Those who reported having both 'phone and Internet' showed a high rate (over 75%) of having hobbies.

In Bago, 46.1% of those who reported having 'no phone, replied 'no' to the question 'Are you interested in health-related articles or TV?', which was significantly higher than the percentage for the group who had a mobile phone. **Table 15** shows the relationship between health-related measurements and mobile phone or Internet usage (t-test, without adjustment). Handgrip and BMI was significantly high in the 'phone and Internet' groups in both Yangon and Bago. The Geriatric Depression Scale (GDS) score, representing proneness to depression, was higher in the 'no phone' group.

Table 14. Comparison of characteristics of study participants according to the ownership of a mobile phone and access to the Internet

			Yangon(N＝599)						Bago(N＝599)					
			Have Mobile Phone and Internet							Have Mobile Phone and Internet				
			TOTAL	No (N=24)	YES (N=396)	YES (N=179)			TOTAL	No (N=154)	YES (N=419)	YES (N=26)		
					And no Internet	And with Internet					And no Internet	And with Internet		
Sex	Men	N	221	8	142	71	0.64		260	60	186	14	0.28	
		%	36.9	33.3	35.9	39.7			43.4	39.0	44.4	53.9		
	Women	N	378	16	254	108			339	94	233	12		
		%	63.1	66.7	64.1	60.3			56.6	61.0	55.6	46.2		
Age	60–69	N	350	13	234	103	0.38		318	248	11	|	0.00	※
		%	58.4	54.2	59.1	57.5			53.1	38.3	59.2	42.3		
	70–79	N	175	6	110	59			205	73	125	7		
		%	29.2	25.0	27.8	33.0			34.2	47.4	29.8	26.9		
	80+	N	74	5	52	17			76	73	125	7		
		%	12.4	20.8	13.1	9.5			12.7	47.4	29.8	26.9		
Education	No school, monastic education, some primary	N	171	12	123	36	0.00	※	386	116	254	16	0.01	※
		%	28.6	50.0	31.1	20.1			64.4	75.3	60.6	61.5		
	Finished primary, middle school	N	233	10	165	58			186	38	140	8		
		%	38.9	41.7	41.7	32.4			31.1	24.7	33.4	30.8		

	High school, Vocational	N	127		2	75	50			26		0	24	2		
		%	21.2		8.3	18.9	27.9			4.3		0.0	5.7	7.7		
	College, university	N	68		0	33	35			1		0	1	0		
		%	11.4		0.0	8.3	19.6			0.2		0.0	0.2	0.0		
Wealth Score	Poorest	N	246		19	192	35	0.00	※	245		113	131	1	0.00	※
		%	41.1		79.2	48.5	19.6			40.9		73.4	31.3	3.9		
	Middle class	N	236		2	157	77			236		33	197	6		
		%	39.4		8.3	39.7	43.0			39.4		21.4	47.0	23.1		
	Richest	N	117		3	47	67			118		8	91	19		
		%	19.5		12.5	11.9	37.4			19.7		5.2	21.7	73.1		
Married	Yes	N	315		9	203	103	0.12		326		65	244	17	0.00	※
		%	52.6		37.5	51.3	57.5			54.4		42.2	58.2	65.4		
	No	N	284		15	193	76			273		|	89	175		
		%	47.4		62.5	48.7	42.5			45.6		57.8	41.8	34.6		
Do you need any nursing care or assistance ?	No need	N	61		1	42	18	0.40		60		11	47	2	0.08	
		%	10.2		4.2	10.6	10.1			10.0		7.1	11.2	7.7		
	Need nursing care but do not receive.	N	22		0	18	4									
		%	3.7		0.0	3.0	0.7									
		N	516		23	336	157			511		130	358	23		

	Have Nursing care or assistance	%	86.1		95.8	84.9	87.7			85.3		84.4	85.4	88.5		
Live alone	Yes	N	24		6	13	5	0.00	※	44		37	7	0	0.00	※
		%	4.0		25.0	3.3	2.8			7.4		24.0	1.7	0.0		
	No	N	575		18	383	174			555		117	412	26	Total	
		%	96.0		75.0	96.7	97.2			92.7		76.0	98.3	100.0		
BMI	<18.5	N	90		6	64	20	0.09	※	248		87	154	7	0.00	※
		%	15.0		25.0	16.2	11.2			41.4		56.5	36.8	26.9		
	≥18.5and＜25	N	282		12	191	79			277		52	212	13		
		%	47.1		50.0	48.2	44.1			46.2		33.8	50.6	50.0		
	≥25	N	227		6	141	80			6		15	53	6		
		%	37.9		25.0	35.6	44.7			12.4		9.7	12.7	23.1		
Underweight	Yes	N	90		6	64	20	0.11		248		87	154	7	0.00	
		%	15.0		25.0	16.2	11.2			41.4		56.5	36.8	26.9		
	No	N	509		18	332	159			351		67	265	19		
		%	85.0		75.0	83.8	88.8			58.6		43.5	63.3	73.1		
Self-related Health	Good	N	233		12	149	72			121		33	83	5		
		%	38.9		50.0	37.6	40.2			20.2		21.4	19.8	19.2		
	Bad	N	366		12	247	107	0.44		478		121	336	21	0.91	
		%	61.1		50.0	62.4	59.8			79.8		78.6	80.2	80.8		

Hypertension	Yes	N	426		18	279	129	0.84		418		106	294	18	0.95	
		%	71.1		75.0	70.5	72.1			69.8		68.8	70.2	69.2		
	No	N	173		6	117	50			181		48	125	8		
		%	28.9		25.0	29.6	27.9			30.2		31.2	29.8	30.8		
How often do you meet friends?	A few times a year or none	N	204		8	116	80			77		25	40	12	0.00	
		%	34.1		33.3	29.3	44.7	0.01	※	12.9		16.2	9.6	46.2		※
	Once a week or less	N	127		4	88	35			74		11	56	7		
		%	21.2		16.7	22.2	19.6			12.4		7.1	13.4	26.9		
	Twice or thrice per week or more	N	268		12	192	64			448		118	323	7		
		%	44.7		50.0	48.5	35.8			74.8		76.6	77.1	26.9		
How many friends have you seen over the past months	1 person	N	156		8	87	61	0.01	※	43		15	21	7	0.00	※
		%	26.0		33.3	22.0	34.1			7.2		9.7	5.0	26.9		
	2 people	N	103		2	79	22			38		6	32	0	Total	
		%	17.2		8.3	20.0	12.3			6.3		3.9	7.6	0.0		
	Over three people	N	340		14	230	96			518		133	366	19		
		%	56.8		58.3	58.1	53.6			86.5		86.4	87.4	73.1		
Did you see a doctor or nurse when you were ill/sick in the past 12 months?	Yes	N	265		6	195	64	0.13		269		75	186	8	0.54	
		%	84.9		66.7	87.1	81.0			88.8		87.2	89.9	80.0		
	No	N	47		3	29	15			34		11	21	2		
		%	15.1		33.3	13.0	19.0			11.2		12.8	10.1	20.0		

How often do you go out?	A few times a year	N	123		6	81	36	0.89		38		6	31	1	0.07	
		%	20.5		25.0	20.5	20.1			6.3		3.9	7.4	3.9		
	Once or week, few times a month	N	58		1	40	17			28		11	14	3		
		%	9.7		4.2	10.1	9.5			4.7		7.1	3.3	11.5		
	Three times a week or less	N	418		17	275	126			533		137	374	22		
		%	69.8		70.8	69.4	70.4			89.0		89.0	89.3	84.6		
Interested in health related articles or TV	Yes	N	507		20	331	156	0.54		402		83	301	18	0.00	
		%	84.6		83.3	83.6	87.2			67.1		53.9	71.8	69.2		
	No	N	92		4	65	23			197		71	118	8		
		%	15.4		16.7	16.4	12.9			32.9		46.1	28.2	30.8		
Do you have a hobby?	Yes	N	428		11	280	137	0.01	※	425		98	307	20	0.00	※
		%	71.5		45.8	70.7	76.5			71.0		63.6	73.3	76.9		
	No	N	171		13	116	42			174		56	112	6		
		%	28.6		54.2	29.3	23.5			29.1		36.4	26.7	23.1		

Age：Target persons are over 60 years in Myanmar study

Wealth score: Calculated based on 17 items (mostly electrical appliances)

Hypertension：Systolic ≥140 or Diastolic≥90 or medication

Table 15. Relationship between health-related measurement and the ownership of a mobile phone and having access to the Internet (t-test)

			Yangon (N＝599）			Bago (N＝599)			
		No Phone (N=24), Phone and no Internet (N=396), Phone and Internet (N=179)				No Phone (N=154), Phone and no Internet (N=419), Phone and Internet (N=26)			
		Average	SD	P		Average	SD	P	
Systolic Blood Pressure (mmHg)	No Phone	140.63	16.08	0.64		145.98	24.00	0.58	
	Phone and no Internet	141.41	22.88			143.84	21.26		
	Phone and Internet	139.55	20.54			144.56	20.75		
Handgrip (kg)	No Phone	19.06	9.77	0.06	※	19.92	7.35	0.02	※
	Phone and no Internet	21.09	9.74			21.93	7.89		
	Phone and Internet	22.99	8.55			22.65	9.04		
BMI (kg/m2)	No Phone	19.31	4.02	0.01	※	18.67	4.30	0.00	※
	Phone and no Internet	22.94	5.59			20.10	4.36		
	Phone and Internet	24.04	4.95			21.45	4.59		
GDS (15 items), depressive symptoms scale	No Phone	3.75	1.83	0.00	※	3.34	2.28	0.434	
	Phone and no Internet	2.95	2.08			3.29	2.26		
	Phone and Internet	2.11	1.70			2.72	1.97		

4-3. Relationship between Health Measurement and Having Mobile (with or without Internet Use) Adjusted by Socio-economic Status in Yangon and Bago

In this analysis, we examined the relationship between health-related measurements and having mobile devices with or without Internet use adjusted by socio-economic status. The health-related measurements were underweight (1=BMI ＜18.5, 0=BMI ≥18.5), self-rated health (SRH, 1=good, 0= Bad), hypertension (1= systolic ≥140, diastolic ≥90 or taking medication, 0= not hypertensive), GDS score (continuous, range 0–15), and handgrip strength (continuous). Self-rated health (SRH) is one of the most frequently used measures in epidemiological, clinical, and social research. It is known to predict mortality and future functional status handgrip strength has predictive validity for decline in cognition, mobility, functional status, and mortality in older community-dwelling populations. Handgrip is reported to be a predictor of future activities of daily living (ADL) and instrumental activities of daily living (IADL) capability in the older adult population. Activities of daily living are classified into basic ADLs and IADLs. Basic ADL includes basic tasks such as feeding, dressing up etc., whereas IADLs include activities that require more complex thinking skills such as shopping, cooking, and using transportation*. Independent variables were 'no phone,' 'only phone (no Internet),' and 'phone and Internet (reference)'. Covariates were sex, age, education, wealth score, marital status, and ADL. We used data from Yangon (city) and Bago (suburb). A Poisson regression model was used for being underweight, SRH, and hypertension. A regression model was used for handgrip, BMI, and GDS.

*(https://pubmed.ncbi.nlm.nih.gov/26016893/,https://pubmed.ncbi.nlm.nih.gov/31788969/)

Results:

The relationship between health measurement and having mobile with or without Internet use adjusted by socio-economic status is shown in **Table 16**. In both Yangon and Bago, there was no association between SRH, hypertension, and being underweight and Internet use. In Yangon, handgrip strength was significantly lower in the 'no phone' and 'phone only' groups than in the 'phone and Internet' group after adjusting by socio-economic status. The GDS score (representing tendency of depression) was significantly high in the 'phone only' group compared to the 'phone and Internet' group. As there are a few Internet users in rural Bago, the significance might not have appeared. Since there are few Internet users in rural Bago, a significant difference might not have appeared. As mobile phones are widespread but Internet use is less common in Bago, we compared the 'no phone' and 'have a phone' groups.

In **Table 17**, weight deficiency, i.e. being underweight, was significantly higher in the 'no phone' than in the 'have phone' group in Bago. There was a positive correlation between wealth score and BMI in Myanmar, and mobile phones reflected SES, especially in Bago. Thus, even after adjusting for SES, the relationship between weight deficiency and 'no phone' might have remained.

Table 16. Relationship between health-related measurements and having a mobile with or without Internet use after adjusting for socio-economic status

		Yangon(N＝599）					Bago(N＝599）				
Poisson regression		RR	95%Cl		P		RR	95%Cl		P	
SRH	(1Good 0 Bad)										
	No Phone	1.27	0.67	2.42	0.47		1.63	0.59	4.51	0.34	
	Phone and no internet	0.99	0.73	1.34	0.95		1.27	0.50	3.27	0.61	
	Phone and internet	reference					reference				
Hypertension	(1 Yes 0 No)										
	No Phone	1.03	0.62	1.73	0.90		1.10	0.64	1.90	0.73	
	Phone and no internet	0.98	0.78	1.23	0.86		1.10	0.67	1.81	0.71	
	Phone and internet	reference					reference				
Underweight	(1Yes 0 No)										
	No Phone	1.51	0.58	3.90	0.40		1.90	0.83	4.34	0.13	
	Phone and no internet	1.09	0.64	1.85	0.76		1.41	0.64	3.10	0.39	
	Phone and internet	reference					reference				
Regression		β	95%Cl		P		β	95%Cl		P	
Handgrip(continuous, regression)											
	No Phone	-2.51	-4.81	-0.20	0.03	※	-1.84	-4.27	0.59	0.14	
	Phone and no internet	-1.16	-2.14	-0.18	0.02	※	-0.87	-3.09	1.36	0.44	
	Phone and internet	reference					reference				
GDS score(0 good 15bad)		reference									
	No Phone	-0.26	-1.10	0.58	0.54		-0.17	-1.19	0.85	0.74	
	Phone and no internet	0.46	0.11	0.81	0.01	※	0.16	-0.77	1.10	0.73	
	Phone and internet	reference					reference				

Adjusted by Sex, Age, Education, Wealth, ADL, and Marital status.
[Dependent variable (outcomes)] Underweight (1, 0); BMI <18.5; SRH (1,0):1. Good, 0. Bad: Hypertension (1, 0); Systolic =>140 or Diastolic =>90 or medication; GDS score (continuous total 15); handgrip (continuous)
【Independent variable】 No Mobile Phone (Have Mobile Phone without Internet, Have Mobile Phone and Internet (reference)

Table 17. Relationship between health-related measurement and having a mobile phone or no mobile phone adjusted for socio-economic status

		Yangon(N＝599)				**Bago(N＝599)**				
Poisson regression		RR	95%CI		P	RR	95%CI		P	
SRH	(1Good 0 Bad)									
	No phone	1.28	0.70	2.33	0.42	1.29	0.82	2.02	0.26	
	Have phone	reference				reference				
Hypertension	(1Yes 2 No)									
	No phone	1.05	0.65	1.70	0.84	1.00	0.78	1.29	0.97	
	Have phone	reference				reference				
Underweight(1Yes 0 No)										
	No phone	1.41	0.60	3.29	0.43	1.36	1.01	1.83	0.04	※
	Have phone	reference				reference				
Regression		β	95%CI		P	β	95%CI		P	
Handgrip(Continuous, regression)										
	No phone	-1.58	-3.76	0.59	0.15	-1.00	-2.11	0.11	0.08	
	Have phone	reference				reference				
GDS score	(0 Good 15 Bad)									
	No phone	-0.63	-1.42	0.17	0.12	-0.33	-0.79	0.13	0.16	
	Have phone	reference				reference				

Adjusted by Sex, Age, Education, Wealth, ADL, and Marital status

【Dependent variable (outcomes)】 Underweight (1,0); BMI <18.5; SRH (1,0) : 1. good 0. bad: Hypertension (1, 0); Systolic =>140 or Diastolic =>90 or medication; GDS score (continuous total 15) ; handgrip (continuous)

[Explanatory variable] No Mobile phone, Have mobile phone (reference)

4-4. The Association between Social Determinants of Health and Internet Usage in Yangon and Bago

As shown in **Table 17**, there were very few participants with 'no phone' in Yangon and 'phone and Internet' in Bago. Thus, in this analysis, we examined the association between social determinants of health and Internet usage in Yangon and mobile phone usage in Bago in the Myanmar data. The objective variables were 'have a mobile phone and have Internet' (=1) and 'have a mobile phone and no Internet' (=0) in Yangon, and 'have a mobile phone' (=1) and 'no mobile phone' (=0) in Bago. **Tables 18** and **20** show the associations of these variables with the social determinants of health. **Tables 20** and **21** show their associations with frequency of meeting friends and number of friends met, going to see doctor when ill, being interested in shows or articles, and having hobbies after adjusting for sex (1,2), age (60, 70, over 80), education, wealth score (17 items not including mobile phones and the Internet), marital status, and ADL indicated by support status (no support, partial support, nursing care, or full support). Results of Poisson regression analyses, a form of analysis examining associations in count data, are presented in all tables.

Results:

In Yangon, 'phone and Internet' use was less frequent in the middle or poor socio-economic group than the rich group (Table 18). Further, people in the 'phone and Internet' group met their friends less frequently and had fewer number of friends than those who were in the 'Internet only' group, even after adjusting for SES (Table 19).

In Bago, people in the poor socio-economic group were more likely to have no mobile phone compared to the middle or rich group (Table 20); there was also a significant association between 'no phone' and living alone even after adjusting for SES (Table 21). On exploring common demographic factors for using the Internet (in Yangon) or having a mobile phone (in Bago), we found differences in the frequency of meeting friends: those who met friends two to three times per week or more made up 44.7% of the participants in Yangon (who had Internet access) and 74.8% in Bago (who had a mobile phone). In Bago, there was no significant association between mobile phone use and meeting friends after adjusting for socio-economic status (Table 19). In Yangon, Internet users met friends less frequently, even after adjusting for SES (Table 18). We found that having a hobby appeared to be related to having a phone or Internet access, but it was not significant after adjusting for socio-economic status (Tables 20, 21). Access to technology possibly determines individual social engagement, which in turn can lead to health in older people. We need to explore this further to find an explanation.

Table 18. Comparison of demographic characteristics by mobile phone and Internet users and non-users in Yangon, after adjusting for socio-economic status

		Yangon(N＝599)				
		Phone and internet (N=396) Phone and no internet (N=179) (Excluded no phone (N=24)				
		RR	95%CI		P	
Sex						
	Women	1.04	0.75	1.44	0.82	
	Men	reference				
Age						
	70	1.09	0.78	1.51	0.63	
	80	0.84	0.48	1.47	0.55	
	60	reference				
ADL						
	Partial support	1.01	0.60	1.69	0.97	
	No support	0.66	0.24	1.81	0.42	
	No support	reference				
Wealth						
	Poor	0.30	0.19	0.47	0.00	※
	Middle	0.62	0.44	0.87	0.01	※
	Rich	reference				
Education						
	No school, monastic education ,some primary	0.73	0.43	1.21	0.22	
	Finished primary, middle school	0.71	0.46	1.10	0.13	
	High school, vocational	0.89	0.58	1.39	0.62	
	College, university	reference				
Married						
	No	0.96	0.69	1.34	0.83	
	Yes	reference				

Compared two groups 1: Have phone and Internet (n=396) 0: Have phone, but no Internet (n=179) (Deleted no phone group, n=24) RR = A probability that the outcome occurs, i.e. phone and Internet use occurs in comparison to the reference category

Table 19. Comparison of behavioural factors between Internet users and non-users in Yangon, after adjusting for socio-economic status

		Yangon(N＝599)				
		RR	95%CI		P	
Live alone						
	Yes	1.09	0.43	2.73	0.86	
	No					
Frequency of Meeting friend						
	A few times a year or none	1.73	1.23	2.44	0.00	※
	Once a week or less	1.15	0.76	1.76	0.50	
	Two to three per week or more					
Number of Friends						
	1 person	1.75	1.25	2.45	0.00	※
	2 people	0.73	0.46	1.16	0.18	
	Over three people					
How often go out?						
	A few times a year	0.93	0.63	1.37	0.71	
	Once or week ,few time a month	1.03	0.61	1.72	0.91	
	Three times a week or less	reference				
See doctor or nurse when ill ?						
	No	1.46	0.82	2.61	0.20	
Yes	Yes	reference				
Interested in health related TV,etc.						
	No	1.01	0.64	1.58	0.97	
	Yes	reference				
Do you have a hobby?						
	No	0.99	0.69	1.44	0.98	
	Yes	reference				

Adjusted by sex, age, education, wealth, ADL, and marital status.
Dependent variable (outcomes): Have mobile phone & 1: Have Internet (n=396) 0: No Internet (n=179) (Deleted No phone, n=24)
Independent variables: Living alone, frequency of meeting friends, number of friends, going to see doctor when ill, interested in health-related TV shows, etc., and having hobbies.

Table 20. Comparison of characteristics of mobile phone users and non-users in Bago, adjusted for socio-economic status

		Bago(N＝599)				
		Phone(N=445)	No phone (N=154)			
		RR	95%CI		P	
Sex						
	Women	1.04	0.84	1.29	0.72	
	Men	reference				
Age						
	70	0.85	0.68	1.05	0.13	
	80	0.95	0.69	1.30	0.75	
	60	reference				
ADL						
	Partial support	0.85	0.68	1.05	0.13	
	No support	0.95	0.69	1.30	0.75	
	No support	reference				
Wealth						
	Poor	0.60	0.46	0.78	0.00	※
	Middle	0.94	0.74	1.18	0.58	
	Rich	reference				
Education						
	No school, monastic education , some primary	0.93	0.13	6.87	0.95	
	Finished primary, middle school	1.01	0.14	7.46	0.99	
	High school, vocational	1.14	0.15	8.70	0.90	
	College, university					
Married						
	No	0.90	0.72	1.12	0.34	
	Yes	reference				

Dependent variable (outcomes): Have mobile phone 1: Yes (n=445) 0: No (n=154)

Table 21. Comparisons of behavioural factors between mobile phone users and non-users in Bago, adjusted for socio-economic status

		Bago(N＝599)			
		RR	95%CI		P
Live alone					
	Yes	0.25	0.12	0.54	0.00 ※
	No				
Frequency of Meeting friend					
	A few times a year or none	0.85	0.63	1.14	0.28
	Once a week or less	1.05	0.80	1.38	0.72
	Two to three per week or more	reference			
Number of Friends					
	1 person	0.84	0.57	1.25	0.39
	2 people	1.15	0.80	1.66	0.45
	Over three people	reference			
How often go out?					
	A few times a year	1.08	0.74	1.57	0.70
	Once or week ,few time a month	0.88	0.54	1.43	0.60
	Three times a week or less				
See doctor or nurse when ill ?					
	No	1.07	0.69	1.67	0.76
Yes	Yes	reference			
Interested in health related TV,etc.					
	No	1.14	0.92	1.42	0.23
	Yes	reference			
Do you have a hobby?					
	No	0.91	0.74	1.14	0.42
	Yes	reference			

Adjusted by sex, age, education, wealth, ADL, and marital status
Dependent variable: Have mobile phone 1: Yes (n=445) 0: No (n=154)
Independent variables: Live alone, frequency of meeting friends, number of friends, going to see doctor when ill, interested in health-related TV etc., and having hobbies

5. DISCUSSION

5-1. Summary of the Results and Interpretations

The results we obtained need to be interpreted with caution before proceeding to a detailed discussion. First, since the data sources were based on self-administered questionnaires and interviews, some health outcomes such as self-reported hypertension and diabetes were subjectively assessed. Therefore, the data may reflect, for example, individual differences in access to healthcare. Second, we used the data on Internet usage in 2016 and 2019, but no information was collected on the Internet use between 2016 and 2019. Third, in the analysis investigating changes in the scores having a fixed range, ceiling and floor effects could occur, and the clinical significance of the analysis examining changes in scores and the amount of score changes is a matter for future studies. Fourth, both Japan and Myanmar data are not from the national representative samples, so care should be taken when interpreting the results. However, for the JAGES data in Japan, the participating municipalities cover a wide range of geographies, including urban, suburban, and rural communities from the northern to the southernmost prefectures in Japan. Finally, this report used indicators whose validity has not been evaluated in other countries.

1. Who uses Internet and who does not? Summary on Internet access by individual socio-demographic characteristics in Japan and Myanmar

Japan

The findings of this report show that older people with high incomes (subjectively and objectively), especially those with high educational attainment, use the Internet more. Those who use the Internet almost every day use it mainly for the purpose of shopping and banking, a trend not seen among infrequent Internet users, suggesting that Internet access can alter the daily lifestyle of Japanese older adults. The availability of online banking and shopping can have a strong impact on how older adults carry on their day-to-day lives. The use of these online facilities has gained critical importance and burgeoned during the COVID-19 lockdowns. Hence, the digital divide among older adults due to their socio-economic status could be expanding in the global crisis.

The majority of older Internet users use mobile phones. However, among those who used them every day, tablets were the most common, followed by smartphones. Active Internet users had a longer history of using it, and in general, those who used the Internet were found to have healthier behaviours. Active users of the Internet tended to be physically and mentally healthier, had easier access to social support and participation, and had more friends. Those with better community environments, such as better Internet access (at the prefecture level), were also more likely to be using the Internet.

The table below is an excerpt of the cross tabulation of equalised income, subjective socio-economic status, educational background, and frequency of Internet use, as **1** shown in Table 17.

		Frequency of Internet use				
		Total	No use	Less than a few times a month	2–3 times /week	Almost everyday
		n=22,252	n=10,331	n=2,827	n=2,506	n=4,677
		n	%	%	%	%
Income	Low	6,326	56	12	10	13
	Middle	5,490	40	15	14	25
	High	5,476	34	13	14	34
Subjective socio-economic status	Poor	6,430	53	12	10	16
	Average	12,695	46	13	12	21
	Rich	2,899	34	13	12	34
Educational attainment （years）	Low(<10)	7,318	64	9	6	8
	Middle (10–12)	9,013	43	15	14	22
	High(13+)	5,548	29	14	14	38

The inhibitors of Internet use among the older adults were old age, low income, low subjective socio-economic status, low education, and living in a rural area, which were independent of sex, marital status, job status, and depressive symptoms. Internet use was also found to be lower among men who lived alone compared to those living with others, whereas Internet use was higher among women who lived alone than among those who lived with others, even after considering age, income, educational attainment, employment status, depression, and population density of residential areas.

Myanmar

By conducting visiting surveys of about 600 older people aged 60 and over in urban areas (around Yangon) and rural areas (Bago region) in Myanmar, we found that there was a huge discrepancy in the access to mobile phones and the Internet between the two regions: in Yangon, 96.0% had mobile phones and 31.1% had Internet access, whereas in rural Bago 74.3% had mobile phones, of which only 5.8% had Internet access.

In both urban Yangon and rural Bago, high income and education were strongly associated with the use of mobile phones and the Internet. Similar to Japan, access to the Internet is strongly associated with health status. The strong link between no access to mobile phones and the Internet and depressive symptom risks was observed only in the urban city of Yangon.

There was a positive correlation between BMI and wealth. There were more underweight people in low-income groups without a mobile phone and more overweight people in high-

income groups with Internet access. In Yangon, 15.0% participants were underweight (BMI<18.5) and 37.9% were overweight (BMI ≥25), whereas in Bago 41.4% participants were underweight and 12.4% were overweight.

There was a difference in the association between Internet and mobile phone access and frequency of meeting friends between Yangon and Bago. In Bago, 74.8% of the respondents said they met friends more than two or three times a week, and the corresponding percentage in Yangon was 44.7%. In Bago, comparing those who did not have a mobile phone and had a mobile phone, the frequency of meeting friends was *higher* for those who had mobile phones. However, in Yangon, when comparing those who had a mobile phone without Internet and mobile phone with Internet, those who had access to the Internet met friends *less* frequently. For reference, in Japan, daily Internet users meet friends more frequently than non-users do. Further studies are needed to understand the background of these differential associations between digital communication tools and meeting friends across regions.

2. Association between Internet access and health and well-being independent of socio-demographic factors

Japan

Our analysis showed that overall, Internet users are physically, mentally, and socially healthy, regardless of their socio-demographic conditions. Internet users are likely to be active participants in social activities in the community. They are more likely to get health check-ups and have less risk of the decline in instrumental and higher-level activities of daily living (ADL). Our findings from the longitudinal analysis point to the preventive role of Internet use in the onset of depressive symptoms and worsening of self-rated health after three years. Some associations were also found with hypertension (self-reported) (in a cross-sectional study, health check-up data showed that Internet use was also associated with prevention of hypertension) and diabetes.

Myanmar

The characteristics of those who do not have a mobile phone in both rural and urban areas are that they are old, less educated, not wealthy (low SES), and live alone. Given the huge urban/rural and socio-economic disparities in access to digital information technologies in the country, access to these technologies may exaggerate health inequality across geographical and socio-economic groups in Myanmar and perhaps also in other low-and middle-income countries in the Western Pacific region. Even in metropolitan Yangon, Internet access was not as high as in Japan and other high-income countries, which may result in health inequality at a global level.

Discussion: Who uses internet and who doesn't?

	JAPAN	Myanmar
Location	Among older adults, the inhabitants with internet use are living in rural areas.	We found a huge discrepancy in the access to mobile phone and the internet between the two regions.
SES	Those with low income and low subjective socioeconomic status are less likely to use the internet.	Low income is strongly associated with not using mobile phones and the internet.
Education	Those with low education attainment are less likely to use the internet.	Low education is not significantly associated with not using mobile phones and the internet.
Health	Active users of the internet tend to be physically and mentally healthy, have easier access to social support and participation, and have more friends.	Similar to Japan, access to the internet is strongly associated with health status.
Others	Those who use the internet for banking and shopping use the internet almost every day, which is the primary difference with those using the internet less.	In Bago, those who have a mobile phone meet friends more than those who do not have it. In Yangon, those who have access to the internet meet friends less frequently.

Although Myanmar and Japan have different socio-economic background, the trend of digital divide looks similar. People with high income or high education use the Internet more frequently.

5-2. Internet Access and Individual level of Social Determinants of Health: Which has a Stronger impact on older people's health?

Does digital access have an equal or greater impact on the health of older people compared to known social determinants of health such as income and education?

Table 22 shows the results of our analysis. The risk of depression after 3 years was found to be 1.27 times higher in those with intermediate level of incomes than in those with high incomes. In terms of educational attainment, the risk of depression after three years was 1.30 times higher among those who received lower education compared to those who received higher education. These values were comparable with the values representing the association between Internet use and health: non-Internet users had 1.4 times higher risk of depression than did Internet users. A similar pattern was found for self-rated health. Hence, we can conclude that Internet access is a strong predictor for older people's health, independent of income, educational attainment, and other factors with similar impacts across. A comparison with other Internet variables, such as frequency and purpose, is shown in **Tables 23 and 24**.

Caution is needed, however, as the variables of Internet use and socio-economic indicators depend on the categorisation of the variables, and direct comparisons with the JAGES findings are not feasible.

Table 22. The extract table from Section 3-1-3

		Depression		Self-rated health	
		OR	P value	OR	P value
Internet use	Yes	Ref.		Ref.	
	No	1.40	0.00	1.28	0.01
Income	Lower	1.19	0.16	1.41	0.01
	Intermediate	1.27	0.07	1.35	0.04
	Higher	Ref.		Ref.	
Educational attainment	≤9 years	1.30	0.03	1.13	0.39
	10–12 years	0.98	0.85	0.95	0.70
	≥13 years	Ref.		Ref.	
Working status	Never	1.31	0.26	1.17	0.54
	Retired	0.92	0.47	1.10	0.49
	Current	Ref.		Ref.	

Table 23. The extract table from associations between frequency of Internet use and health outcomes

		Depression (n = 5631)		Self-rated health (n = 6427)	
		OR	P value	OR	P value
Internet use	No	Ref.		Ref.	
	Yes: A few times a month	0.77	0.03	0.80	0.08
	Yes: A few times a week	0.66	0	0.76	0.05
	Yes: Almost every day	0.58	0	0.72	0.01
Income	Lower	1.25	0.06	1.46	0
	Intermediate	1.26	0.05	1.27	0.1
	Higher	Ref.		Ref.	
Educational attainment	≤9 years	1.24	0.04	1.07	0.56
	10–12 years	1.07	0.39	0.9	0.36
	≥13 years	Ref.		Ref.	
Employment status	Never	1.42	0.11	1.37	0.21
	Retired	1.06	0.55	1.16	0.25
	Current	Ref.		Ref.	

Table 24. The extract table from associations between purposes of Internet use and health outcomes

		Depression (n = 5570)		Self-rated health (n = 6355)	
		OR	P value	OR	P value
Purposes of Internet use	Information searching (Health and medical issues)	1.10	0.61	1.23	0.3
	Information searching (General purposes)	0.69	0.03	0.67	0.01
	Communication with friends/family	0.76	0.01	0.82	0.04
	Navigation and public transportation	0.98	0.86	0.82	0.19
	Shopping for goods and services	0.78	0.15	1.33	0.13
	Banking and financial services	0.97	0.89	0.73	0.17
	LINE, Facebook, Twitter	1.03	0.86	1.14	0.48
	Others	0.80	0.25	1.10	0.59
Income	Lower	1.23	0.09	1.43	0
	Intermediate	1.24	0.08	1.25	0.09
	Higher	Ref.		Ref.	
Educational attainment	≤9 years	1.23	0.05	1.03	0.78
	10–12 years	1.03	0.67	0.89	0.33
	≥13 years	Ref.		Ref.	
Working status	Never	1.46	0.08	1.47	0.12
	Retired	1.09	0.41	1.18	0.19
	Current	Ref.		Ref.	

Another discussion is whether digital access is effective in counteracting the effects of other SDOH in older adults. **Is the Internet powerful enough to mitigate risks from the SDOH? Table 25** presents an extract of our results in Section 3-2-2. The ORs of income and education in Model 1 decreased when Internet use was considered in Model 2. For example, the OR of depression for those who received lower education was 1.52 in Model 1, but it was 1.30 in Model 2, meaning that 42% of the longitudinal association between educational attainment and depression was explained by Internet use. This is interpreted as high income and educational attainment enabling people to access the Internet, resulting in better health, or Internet access helping increase income and leading to better health, given the educational attainments. Further observational and interventional studies are needed to elucidate if, for example, the provision of Internet access to the poor eliminates their health risks.

Table 25. The extract table from Section 3-2-2

		Depression			
		Model 1		Model 2	
		OR	P value	OR	P value
Internet use	Yes	-		Ref.	
	No	-		1.40	0.00
Equalised household income	Lower	1.28	0.05	1.19	0.16
	Intermediate	1.29	0.06	1.27	0.07
	Higher	Ref.		Ref.	
Educational attainment	≤9 years	1.52	0.00	1.30	0.03
	10–12 years	1.04	0.72	0.98	0.85
	≥13 years	Ref.		Ref.	
Working status	Never	1.35	0.20	1.31	0.26
	Retired	0.91	0.38	0.92	0.47
	Current	Ref.		Ref.	

In Model 1, age, sex, living arrangement, pre-existing diseases (hypertension, diabetes, cardiovascular disease, stroke, cancer, and respiratory diseases), self-rated health, ADL, depression, and population density were included.
In Model 2, Internet use was added.

5-3. Agenda for future studies

We understand that our report sets an agenda to understand interplays between socioeconomic and social environmental factors, Internet access, and older adult's health and wellbeing. We suggest that future studies are to enrich better understanding of the role of Internet use in the context of social determinants of health.

Future studies should evaluate the findings of our report using more robust causal inference models, ideally using internally and externally more valid data from Japan, Myanmar and many other parts of the world. Health outcomes, including mortality from administrative records, medically diagnosed diseases onsets and more positive and social aspects of health dimensions would be useful (Seligman & Matrin, 2008).

In the emerging digital era, many services, including shopping and banking, as observed in Yangon in our study, have been provided through digital information platforms. Although we did not investigate this time, healthcare services would not be the exception. Given that digital divide links to the divide of healthcare access in the personal health emergency and chronic disease care, we think that these might have played a major role in our findings and warrant further studies, which should be prioritized. Interactions between Internet access and the access to other infrastructure, such as health services may also exist. For example, even if an Internet article recommends a certain health service, it does not work if there is no service available nearby the person's place. Close links among Internet use, socioeconomic statuses (SES) and healthcare systems should be examined (**Figure 16**).

It is likely that the quality of information that people access via Internet matters. Even if the Internet is available and people access to health information, it is meaningless if there is no good information. Since this report shows only a small part of the Internet disparity among the older adults, it is significant to clarify the relationship between individual SES, the Internet environment, and the social environment related to the healthcare system in various countries.

Future agenda Clarifying the relationship between the three interactions in various countries.

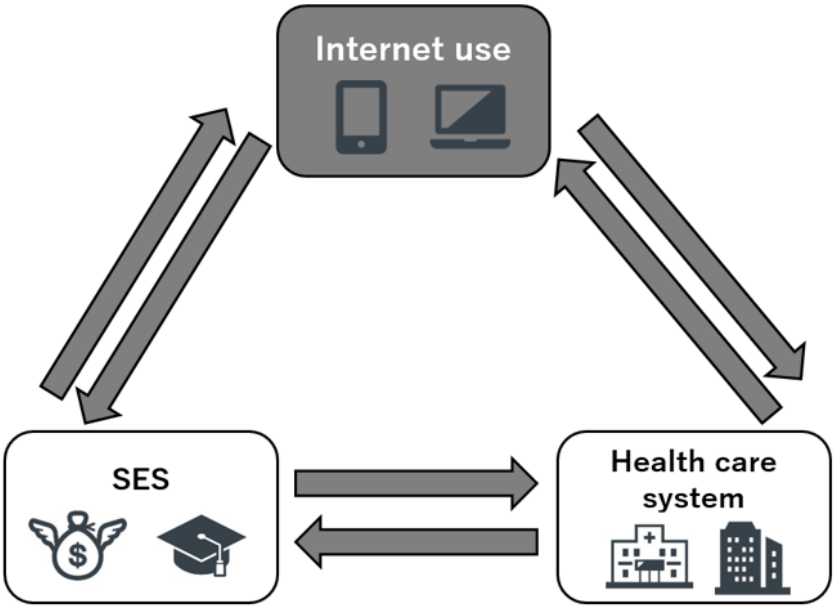


Figure 16. Future agenda of observational study in the link across the accesses to the Internet, socioeconomic resources and healthcare.

The formal impacts of the intervention of providing Internet access to older people on health and wellbeing, and their gap across sociodemographic conditions should also be investigated, conducting intervention trials in a society. This may be urgent as our society is rapidly changing into the new era of digital world., which has been surely accelerated by the current COVID-19 pandemic. The people who are left behind this global trend would have large disadvantages due to the limited access to digital technologies and limited skills in utilizing the technologies, resulting in more health gaps across regions and social statuses at local, national and global settings.

5-4. Policy implications

We cannot ascertain the exact conditions on the digital divide that we have described in this report in many parts of the world. Further political efforts to understand that would be and urgent message of this report showing the large digital divide among older people regardless of the countries' levels of wealth. Even in the two countries we evaluated, the two data are not ideal in understanding the current conditions of national level access to Internet and other digital technologies in various generations, and their socioeconomic gaps. Making those data is urgent in monitoring the levels of the access to the Internet and digital devices in the countries. The monitoring should be continuous and frequent, say annually, given the rapid changes in the situation of expanding digital infrastructure worldwide. The impact assessment of the societal intervention such as developing Internet infrastructures on health and its equity, as well as continuous monitoring of the access to the digital technologies which is an important social determinant of health, are strongly recommended by the final report of WHO Commission on Social Determinants of Health published in in 2008 (WHO CSDH, 2008).

In both Japan and Myanmar, we suggest that there is a disparity in Internet use between socioeconomic groups and between urban and rural areas. It is necessary to improve the environment to ensure the fairness of Internet use and eliminate the disparity regardless of urban or rural areas and socioeconomic status. Since Internet use was associated with the health of the older adults, reducing Internet disparities may also contribute to reducing health disparities among older adults (**Figure 17**).

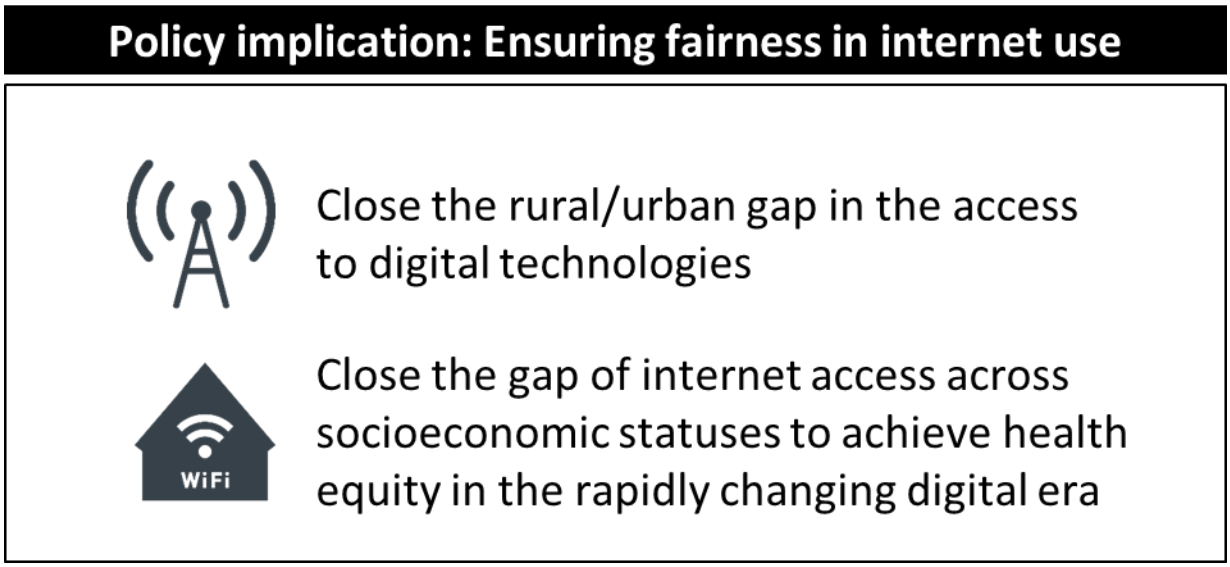


Figure 17. Policy implications

6. CONCLUSION

The figure summarises the findings of the series of analyses in this report project (**Figure 18**). Using cross-sectional and longitudinal data from Japan and Myanmar, we found that Internet use was determined by, or at least linked to, individual socio-economic status including income and educational attainment, and surrounding contextual factors such as the level of digital infrastructure in the residential areas. Internet use can promote individual mental, physical, and social health and well-being of older adults and potentially contribute to healthy ageing.

The Internet was used by half of the older population in Japan in 2016. However, there was a digital divide based on socio-economic status and location. Internet usage was associated with lower risk of depression, better self-rated health, lower risk for ADL decline, and greater social capital. It is expected that the number of older Internet users will increase over time, but disparities in Internet access between regions and individual Internet ownership by socio-economic status needs to be evaluated if the gap causes unjust health gaps.

Given the findings of this report, reducing the digital divide may contribute to achieving health equity. Since this report provides a largely superficial view of the digital divide among older adults, we hope that it triggers a series of new study projects aiming to uncover the link between Internet access, socio-economic status, and health and wellbeing of older adults residing in the Western Pacific region completely.

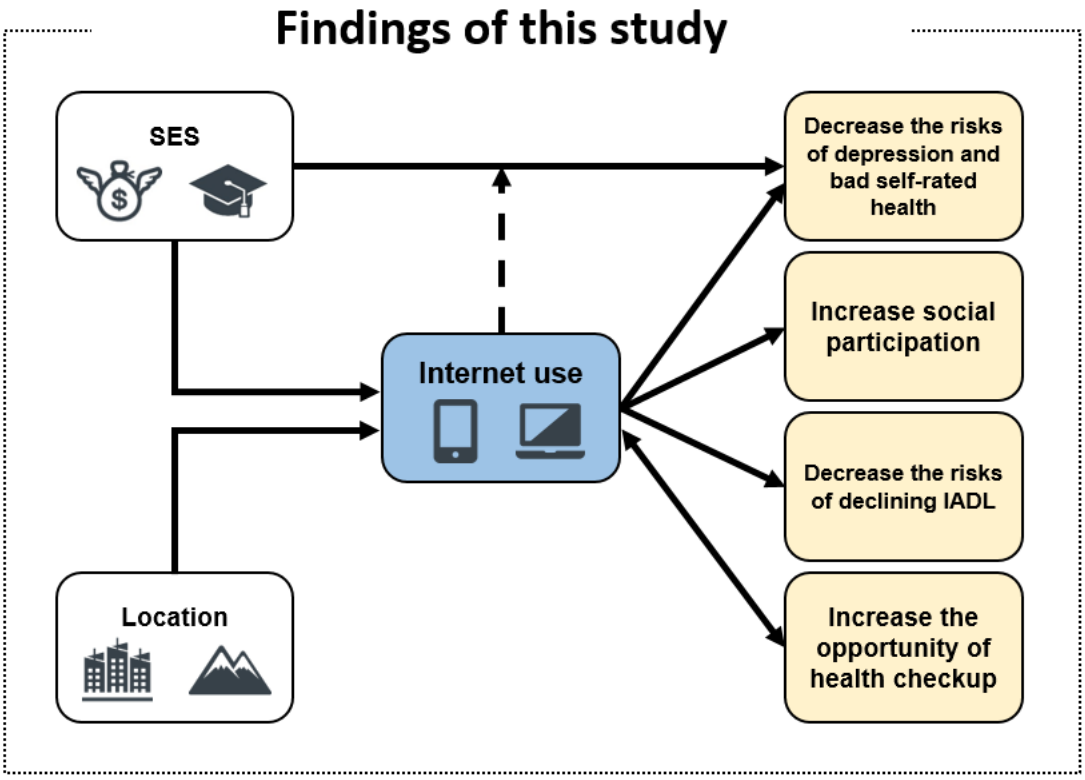


Figure 18. Findings of this study

Reference

Seligman MEP. Positive Health. Applied Psychology. 2008;57(s1):3–18.
WHO Commission on Social Determinants of Health. Closing the gap in a generation: Health equity through action on the social determinants of health. Final Report of the Commission on Social Determinants of Health. Geneva: World Health Organization, 2008.

Appendix 1.

The following questions are about your Internet access and use of e-mail on a computer, cell phone, and other device.	
1)	Have you used the Internet or e-mail in the past year? If yes, please indicate how often
	1.No
	2.Yes (less than a few times a month)
	3.Yes (two to three times a week)
	4. Yes (almost every day)
2)	If you chose '2', '3', or '4' above, please answer the questions 2) to 4). For what purposes do you use the Internet or e-mail? Circle all that apply.
	1. For finding and collecting medical and health-related information
	2. For finding and collecting information other than medical and health-related information
	3. For communicating with my family and friends
	4. For accessing maps and traffic information
	5. For purchasing commodities and services
	6. For online banking or trading securities and bonds
	7. For using social networking services (Line, Facebook, Twitter, etc.)
	8. For other reasons ( )
3)	What devices do you use to access the Internet or e-mail? Circle all that apply
	1. Personal computer
	2. Cell phone
	3. Smartphone
	4. Tablet PC
	5. Other ( )
4)	When did you start using the Internet or e-mail? Circle the one answer that best applies.
	1. More than 10 years ago
	2. More than 5 years ago
	3. Three to 4 years ago
	4. One to 2 years ago
	5. Less than 1 year ago

Appendix 2.

(Table 1) The Relationship between Internet Use and Social Participation among the Older adults in Japan: A Cross-sectional Study of JAGES 2016

		Volunteer participation		Sport participation		Hobby activity		Meeting with friends	
Factor	Level	No	Yes	No	Yes	No	Yes	No	Yes
N		13384	2102	11113	4373	10015	5471	8132	7354
Internet use	No	6620 (49.5%)	690(32.8%)	5951 (53.5%)	1359 (31.1%)	5470 (54.6%)	1840 (33.6%)	4195 (51.6%)	3115 (42.4%)
	Yes	6764 (50.5%)	1412 (67.2%)	5162 (46.5%)	3014 (68.9%)	4545 (45.4%)	3631 (66.4%)	3937 (48.4%)	4239 (57.6%)
Sex	Male	6588 (49.2%)	930 (44.2%)	5649 (50.8%)	1869 (42.7%)	5323 (53.2%)	2195 (40.1%)	4518 (55.6%)	3000 (40.8%)
	Female	6796 (50.8%)	1172 (55.8%)	5464 (49.2%)	2504 (57.3%)	4692 (46.8%)	3276 (59.9%)	3614 (44.4%)	4354 (59.2%)
Age	65-69	4601 (34.4%)	675 (32.1%)	3809 (34.3%)	1467 (33.5%)	3569 (35.6%)	1707 (31.2%)	2857 (35.1%)	2419 (32.9%)
	70-74	3616 (27.0%)	653 (31.1%)	2925 (26.3%)	1344 (30.7%)	2574 (25.7%)	1695 (31.0%)	2121 (26.1%)	2148 (29.2%)
	75-79	2769 (20.7%)	467 (22.2%)	2261 (20.3%)	975 (22.3%)	1981 (19.8%)	1255 (22.9%)	1587 (19.5%)	1649 (22.4%)
	80-84	1576 (11.8%)	245 (11.7%)	1359 (12.2%)	462 (10.6%)	1186 (11.8%)	635 (11.6%)	992 (12.2%)	829 (11.3%)
	≥85	822 (6.1%)	62 (2.9%)	759 (6.8%)	125 (2.9%)	705 (7.0%)	179 (3.3%)	575 (7.1%)	309 (4.2%)
Educational attainment	Other	50 (0.4%)	17 (0.8%)	46 (0.4%)	21 (0.5%)	40 (0.4%)	27 (0.5%)	35 (0.4%)	32 (0.4%)
	≤9 years	3985 (29.8%)	429 (20.4%)	3592 (32.3%)	822 (18.8%)	3325 (33.2%)	1089 (19.9%)	2350 (28.9%)	2064 (28.1%)
	10-12 years	5679 (42.4%)	886 (42.2%)	4537 (40.8%)	2028 (46.4%)	4069 (40.6%)	2496 (45.6%)	3383 (41.6%)	3182 (43.3%)
	≥13years	3600 (26.9%)	756 (36.0%)	2873 (25.9%)	1483 (33.9%)	2521 (25.2%)	1835 (33.5%)	2314 (28.5%)	2042 (27.8%)
	Missing	70 (0.5%)	14 (0.7%)	65 (0.6%)	19 (0.4%)	60 (0.6%)	24 (0.4%)	50 (0.6%)	34 (0.5%)
Marital status	Married	9789 (73.1%)	1587 (75.5%)	8025 (72.2%)	3351 (76.6%)	7259 (72.5%)	4117 (75.3%)	6159 (75.7%)	5217 (70.9%)
	Widowed	2324 (17.4%)	395 (18.8%)	1951 (17.6%)	768 (17.6%)	1730 (17.3%)	989 (18.1%)	1202 (14.8%)	1517 (20.6%)
	Separated	604 (4.5%)	58 (2.8%)	545 (4.9%)	117 (2.7%)	486 (4.9%)	176 (3.2%)	369 (4.5%)	293 (4.0%)
	Unmarried	464 (3.5%)	43 (2.0%)	404 (3.6%)	103 (2.4%)	367 (3.7%)	140 (2.6%)	286 (3.5%)	221 (3.0%)
	Others	102 (0.8%)	7 (0.3%)	94 (0.8%)	15 (0.3%)	88 (0.9%)	21 (0.4%)	61 (0.8%)	48 (0.7%)
	Missing	101 (0.8%)	12 (0.6%)	94 (0.8%)	19 (0.4%)	85 (0.8%)	28 (0.5%)	55 (0.7%)	58 (0.8%)
Living arrangement	Alone	1958 (14.6%)	291 (13.8%)	1642 (14.8%)	607 (13.9%)	1460 (14.6%)	789 (14.4%)	1025 (12.6%)	1224 (16.6%)

	Couple with 65yrs=<	6065 (45.3%)	1011 (48.1%)		4882 (43.9%)	2194 (50.2%)		4334 (43.3%)	2742 (50.1%)		3798 (46.7%)	3278 (44.6%)
	Couple with 65yrs>	678 (5.1%)	78 (3.7%)		567 (5.1%)	189 (4.3%)		575 (5.7%)	181 (3.3%)		479 (5.9%)	277 (3.8%)
	With a child/children	2682 (20.0%)	406 (19.3%)		2294 (20.6%)	794 (18.2%)		2094 (20.9%)	994 (18.2%)		1587 (19.5%)	1501 (20.4%)
	Other	1376 (10.3%)	221 (10.5%)		1167 (10.5%)	430 (9.8%)		1066 (10.6%)	531 (9.7%)		858 (10.6%)	739 (10.0%)
	Missing	625 (4.7%)	95 (4.5%)		561 (5.0%)	159 (3.6%)		486 (4.9%)	234 (4.3%)		385 (4.7%)	335 (4.6%)
Income	Low	3813 (28.5%)	528 (25.1%)		3399 (30.6%)	942 (21.5%)		3090 (30.9%)	1251 (22.9%)		2465 (30.3%)	1876 (25.5%)
	Middle	3533 (26.4%)	594 (28.3%)		2844 (25.6%)	1283 (29.3%)		2504 (25.0%)	1623 (29.7%)		2189 (26.9%)	1938 (26.4%)
	High	3433 (25.7%)	608 (28.9%)		2638 (23.7%)	1403 (32.1%)		2415 (24.1%)	1626 (29.7%)		1957 (24.1%)	2084 (28.3%)
	Missing	2605 (19.5%)	372 (17.7%)		2232 (20.1%)	745 (17.0%)		2006 (20.0%)	971 (17.7%)		1521 (18.7%)	1456 (19.8%)
Working status	Never	803 (6.0%)	94 (4.5%)		678 (6.1%)	219 (5.0%)		578 (5.8%)	319 (5.8%)		470 (5.8%)	427 (5.8%)
	Past worker	7442 (55.6%)	1271(60.5%)		5993 (53.9%)	2720 (62.2%)		5396 (53.9%)	3317 (60.6%)		4736 (58.2%)	3977 (54.1%)
	Current worker	3382 (25.3%)	450 (21.4%)		2926 (26.3%)	906 (20.7%)		2710 (27.1%)	1122 (20.5%)		1892 (23.3%)	1940 (26.4%)
	Missing	1757 (13.1%)	287 (13.7%)		1516 (13.6%)	528 (12.1%)		1331 (13.3%)	713 (13.0%)		1034 (12.7%)	1010 (13.7%)
Comorbidities	No	2444 (18.3%)	443 (21.1%)		2010 (18.1%)	877 (20.1%)		1770 (17.7%)	1117 (20.4%)		1407 (17.3%)	1480 (20.1%)
	Yes	10410 (77.8%)	1574 (74.9%)		8676 (78.1%)	3308 (75.6%)		7854 (78.4%)	4130 (75.5%)		6410 (78.8%)	5574 (75.8%)
	Missing	530 (4.0%)	85 (4.0%)		427 (3.8%)	188 (4.3%)		391 (3.9%)	224 (4.1%)		315 (3.9%)	300 (4.1%)
ADL	Free	11944 (89.2%)	1935 (92.1%)		9800 (88.2%)	4079 (93.3%)		8811 (88.0%)	5068 (92.6%)		7101 (87.3%)	6778 (92.2%)
	Not free	754 (5.6%)	64 (3.0%)		710 (6.4%)	108 (2.5%)		669 (6.7%)	149 (2.7%)		583 (7.2%)	235 (3.2%)
	Missing	686 (5.1%)	103 (4.9%)		603 (5.4%)	186 (4.3%)		535 (5.3%)	254 (4.6%)		448 (5.5%)	341 (4.6%)
Self-rated health	Good	11035 (82.4%)	1898 (90.3%)		8971 (80.7%)	3962 (90.6%)		8062 (80.5%)	4871 (89.0%)		6513 (80.1%)	6420 (87.3%)
	Bad	2086 (15.6%)	166 (7.9%)		1913 (17.2%)	339 (7.8%)		1755 (17.5%)	497 (9.1%)		1453 (17.9%)	799 (10.9%)
	Missing	263 (2.0%)	38 (1.8%)		229 (2.1%)	72 (1.6%)		198 (2.0%)	103 (1.9%)		166 (2.0%)	135 (1.8%)
GDS	No	9728 (72.7%)	1794 (85.3%)		7855 (70.7%)	3667 (83.9%)		6963 (69.5%)	4559 (83.3%)		5579 (68.6%)	5943 (80.8%)

	Yes	3125 (23.3%)	233 (11.1%)		2808 (25.3%)	550 (12.6%)		2657 (26.5%)	701 (12.8%)		2221 (27.3%)	1137 (15.5%)
	Missing	531 (4.0%)	75 (3.6%)		450 (4.0%)	156 (3.6%)		395 (3.9%)	211 (3.9%)		332 (4.1%)	274 (3.7%)
Frequency of going out	More than 1 week	12670 (94.7%)	2050 (97.5%)		10417 (93.7%)	4303 (98.4%)		9355 (93.4%)	5365 (98.1%)		7524 (92.5%)	7196 (97.9%)
	<1 week	565 (4.2%)	36 (1.7%)		566 (5.1%)	35 (0.8%)		546 (5.5%)	55 (1.0%)		511 (6.3%)	90 (1.2%)
	Missing	149 (1.1%)	16 (0.8%)		130 (1.2%)	35 (0.8%)		114 (1.1%)	51 (0.9%)		97 (1.2%)	68 (0.9%)
Population density	Metropolitan	5292 (39.5%)	844 (40.2%)		4320 (38.9%)	1816 (41.5%)		3863 (38.6%)	2273 (41.5%)		3461 (42.6%)	2675 (36.4%)
	Urban	3114 (23.3%)	584 (27.8%)		2524 (22.7%)	1174 (26.8%)		2304 (23.0%)	1394 (25.5%)		1835 (22.6%)	1863 (25.3%)
	Semi-urban	1928 (14.4%)	288 (13.7%)		1589 (14.3%)	627 (14.3%)		1418 (14.2%)	798 (14.6%)		1106 (13.6%)	1110 (15.1%)
	Rural	3050 (22.8%)	386 (18.4%)		2680 (24.1%)	756 (17.3%)		2430 (24.3%)	1006 (18.4%)		1730 (21.3%)	1706 (23.2%)

(Table 2) The Relationship between Internet Use and Social Participation among the Older adults in Japan: A Cross-sectional Study of JAGES 2016

		Volunteer participation			Sport participation			Hobby activity			Meeting with friends		
		IRR	[95% CI]	P value	IRR	[95% CI]	P value	IRR	[95% CI]	P value	IRR	[95% CI]	P value
Internet use	Yes	1.620	[1.47, 1.78]	<0.001	1.66	[1.56, 1.75]	<0.001	1.56	[1.50, 1.63]	<0.001	1.20	[1.15, 1.25]	<0.001
	No	Ref.			Ref.			Ref.			Ref.		
Sex	Female	1.20	[1.10,1.32]	<0.001	1.28	[1.20, 1.36]	<0.001	1.42	[1.36, 1.48]	<0.001	1.33	[1.28, 1.39]	<0.001
	Male	Ref.			Ref.			Ref.			Ref.		
Age	65-69	Ref.			Ref.			Ref.			Ref.		
	70-74	1.250	[1.15, 1.37]	<0.001	1.19	[1.12, 1.27]	<0.001	1.29	[1.23, 1.35]	<0.001	1.13	[1.09, 1.18]	<0.001
	75-79	1.29	[1.15, 1.44]	<0.001	1.27	[1.18, 1.37]	<0.001	1.38	[1.30, 1.46]	<0.001	1.20	[1.16, 1.25]	<0.001
	80-84	1.31	[1.12, 1.54]	0.001	1.20	[1.10, 1.31]	<0.001	1.38	]1.28, 1.50]	<0.001	1.13	[1.07, 1.19]	<0.001
	≥85	0.82	[0.62, 1.07]	0.143	0.84	[0.72, 0.98]	0.029	0.99	[0.87, 1.13]	0.881	0.95	[0.86, 1.05]	0.326
Education	Other	1.71	[1.19, 2.49]	0.004	1.12	[0.71, 1.77]	0.628	1.10	[0.85, 1.43]	0.451	1.05	[0.84, 1.31]	0.675
	-9yrs	0.67	[0.59, 0.76]	<0.001	0.73	[0.68, 0.78]	<0.001	0.70	[0.66, 0.75]	<0.001	1.03	[0.98, 1.08]	0.227
	10-12yrs	0.79	[0.73, 0.86]	<0.001	0.95	[0.91, 1.00]	0.074	0.91	[0.86, 0.96]	<0.001	1.00	[0.95, 1.04]	0.872
	≥13years	Ref.			Ref.			Ref.			Ref.		
	Missing	1.08	[0.77, 1.51]	0.067	0.85	[0.61, 1.19]	0.331	0.79	[0.57, 1.10]	0.163	0.86	[0.66, 1.13]	0.276
Marital status	Married	Ref.			Ref.			Ref.			Ref.		
	Widowed	1.04	[0.92, 1.17]	0.534	0.99	[0.90, 1.08]	0.791	0.97	[0.90, 1.04]	0.443	1.09	[1.03, 1.15]	0.002
	Separated	0.65	[0.47, 0.91]	0.012	0.65	[0.54, 0.77]	<0.001	0.78	[0.69, 0.88]	<0.001	0.90	[0.81, 0.99]	0.039
	Unmarried	0.64	[0.47, 0.87]	0.004	0.74	[0.62, 0.89]	0.001	0.83	[0.73, 0.94]	0.003	0.94	[0.86, 1.04]	0.262

	Others	0.54	[0.28, 1.29]	0.164	0.60	[0.36, 1.01]	0.056	0.65	[0.43, 1.00]	0.048	1.02	[0.83, 1.25]	0.878
	Missing	0.93	[0.56, 1.54]	0.770	0.82	[0.57, 1.18]	0.290	0.91	[0.67, 1.22]	0.519	1.17	[0.99, 1.39]	0.059
Living arrangement	Alone	1.15	[0.97, 1.37]	0.106	1.10	[0.99, 1.22]	0.080	1.06	[0.97, 1.15]	0.194	1.17	[1.10, 1.25]	<0.001
	Couple with 65yrs=<	Ref.			Ref.			Ref.			Ref.		
	Couple with 65yrs>	0.81	[0.62, 1.04]	0.099	0.93	[0.81, 1.06]	0.276	0.77	[0.68, 0.86]	<0.001	0.88	[0.79, 0.97]	0.013
	With a child/children	1.05	[0.92, 1.19]	0.507	0.94	[0.87, 1.01]	0.094	0.93	[0.87, 0.99]	0.020	1.02	[0.98, 1.07]	0.229
	Other	1.07	[0.92, 1.24]	0.366	0.94	[0.87, 1.02]	0.141	0.93	[0.87, 0.99]	0.018	0.98	[0.92, 1.03]	0.407
	Missing	1.12	[0.92, 1.36]	0.274	0.89	[0.77, 1.02]	0.098	1.00	[0.89, 1.12]	0.983	1.00	[0.94, 1.06]	0.925
Income	Low	1.07	[0.96, 1.19]	0.221	0.81	[0.73, 0.87]	<0.001	0.90	[0.84, 0.95]	<0.001	0.92	[0.89, 0.95]	<0.001
	Middle	1.01	[0.90, 1.12]	0.889	0.90	[0.86, 0.94]	<0.001	0.98	[0.94, 1.03]	0.396	0.93	[0.90, 0.97]	<0.001
	High	Ref.			Ref.			Ref.			Ref.		
	Missing	1.00	[0.87, 1.16]	0.955	0.89	[0.82, 0.95]	0.001	0.94	[0.88, 1.00]	0.050	0.95	[0.91, 0.99]	0.028
Working status	Never	0.92	[0.74, 1.15]	0.477	1.11	[0.97, 1.27]	0.137	1.17	[1.07, 1.29]	0.001	0.87	[0.81, 0.94]	<0.001
	Past worker	1.25	[1.12, 1.40]	<0.001	1.36	[1.28, 1.45]	<0.001	1.27	[1.20, 1.34]	<0.001	0.90	[0.87, 0.93]	<0.001
	Current worker	Ref.			Ref.			Ref.			Ref.		
	Missing	1.32	[1.16, 1.50]	<0.001	1.28	[1.14, 1.43]	<0.001	1.27	[1.20, 1.35]	<0.001	0.96	[0.91, 1.01]	0.090
Comorbidities	No	Ref.			Ref.			Ref.			Ref.		
	Yes	0.93	[0.86-1.01]	0.080	1.00	[0.94, 1.06]	0.915	0.95	[0.90, 0.99]	0.019	0.95	[0.92, 0.98]	0.004
	Missing	0.98	[0.80, 1.20]	0.830	1.16	[1.03, 1.30]	0.011	1.01	[0.91, 1.12]	0.851	1.00	[0.92, 1.08]	0.954
ADL	Free	Ref.			Ref.			Ref.			Ref.		

	Not free	1.00	[0.77, 1.30]	0.998	0.84	[0.70, 1.02]	0.086	0.83	[0.72, 0.95]	0.009	0.80	[0.73, 0.89]	<0.001
	Missing	1.03	[0.85, 1.26]	0.744	0.89	[0.79, 1.01]	0.083	0.95	[0.85, 1.05]	0.300	0.92	[0.85, 0.99]	0.025
SRH	Good	Ref.			Ref.			Ref.			Ref.		
	Bad	0.68	[0.58, 0.80]	<0.001	0.68	[0.62, 0.74]	<0.001	0.80	[0.74, 0.87]	<0.001	0.90	[0.84, 0.96]	0.002
	Missing	0.90	[0.61, 1.34]	0.614	0.86	[0.72, 1.02]	0.089	0.98	[0.83, 1.16]	0.839	0.97	[0.86, 1.10]	0.672
GDS	No	Ref.			Ref.			Ref.			Ref.		
	Yes	0.55	[0.49, 0.62]	<0.001	0.68	[0.63, 0.73]	<0.001	0.65	[0.61, 0.70]	<0.001	0.73	[0.70, 0.78]	<0.001
	Missing	0.83	[0.68, 1.03]	0.085	0.89	[0.79, 1.00]	0.056	0.91	[0.83, 1.01]	0.065	0.88	[0.81, 0.96]	0.004
Frequency of going out	More than 1 week	Ref.			Ref.			Ref.			Ref.		
	<1 week	0.70	[0.47, 1.02]	0.066	0.34	[0.24, 0.49]	<0.001	0.40	[0.31, 0.52]	<0.001	0.39	[0.31, 0.50]	<0.001
	Missing	0.76	[0.49, 1.19]	0.230	0.82	[0.54, 1.25]	0.364	0.95	[0.76, 1.19]	0.636	0.84	[0.68, 1.04]	0.107
Population density	Metropolitan	Ref.			Ref.			Ref.			Ref.		
	Urban	1.21	[1.12, 1.30]	<0.001	1.12	[1.06, 1.19]	<0.001	1.08	[1.02, 1.14]	0.014	1.17	[1.11, 1.23]	<0.001
	Semi-urban	1.09	[0.99, 1.20]	0.093	1.10	[1.00, 1.22]	0.062	1.12	[1.03, 1.23]	0.011	1.19	[1.15, 1.24]	<0.001
	Rural	0.97	[0.82, 1.15]	0.729	0.91	[0.83, 0.98]	0.018	0.96	[0.88, 1.04]	0.282	1.22	[1.16, 1.28]	<0.001

(Table1) The Association between Internet Usage and Medical Check Data among Japanese Older People

Table1. Characteristics of the study participants by datasets

		Total (n = 985)	Non-hypertensive people (n=391)	Hypertensive people (n=594)
		N (%)	N (%)	N (%)
Internet use	No	541(54.9%)	186(47.6%)	355(59.8%)
	Yes (A few times or more a month)	444(45.1%)	205(52.4%)	239(40.2%)
Sex	Female	587(59.6%)	240(61.4%)	347(58.4%)
	Male	398(40.4%)	151(38.6%)	247(41.6%)
Age	65-69	237(24.1%)	118(30.2%)	119(20%)
	70-74	246(25%)	103(26.3%)	143(24.1%)
	75-79	274(27.8%)	101(25.8%)	173(29.1%)
	80-84	155(15.7%)	47(12%)	108(18.2%)
	85-	73(7.4%)	22(5.6%)	51(8.6%)
Income	Lower	279(28.3%)	104(26.6%)	175(29.5%)
	Intermediate	258(26.2%)	114(29.2%)	144(24.2%)
	Higher	247(25.1%)	102(26.1%)	145(24.4%)
	missing	201(20.4%)	71(18.2%)	130(21.9%)
Educational attainment	other	7(0.7%)	2(0.5%)	5(0.8%)
	-9yrs	342(34.7%)	126(32.2%)	216(36.4%)
	10-12yrs	425(43.2%)	179(45.8%)	246(41.4%)
	13-yrs	201(20.4%)	80(20.5%)	121(20.4%)
	missing	10(1%)	4(1%)	6(1%)
Working status	never	62(6.3%)	21(5.4%)	41(6.9%)
	past worker	548(55.6%)	213(54.5%)	335(56.4%)
	current worker	185(18.8%)	80(20.5%)	105(17.7%)
	missing	190(19.3%)	77(19.7%)	113(19%)
Living arrangement	with others	796(80.8%)	328(83.9%)	468(78.8%)
	alone	126(12.8%)	48(12.3%)	78(13.1%)
	missing	63(6.4%)	15(3.8%)	48(8.1%)
Marital status	single	13(1.3%)	6(1.5%)	7(1.2%)
	married	734(74.5%)	306(78.3%)	428(72.1%)
	widows/divorced	220(22.3%)	69(17.7%)	151(25.4%)
	others	3(0.3%)	1(0.3%)	2(0.3%)
	missing	15(1.5%)	9(2.3%)	6(1%)

Preexisting diabetes	No	835(84.8%)	340(87%)	495(83.3%)
	Yes	149(15.1%)	50(12.8%)	99(16.7%)
	Missing	1(0.1%)	1(0.3%)	0(0%)
Preexisting stroke	No	921(93.5%)	362(92.6%)	559(94.1%)
	Yes	27(2.7%)	7(1.8%)	20(3.4%)
	Missing	37(3.8%)	22(5.6%)	15(2.5%)
Preexisting heart disease	No	874(88.7%)	347(88.8%)	527(88.7%)
	Yes	74(7.5%)	22(5.6%)	52(8.8%)
	Missing	37(3.8%)	22(5.6%)	15(2.5%)
Geriatric depression screening scale	0-4	656(66.6%)	263(67.3%)	393(66.2%)
	5-9	142(14.4%)	59(15.1%)	83(14%)
	10-15	34(3.5%)	5(1.3%)	29(4.9%)
	Missing	153(15.5%)	64(16.4%)	89(15%)
Self-rated health	Poor	146(14.8%)	56(14.3%)	90(15.2%)
	Good	811(82.3%)	323(82.6%)	488(82.2%)
	Missing	28(2.8%)	12(3.1%)	16(2.7%)
Body mass index	normal	698(70.9%)	292(74.7%)	406(68.4%)
	less than 18.5	65(6.6%)	39(10%)	26(4.4%)
	more than 25	222(22.5%)	60(15.4%)	162(27.3%)
	Missing	0(0%)	0(0%)	0(0%)
Activities of dairy living	Independent	882(89.5%)	347(88.8%)	535(90.1%)
	Dependent	54(5.5%)	21(5.4%)	33(5.6%)
	Missing	49(5%)	23(5.9%)	26(4.4%)
Frequency of going out	Less than once a week	29(2.9%)	10(2.6%)	19(3.2%)
	Once or more a week	944(95.8%)	376(96.2%)	568(95.6%)
	Missing	12(1.2%)	5(1.3%)	7(1.2%)
Social participation in horizontal groups	Less than once a month	445(45.2%)	165(42.2%)	280(47.1%)
	Once or more a month	473(48%)	197(50.4%)	276(46.5%)
	Missing	67(6.8%)	29(7.4%)	38(6.4%)

Participants without data of Internet usage or hypertesion were excluded.

Missing data of the covariates were assigned to ‘a missing category.’

(Table2) The Association between Internet Usage and Medical Check Data among Japanese Older People

Table2. The Association between Internet usage and prevalence of Hypertension among Japanese older people. (n=985)

		crude		model 1		model 2	
		PR	[95% CI]	PR	[95% CI]	PR	[95% CI]
Internet usage	No	ref.		ref.		ref.	
	Yes (A few times or more a month)	0.82*	[0.74-0.91]	0.88*	[0.78-0.98]	0.87*	[0.77-0.98]

Data is shown as Prevalence Ratio and 95% Confidence Interval.

**P*<0.05

Abbreviations: PR, Prevalence Ratio: CI, Confidence Interval: GDS, geriatric depression screening scale: SRH, self-rated health: BMI, body mass index: ADL, activities of daily living

Model 1: adjusted for sex and age

Model 2: adjusted for sex, age, income, educational attainment, employment status, living status, marital status, past history of diabetes, stroke and heart disease, GDS, SRH, BMI, ADL, frequency of going out, social participation in horizontal group.

(Table 1) The Association between Internet Usage and Medical examination among Japanese Older People

Table1 Characteristics of participants (N=19,843)				
		Had a checkup within the past year	Have not had a checkup within one year	p-value
N		12104	7739	
Internet use frequency	no	5494 (45.4%)	4496 (58.1%)	<0.001
	several/m	1796 (14.8%)	970 (12.5%)	
	2-3/w	1626 (13.4%)	835 (10.8%)	
	everyday	3188 (26.3%)	1438 (18.6%)	
Age category	65-59	4039 (33.4%)	2118 (27.4%)	<0.001
	70-74	3463 (28.6%)	1928 (24.9%)	
	75-79	2597 (21.5%)	1823 (23.6%)	
	80-84	1429 (11.8%)	1214 (15.7%)	
	85-	576 (4.8%)	656 (8.5%)	
Sex	Male	5583 (46.1%)	3604 (46.6%)	0.54
	Female	6521 (53.9%)	4135 (53.4%)	
Income quartile	1Q	1955 (16.2%)	1618 (20.9%)	<0.001
	2Q	2510 (20.7%)	1581 (20.4%)	
	3Q	2522 (20.8%)	1450 (18.7%)	
	4Q	2850 (23.5%)	1346 (17.4%)	
	missing	2267 (18.7%)	1744 (22.5%)	
Educational attainment	other	60 (0.5%)	36 (0.5%)	<0.001
	-9yrs	3505 (29.0%)	2672 (34.5%)	
	10-12yrs	5133 (42.4%)	3087 (39.9%)	
	13-yrs	3335 (27.6%)	1859 (24.0%)	
	missing	71 (0.6%)	85 (1.1%)	
Longest job	professional	2043 (16.9%)	1244 (16.1%)	<0.001
	manager/cleri	3175 (26.2%)	1681 (21.7%)	
	manu&serv	3980 (32.9%)	2618 (33.8%)	
	other	933 (7.7%)	681 (8.8%)	
	unemployed	606 (5.0%)	528 (6.8%)	
	missing	1367 (11.3%)	987 (12.8%)	
Marital status	married	8913 (73.6%)	5385 (69.6%)	<0.001
	widowed	2244 (18.5%)	1529 (19.8%)	

	separated/unmarried	792 (6.5%)	633 (8.2%)	
	others	52 (0.4%)	86 (1.1%)	
	missing	103 (0.9%)	106 (1.4%)	
Number of people met within a recent month	0/m	804 (6.6%)	911 (11.8%)	<0.001
	1-2/m	1903 (15.7%)	1675 (21.6%)	
	3-5/m	2877 (23.8%)	1886 (24.4%)	
	6-9/m	1704 (14.1%)	924 (11.9%)	
	10=</m	4531 (37.4%)	2120 (27.4%)	
	missing	285 (2.4%)	223 (2.9%)	

(Table 2) The Association between Internet Usage and Medical examination among Japanese Older People
Table2 Prevalence ratios (95% confidence intervals) of NOT having health checkup by Internet use frequency

	Model1	Model2	Model3
Internet usage (frequency)			
No	**1.36 (1.28 - 1.45)**	**1.28 (1.20 - 1.37)**	**1.22 (1.14 - 1.30)**
Several times/month	**1.12 (1.03 - 1.21)**	**1.09 (1.00 - 1.18)**	1.06 (0.98 - 1.15)
2-3 times/week	**1.09 (1.00 - 1.19)**	1.07 (0.98 - 1.17)	1.06 (0.97 - 1.16)
Mostly everyday	1 (referent)	1 (referent)	1 (referent)
Income quartile			
1Q (Poorest)		**1.21 (1.13 - 1.29)**	**1.16 (1.09 - 1.24)**
2Q		**1.11 (1.04 - 1.19)**	**1.09 (1.02 - 1.17)**
missing		**1.18 (1.10 - 1.26)**	**1.15 (1.07 - 1.24)**
3Q (Richest)		1 (referent)	1 (referent)
Formal education			
other		0.90 (0.65 - 1.26)	0.89 (0.64 - 1.23)
9yrs		1.00 (0.94 - 1.07)	0.99 (0.93 - 1.06)
10-12yrs		0.99 (0.94 - 1.06)	0.99 (0.94 - 1.06)
missing		**1.27 (1.02 - 1.58)**	1.18 (0.95 - 1.47)
13yrs+		1 (referent)	1 (referent)
Longest employment			
Professional/Technical		1 (referent)	1 (referent)
Managerial/Clerical		0.95 (0.88 - 1.02)	0.96 (0.89 - 1.03)
Manual/Service		0.99 (0.92 - 1.06)	0.99 (0.92 - 1.06)
Others		1.02 (0.92 - 1.12)	1 (0.91 - 1.1)
Unemployed		1.10 (0.99 - 1.22)	1.08 (0.97 - 1.21)
Missing		1.01 (0.93 - 1.10)	1.02 (0.93 - 1.11)
Marital status			
Married		1 (referent)	1 (referent)
Widowed		0.96 (0.90 - 1.02)	0.96 (0.9 - 1.02)
separated/unmarried		**1.14 (1.05 - 1.24)**	**1.11 (1.02 - 1.2)**
others		**1.46 (1.18 - 1.81)**	**1.41 (1.14 - 1.75)**
missing		1.11 (0.91 - 1.35)	1.09 (0.9 - 1.32)
Number of friends (met in recent 1 month)			
0			**1.50 (1.38 - 1.62)**
1-2			**1.35 (1.26 - 1.44)**

3-5	**1.17 (1.10 - 1.25)**
6-9	**1.06 (0.99 - 1.15)**
missing	**1.18 (1.03 - 1.36)**
10 or more	1 (referent)

Model1 was adjusted for age and sex
Model2 was adjusted for income quartile, years of formal education, longest occupation and marital status
Model3 was additionally adjusted for number of friends (met in recent 1 month)

(Table1) The association between Internet use and Social Participation among Japanese older adults: JAGES longitudinal study

Table 1 Baseline characteristics													
			Volunteer			Sports			Hobby			Meeting with friends	
		Total (n = 4753)	No (n = 4459)	Yes (n = 294)	Total (n = 3586)	No (n = 3318)	Yes (n = 268)	Total (n = 3298)	No (n = 2863)	Yes (n = 435)	Total (n = 3546)	No (n = 2745)	Yes (n = 801)
		N (%)	N (%)	N (%)	N (%)	N (%)	N (%)	N (%)	N (%)	N (%)	N (%)	N (%)	N (%)
Internet use	No	1900 (40.0%)	1807 (40.5%)	93 (31.6%)	1577 (44.0%)	1496 (45.1%)	81 (30.2%)	1450 (44.0%)	1322 (46.2%)	128 (29.4%)	1592 (44.9%)	1261 (45.9%)	331 (41.3%)
	Yes	2853 (60.0%)	2652 (59.5%)	201 (68.4%)	2009 (56.0%)	1822 (54.9%)	187 (69.8%)	1848 (56.0%)	1541 (53.8%)	307 (70.6%)	1954 (55.1%)	1484 (54.1%)	470 (58.7%)
Age	65-69	1807 (38.0%)	1703 (38.2%)	104 (35.4%)	1382 (38.5%)	1268 (38.2%)	114 (42.5%)	1328 (40.3%)	1142 (39.9%)	186 (42.8%)	1287 (36.3%)	1003 (36.5%)	284 (35.5%)
	70-74	1371 (28.8%)	1261 (28.3%)	110 (37.4%)	1019 (28.4%)	932 (28.1%)	87 (32.5%)	930 (28.2%)	790 (27.6%)	140 (32.2%)	969 (27.3%)	726 (26.4%)	243 (30.3%)
	75-79	981 (20.6%)	918 (20.6%)	63 (21.4%)	711 (19.8%)	667 (20.1%)	44 (16.4%)	613 (18.6%)	544 (19.0%)	69 (15.9%)	759 (21.4%)	578 (21.1%)	181 (22.6%)
	80-84	428 (9.0%)	413 (9.3%)	15 (5.1%)	330 (9.2%)	311 (9.4%)	19 (7.1%)	300 (9.1%)	270 (9.4%)	30 (6.9%)	383 (10.8%)	318 (11.6%)	65 (8.1%)
	85-	166 (3.5%)	164 (3.7%)	2 (0.7%)	144 (4.0%)	140 (4.2%)	4 (1.5%)	127 (3.9%)	117 (4.1%)	10 (2.3%)	148 (4.2%)	120 (4.4%)	28 (3.5%)
Sex	Male	2439 (51.3%)	2298 (51.5%)	141 (48.0%)	1920 (53.5%)	1814 (54.7%)	106 (39.6%)	1848 (56.0%)	1625 (56.8%)	223 (51.3%)	1996 (56.3%)	1594 (58.1%)	402 (50.2%)
	Female	2314 (48.7%)	2161 (48.5%)	153 (52.0%)	1666 (46.5%)	1504 (45.3%)	162 (60.4%)	1450 (44.0%)	1238 (43.2%)	212 (48.7%)	1550 (43.7%)	1151 (41.9%)	399 (49.8%)
Income	Lower	1359 (28.6%)	1277 (28.6%)	82 (27.9%)	1102 (30.7%)	1033 (31.1%)	69 (25.7%)	1031 (31.3%)	918 (32.1%)	113 (26.0%)	1116 (31.5%)	867 (31.6%)	249 (31.1%)
	Intermediate	1279 (26.9%)	1191 (26.7%)	88 (29.9%)	949 (26.5%)	876 (26.4%)	73 (27.2%)	841 (25.5%)	729 (25.5%)	112 (25.7%)	955 (26.9%)	778 (28.3%)	177 (22.1%)
	Higher	1374 (28.9%)	1293 (29.0%)	81 (27.6%)	960 (26.8%)	867 (26.1%)	93 (34.7%)	899 (27.3%)	753 (26.3%)	146 (33.6%)	909 (25.6%)	687 (25.0%)	222 (27.7%)
	Missing	741 (15.6%)	698 (15.7%)	43 (14.6%)	575 (16.0%)	542 (16.3%)	33 (12.3%)	527 (16.0%)	463 (16.2%)	64 (14.7%)	566 (16.0%)	413 (15.0%)	153 (19.1%)

Educational attainment	Others	12 (0.3%)	11 (0.2%)	1 (0.3%)	9 (0.3%)	6 (0.2%)	3 (1.1%)	7 (0.2%)	6 (0.2%)	1 (0.2%)	12 (0.3%)	10 (0.4%)	2 (0.2%)
	-9 years	1111 (23.4%)	1050 (23.5%)	61 (20.7%)	913 (25.5%)	853 (25.7%)	60 (22.4%)	864 (26.2%)	782 (27.3%)	82 (18.9%)	874 (24.6%)	700 (25.5%)	174 (21.7%)
	10-12 years	2070 (43.6%)	1948 (43.7%)	122 (41.5%)	1524 (42.5%)	1409 (42.5%)	115 (42.9%)	1397 (42.4%)	1214 (42.4%)	183 (42.1%)	1537 (43.3%)	1169 (42.6%)	368 (45.9%)
	13 years-	1539 (32.4%)	1431 (32.1%)	108 (36.7%)	1122 (31.3%)	1033 (31.1%)	89 (33.2%)	1014 (30.7%)	846 (29.5%)	168 (38.6%)	1105 (31.2%)	854 (31.1%)	251 (31.3%)
	Missing	21 (0.4%)	19 (0.4%)	2 (0.7%)	18 (0.5%)	17 (0.5%)	1 (0.4%)	16 (0.5%)	15 (0.5%)	1 (0.2%)	18 (0.5%)	12 (0.4%)	6 (0.7%)
Working status	Never	240 (5.0%)	230 (5.2%)	10 (3.4%)	171 (4.8%)	161 (4.9%)	10 (3.7%)	135 (4.1%)	122 (4.3%)	13 (3.0%)	173 (4.9%)	130 (4.7%)	43 (5.4%)
	Retired	2659 (55.9%)	2473 (55.5%)	186 (63.3%)	1959 (54.6%)	1806 (54.4%)	153 (57.1%)	1795 (54.4%)	1565 (54.7%)	230 (52.9%)	2022 (57.0%)	1614 (58.8%)	408 (50.9%)
	Current	1323 (27.8%)	1259 (28.2%)	64 (21.8%)	1061 (29.6%)	985 (29.7%)	76 (28.4%)	1011 (30.7%)	869 (30.4%)	142 (32.6%)	922 (26.0%)	689 (25.1%)	233 (29.1%)
	Missing	531 (11.2%)	497 (11.1%)	34 (11.6%)	395 (11.0%)	366 (11.0%)	29 (10.8%)	357 (10.8%)	307 (10.7%)	50 (11.5%)	429 (12.1%)	312 (11.4%)	117 (14.6%)
Marital status	Married	3639 (76.6%)	3413 (76.5%)	226 (76.9%)	2722 (75.9%)	2517 (75.9%)	205 (76.5%)	2527 (76.6%)	2191 (76.5%)	336 (77.2%)	2795 (78.8%)	2174 (79.2%)	621 (77.5%)
	Widowed	689 (14.5%)	643 (14.4%)	46 (15.6%)	524 (14.6%)	482 (14.5%)	42 (15.7%)	461 (14.0%)	397 (13.9%)	64 (14.7%)	447 (12.6%)	326 (11.9%)	121 (15.1%)
	Divorced	191 (4.0%)	177 (4.0%)	14 (4.8%)	156 (4.4%)	146 (4.4%)	10 (3.7%)	143 (4.3%)	127 (4.4%)	16 (3.7%)	144 (4.1%)	110 (4.0%)	34 (4.2%)
	Single	173 (3.6%)	168 (3.8%)	5 (1.7%)	132 (3.7%)	123 (3.7%)	9 (3.4%)	121 (3.7%)	106 (3.7%)	15 (3.4%)	116 (3.3%)	99 (3.6%)	17 (2.1%)
	Others	35 (0.7%)	34 (0.8%)	1 (0.3%)	30 (0.8%)	29 (0.9%)	1 (0.4%)	28 (0.8%)	26 (0.9%)	2 (0.5%)	25 (0.7%)	20 (0.7%)	5 (0.6%)
	Missing	26 (0.5%)	24 (0.5%)	2 (0.7%)	22 (0.6%)	21 (0.6%)	1 (0.4%)	18 (0.5%)	16 (0.6%)	2 (0.5%)	19 (0.5%)	16 (0.6%)	3 (0.4%)
Living arrangement	Alone	648 (13.6%)	608 (13.6%)	40 (13.6%)	493 (13.7%)	451 (13.6%)	42 (15.7%)	443 (13.4%)	386 (13.5%)	57 (13.1%)	439 (12.4%)	334 (12.2%)	105 (13.1%)

	Couple with 65yrs=<	2384 (50.2%)	2238 (50.2%)	146 (49.7%)	1741 (48.5%)	1608 (48.5%)	133 (49.6%)	1578 (47.8%)	1360 (47.5%)	218 (50.1%)	1818 (51.3%)	1406 (51.2%)	412 (51.4%)
	Couple with 65yrs>	271 (5.7%)	255 (5.7%)	16 (5.4%)	216 (6.0%)	198 (6.0%)	18 (6.7%)	223 (6.8%)	199 (7.0%)	24 (5.5%)	214 (6.0%)	175 (6.4%)	39 (4.9%)
	With a chile/children	828 (17.4%)	778 (17.4%)	50 (17.0%)	637 (17.8%)	596 (18.0%)	41 (15.3%)	611 (18.5%)	534 (18.7%)	77 (17.7%)	611 (17.2%)	474 (17.3%)	137 (17.1%)
	Others	443 (9.3%)	416 (9.3%)	27 (9.2%)	363 (10.1%)	343 (10.3%)	20 (7.5%)	327 (9.9%)	288 (10.1%)	39 (9.0%)	334 (9.4%)	256 (9.3%)	78 (9.7%)
	Missing	179 (3.8%)	164 (3.7%)	15 (5.1%)	136 (3.8%)	122 (3.7%)	14 (5.2%)	116 (3.5%)	96 (3.4%)	20 (4.6%)	130 (3.7%)	100 (3.6%)	30 (3.7%)
Self-reported medical condition	No illness	940 (19.8%)	874 (19.6%)	66 (22.4%)	716 (20.0%)	652 (19.7%)	64 (23.9%)	638 (19.3%)	548 (19.1%)	90 (20.7%)	658 (18.6%)	485 (17.7%)	173 (21.6%)
	Having illness	3619 (76.1%)	3397 (76.2%)	222 (75.5%)	2725 (76.0%)	2535 (76.4%)	190 (70.9%)	2534 (76.8%)	2204 (77.0%)	330 (75.9%)	2737 (77.2%)	2144 (78.1%)	593 (74.0%)
	Missing	194 (4.1%)	188 (4.2%)	6 (2.0%)	145 (4.0%)	131 (3.9%)	14 (5.2%)	126 (3.8%)	111 (3.9%)	15 (3.4%)	151 (4.3%)	116 (4.2%)	35 (4.4%)
Self-rated health	Good	4142 (87.1%)	3871 (86.8%)	271 (92.2%)	3078 (85.8%)	2836 (85.5%)	242 (90.3%)	2843 (86.2%)	2451 (85.6%)	392 (90.1%)	3002 (84.7%)	2308 (84.1%)	694 (86.6%)
	Bad	527 (11.1%)	508 (11.4%)	19 (6.5%)	441 (12.3%)	422 (12.7%)	19 (7.1%)	398 (12.1%)	363 (12.7%)	35 (8.0%)	464 (13.1%)	384 (14.0%)	80 (10.0%)
	Missing	84 (1.8%)	80 (1.8%)	4 (1.4%)	67 (1.9%)	60 (1.8%)	7 (2.6%)	57 (1.7%)	49 (1.7%)	8 (1.8%)	80 (2.3%)	53 (1.9%)	27 (3.4%)
Activity of daily living	Independent	4391 (92.4%)	4118 (92.4%)	273 (92.9%)	3278 (91.4%)	3036 (91.5%)	242 (90.3%)	3033 (92.0%)	2627 (91.8%)	406 (93.3%)	3224 (90.9%)	2494 (90.9%)	730 (91.1%)
	Dependent	133 (2.8%)	125 (2.8%)	8 (2.7%)	124 (3.5%)	114 (3.4%)	10 (3.7%)	106 (3.2%)	98 (3.4%)	8 (1.8%)	128 (3.6%)	106 (3.9%)	22 (2.7%)
	Missing	229 (4.8%)	216 (4.8%)	13 (4.4%)	184 (5.1%)	168 (5.1%)	16 (6.0%)	159 (4.8%)	138 (4.8%)	21 (4.8%)	194 (5.5%)	145 (5.3%)	49 (6.1%)
Depressive symptoms	Not depressed (GDS <5)	3679 (77.4%)	3443 (77.2%)	236 (80.3%)	2703 (75.4%)	2483 (74.8%)	220 (82.1%)	2458 (74.5%)	2102 (73.4%)	356 (81.8%)	2618 (73.8%)	1986 (72.3%)	632 (78.9%)

	Depressed (GDS ≥5)	911 (19.2%)	864 (19.4%)	47 (16.0%)	761 (21.2%)	721 (21.7%)	40 (14.9%)	736 (22.3%)	668 (23.3%)	68 (15.6%)	803 (22.6%)	661 (24.1%)	142 (17.7%)
	Missing	163 (3.4%)	152 (3.4%)	11 (3.7%)	122 (3.4%)	114 (3.4%)	8 (3.0%)	104 (3.2%)	93 (3.2%)	11 (2.5%)	125 (3.5%)	98 (3.6%)	27 (3.4%)
Frequency of going out	Once or more a week	4600 (96.8%)	4311 (96.7%)	289 (98.3%)	3448 (96.2%)	3186 (96.0%)	262 (97.8%)	3164 (95.9%)	2745 (95.9%)	419 (96.3%)	3381 (95.3%)	2601 (94.8%)	780 (97.4%)
	Less than once a week	111 (2.3%)	109 (2.4%)	2 (0.7%)	108 (3.0%)	103 (3.1%)	5 (1.9%)	101 (3.1%)	91 (3.2%)	10 (2.3%)	133 (3.8%)	115 (4.2%)	18 (2.2%)
	Missing	42 (0.9%)	39 (0.9%)	3 (1.0%)	30 (0.8%)	29 (0.9%)	1 (0.4%)	33 (1.0%)	27 (0.9%)	6 (1.4%)	32 (0.9%)	29 (1.1%)	3 (0.4%)
Population density	Metropolitan	2227 (46.9%)	2100 (47.1%)	127 (43.2%)	1649 (46.0%)	1533 (46.2%)	116 (43.3%)	1492 (45.2%)	1287 (45.0%)	205 (47.1%)	1735 (48.9%)	1364 (49.7%)	371 (46.3%)
	Urban	1353 (28.5%)	1255 (28.1%)	98 (33.3%)	990 (27.6%)	914 (27.5%)	76 (28.4%)	918 (27.8%)	781 (27.3%)	137 (31.5%)	937 (26.4%)	721 (26.3%)	216 (27.0%)
	Semi-urban	579 (12.2%)	538 (12.1%)	41 (13.9%)	455 (12.7%)	416 (12.5%)	39 (14.6%)	425 (12.9%)	372 (13.0%)	53 (12.2%)	434 (12.2%)	334 (12.2%)	100 (12.5%)
	Rural	594 (12.5%)	566 (12.7%)	28 (9.5%)	492 (13.7%)	455 (13.7%)	37 (13.8%)	463 (14.0%)	423 (14.8%)	40 (9.2%)	440 (12.4%)	326 (11.9%)	114 (14.2%)

(Table2) The association between Internet use and Social Participation among Japanese older adults: JAGES longitudinal study

Table 2 Associations between Internet use and social capital																					
		Outcomes																			
		Volunteer					Sports					Hobby					Meeting with friends				
		OR	95% CI			P value	OR	95% CI			P value	PR	95% CI			P value	PR	95% CI			P value
Internet use	No	Ref.					Ref.					Ref.					Ref.				
	Yes	1.35	(1.06	–	1.72)	0.015	1.69	(1.29	–	2.22)	<0.001	1.59	(1.27	–	1.98)	<0.001	1.17	(1.02	–	1.35)	0.028
Age	65-69	Ref.					Ref.					Ref.					Ref.				
	70-74	1.44	(1.12	–	1.85)	0.005	1.17	(0.80	–	1.72)	0.406	1.15	(0.88	–	1.51)	0.295	1.19	(1.04	–	1.37)	0.012
	75-79	1.16	(0.83	–	1.62)	0.389	0.89	(0.54	–	1.45)	0.638	0.96	(0.70	–	1.30)	0.772	1.17	(0.95	–	1.46)	0.143
	80-84	0.62	(0.35	–	1.11)	0.107	0.89	(0.51	–	1.54)	0.668	0.86	(0.61	–	1.22)	0.400	0.84	(0.64	–	1.09)	0.181
	85-	0.21	(0.05	–	0.90)	0.035	0.41	(0.10	–	1.61)	0.202	0.72	(0.38	–	1.35)	0.308	0.98	(0.68	–	1.40)	0.908
Sex	Male	Ref.					Ref.					Ref.					Ref.				
	Female	1.12	(0.86	–	1.45)	0.411	2.01	(1.53	–	2.65)	<0.001	1.32	(1.11	–	1.57)	0.002	1.20	(1.04	–	1.39)	0.014
Income	Lower	1.10	(0.75	–	1.62)	0.623	0.65	(0.43	–	0.98)	0.039	0.85	(0.64	–	1.13)	0.269	1.00	(0.86	–	1.18)	0.961
	Intermediate	1.18	(0.86	–	1.64)	0.309	0.79	(0.53	–	1.19)	0.267	0.89	(0.68	–	1.16)	0.380	0.81	(0.69	–	0.95)	0.010
	Higher	Ref.					Ref.					Ref.					Ref.				
	Missing	1.07	(0.66	–	1.73)	0.775	0.53	(0.32	–	0.88)	0.014	0.92	(0.66	–	1.28)	0.627	1.14	(0.93	–	1.40)	0.216
Educational attainment	Others	1.30	(0.22	–	7.73)	0.771	6.22	(1.05	–	36.74)	0.044	1.03	(0.14	–	7.74)	0.979	0.67	(0.19	–	2.33)	0.534
	-9 years	0.86	(0.58	–	1.27)	0.447	1.02	(0.75	–	1.38)	0.913	0.70	(0.55	–	0.88)	0.002	0.85	(0.70	–	1.02)	0.082
	10-12 years	0.79	(0.63	–	0.99)	0.038	0.89	(0.67	–	1.20)	0.459	0.81	(0.67	–	0.98)	0.033	1.01	(0.88	–	1.15)	0.925
	13 years-	Ref.					Ref.					Ref.					Ref.				
	Missing	1.35	(0.30	–	6.03)	0.697	0.78	(0.09	–	6.48)	0.819	0.43	(0.07	–	2.72)	0.371	1.47	(0.69	–	3.13)	0.317

Working status	Never	0.97	(0.48	–	1.97)	0.932	0.80	(0.42	–	1.51)	0.482	0.82	(0.45	–	1.47)	0.502	0.99	(0.80	–	1.23)	0.937
	Retired	1.57	(1.17	–	2.11)	0.003	1.25	(0.90	–	1.75)	0.184	1.01	(0.82	–	1.24)	0.927	0.82	(0.70	–	0.96)	0.017
	Current	Ref.					Ref.					Ref.					Ref.				
	Missing	1.47	(0.98	–	2.22)	0.065	1.18	(0.72	–	1.93)	0.510	1.18	(0.85	–	1.63)	0.331	1.10	(0.86	–	1.41)	0.447
Marital status	Married	Ref.					Ref.					Ref.					Ref.				
	Widowed	1.08	(0.66	–	1.76)	0.768	0.87	(0.41	–	1.83)	0.713	1.19	(0.89	–	1.60)	0.244	1.20	(0.91	–	1.59)	0.197
	Divorced	1.13	(0.53	–	2.38)	0.754	0.67	(0.23	–	1.94)	0.465	0.96	(0.62	–	1.46)	0.836	1.05	(0.68	–	1.61)	0.834
	Single	0.42	(0.14	–	1.22)	0.109	0.77	(0.32	–	1.84)	0.555	1.08	(0.62	–	1.88)	0.790	0.72	(0.44	–	1.18)	0.192
	Others	0.48	(0.07	–	3.32)	0.461	0.37	(0.04	–	3.09)	0.358	0.65	(0.16	–	2.54)	0.531	0.95	(0.32	–	2.85)	0.929
	Missing	1.43	(0.27	–	7.48)	0.670	0.64	(0.09	–	4.81)	0.666	1.03	(0.29	–	3.69)	0.961	0.76	(0.29	–	2.02)	0.580
Living arrangement	Alone	1.21	(0.71	–	2.08)	0.483	1.62	(0.76	–	3.45)	0.213	0.95	(0.64	–	1.40)	0.792	0.98	(0.74	–	1.29)	0.892
	Couple with 65 yrs≤	Ref.					Ref.					Ref.					Ref.				
	Couple with 65 yrs>	1.04	(0.57	–	1.92)	0.891	1.32	(0.78	–	2.24)	0.304	0.76	(0.48	–	1.21)	0.247	0.84	(0.63	–	1.12)	0.241
	With a child/children	1.04	(0.71	–	1.51)	0.848	0.88	(0.59	–	1.32)	0.537	0.91	(0.69	–	1.19)	0.483	0.91	(0.75	–	1.11)	0.351
	Others	1.07	(0.69	–	1.67)	0.750	0.72	(0.43	–	1.19)	0.202	0.83	(0.58	–	1.17)	0.280	0.98	(0.76	–	1.25)	0.858
	Missing	1.65	(0.99	–	2.74)	0.054	1.66	(0.99	–	2.79)	0.053	1.29	(0.83	–	2.01)	0.252	0.96	(0.71	–	1.29)	0.784
Self-reported medical condition	No illness	Ref.					Ref.					Ref.					Ref.				

	Having illness	0.90	(0.65	–	1.23)	0.496	0.88	(0.67	–	1.16)	0.355	1.02	(0.83	–	1.25)	0.875	0.86	(0.74	–	1.00)	0.055
	Missing	0.41	(0.17	–	0.96)	0.041	0.97	(0.50	–	1.87)	0.921	0.86	(0.43	–	1.71)	0.674	0.71	(0.46	–	1.08)	0.112
Self-rated health	Good	Ref.					Ref.					Ref.					Ref.				
	Bad	0.54	(0.33	–	0.88)	0.013	0.59	(0.33	–	1.04)	0.069	0.80	(0.53	–	1.21)	0.291	0.89	(0.72	–	1.10)	0.263
	Missing	1.07	(0.37	–	3.08)	0.907	1.30	(0.43	–	3.94)	0.640	1.16	(0.53	–	2.53)	0.715	1.73	(1.18	–	2.51)	0.005
Activity of daily living	Independent	Ref.					Ref.					Ref.					Ref.				
	Dependent	1.65	(0.73	–	3.77)	0.232	2.00	(0.79	–	5.05)	0.143	0.81	(0.35	–	1.87)	0.621	0.93	(0.58	–	1.48)	0.748
	Missing	1.16	(0.66	–	2.02)	0.611	1.19	(0.67	–	2.09)	0.553	1.12	(0.73	–	1.70)	0.610	0.98	(0.73	–	1.32)	0.914
Depressive symptoms	Not depressed (GDS <5)	Ref.					Ref.					Ref.					Ref.				
	Depressed (GDS ≥5)	0.90	(0.65	–	1.25)	0.538	0.73	(0.50	–	1.05)	0.094	0.74	(0.55	–	0.98)	0.036	0.78	(0.67	–	0.90)	0.001
	Missing	1.05	(0.52	–	2.11)	0.897	0.81	(0.41	–	1.60)	0.539	0.70	(0.37	–	1.33)	0.276	0.91	(0.65	–	1.27)	0.591
Frequency of going out	Once or more a week	Ref.					Ref.					Ref.					Ref.				
	Less than once a week	0.33	(0.08	–	1.32)	0.117	0.79	(0.27	–	2.34)	0.676	1.01	(0.53	–	1.93)	0.968	0.67	(0.42	–	1.06)	0.086
	Missing	1.23	(0.40	–	3.76)	0.718	0.38	(0.04	–	3.27)	0.376	1.35	(0.68	–	2.68)	0.392	0.36	(0.12	–	1.04)	0.060
Population density	Metropolitan	Ref.					Ref.					Ref.					Ref.				
	Urban	1.28	(0.96	–	1.71)	0.096	1.17	(0.79	–	1.72)	0.428	1.12	(0.94	–	1.33)	0.195	1.12	(0.97	–	1.30)	0.121

	Semi-urban	1.34	(0.90	–	2.00)	0.144		1.39	(1.05	–	1.85)	0.022		0.98	(0.86	–	1.11)	0.748		1.14	(0.96	–	1.36)	0.144
	Rural	0.91	(0.53	–	1.55)	0.721		1.39	(0.80	–	2.41)	0.244		0.72	(0.56	–	0.92)	0.008		1.26	(0.99	–	1.59)	0.058

OR: Odds ratio; PR: Prevalence ratio; CI: Confidence interval; Ref.: Reference

Adjusting for age, sex, income, educational attainment, working status, marital status, living arrangement, self-reported medical condition, self-rated health, activity of daily living, depressive symptoms, frequency of going out, population density.

(Table1) Exploring the area contextual role of Internet access in the relationships between Internet use and changes in Instrumental Activity of Living (IADL) among Japanese older people: Longitudinal research evidence from the Japan Gerontological Evaluation Study

	Stayed low, % (n=263)	Declined, % (n=253)	Improved, % (n=162)	Stayed high, % (n=5159)
Internet use: none	62.74	54.15	50.62	35.88
2-3 times/month	8.37	13.04	16.67	16.09
2-3 times/week	8.37	9.88	9.26	15.89
Almost daily	20.53	22.92	23.46	32.14
Social network size:	20.91	13.44	18.52	7.06
0				
1-2	21.29	21.74	20.37	15.84
3-5	20.53	25.30	17.90	23.14
6-9	11.41	14.23	16.05	14.11
10+	25.86	25.30	27.16	39.85
Income:	36.88	35.57	35.19	33.84
Low				
Middle	33.84	36.36	29.63	33.26
High	29.28	28.06	35.19	32.89
Education: University level	30.04	29.64	31.48	32.87
Gender: Male	78.71	68.77	87.65	45.82
Age:	26.24	26.48	33.95	36.56
65-69				
70-74	28.52	24.51	31.48	30.80
75-79	22.81	24.51	17.90	21.13
80-84	12.55	14.62	11.73	9.21
85+	9.89	9.88	4.94	2.31
Partnership: yes	83.65	82.61	91.98	76.68
ADL:	82.13	88.14	90.12	93.74
Independent				
Dependent	15.21	6.32	3.70	1.78
Missing	2.66	5.53	6.17	4.48
Area level Internet use, Mean (SD)	84.80(4.30)	84.84(4.06)	84.64(4.11)	85.11(3.67)

Table 2: Associations between internet use frequencies and changes in disability status from 2016 to 2019 (N=6941)

	Stayed disabled (n=263)	declined (n=253)	improved (n=162)	Stayed functional (n=5159)
Internet use				
No	2.89(2.07-4.02)	2.02(1.46-2.79)	2.27(1.51-3.41)	Reference
2-3/mo	0.94(0.58-1.52)	1.06(0.69-1.63)	1.57(0.96-2.57)	Reference
2-3/wk	1.16(0.71-1.87)	0.94(0.59-1.50)	1.04(0.58-1.89)	Reference
Almost everyday	Reference	Reference	Reference	Reference
Education				
Not educated at university level	Reference	Reference	Reference	Reference

University educated	0.92(0.70-1.22)	0.91(0.69-1.19)	0.87(0.62-1.24)	Reference
Sex				
Men	Reference	Reference	Reference	Reference
Women	0.19(0.14-0.26)	0.42(0.32-0.54)	0.14(0.09-0.21)	Reference
Age categories				
65-69	Reference	Reference	Reference	Reference
70-76	1.29(0.93-1.78)	1.10(0.78-1.54)	1.07(0.73-1.56)	Reference
75-79	1.23(0.88-1.74)	1.35(0.96-1.91)	0.79(0.50-1.22)	Reference
80-84	1.20(0.79-1.82)	2.18(1.50-3.17)	1.15(0.70-1.91)	Reference
85+	3.82(2.35-6.21)	4.87(3.04-7.80)	1.62(0.74-3.55)	Reference
Partnership status				
Not Partnered	Reference	Reference	Reference	Reference
Partnered	1.48(1.07-2.06)	1.54(1.13-2.12)	2.58(1.49-4.45)	Reference
ADL				
Independent living	1.02(0.59-176)	0.98(0.58-1.64)	0.83(0.44-1.57)	Reference
Not independent	9.54(4.97-18.31)	3.69(1.88-7.24)	2.53(0.97-6.60)	Reference
Missing	Reference	Reference	Reference	Reference

Table 3: Associations between internet use frequencies, area level internet use and changes in disability status from 2016 to 2019 (N-6941)

	Stayed disabled (n=263)	declined (n=253)	improved (n-162)	Stayed functional (n=5159)
Internet use				
No	2.87(2.05-4.00)	2.01(1.45-2.76)	2.25(1.49-3.38)	Reference
2-3/month	0.94(0.58-1.52)	1.05(0.69-1.62)	1.56(0.95-2.56)	Reference
2-3/week	1.16(0.71-1.87)	0.94(0.59-1.50)	1.05(0.58-1.90)	Reference
Almost everyday	Reference	Reference	Reference	Reference
% Area level internet use	0.99(0.96-1.02)	0.99(0.96-1.02)	0.98(0.95-1.03)	Reference
Education				
Not educated at university level	Reference	Reference	Reference	Reference
University educated	0.92(0.70-1.21)	0.91(0.69-1.19)	0.88(0.62-1.23)	Reference
Sex				
Men	Reference	Reference	Reference	Reference

Women	0.19(0.14-0.26)	0.41(0.32-1.55)	0.14(0.09-0.21)	
Age categories				
65-69	Reference	Reference	Reference	Reference
70-76	1.29(0.93-1.79)	1.10(0.78-1.54)	1.08(0.74-1.57)	Reference
75-79	1.24(0.88-1.75)	1.36(0.97-1.92)	0.79(0.51-1.23)	Reference
80-84	1.21(0.79-1.83)	2.19(1.50-3.18)	1.16(0.70-1.92)	Reference
85+	3.84(1.07-2.06)	4.90(3.06-7.85)	1,63(0.74-3.58)	Reference
Partnership status				
Not Partnered	Reference	Reference	Reference	Reference
Partnered	1.48(1.07-2.06)	1.54(1.13-2.11)	2.57(1.49-4.45)	Reference
ADL				
Independent living	1.02(0.59-1.76)	0.98(0.58-1.63)	0.83(0.33-1.56)	Reference
Not independent	9.47(4.93-18.18)	3.64(1.85-7.16)	2.50(0.96-6.51)	Reference
Missing	Reference	Reference	Reference	Reference

Table 4: Associations between internet use frequencies, area level internet access, social network size and changes in disability status from 2016 to 2019

	Stayed disabled (n=263)	declined (n=253)	improved (n-162)	Stayed functional (n=5159)
Internet use				
No	2.61(1.86-3.66)	1.81(1.31-2.51)	2.06(1.37-3.11)	Reference
2-3/month	0.93(0.57-1.50)	1.00(0.65-1.54)	1.51(0.92-2.47)	Reference
2-3/week	1.15(0.71-1.88)	0.91(0.57-1.46)	1.05(0.58-1.90)	Reference
Almost everyday	Reference	Reference	Reference	Reference
% Area Internet use	0.99(0.96-1.02)	0.99(0.96-1.02)	0.98(0.95-1.02)	Reference
Social network size				
Zero	Reference	Reference	Reference	Reference
One to two	0.55(0.38-0.82)	0.86(0.57-1.30)	0.66(0.40-1.08)	Reference
Three to five	0.48(0.33-0.70)	0.75(0.50-1.13)	0.48(0.29-0.80)	Reference
Six to nine	0.44(0.28-0.69)	0.73(0.46-1.16)	0.70(0.41-1.19)	Reference
Ten or over	0.39(0.27-0.86)	0.48(0.31-0.72)	0.45(0.28-0.72)	Reference
Education				
Not educated at university level	Reference	Reference	Reference	Reference
University educated	0.92(0.69-1.22)	0.93(0.70-1.22)	0.88(0.62-1.24)	Reference

Sex				
Men	Reference	Reference	Reference	Reference
Women	0.21(0.16-0.29)	0.44(0.34-0.57)	0.15(0.09-0.23)	
Age categories				
65-69	Reference	Reference	Reference	Reference
70-76	1.37(0.99-1.90)	1.15(0.81-1.61)	1.12(0.77-1.64)	Reference
75-79	1.32(0.93-1.87)	1.43(0.70-1.22)	0.84(0.54-1.30)	Reference
80-84	1.29(0.83-1.97)	2.28(1.56-3.32)	1.22(0.74-2.03)	Reference
85+	3.80(2.33-6.18)	4.80(3.00-7.70)	1.60(0.73-3.53)	Reference
Partnership status				
Not Partnered	Reference	Reference	Reference	Reference
Partnered	1.54(1.11-2.15)	1.57(1.14-2.15)	2.63(1.52-4.55)	Reference
ADL				
Independent living	1.03(0.59-1.78)	0.99(0.59-1.66)	0.85(0.44-1.60)	Reference
Not independent	8.84(4.59-17.03)	3.46(1.75-6.81)	2.38(0.91-6.23)	Reference
Missing	Reference	Reference	Reference	Reference

(Table1-1) Associations of Internet use/frequency of Internet use/purposes of Internet use with health outcomes (depression, self-rate health, hypertension, diabetes)

Table 1 Baseline characteristics of participants without depression in 2016				
		Total (n = 5631)	Non-Depression in 2019 (n = 4974)	Depression in 2019 (n = 657)
		N (%)	N (%)	N (%)
Internet use	No	2185 (38.8%)	1844 (37.1%)	341 (51.9%)
	Yes (A few times or more a month)	3446 (61.2%)	3130 (62.9%)	316 (48.1%)
	A few times a month	873 (15.5%)	777 (15.6%)	96 (14.6%)
	A few times a week	794 (14.1%)	718 (14.4%)	76 (11.6%)
	Almost every day	1779 (31.6%)	1635 (32.9%)	144 (21.9%)
Age	65-69	1916 (34%)	1730 (34.8%)	186 (28.3%)
	70-74	1646 (29.2%)	1464 (29.4%)	182 (27.7%)
	75-79	1275 (22.6%)	1125 (22.6%)	150 (22.8%)
	80-84	603 (10.7%)	501 (10.1%)	102 (15.5%)
	85-	191 (3.4%)	154 (3.1%)	37 (5.6%)
Sex	Female	2894 (51.4%)	2549 (51.3%)	345 (52.5%)
	Male	2737 (48.6%)	2425 (48.8%)	312 (47.5%)
Income	Lower	1488 (26.4%)	1287 (25.9%)	201 (30.6%)
	Intermediate	1631 (29%)	1441 (29%)	190 (28.9%)
	Higher	1674 (29.7%)	1528 (30.7%)	146 (22.2%)
	Missing	838 (14.9%)	718 (14.4%)	120 (18.3%)
Educational attainment	-9 years	1324 (23.5%)	1125 (22.6%)	199 (30.3%)
	10-12 years	2455 (43.6%)	2182 (43.9%)	273 (41.6%)
	13 years-	1808 (32.1%)	1632 (32.8%)	176 (26.8%)
	Missing or others	44 (0.8%)	35 (0.7%)	9 (1.4%)
Working status	Never	300 (5.3%)	253 (5.1%)	47 (7.2%)
	Retired	3073 (54.6%)	2708 (54.4%)	365 (55.6%)
	Current	1554 (27.6%)	1398 (28.1%)	156 (23.7%)
	Missing	704 (12.5%)	615 (12.4%)	89 (13.6%)
Marital status	Married	4382 (77.8%)	3893 (78.3%)	489 (74.4%)
	Widowed	883 (15.7%)	781 (15.7%)	102 (15.5%)
	Divorced	173 (3.1%)	148 (3%)	25 (3.8%)

	Single	139 (2.5%)	109 (2.2%)	30 (4.6%)
	Others	26 (0.5%)	22 (0.4%)	4 (0.6%)
	Missing	28 (0.5%)	21 (0.4%)	7 (1.1%)
Living arrangement	Living with someone	4712 (83.7%)	4179 (84%)	533 (81.1%)
	Living alone	703 (12.5%)	604 (12.1%)	99 (15.1%)
	Missing	216 (3.8%)	191 (3.8%)	25 (3.8%)
Preexisting disease	No	2354 (41.8%)	2099 (42.2%)	255 (38.8%)
	Yes	3029 (53.8%)	2658 (53.4%)	371 (56.5%)
	Missing	248 (4.4%)	217 (4.4%)	31 (4.7%)
Self-rated health	Good	5155 (91.6%)	4605 (92.6%)	550 (83.7%)
	Bad	361 (6.4%)	266 (5.4%)	95 (14.5%)
	Missing	115 (2%)	103 (2.1%)	12 (1.8%)
ADL	Independent	5222 (92.7%)	4622 (92.9%)	600 (91.3%)
	Dependent	107 (1.9%)	85 (1.7%)	22 (3.4%)
	Missing	302 (5.4%)	267 (5.4%)	35 (5.3%)
Population density	Metropolitan	2545 (45.2%)	2240 (45%)	305 (46.4%)
	Urban	1681 (29.9%)	1519 (30.5%)	162 (24.7%)
	Semi-urban	691 (12.3%)	595 (12%)	96 (14.6%)
	Rural	714 (12.7%)	620 (12.5%)	94 (14.3%)

Participants with missing data in Internet use (2016) and depression (2016 and 2019) were excluded.
Participants with depression at baseline (2016) were excluded.

(Table1-2) Associations of Internet use/frequency of Internet use/purposes of Internet use with health outcomes (depression, self-rate health, hypertension, diabetes)

Table 1-2 Baseline characteristics of participants with good self-rated health in 2016				
		Total (n = 6427)	Good self-rated health in 2019 (n = 5823)	Bad self-rated health in 2019 (n = 604)
		N (%)	N (%)	N (%)
Internet use	No	2596 (40.4%)	2273 (39%)	323 (53.5%)
	Yes (A few times or more a month)	3831 (59.6%)	3550 (61%)	281 (46.5%)
	A few times a month	1000 (15.6%)	916 (15.7%)	84 (13.9%)
	A few times a week	912 (14.2%)	844 (14.5%)	68 (11.3%)
	Almost every day	1919 (29.9%)	1790 (30.7%)	129 (21.4%)
Age	65-69	2193 (34.1%)	2063 (35.4%)	130 (21.5%)
	70-74	1904 (29.6%)	1742 (29.9%)	162 (26.8%)
	75-79	1410 (21.9%)	1250 (21.5%)	160 (26.5%)
	80-84	698 (10.9%)	586 (10.1%)	112 (18.5%)
	85-	222 (3.5%)	182 (3.1%)	40 (6.6%)
Sex	Female	3393 (52.8%)	3098 (53.2%)	295 (48.8%)
	Male	3034 (47.2%)	2725 (46.8%)	309 (51.2%)
Income	Lower	1804 (28.1%)	1592 (27.3%)	212 (35.1%)
	Intermediate	1802 (28%)	1635 (28.1%)	167 (27.7%)
	Higher	1785 (27.8%)	1667 (28.6%)	118 (19.5%)
	Missing	1036 (16.1%)	929 (16%)	107 (17.7%)
Educational attainment	-9 years	1565 (24.4%)	1369 (23.5%)	196 (32.5%)
	10-12 years	2811 (43.7%)	2575 (44.2%)	236 (39.1%)
	13 years-	1999 (31.1%)	1831 (31.4%)	168 (27.8%)
	Missing or others	52 (0.8%)	48 (0.8%)	4 (0.7%)
Working status	Never	345 (5.4%)	302 (5.2%)	43 (7.1%)
	Retired	3460 (53.8%)	3114 (53.5%)	346 (57.3%)
	Current	1755 (27.3%)	1629 (28%)	126 (20.9%)
	Missing	867 (13.5%)	778 (13.4%)	89 (14.7%)
Marital status	Married	4865 (75.7%)	4407 (75.7%)	458 (75.8%)
	Widowed	1056 (16.4%)	958 (16.5%)	98 (16.2%)

	Divorced	249 (3.9%)	224 (3.9%)	25 (4.1%)
	Single	186 (2.9%)	172 (3%)	14 (2.3%)
	Others	36 (0.6%)	32 (0.6%)	4 (0.7%)
	Missing	35 (0.5%)	30 (0.5%)	5 (0.8%)
Living arrangement	Living with someone	5270 (82%)	4769 (81.9%)	501 (83%)
	Living alone	898 (14%)	825 (14.2%)	73 (12.1%)
	Missing	259 (4%)	229 (3.9%)	30 (5%)
Preexisting disease	No	2779 (43.2%)	2580 (44.3%)	199 (33%)
	Yes	3426 (53.3%)	3036 (52.1%)	390 (64.6%)
	Missing	222 (3.5%)	207 (3.6%)	15 (2.5%)
ADL	Independent	6071 (94.5%)	5524 (94.9%)	547 (90.6%)
	Dependent	103 (1.6%)	78 (1.3%)	25 (4.1%)
	Missing	253 (3.9%)	221 (3.8%)	32 (5.3%)
Depression	Non-depression	5244 (81.6%)	4824 (82.8%)	420 (69.5%)
	Depression	940 (14.6%)	780 (13.4%)	160 (26.5%)
	Missing	243 (3.8%)	219 (3.8%)	24 (4%)
Population density	Metropolitan	2899 (45.1%)	2633 (45.2%)	266 (44%)
	Urban	1912 (29.8%)	1725 (29.6%)	187 (31%)
	Semi-urban	808 (12.6%)	731 (12.6%)	77 (12.8%)
	Rural	808 (12.6%)	734 (12.6%)	74 (12.3%)

Participants with missing data in Internet use (2016) and self-rated health (2016 and 2019) were excluded. Participants with bad self-rated health at baseline (2016) were excluded.

(Table1-3) Associations of Internet use/frequency of Internet use/purposes of Internet use with health outcomes (depression, self-rate health, hypertension, diabetes)

Table 1-3 Baseline characteristics of participants without hypertension in 2016				
		Total (n = 3842)	Non-hypertension in 2019 (n = 3298)	Hypertension in 2019 (n = 544)
		N (%)	N (%)	N (%)
Internet use	No	1531 (39.9%)	1275 (38.7%)	256 (47.1%)
	Yes (A few times or more a month)	2311 (60.2%)	2023 (61.3%)	288 (52.9%)
	A few times a month	585 (15.2%)	511 (15.5%)	74 (13.6%)
	A few times a week	574 (14.9%)	494 (15%)	80 (14.7%)
	Almost every day	1152 (30%)	1018 (30.9%)	134 (24.6%)
Age	65-69	1448 (37.7%)	1263 (38.3%)	185 (34%)
	70-74	1118 (29.1%)	950 (28.8%)	168 (30.9%)
	75-79	778 (20.3%)	684 (20.7%)	94 (17.3%)
	80-84	380 (9.9%)	308 (9.3%)	72 (13.2%)
	85-	118 (3.1%)	93 (2.8%)	25 (4.6%)
Sex	Female	2025 (52.7%)	1748 (53%)	277 (50.9%)
	Male	1817 (47.3%)	1550 (47%)	267 (49.1%)
Income	Lower	1103 (28.7%)	917 (27.8%)	186 (34.2%)
	Intermediate	1076 (28%)	928 (28.1%)	148 (27.2%)
	Higher	1076 (28%)	940 (28.5%)	136 (25%)
	Missing	587 (15.3%)	513 (15.6%)	74 (13.6%)
Educational attainment	-9 years	893 (23.2%)	738 (22.4%)	155 (28.5%)
	10-12 years	1669 (43.4%)	1430 (43.4%)	239 (43.9%)
	13 years-	1253 (32.6%)	1105 (33.5%)	148 (27.2%)
	Missing or others	27 (0.7%)	25 (0.8%)	2 (0.4%)
Working status	Never	205 (5.3%)	188 (5.7%)	17 (3.1%)
	Retired	2102 (54.7%)	1817 (55.1%)	285 (52.4%)
	Current	1053 (27.4%)	885 (26.8%)	168 (30.9%)
	Missing	482 (12.6%)	408 (12.4%)	74 (13.6%)
Marital status	Married	2898 (75.4%)	2499 (75.8%)	399 (73.4%)

	Widowed	618 (16.1%)	503 (15.3%)	115 (21.1%)
	Divorced	149 (3.9%)	132 (4%)	17 (3.1%)
	Single	128 (3.3%)	120 (3.6%)	8 (1.5%)
	Others	24 (0.6%)	22 (0.7%)	2 (0.4%)
	Missing	25 (0.7%)	22 (0.7%)	3 (0.6%)
Living arrangement	Living with someone	3129 (81.4%)	2688 (81.5%)	441 (81.1%)
	Living alone	566 (14.7%)	494 (15%)	72 (13.2%)
	Missing	147 (3.8%)	116 (3.5%)	31 (5.7%)
Preexisting disease	No	2832 (73.7%)	2440 (74%)	392 (72.1%)
	Yes	1010 (26.3%)	858 (26%)	152 (27.9%)
Self-rated health	Good	3446 (89.7%)	2965 (89.9%)	481 (88.4%)
	Bad	368 (9.6%)	310 (9.4%)	58 (10.7%)
	Missing	28 (0.7%)	23 (0.7%)	5 (0.9%)
ADL	Independent	3583 (93.3%)	3091 (93.7%)	492 (90.4%)
	Dependent	104 (2.7%)	83 (2.5%)	21 (3.9%)
	Missing	155 (4%)	124 (3.8%)	31 (5.7%)
Depression	Non-depression	3033 (78.9%)	2593 (78.6%)	440 (80.9%)
	Depression	654 (17%)	567 (17.2%)	87 (16%)
	Missing	155 (4%)	138 (4.2%)	17 (3.1%)
Population density	Metropolitan	1751 (45.6%)	1529 (46.4%)	222 (40.8%)
	Urban	1128 (29.4%)	967 (29.3%)	161 (29.6%)
	Semi-urban	478 (12.4%)	403 (12.2%)	75 (13.8%)
	Rural	485 (12.6%)	399 (12.1%)	86 (15.8%)

Participants with missing data in Internet use (2016) and hypertension (2016 and 2019) were excluded. Participants with hypertension at baseline (2016) were excluded.

(Table1-4) Associations of Internet use/frequency of Internet use/purposes of Internet use with health outcomes (depression, self-rate health, hypertension, diabetes)

Table 1-4 Baseline characteristics of participants without diabetes in 2016				
		Total (n = 5914)	Non-diabetes in 2019 (n = 5721)	Diabetes in 2019 (n = 193)
		N (%)	N (%)	N (%)
Internet use	No	2464 (41.7%)	2370 (41.4%)	94 (48.7%)
	Yes (A few times or more a month)	3450 (58.3%)	3351 (58.6%)	99 (51.3%)
	A few times a month	936 (15.8%)	914 (16%)	22 (11.4%)
	A few times a week	835 (14.1%)	813 (14.2%)	22 (11.4%)
	Almost every day	1679 (28.4%)	1624 (28.4%)	55 (28.5%)
Age	65-69	1978 (33.5%)	1911 (33.4%)	67 (34.7%)
	70-74	1703 (28.8%)	1656 (29%)	47 (24.4%)
	75-79	1323 (22.4%)	1273 (22.3%)	50 (25.9%)
	80-84	682 (11.5%)	656 (11.5%)	26 (13.5%)
	85-	228 (3.9%)	225 (3.9%)	3 (1.6%)
Sex	Female	3204 (54.2%)	3110 (54.4%)	94 (48.7%)
	Male	2710 (45.8%)	2611 (45.6%)	99 (51.3%)
Income	Lower	1700 (28.8%)	1641 (28.7%)	59 (30.6%)
	Intermediate	1656 (28%)	1605 (28.1%)	51 (26.4%)
	Higher	1584 (26.8%)	1526 (26.7%)	58 (30.1%)
	Missing	974 (16.5%)	949 (16.6%)	25 (13%)
Educational attainment	-9 years	1469 (24.8%)	1417 (24.8%)	52 (26.9%)
	10-12 years	2600 (44%)	2518 (44%)	82 (42.5%)
	13 years-	1795 (30.4%)	1739 (30.4%)	56 (29%)
	Missing or others	50 (0.9%)	47 (0.8%)	3 (1.6%)
Working status	Never	333 (5.6%)	323 (5.7%)	10 (5.2%)
	Retired	3254 (55%)	3144 (55%)	110 (57%)
	Current	1545 (26.1%)	1501 (26.2%)	44 (22.8%)
	Missing	782 (13.2%)	753 (13.2%)	29 (15%)
Marital status	Married	4395 (74.3%)	4258 (74.4%)	137 (71%)
	Widowed	1019 (17.2%)	985 (17.2%)	34 (17.6%)
	Divorced	240 (4.1%)	232 (4.1%)	8 (4.2%)

	Single	182 (3.1%)	175 (3.1%)	7 (3.6%)
	Others	43 (0.7%)	36 (0.6%)	7 (3.6%)
	Missing	35 (0.6%)	35 (0.6%)	0 (0%)
Living arrangement	Living with someone	4797 (81.1%)	4641 (81.1%)	156 (80.8%)
	Living alone	882 (14.9%)	853 (14.9%)	29 (15%)
	Missing	235 (4%)	227 (4%)	8 (4.2%)
Preexisting disease	No	2832 (47.9%)	2760 (48.2%)	72 (37.3%)
	Yes	3082 (52.1%)	2961 (51.8%)	121 (62.7%)
Self-rated health	Good	5268 (89.1%)	5097 (89.1%)	171 (88.6%)
	Bad	593 (10%)	572 (10%)	21 (10.9%)
	Missing	53 (0.9%)	52 (0.9%)	1 (0.5%)
ADL	Independent	5507 (93.1%)	5328 (93.1%)	179 (92.8%)
	Dependent	168 (2.8%)	162 (2.8%)	6 (3.1%)
	Missing	239 (4%)	231 (4%)	8 (4.2%)
Depression	Non-depression	4613 (78%)	4467 (78.1%)	146 (75.7%)
	Depression	1056 (17.9%)	1013 (17.7%)	43 (22.3%)
	Missing	245 (4.1%)	241 (4.2%)	4 (2.1%)
Population density	Metropolitan	2640 (44.6%)	2544 (44.5%)	96 (49.7%)
	Urban	1737 (29.4%)	1686 (29.5%)	51 (26.4%)
	Semi-urban	756 (12.8%)	733 (12.8%)	23 (11.9%)
	Rural	781 (13.2%)	758 (13.3%)	23 (11.9%)

Participants with missing data in Internet use (2016) and diabetes (2016 and 2019) were excluded.
Participants with diabetes at baseline (2016) were excluded.

(Table2-1) Associations of Internet use/frequency of Internet use/purposes of Internet use with health outcomes (depression, self-rate health, hypertension, diabetes)

Table 3 Associations between Internet use and health outcomes									
		Outcomes							
		Depression (n = 5631)		Self-rated health (n = 6427)		Hypertension (n = 3842)		Diabetes (n = 5914)	
		OR [95%CI]	p	OR [95%CI]	p	OR [95%CI]	p	OR [95%CI]	p
Internet use	No	Ref.		Ref.		Ref.		Ref.	
	Yes (A few times or more a month)	0.66 [0.55, 0.79]	0	0.76 [0.62, 0.92]	0.01	0.81 [0.65, 1.01]	0.06	0.71 [0.51, 0.99]	0.04
Age	65-69	Ref.		Ref.		Ref.		Ref.	
	70-74	1.06 [0.82, 1.38]	0.65	1.37 [1.08, 1.75]	0.01	1.17 [0.93, 1.48]	0.19	0.74 [0.48, 1.15]	0.18
	75-79	1.01 [0.79, 1.31]	0.92	1.71 [1.34, 2.18]	0	0.87 [0.6, 1.25]	0.45	0.96 [0.6, 1.52]	0.85
	80-84	1.46 [1.08, 1.97]	0.02	2.49 [1.84, 3.38]	0	1.46 [1, 2.13]	0.05	0.92 [0.54, 1.56]	0.75
	85-	1.55 [1.02, 2.36]	0.04	2.68 [1.78, 4.06]	0	1.43 [0.79, 2.58]	0.24	0.28 [0.08, 0.96]	0.04
Sex	Female	Ref.		Ref.		Ref.		Ref.	
	Male	1 [0.83, 1.2]	0.98	1.15 [0.97, 1.37]	0.1	1.14 [0.95, 1.37]	0.17	1.34 [0.98, 1.85]	0.07
Income	Lower	1.27 [1.01, 1.62]	0.05	1.47 [1.19, 1.82]	0	1.29 [0.99, 1.69]	0.06	0.78 [0.5, 1.22]	0.29
	Intermediate	1.28 [1.01, 1.63]	0.04	1.27 [0.97, 1.67]	0.09	1.1 [0.84, 1.45]	0.48	0.8 [0.55, 1.15]	0.22
	Higher	Ref.		Ref.		Ref.		Ref.	
	Missing	1.37 [1.03, 1.83]	0.03	1.22 [0.92, 1.61]	0.17	0.86 [0.6, 1.25]	0.43	0.58 [0.33, 1]	0.05
Educational attainment	-9 years	1.28 [1.04, 1.57]	0.02	1.08 [0.87, 1.35]	0.49	1.29 [0.99, 1.68]	0.06	1.16 [0.78, 1.73]	0.47

	10-12 years	1.09 [0.94, 1.27]	0.26	0.91 [0.73, 1.13]	0.38	1.16 [0.88, 1.53]	0.28	1.09 [0.8, 1.48]	0.6
	13 years-	Ref.		Ref.		Ref.		Ref.	
	Missing or others	1.84 [0.8, 4.25]	0.15	0.64 [0.19, 2.14]	0.47	0.5 [0.12, 2.07]	0.34	2.24 [0.62, 8.16]	0.22
Working status	Never	1.42 [0.93, 2.18]	0.11	1.37 [0.84, 2.24]	0.21	0.38 [0.22, 0.66]	0	1.11 [0.56, 2.17]	0.77
	Retired	1.07 [0.87, 1.31]	0.54	1.16 [0.9, 1.49]	0.24	0.8 [0.66, 0.97]	0.02	1.28 [0.95, 1.73]	0.1
	Current	Ref.		Ref.		Ref.		Ref.	
	Missing	1.03 [0.79, 1.33]	0.85	1.05 [0.71, 1.55]	0.8	0.86 [0.65, 1.15]	0.32	1.51 [0.93, 2.45]	0.1
Marital status	Married	Ref.		Ref.		Ref.		Ref.	
	Widowed	0.82 [0.56, 1.18]	0.28	0.87 [0.61, 1.23]	0.42	1.64 [1.17, 2.29]	0	1.4 [0.89, 2.21]	0.15
	Divorced	1.34 [0.73, 2.48]	0.35	1.19 [0.76, 1.88]	0.44	0.99 [0.56, 1.76]	0.97	1.3 [0.57, 2.99]	0.53
	Single	1.99 [1.14, 3.47]	0.02	0.89 [0.49, 1.64]	0.71	0.51 [0.25, 1.05]	0.07	1.39 [0.63, 3.1]	0.42
	Others	1.26 [0.41, 3.91]	0.68	1.09 [0.38, 3.08]	0.88	0.62 [0.13, 2.93]	0.55	7.09 [2.8, 17.97]	0
	Missing	1.87 [0.8, 4.38]	0.15	1.15 [0.48, 2.78]	0.75	0.82 [0.24, 2.75]	0.75	-	
Living arrangement	Living with someone	Ref.		Ref.		Ref.		Ref.	
	Living alone	1.1 [0.75, 1.6]	0.63	0.77 [0.55, 1.09]	0.14	0.77 [0.53, 1.13]	0.19	0.74 [0.42, 1.3]	0.29
	Missing	0.92 [0.61, 1.38]	0.67	1.1 [0.75, 1.6]	0.63	1.4 [0.96, 2.03]	0.08	1.03 [0.52, 2.01]	0.94
Preexisting disease	No	Ref.		Ref.		Ref.		Ref.	
	Yes	1.02 [0.87, 1.19]	0.83	1.47 [1.24, 1.74]	0	NA	NA	NA	NA
	Missing	1.18 [0.71, 1.95]	0.52	0.86 [0.49, 1.5]	0.59	NA	NA	NA	NA

Self-rated health	Good	Ref.		NA	NA	Ref.		Ref.	
	Bad	2.74 [2.07, 3.64]	0	NA	NA	1.1 [0.83, 1.47]	0.5	0.94 [0.61, 1.47]	0.8
	Missing	0.8 [0.4, 1.59]	0.53	NA	NA	1.19 [0.46, 3.12]	0.72	0.59 [0.08, 4.4]	0.61
ADL	Independent	Ref.		Ref.		Ref.		Ref.	
	Dependent	1.08 [0.74, 1.57]	0.7	2.22 [1.49, 3.29]	0	1.42 [0.84, 2.4]	0.19	1 [0.47, 2.16]	0.99
	Missing	0.95 [0.61, 1.48]	0.82	1.37 [0.9, 2.08]	0.14	1.47 [1, 2.15]	0.05	1.16 [0.57, 2.35]	0.68
Depression	No	NA	NA	Ref.		Ref.		Ref.	
	Yes	NA	NA	2.19 [1.82, 2.64]	0	0.84 [0.67, 1.05]	0.13	1.25 [0.84, 1.86]	0.27
	Missing	NA	NA	1.24 [0.81, 1.91]	0.32	0.67 [0.42, 1.05]	0.08	0.5 [0.19, 1.37]	0.18
Population density	Metropolitan	Ref.		Ref.		Ref.		Ref.	
	Urban	0.77 [0.63, 0.93]	0.01	1.06 [0.84, 1.34]	0.61	1.07 [0.87, 1.3]	0.53	0.77 [0.55, 1.07]	0.12
	Semi-urban	1.12 [0.87, 1.44]	0.38	1.01 [0.79, 1.29]	0.95	1.18 [0.93, 1.5]	0.19	0.77 [0.55, 1.08]	0.13
	Rural	0.89 [0.72, 1.1]	0.29	0.86 [0.62, 1.19]	0.37	1.32 [0.99, 1.74]	0.06	0.77 [0.49, 1.21]	0.26

(Table2-2) Associations of Internet use/frequency of Internet use/purposes of Internet use with health outcomes (depression, self-rate health, hypertension, diabetes)

Table 4 Associations between frequency of Internet use and health outcomes									
		Outcomes							
		Depression (n = 5631)		Self-rated health (n = 6427)		Hypertension (n = 3842)		Diabetes (n = 5914)	
		OR [95%CI]	P value	OR [95%CI]	P value	OR [95%CI]	P value	OR [95%CI]	P value
Internet use	No	Ref.		Ref.		Ref.		Ref.	
	Yes: A few times a month	0.77 [0.61, 0.97]	0.03	0.8 [0.63, 1.02]	0.08	0.8 [0.56, 1.13]	0.21	0.61 [0.37, 1.01]	0.05
	Yes: A few times a week	0.66 [0.53, 0.83]	<0.001	0.76 [0.58, 1]	0.05	0.92 [0.7, 1.2]	0.53	0.66 [0.42, 1.03]	0.07
	Yes: Almost every day	0.58 [0.46, 0.74]	<0.001	0.72 [0.57, 0.93]	0.01	0.76 [0.6, 0.96]	0.02	0.81 [0.57, 1.17]	0.27
Age	65-69	Ref.		Ref.		Ref.		Ref.	
	70-74	1.05 [0.81, 1.37]	0.7	1.37 [1.07, 1.75]	0.01	1.17 [0.93, 1.47]	0.19	0.75 [0.48, 1.16]	0.19
	75-79	1 [0.77, 1.29]	1.00	1.7 [1.34, 2.17]	<0.001	0.87 [0.6, 1.25]	0.44	0.97 [0.61, 1.54]	0.89
	80-84	1.44 [1.07, 1.95]	0.02	2.49 [1.84, 3.37]	<0.001	1.46 [1, 2.13]	0.05	0.92 [0.54, 1.58]	0.77
	85-	1.54 [1.01, 2.33]	0.04	2.67 [1.77, 4.03]	<0.001	1.43 [0.79, 2.58]	0.24	0.28 [0.08, 0.98]	0.05
Sex	Female	Ref.		Ref.		Ref.		Ref.	
	Male	1.01 [0.84, 1.21]	0.94	1.16 [0.97, 1.37]	0.1	1.15 [0.95, 1.39]	0.15	1.33 [0.97, 1.82]	0.08
Income	Lower	1.25 [0.99, 1.58]	0.06	1.46 [1.18, 1.81]	0	1.29 [0.98, 1.69]	0.07	0.8 [0.51, 1.24]	0.32
	Intermediate	1.26 [1, 1.6]	0.05	1.27 [0.96, 1.67]	0.1	1.1 [0.83, 1.45]	0.52	0.81 [0.56, 1.16]	0.25
	Higher	Ref.		Ref.		Ref.		Ref.	
	Missing	1.35 [1.02, 1.8]	0.04	1.21 [0.91, 1.61]	0.19	0.86 [0.59, 1.25]	0.44	0.58 [0.34, 1.01]	0.05
Educational attainment	-9 years	1.24 [1.01, 1.53]	0.04	1.07 [0.85, 1.34]	0.56	1.27 [0.98, 1.65]	0.07	1.2 [0.81, 1.78]	0.37
	10-12 years	1.07 [0.91, 1.26]	0.39	0.9 [0.72, 1.13]	0.36	1.15 [0.88, 1.5]	0.31	1.12 [0.81, 1.54]	0.51

	13 years-	Ref.		Ref.		Ref.		Ref.	
	Missing or others	1.81 [0.78, 4.21]	0.17	0.64 [0.19, 2.13]	0.46	0.5 [0.12, 2.07]	0.34	2.3 [0.64, 8.25]	0.2
Working status	Never	1.42 [0.92, 2.18]	0.11	1.37 [0.84, 2.24]	0.21	0.38 [0.22, 0.66]	0	1.12 [0.57, 2.19]	0.75
	Retired	1.06 [0.87, 1.31]	0.55	1.16 [0.9, 1.49]	0.25	0.8 [0.66, 0.97]	0.02	1.29 [0.96, 1.74]	0.09
	Current	Ref.		Ref.		Ref.		Ref.	
	Missing	1.02 [0.79, 1.33]	0.88	1.05 [0.71, 1.55]	0.8	0.86 [0.65, 1.15]	0.32	1.51 [0.93, 2.46]	0.09
Marital status	Married	Ref.		Ref.		Ref.		Ref.	
	Widowed	0.82 [0.57, 1.19]	0.3	0.87 [0.61, 1.23]	0.42	1.63 [1.17, 2.28]	0	1.4 [0.89, 2.2]	0.15
	Divorced	1.36 [0.73, 2.5]	0.33	1.19 [0.76, 1.88]	0.44	0.99 [0.55, 1.75]	0.96	1.29 [0.56, 2.96]	0.54
	Single	2.02 [1.16, 3.52]	0.01	0.9 [0.49, 1.65]	0.73	0.51 [0.25, 1.06]	0.07	1.38 [0.62, 3.05]	0.43
	Others	1.27 [0.41, 3.92]	0.68	1.08 [0.38, 3.08]	0.88	0.61 [0.13, 2.84]	0.53	7.13 [2.85, 17.86]	<0.001
	Missing	1.85 [0.79, 4.33]	0.16	1.16 [0.48, 2.79]	0.75	0.81 [0.24, 2.71]	0.73	-	
Living arrangement	Living with someone	Ref.		Ref.		Ref.		Ref.	
	Living alone	1.1 [0.75, 1.6]	0.64	0.77 [0.55, 1.08]	0.13	0.78 [0.53, 1.14]	0.19	0.74 [0.42, 1.3]	0.3
	Missing	0.91 [0.61, 1.36]	0.64	1.09 [0.75, 1.6]	0.64	1.4 [0.97, 2.03]	0.08	1.03 [0.53, 2.01]	0.94
Preexisting disease	No	Ref.		Ref.		NA	NA	NA	NA
	Yes	1.02 [0.87, 1.2]	0.82	1.47 [1.24, 1.74]	0	NA	NA	NA	NA
	Missing	1.18 [0.71, 1.95]	0.53	0.86 [0.49, 1.5]	0.59	NA	NA	NA	NA
Self-rated health	Good	Ref.		NA	NA	Ref.		Ref.	
	Bad	2.75 [2.07, 3.65]	<0.001	NA	NA	1.1 [0.83, 1.47]	0.5	0.94 [0.61, 1.47]	0.79

	Missing	0.8 [0.4, 1.59]	0.52	NA	NA	1.2 [0.46, 3.15]	0.71	0.59 [0.08, 4.42]	0.61
ADL	Independent	Ref.		Ref.		Ref.		Ref.	
	Dependent	1.07 [0.73, 1.56]	0.72	2.22 [1.49, 3.3]	0	1.42 [0.84, 2.4]	0.2	1.01 [0.47, 2.17]	0.99
	Missing	0.95 [0.61, 1.47]	0.8	1.37 [0.91, 2.08]	0.14	1.47 [1, 2.16]	0.05	1.16 [0.57, 2.36]	0.68
Depression	No	NA	NA	Ref.		Ref.		Ref.	
	Yes	NA	NA	2.19 [1.82, 2.63]	0	0.84 [0.67, 1.05]	0.12	1.26 [0.85, 1.88]	0.25
	Missing	NA	NA	1.24 [0.81, 1.91]	0.33	0.66 [0.42, 1.05]	0.08	0.51 [0.19, 1.37]	0.18
Population density	Metropolitan	Ref.		Ref.		Ref.		Ref.	
	Urban	0.76 [0.63, 0.92]	0.01	1.06 [0.84, 1.34]	0.61	1.06 [0.87, 1.3]	0.54	0.77 [0.55, 1.08]	0.13
	Semi-urban	1.11 [0.86, 1.43]	0.43	1 [0.78, 1.29]	0.97	1.17 [0.92, 1.5]	0.2	0.78 [0.56, 1.1]	0.16
	Rural	0.88 [0.71, 1.09]	0.24	0.86 [0.62, 1.18]	0.35	1.32 [1, 1.74]	0.05	0.78 [0.49, 1.24]	0.3

(Table2-3) Associations of Internet use/frequency of Internet use/purposes of Internet use with health outcomes (depression, self-rate health, hypertension, diabetes)

Table 5 Associations between purposes of Internet use and health outcomes

		Outcomes							
		Depression (n = 5570)		Self-rated health (n = 6355)		Hypertension (n = 3802)		Diabetes (n = 5812)	
		OR [95%CI]	P value	OR [95%CI]	P value	OR [95%CI]	P value	OR [95%CI]	P value
Purposes of Internet use	Information searching (Health and medical issues)	1.1 [0.77, 1.57]	0.61	1.23 [0.83, 1.84]	0.3	0.88 [0.62, 1.24]	0.46	0.94 [0.56, 1.57]	0.81
	Information searching (General purposes)	0.69 [0.5, 0.96]	0.03	0.67 [0.5, 0.9]	0.01	0.84 [0.62, 1.13]	0.25	1.07 [0.76, 1.52]	0.69
	Communication with friends/family	0.76 [0.62, 0.93]	0.01	0.82 [0.68, 0.99]	0.04	1.06 [0.84, 1.34]	0.64	0.8 [0.59, 1.1]	0.18
	Navigation and public transportation	0.98 [0.77, 1.25]	0.86	0.82 [0.6, 1.1]	0.19	0.99 [0.73, 1.35]	0.96	0.73 [0.48, 1.11]	0.14
	Shopping for goods and services	0.78 [0.55, 1.1]	0.15	1.33 [0.92, 1.93]	0.13	0.86 [0.6, 1.22]	0.39	0.76 [0.41, 1.42]	0.39
	Banking and financial services	0.97 [0.65, 1.46]	0.89	0.73 [0.46, 1.15]	0.17	0.98 [0.65, 1.46]	0.91	1.24 [0.81, 1.89]	0.33
	LINE, Facebook, Twitter	1.03 [0.71, 1.5]	0.86	1.14 [0.8, 1.61]	0.48	1.1 [0.76, 1.59]	0.63	1.72 [1, 2.95]	0.05
	Others	0.8 [0.54, 1.18]	0.25	1.1 [0.77, 1.58]	0.59	0.55 [0.31, 0.99]	0.05	0.9 [0.48, 1.71]	0.75
Age	65-69	Ref.		Ref.		Ref.		Ref.	
	70-74	1.05 [0.8, 1.37]	0.75	1.37 [1.08, 1.75]	0.01	1.17 [0.92, 1.48]	0.19	0.76 [0.49, 1.19]	0.23
	75-79	1.01 [0.78, 1.29]	0.97	1.66 [1.31, 2.11]	0	0.89 [0.62, 1.27]	0.51	1 [0.63, 1.57]	0.99
	80-84	1.43 [1.04, 1.95]	0.03	2.56 [1.9, 3.46]	0	1.48 [1.02, 2.17]	0.04	0.99 [0.58, 1.69]	0.97
	85-	1.5 [1.01, 2.23]	0.05	2.64 [1.72, 4.06]	0	1.56 [0.86, 2.82]	0.14	0.3 [0.09, 1.04]	0.06
Sex	Female	Ref.		Ref.		Ref.		Ref.	
	Male	1.02 [0.84, 1.24]	0.83	1.2 [1, 1.43]	0.05	1.21 [0.98, 1.48]	0.08	1.39 [1, 1.91]	0.05

Income	Lower	1.23 [0.97, 1.56]	0.09	1.43 [1.17, 1.73]	0	1.27 [0.97, 1.67]	0.09	0.78 [0.5, 1.21]	0.27
	Intermediate	1.24 [0.98, 1.58]	0.08	1.25 [0.96, 1.61]	0.09	1.1 [0.83, 1.45]	0.51	0.79 [0.55, 1.13]	0.2
	Higher	Ref.		Ref.		Ref.		Ref.	
	Missing	1.33 [0.99, 1.78]	0.06	1.21 [0.93, 1.59]	0.16	0.85 [0.59, 1.23]	0.38	0.55 [0.33, 0.93]	0.03
Educational attainment	-9 years	1.23 [1, 1.52]	0.05	1.03 [0.82, 1.3]	0.78	1.28 [0.98, 1.67]	0.07	1.22 [0.8, 1.86]	0.36
	10-12 years	1.03 [0.88, 1.21]	0.67	0.89 [0.71, 1.12]	0.33	1.14 [0.87, 1.51]	0.34	1.11 [0.79, 1.55]	0.54
	13 years-	Ref.		Ref.		Ref.		Ref.	
	Missing or others	1.87 [0.81, 4.3]	0.14	0.64 [0.2, 2.04]	0.45	0.51 [0.13, 2.06]	0.35	2.3 [0.64, 8.28]	0.2
Working status	Never	1.46 [0.95, 2.25]	0.08	1.47 [0.9, 2.41]	0.12	0.39 [0.22, 0.67]	0	1.16 [0.59, 2.26]	0.67
	Retired	1.09 [0.88, 1.36]	0.41	1.18 [0.92, 1.52]	0.19	0.8 [0.66, 0.96]	0.02	1.28 [0.94, 1.73]	0.11
	Current	Ref.		Ref.		Ref.		Ref.	
	Missing	1.02 [0.78, 1.34]	0.86	1.07 [0.73, 1.59]	0.72	0.87 [0.65, 1.16]	0.35	1.54 [0.96, 2.49]	0.08
Marital status	Married	Ref.		Ref.		Ref.		Ref.	
	Widowed	0.82 [0.56, 1.2]	0.31	0.86 [0.6, 1.23]	0.42	1.63 [1.17, 2.29]	0	1.45 [0.92, 2.29]	0.11
	Divorced	1.25 [0.68, 2.3]	0.47	1.21 [0.77, 1.91]	0.41	1.02 [0.57, 1.82]	0.94	1.38 [0.6, 3.17]	0.45
	Single	2.01 [1.13, 3.58]	0.02	0.88 [0.47, 1.62]	0.67	0.55 [0.26, 1.13]	0.1	1.48 [0.66, 3.35]	0.34
	Others	1.26 [0.42, 3.79]	0.68	1.12 [0.39, 3.22]	0.84	0.64 [0.14, 2.96]	0.56	7.23 [2.87, 18.21]	0
	Missing	1.94 [0.82, 4.6]	0.13	1.24 [0.51, 3.03]	0.63	0.8 [0.23, 2.73]	0.72	-	
Living arrangement	Living with someone	Ref.		Ref.		Ref.		Ref.	
	Living alone	1.13 [0.76, 1.67]	0.55	0.78 [0.55, 1.11]	0.17	0.75 [0.51, 1.09]	0.13	0.72 [0.4, 1.29]	0.27
	Missing	0.9 [0.6, 1.36]	0.63	0.95 [0.6, 1.49]	0.81	1.39 [0.96, 2.02]	0.08	1.05 [0.53, 2.06]	0.9

Preexisting disease	No	Ref.		Ref.		NA	NA	NA	NA
	Yes	1.01 [0.86, 1.2]	0.89	1.48 [1.24, 1.78]	0	NA	NA	NA	NA
	Missing	1.2 [0.72, 2.01]	0.48	0.91 [0.52, 1.6]	0.74	NA	NA	NA	NA
Self-rated health	Good	Ref.		NA	NA	Ref.		Ref.	
	Bad	2.73 [2.05, 3.65]	0	NA	NA	1.14 [0.86, 1.51]	0.35	0.91 [0.58, 1.43]	0.67
	Missing	0.83 [0.41, 1.67]	0.6	NA	NA	1.3 [0.5, 3.39]	0.59	0.62 [0.08, 4.71]	0.65
ADL	Independent	Ref.		Ref.		Ref.		Ref.	
	Dependent	1.11 [0.76, 1.62]	0.61	2.25 [1.52, 3.33]	0	1.33 [0.77, 2.27]	0.3	1.05 [0.49, 2.25]	0.9
	Missing	0.94 [0.6, 1.49]	0.81	1.36 [0.91, 2.05]	0.14	1.48 [0.99, 2.19]	0.05	1.19 [0.59, 2.39]	0.62
Depression	No	NA	NA	Ref.		Ref.		Ref.	
	Yes	NA	NA	2.19 [1.81, 2.64]	0	0.85 [0.68, 1.07]	0.16	1.26 [0.84, 1.89]	0.27
	Missing	NA	NA	1.22 [0.81, 1.86]	0.35	0.68 [0.43, 1.09]	0.11	0.51 [0.19, 1.37]	0.18
Population density	Metropolitan	Ref.		Ref.		Ref.		Ref.	
	Urban	0.76 [0.63, 0.92]	0.01	1.08 [0.86, 1.36]	0.52	1.05 [0.86, 1.28]	0.66	0.75 [0.55, 1.04]	0.09
	Semi-urban	1.1 [0.87, 1.38]	0.43	0.99 [0.76, 1.3]	0.95	1.18 [0.93, 1.51]	0.18	0.78 [0.56, 1.09]	0.14
	Rural	0.88 [0.71, 1.09]	0.25	0.87 [0.64, 1.19]	0.39	1.33 [1.01, 1.74]	0.04	0.75 [0.47, 1.2]	0.23

(Table1) The relationship between physical activity and use of the Internet in Japanese older adults

	Internet use group n = 3,012	Internet non-use group n = 3,945	p value
PAL* = High (n, %)	1233 (42.2)	1545 (41.6)	0.667
estimated TEE (mean, SD)	2229.54 (464.75)	2143.11 (469.01)	<0.001
Age (n, %)			<0.001
65–69	1350 (44.8)	1035 (26.2)	
70–74	929 (30.8)	1114 (28.2)	
75–79	491 (16.3)	1068 (27.1)	
80–84	203 (6.7)	541 (13.7)	
85 <	39 (1.3)	187 (4.7)	
Sex = female (n, %)	1489 (49.4)	2136 (54.1)	<0.001
Household equivalised income (Japanese Yen) (n, %)			<0.001
Less than 199	362 (12.0)	947 (24.0)	
200–399	1256 (41.7)	1549 (39.3)	
More than 400	1200 (39.8)	934 (23.7)	
missing	194 (6.4)	515 (13.1)	
Years of education (n, %)			<0.001
Less than 6 years	1 (0.0)	26 (0.7)	
6 to 9 years	329 (10.9)	1324 (33.6)	
10 to 12 years	1330 (44.2)	1721 (43.6)	
More than 13 years	1335 (44.3)	828 (21.0)	
others	8 (0.3)	18 (0.5)	
Missing	9 (0.3)	28 (0.7)	
Employment status (n, %)			<0.001
In Labor	1772 (58.8)	2414 (61.2)	
Non-labour	939 (31.2)	911 (23.1)	
Missing	301 (10.0)	620 (15.7)	
Longest career (n, %)			<0.001
Professional and technical positions	636 (21.1)	620 (15.7)	
Management	369 (12.3)	174 (4.4)	
Office work	737 (24.5)	673 (17.1)	
Sales and service	444 (14.7)	702 (17.8)	
Technical and Labor	215 (7.1)	495 (12.5)	
Agriculture, Forestry & Fishing	18 (0.6)	183 (4.6)	
Self-employed other than agriculture, forestry and fishery	53 (1.8)	109 (2.8)	
Other	160 (5.3)	314 (8.0)	
Never held a job	107 (3.6)	242 (6.1)	
Missing	273 (9.1)	433 (11.0)	
Subjective economic status (n, %)			<0.001
Financially very distressed	117 (3.9)	234 (6.0)	
Financially distressed	527 (17.5)	908 (23.1)	
Normal	1743 (58.0)	2318 (59.0)	
Somewhat comfortable	504 (16.8)	382 (9.7)	

Very comfortable	116 (3.9)	87 (2.2)	
Martial status (n, %)			<0.001
Have a spouse (including common-law relationships)	2369 (78.7)	2898 (73.5)	
Bereaved	400 (13.3)	708 (17.9)	
Separated	128 (4.2)	157 (4.0)	
Unmarried	91 (3.0)	121 (3.1)	
Others	15 (0.5)	26 (0.7)	
Missing	9 (0.3)	35 (0.9)	
Living alone or not (n, %)			<0.001
Not living alone	2527 (83.9)	3177 (80.5)	
Living alone	395 (13.1)	577 (14.6)	
Missing	90 (3.0)	191 (4.8)	
Number of cohabitants (n, %)			<0.001
1	323 (10.7)	437 (11.1)	
2	1628 (54.1)	1862 (47.2)	
3	522 (17.3)	644 (16.3)	
4	179 (5.9)	240 (6.1)	
5	92 (3.1)	176 (4.5)	
6	72 (2.4)	155 (3.9)	
7	28 (0.9)	52 (1.3)	
8	9 (0.3)	15 (0.4)	
9	3 (0.1)	0 (0.0)	
10	1 (0.0)	2 (0.1)	
11	1 (0.0)	1 (0.0)	
Missing	154 (5.1)	361 (9.2)	
GDS15 sum score (mean, SD)	2.14 (2.52)	2.94 (2.98)	<0.001
IADL sum score (13points) (mean, SD)	12.01 (1.22)	11.50 (1.72)	<0.001
Need for care and assistance (n, %)			<0.001
Do not need care or assistance	2833 (98.3)	3552 (95.9)	
Need care or assistance, but not currently receiving it	31 (1.1)	131 (3.5)	
Need care or assistance and am currently receiving it	18 (0.6)	22 (0.6)	

*** PAL of each participant was determined using the reference values for determining PAL shown in ' the Dietary Intake Standards for Japanese (2015 version)', a document of the Ministry of Health, Labor and Welfare. Since there were no respondents corresponding to the 'Low' category, we classified them into two categories, 'Middle' and 'High'.**

(Table2) The relationship between physical activity and use of the Internet in Japanese older adults

Variables		Model 1 (Crude Model)				Model 2				Model 3				Model 4			
		Estimates	Lower 95%CI	Upper 95%CI	p value	Estimates	Lower 95%CI	Upper 95%CI	p value	Estimates	Lower 95%CI	Upper 95%CI	p value	Estimates	Lower 95%CI	Upper 95%CI	p value
Internet use	Users group	99.6	77.7	121.5	<0.001	15.7	0.0	31.4	0.0494	5.0	-7.6	17.6	0.4363	4.9	-8.4	18.2	0.470
Age	70─74					-91.2	-110.1	-72.2	< 0.001	-34.5	-49.5	-19.4	< 0.001	-32.4	-47.6	-17.1	< 0.001
	75─79					-174.2	-195.0	-153.4	< 0.001	-57.4	-74.3	-40.6	< 0.001	-53.8	-71.2	-36.4	< 0.001
	80─84					-315.0	-341.7	-288.2	< 0.001	-135.2	-157.7	-112.6	< 0.001	-129.7	-153.1	-106.3	< 0.001
	85 <					-451.9	-496.0	-407.8	< 0.001	-166.9	-204.2	-129.7	< 0.001	-156.5	-194.9	-118.0	< 0.001
Sex	Female					-637.2	-652.2	-622.1	< 0.001	-215.3	-232.7	-197.9	< 0.001	-211.5	-230.5	-192.5	< 0.001
GDS15 sum score										-0.8	-3.2	1.5	0.4796	-1.8	-4.3	0.7	0.158
IADL (13points) sum score										6.9	2.5	11.3	0.0022	5.7	1.2	10.1	0.013
estimated TEE										0.7	0.6	0.7	< 0.001	0.7	0.6	0.7	< 0.001
Household equivalised income (Japanese Yen)	200─399													7.1	-11.5	25.7	0.453
	More than 400													0.6	-20.2	21.5	0.951
	missing													23.8	-1.4	48.9	0.064
Years of education	6 to 9 years													28.9	-69.4	127.2	0.564
	10 to 12 years													39.1	-59.1	137.3	0.435
	More than 13 years													41.3	-57.3	139.9	0.412
	others													135.6	-16.3	287.5	0.080
	Missing													15.0	-125.7	155.8	0.834

Employment status	Labor	11.5	-3.6	26.5	0.136
	Missing	-6.5	-28.3	15.4	0.561
Longest career	Management	5.7	-19.9	31.4	0.661
	Office work	2.1	-18.1	22.3	0.840
	Sales and service	12.7	-8.0	33.5	0.229
	Technical and Labor	22.6	-1.4	46.6	0.065
	Agriculture, Forestry & Fishing	10.6	-30.2	51.4	0.611
	Self-employed other than agriculture, forestry and fishery	2.3	-38.8	43.5	0.912
	Other	2.5	-25.3	30.2	0.861
	Never held a job	-15.1	-47.1	16.8	0.354
	Missing	17.1	-9.7	43.9	0.212
Subjective economic status	Financially distressed	-33.9	-65.0	-2.8	0.033
	Normal	-40.1	-70.5	-9.8	0.010
	Somewhat comfortable	-35.9	-70.5	-1.3	0.042
	Very comfortable	-54.9	-101.1	-8.7	0.020
Marital Status	Bereaved	-15.1	-37.0	6.9	0.180
	Separated	-20.2	-55.0	14.5	0.253
	Unmarried	-40.9	-80.8	-1.1	0.044
	Others	-42.3	-126.2	41.7	0.324
	Missing	-31.3	-125.1	62.6	0.514
Living alone or not	Living alone	20.7	-4.7	46.0	0.110

Missing	19.7	-12.8	52.2	0.236

Explanatory variables entered into each Model*

Model 2: Model 1 + Demographic factors (Age, Sex)

Model 3: Model 2 + Possible confounding factor(GDS15 sum score, IADL (13points) sum score, estimated TEE)

Model 4: Model 3 + Socioeconomic status(Household equivalised income (Japanese Yen), Years of education, Employment status, Longest career, Subjective economic status, Marial Status, Living alone or not)

* All these variables are measured in 2016

(Table1) ASSOCIATIONS BETWEEN AGE, SOCIO-ECONOMIC STRATA, LIVING ARRANGEMENT, POPULATION DENSITY AND INTERNET USE

Analysis 1 Table1: Characteristics of respondents.

		Total	At least once a week				At least once a month			
			No		Yes		No		Yes	
		n	n	%	n	%	n	%	n	%
Age(years)	65-69	5,069	2,285	45.1	2,784	54.9	1,475	29.1	3,594	70.9
	70-74	4,299	2,516	58.5	1,783	41.5	1,831	42.6	2,468	57.4
	75-79	3,279	2,341	71.4	938	28.6	1,874	57.2	1,405	42.8
	80-84	1,782	1,384	77.7	398	22.3	1,201	67.4	581	32.6
	≥85	840	761	90.6	79	9.4	707	84.2	133	15.8
Income (3 percentile)	Q1(Low)	5,335	3,961	74.2	1,374	25.8	3,259	61.1	2,076	38.9
	Q2(Middle)	4,991	2,915	58.4	2,076	41.6	2,096	42.0	2,895	58.0
	Q3(High)	4,943	2,411	48.8	2,532	51.2	1,733	35.1	3,210	64.9
Subjective social economic status	Poor	4,167	2,815	67.6	1,352	32.4	2,236	53.7	1,931	46.3
	Usual	8,801	5,382	61.2	3,419	38.8	4,086	46.4	4,715	53.6
	Rich	2,301	1,090	47.4	1,211	52.6	766	33.3	1,535	66.7
Educational attainment (years)	Low(<10)	4,215	3,470	82.3	745	17.7	2,974	70.6	1,241	29.4
	Middle(10-12)	6,623	3,919	59.2	2,704	40.8	2,850	43.0	3,773	57.0
	High(≥13)	4,369	1,855	42.5	2,514	57.5	1,227	28.1	3,142	71.9
	Others	62	43	69.4	19	30.6	37	59.7	25	40.3
Living arrangement	Living with someone	13,116	7,869	60.0	5,247	40.0	5,955	45.4	7,161	54.6
	Living alone	2,153	1,418	65.9	735	34.1	1,133	52.6	1,020	47.4
Population density	Metropolitan	6,244	3,323	53.2	2,921	46.8	2,420	38.8	3,824	61.2
	Urban	3,641	2,208	60.6	1,433	39.4	1,670	45.9	1,971	54.1
	Semi–urban	2,223	1,501	67.5	722	32.5	1,158	52.1	1,065	47.9
	Rural	3,161	2,255	71.3	906	28.7	1,840	58.2	1,321	41.8
Activity of Daily Living	Independent	13740	8136	59.2	5604	40.8	6121	44.5	7619	55.5
	In need of care but not receiving	615	537	87.3	78	12.7	482	78.4	133	21.6
	Receiving care	152	112	73.7	40	26.3	97	63.8	55	36.2
	Missing	762	502	65.9	260	34.1	388	50.9	374	49.1
Sex	Male	7,508	4,433	59.0	3,075	41.0	3,414	45.5	4,094	54.5
	Female	7,761	4,854	62.5	2,907	37.5	3,674	47.3	4,087	52.7
Marital status	Married	11,449	6,667	58.2	4,782	41.8	4,934	43.1	6,515	56.9
	Widowed	2,607	1,839	70.5	768	29.5	1,510	57.9	1,097	42.1
	Divorced	594	350	58.9	244	41.1	274	46.1	320	53.9

	Never married	458	303	66.2	155	33.8	257	56.1	201	43.9
	Others	80	62	77.5	18	22.5	58	72.5	22	27.5
	Missing	81	66	81.5	15	18.5	55	67.9	26	32.1
Employment status	Employed	3,821	1,977	51.7	1,844	48.3	1,422	37.2	2,399	62.8
	Retired/Not employed	8,660	5,301	61.2	3,359	38.8	3,991	46.1	4,669	53.9
	Never employed	844	626	74.2	218	25.8	538	63.7	306	36.3
	Missing	1,944	1,383	71.1	561	28.9	1,137	58.5	807	41.5
Depression	No	11,493	6,571	57.2	4,922	42.8	4,875	42.4	6,618	57.6
	Mild	2,466	1,765	71.6	701	28.4	1,450	58.8	1,016	41.2
	Mild to severe	708	556	78.5	152	21.5	461	65.1	247	34.9
	Missing	602	395	65.6	207	34.4	302	50.2	300	49.8

(Table2) ASSOCIATIONS BETWEEN AGE, SOCIO-ECONOMIC STRATA, LIVING ARRANGEMENT, POPULATION DENSITY AND INTERNET USE

Analysis 1 Table2: PRs for age, socio-economic strata, living arrangement and population density.

Variable		At least once a week				At least once a month			
		PR	95%CI		p	PR	95%CI		p
Age(years)	65-69	Ref.				Ref.			
	70-74	0.81	0.78	0.85	p<0.001	0.86	0.83	0.88	p<0.001
	75-79	0.60	0.56	0.63	p<0.001	0.67	0.65	0.70	p<0.001
	80-84	0.50	0.46	0.55	p<0.001	0.55	0.51	0.58	p<0.001
	≥85	0.24	0.19	0.29	p<0.001	0.29	0.25	0.34	p<0.001
Income (3 percentile)	Q3(High)	Ref.				Ref.			
	Q2(Middle)	0.90	0.86	0.93	p<0.001	0.96	0.94	0.99	0.017
	Q1(Low)	0.68	0.65	0.72	p<0.001	0.76	0.74	0.79	p<0.001
Subjective social economic status	Rich	Ref.				Ref.			
	Usual	0.86	0.83	0.90	p<0.001	0.90	0.88	0.93	p<0.001
	Poor	0.82	0.77	0.87	p<0.001	0.87	0.83	0.90	p<0.001
Educational attainment (years)	High(≥13)	Ref.				Ref.			
	Middle(10-12)	0.78	0.75	0.81	p<0.001	0.85	0.82	0.87	p<0.001
	Low(<10)	0.44	0.41	0.47	p<0.001	0.54	0.51	0.57	p<0.001
	Other	0.70	0.50	0.99	0.041	0.70	0.53	0.92	0.011
Living arrangement	Living with someone	Ref.				Ref.			
	Living alone	1.06	0.98	1.15	0.161	1.09	1.02	1.16	0.009
Population density	Metropolitan	Ref.				Ref.			
	Urban	0.89	0.85	0.93	p<0.001	0.92	0.89	0.95	p<0.001
	Semi–urban	0.75	0.70	0.79	p<0.001	0.83	0.79	0.86	p<0.001
	Rural	0.70	0.66	0.74	p<0.001	0.76	0.73	0.79	p<0.001

PR: Prevalence ratio; CI: Confidence interval; Ref.: Reference
Adjusting for sex, marital status, employment status, depression.
Income and subjective social economic status are analyzed separately.

(Table1) ASSOCIATIONS BETWEEN LIVING ARRANGEMENT, FAMILY STRUCTURE AND INTERNET USE

Analysis 2 Table1: Characteristics of respondents.

		Total	At least once a week				At least once a week			
			No		Yes		No		Yes	
		n	n	%	n	%	n	%	n	%
Living arrangement	Living alone	16,141	10,178	63.1	5,963	36.9	7,879	48.8	8,262	51.2
	Living with someone	3,071	2,113	68.8	958	31.2	1,709	55.6	1,362	44.4
Family structure	Living alone	3,071	2,113	68.8	958	31.2	1,709	55.6	1,362	44.4
	Only spouse	10,018	6,025	60.1	3,993	39.9	4,488	44.8	5,530	55.2
	Two households with son or daughter	4,132	2,902	70.2	1,230	29.8	2,415	58.4	1,717	41.6
	Other (including 3 households)	1991	1251	62.8	740	37.2	976	49.0	1015	51.0
Activity of Daily Living	Independent	17023	10589	62.2	6434	37.8	8128	47.7	8895	52.3
	In need of care but not receiving	843	741	87.9	102	12.1	673	79.8	170	20.2
	Receiving care	206	154	74.8	52	25.2	136	66.0	70	34.0
	Missing	1140	807	70.8	333	29.2	651	57.1	489	42.9
Sex	Male	8,975	5,555	61.9	3,420	38.1	4,370	48.7	4,605	51.3
	Female	10,237	6,736	65.8	3,501	34.2	5,218	51.0	5,019	49.0
Age(years)	65-69	5,967	2,832	47.5	3,135	52.5	1,865	31.3	4,102	68.7
	70-74	5,210	3,173	60.9	2,037	39.1	2,350	45.1	2,860	54.9
	75-79	4,303	3,169	73.6	1134	26.4	2,584	60.1	1,719	39.9
	80-84	2,553	2,043	80.0	510	20.0	1,784	69.9	769	30.1
	≥85	1179	1074	91.1	105	8.9	1005	85.2	174	14.8
Income (3 percentile)	Q1(Low)	5,389	4,007	74.4	1,382	25.6	3,299	61.2	2,090	38.8
	Q2(Middle)	5,013	2,932	58.5	2,081	41.5	2,111	42.1	2,902	57.9
	Q3(High)	4,967	2,422	48.8	2,545	51.2	1,740	35.0	3,227	65.0
	Missing	3,843	2,930	76.2	913	23.8	2,438	63.4	1,405	36.6
Educational attainment (years)	Low(<10)	5,884	4,913	83.5	971	16.5	4,264	72.5	1,620	27.5
	Middle(10-12)	7,998	4,894	61.2	3,104	38.8	3,610	45.1	4,388	54.9
	High(≥13)	5,085	2,295	45.1	2,790	54.9	1,550	30.5	3,535	69.5
	Others	95	71	74.7	24	25.3	59	62.1	36	37.9
	Missing	150	118	78.7	32	21.3	105	70.0	45	30.0
Population density	Metropolitan	7,455	4,188	56.2	3,267	43.8	3,100	41.6	4,355	58.4
	Urban	4,553	2,872	63.1	1,681	36.9	2,211	48.6	2,342	51.4
	Semi–urban	2,774	1,949	70.3	825	29.7	1,543	55.6	1,231	44.4
	Rural	4,430	3,282	74.1	1148	25.9	2,734	61.7	1,696	38.3

Employment status	Employed	4,568	2,469	54.0	2,099	46.0	1,819	39.8	2,749	60.2
	Retired/Not employed	10,428	6,638	63.7	3,790	36.3	5,085	48.8	5,343	51.2
	Never employed	1138	878	77.2	260	22.8	752	66.1	386	33.9
	Missing	3,078	2,306	74.9	772	25.1	1,932	62.8	1146	37.2
Depression	No	14,141	8,530	60.3	5,611	39.7	6,476	45.8	7,665	54.2
	Mild	3,182	2,334	73.4	848	26.6	1,946	61.2	1,236	38.8
	Mild to severe	948	771	81.3	177	18.7	646	68.1	302	31.9
	Missing	941	656	69.7	285	30.3	520	55.3	421	44.7

(Table2) ASSOCIATIONS BETWEEN LIVING ARRANGEMENT, FAMILY STRUCTURE AND INTERNET USE

Analysis 2 Table2: PRs for living arrangement and family structure.

At least once a week

Variable		Male				Female			
		PR	95%CI		p	PR	95%CI		p
Living arrangement	Living alone	Ref.				Ref.			
	Living with someone	1.18	1.07	1.30	0.001	0.88	0.82	0.93	p<0.001
Family structure	Living alone	Ref.				Ref.			
	Only spouse	1.22	1.10	1.34	p<0.001	0.90	0.84	0.96	0.002
	Two households with son or daughter	1.07	0.95	1.19	0.253	0.84	0.78	0.92	p<0.001
	Other (including 3 households)	1.16	1.03	1.30	0.016	0.83	0.75	0.91	p<0.001

At least once a month

Variable		Male				Female			
		PR	95%CI		p	PR	95%CI		p
Living arrangement	Living alone	Ref.				Ref.			
	Living with someone	1.19	1.11	1.29	p<0.001	0.90	0.86	0.95	p<0.001
Family structure	Living alone	Ref.				Ref.			
	Only spouse	1.23	1.14	1.33	p<0.001	0.94	0.90	0.99	0.013
	Two households with son or daughter	1.09	1.00	1.19	0.050	0.84	0.79	0.89	p<0.001
	Other (including 3 households)	1.15	1.05	1.26	0.004	0.87	0.81	0.93	p<0.001

PR: Prevalence ratio; CI: Confidence interval; Ref.: Reference
Adjusting for age, income, educational attainment, employment status, depression, population density.
Living arrangement and family structure are analyzed separately.

(Table1-1) Roles of Internet use on the associations between socioeconomic status and depression, self-rated health, hypertension, and diabetes

Table 1-1 Baseline characteristics of participants without depression in 2016

		Total (n = 4254)	Non-Depression (n = 3777)	Depression (n = 477)
		N (%)	N (%)	N (%)
Internet use	No	1464 (34.4%)	1228 (32.5%)	236 (49.5%)
	Yes (A few times or more a month)	2790 (65.6%)	2549 (67.5%)	241 (50.5%)
Age	65-69	1565 (36.8%)	1419 (37.6%)	146 (30.6%)
	70-74	1300 (30.6%)	1165 (30.8%)	135 (28.3%)
	75-79	881 (20.7%)	777 (20.6%)	104 (21.8%)
	80-84	381 (9%)	315 (8.3%)	66 (13.8%)
	85-	127 (3%)	101 (2.7%)	26 (5.5%)
Sex	Female	2044 (48.1%)	1816 (48.1%)	228 (47.8%)
	Male	2210 (52%)	1961 (51.9%)	249 (52.2%)
Income	Lower	1249 (29.4%)	1081 (28.6%)	168 (35.2%)
	Intermediate	1472 (34.6%)	1301 (34.5%)	171 (35.9%)
	Higher	1533 (36%)	1395 (36.9%)	138 (28.9%)
Educational attainment	-9 years	889 (20.9%)	749 (19.8%)	140 (29.4%)
	10-12 years	1890 (44.4%)	1696 (44.9%)	194 (40.7%)
	13 years-	1475 (34.7%)	1332 (35.3%)	143 (30%)
Working status	Never	240 (5.6%)	202 (5.4%)	38 (8%)
	Retired	2659 (62.5%)	2362 (62.5%)	297 (62.3%)
	Current	1355 (31.9%)	1213 (32.1%)	142 (29.8%)
Marital status	Married	3413 (80.2%)	3048 (80.7%)	365 (76.5%)
	Widowed	584 (13.7%)	519 (13.7%)	65 (13.6%)
	Divorced	119 (2.8%)	105 (2.8%)	14 (2.9%)
	Single	105 (2.5%)	81 (2.1%)	24 (5%)
	Others	17 (0.4%)	13 (0.3%)	4 (0.8%)
	Missing	16 (0.4%)	11 (0.3%)	5 (1.1%)
Living arrangement	Living with someone	3640 (85.6%)	3249 (86%)	391 (82%)
	Living alone	458 (10.8%)	391 (10.4%)	67 (14.1%)
	Missing	156 (3.7%)	137 (3.6%)	19 (4%)
	No	1821 (42.8%)	1625 (43%)	196 (41.1%)

Preexisting disease	Yes	2272 (53.4%)	2008 (53.2%)	264 (55.4%)	
	Missing	161 (3.8%)	144 (3.8%)	17 (3.6%)	
Self-rated health	Good	3911 (91.9%)	3511 (93%)	400 (83.9%)	
	Bad	270 (6.4%)	199 (5.3%)	71 (14.9%)	
	Missing	73 (1.7%)	67 (1.8%)	6 (1.3%)	
ADL	Independent	3995 (93.9%)	3554 (94.1%)	441 (92.5%)	
	Dependent	72 (1.7%)	57 (1.5%)	15 (3.1%)	
	Missing	187 (4.4%)	166 (4.4%)	21 (4.4%)	
Population density	Metropolitan	2024 (47.6%)	1789 (47.4%)	235 (49.3%)	
	Urban	1281 (30.1%)	1164 (30.8%)	117 (24.5%)	
	Semi-urban	539 (12.7%)	468 (12.4%)	71 (14.9%)	
	Rural	410 (9.6%)	356 (9.4%)	54 (11.3%)	

Participants with missing data in Internet use (2016), socioeconomic status (2016), and depression (2016 and 2019) were excluded

Participants with depression at baseline (2016) were excluded.

(Table1-2) Roles of Internet use on the associations between socioeconomic status and depression, self-rated health, hypertension, and diabetes

Table 1-2 Baseline characteristics of participants with good self-rated health in 2016

		Total (n = 4741)	Good self-rated health in 2019 (n = 4312)	Bad self-rated health in 2019 (n = 429)
		N (%)	N (%)	N (%)
Internet use	No	1702 (35.9%)	1488 (34.5%)	214 (49.9%)
	Yes (A few times or more a month)	3039 (64.1%)	2824 (65.5%)	215 (50.1%)
Age	65-69	1763 (37.2%)	1657 (38.4%)	106 (24.7%)
	70-74	1458 (30.8%)	1336 (31%)	122 (28.4%)
	75-79	955 (20.1%)	852 (19.8%)	103 (24%)
	80-84	431 (9.1%)	356 (8.3%)	75 (17.5%)
	85-	134 (2.8%)	111 (2.6%)	23 (5.4%)
Sex	Female	2325 (49%)	2126 (49.3%)	199 (46.4%)
	Male	2416 (51%)	2186 (50.7%)	230 (53.6%)
Income	Lower	1501 (31.7%)	1333 (30.9%)	168 (39.2%)
	Intermediate	1615 (34.1%)	1459 (33.8%)	156 (36.4%)
	Higher	1625 (34.3%)	1520 (35.3%)	105 (24.5%)
Educational attainment	-9 years	1004 (21.2%)	878 (20.4%)	126 (29.4%)
	10-12 years	2125 (44.8%)	1948 (45.2%)	177 (41.3%)
	13 years-	1612 (34%)	1486 (34.5%)	126 (29.4%)
Working status	Never	269 (5.7%)	238 (5.5%)	31 (7.2%)
	Retired	2961 (62.5%)	2673 (62%)	288 (67.1%)
	Current	1511 (31.9%)	1401 (32.5%)	110 (25.6%)
Marital status	Married	3722 (78.5%)	3376 (78.3%)	346 (80.7%)
	Widowed	676 (14.3%)	619 (14.4%)	57 (13.3%)
	Divorced	169 (3.6%)	155 (3.6%)	14 (3.3%)
	Single	135 (2.9%)	127 (3%)	8 (1.9%)
	Others	21 (0.4%)	18 (0.4%)	3 (0.7%)
	Missing	18 (0.4%)	17 (0.4%)	1 (0.2%)
Living arrangement	Living with someone	3990 (84.2%)	3621 (84%)	369 (86%)
	Living alone	579 (12.2%)	538 (12.5%)	41 (9.6%)

	Missing	172 (3.6%)	153 (3.6%)	19 (4.4%)
Preexisting disease	No	2076 (43.8%)	1927 (44.7%)	149 (34.7%)
	Yes	2520 (53.2%)	2250 (52.2%)	270 (62.9%)
	Missing	145 (3.1%)	135 (3.1%)	10 (2.3%)
ADL	Independent	4533 (95.6%)	4135 (95.9%)	398 (92.8%)
	Dependent	60 (1.3%)	45 (1%)	15 (3.5%)
	Missing	148 (3.1%)	132 (3.1%)	16 (3.7%)
Depression	Non-depression	3956 (83.4%)	3644 (84.5%)	312 (72.7%)
	Depression	649 (13.7%)	541 (12.6%)	108 (25.2%)
	Missing	136 (2.9%)	127 (3%)	9 (2.1%)
Population density	Metropolitan	2255 (47.6%)	2058 (47.7%)	197 (45.9%)
	Urban	1440 (30.4%)	1304 (30.2%)	136 (31.7%)
	Semi-urban	599 (12.6%)	546 (12.7%)	53 (12.4%)
	Rural	447 (9.4%)	404 (9.4%)	43 (10%)

Participants with missing data in Internet use (2016), socioeconomic status (2016), and self-rated health (2016 and 2019) were excluded.
Participants with bad self-rated health at baseline (2016) were excluded.

(Table1-3) Roles of Internet use on the associations between socioeconomic status and depression, self-rated health, hypertension, and diabetes

Table 1-3 Baseline characteristics of participants without hypertension in 2016				
		Total (n = 2896)	Non-Hypertension in 2019 (n = 2483)	Hypertension in 2019 (n = 413)
		N (%)	N (%)	N (%)
Internet use	No	1030 (35.6%)	854 (34.4%)	176 (42.6%)
	Yes (A few times or more a month)	1866 (64.4%)	1629 (65.6%)	237 (57.4%)
Age	65-69	1166 (40.3%)	1018 (41%)	148 (35.8%)
	70-74	872 (30.1%)	742 (29.9%)	130 (31.5%)
	75-79	544 (18.8%)	478 (19.3%)	66 (16%)
	80-84	238 (8.2%)	186 (7.5%)	52 (12.6%)
	85-	76 (2.6%)	59 (2.4%)	17 (4.1%)
Sex	Female	1442 (49.8%)	1249 (50.3%)	193 (46.7%)
	Male	1454 (50.2%)	1234 (49.7%)	220 (53.3%)
Income	Lower	941 (32.5%)	783 (31.5%)	158 (38.3%)
	Intermediate	967 (33.4%)	834 (33.6%)	133 (32.2%)
	Higher	988 (34.1%)	866 (34.9%)	122 (29.5%)
Educational attainment	-9 years	586 (20.2%)	473 (19.1%)	113 (27.4%)
	10-12 years	1270 (43.9%)	1092 (44%)	178 (43.1%)
	13 years-	1040 (35.9%)	918 (37%)	122 (29.5%)
Working status	Never	169 (5.8%)	154 (6.2%)	15 (3.6%)
	Retired	1803 (62.3%)	1557 (62.7%)	246 (59.6%)
	Current	924 (31.9%)	772 (31.1%)	152 (36.8%)
Marital status	Married	2258 (78%)	1943 (78.3%)	315 (76.3%)
	Widowed	413 (14.3%)	335 (13.5%)	78 (18.9%)
	Divorced	104 (3.6%)	90 (3.6%)	14 (3.4%)
	Single	93 (3.2%)	88 (3.5%)	5 (1.2%)
	Others	16 (0.6%)	15 (0.6%)	1 (0.2%)
	Missing	12 (0.4%)	12 (0.5%)	0 (0%)
Living arrangement	Living with someone	2427 (83.8%)	2085 (84%)	342 (82.8%)
	Living alone	368 (12.7%)	322 (13%)	46 (11.1%)
	Missing	101 (3.5%)	76 (3.1%)	25 (6.1%)
Preexisting disease	No	2136 (73.8%)	1831 (73.7%)	305 (73.9%)
	Yes	760 (26.2%)	652 (26.3%)	108 (26.2%)
	Good	2598 (89.7%)	2231 (89.9%)	367 (88.9%)

Self-rated health	Bad	278 (9.6%)	234 (9.4%)	44 (10.7%)
	Missing	20 (0.7%)	18 (0.7%)	2 (0.5%)
ADL	Independent	2725 (94.1%)	2342 (94.3%)	383 (92.7%)
	Dependent	76 (2.6%)	64 (2.6%)	12 (2.9%)
	Missing	95 (3.3%)	77 (3.1%)	18 (4.4%)
Depression	Non-depression	2343 (80.9%)	2001 (80.6%)	342 (82.8%)
	Depression	464 (16%)	400 (16.1%)	64 (15.5%)
	Missing	89 (3.1%)	82 (3.3%)	7 (1.7%)
Population density	Metropolitan	1384 (47.8%)	1201 (48.4%)	183 (44.3%)
	Urban	865 (29.9%)	744 (30%)	121 (29.3%)
	Semi-urban	369 (12.7%)	314 (12.7%)	55 (13.3%)
	Rural	278 (9.6%)	224 (9%)	54 (13.1%)

Participants with missing data in Internet use (2016), socioeconomic status (2016), and hypertension (2016 and 2019) were excluded.
Participants with hypertension at baseline (2016) were excluded.

(Table1-4) Roles of Internet use on the associations between socioeconomic status and depression, self-rated health, hypertension, and diabetes

Table 1-4 Baseline characteristics of participants without diabetes in 2016

		Total (n = 4380)	Non-Diabetes in 2019 (n = 4241)	Diabetes in 2019 (n = 139)
		N (%)	N (%)	N (%)
Internet use	No	1618 (36.9%)	1551 (36.6%)	67 (48.2%)
	Yes (A few times or more a month)	2762 (63.1%)	2690 (63.4%)	72 (51.8%)
Age	65-69	1596 (36.4%)	1546 (36.5%)	50 (36%)
	70-74	1315 (30%)	1278 (30.1%)	37 (26.6%)
	75-79	903 (20.6%)	869 (20.5%)	34 (24.5%)
	80-84	417 (9.5%)	401 (9.5%)	16 (11.5%)
	85-	149 (3.4%)	147 (3.5%)	2 (1.4%)
Sex	Female	2230 (50.9%)	2173 (51.2%)	57 (41%)
	Male	2150 (49.1%)	2068 (48.8%)	82 (59%)
Income	Lower	1429 (32.6%)	1384 (32.6%)	45 (32.4%)
	Intermediate	1489 (34%)	1443 (34%)	46 (33.1%)
	Higher	1462 (33.4%)	1414 (33.3%)	48 (34.5%)
Educational attainment	-9 years	955 (21.8%)	919 (21.7%)	36 (25.9%)
	10-12 years	1985 (45.3%)	1926 (45.4%)	59 (42.5%)
	13 years-	1440 (32.9%)	1396 (32.9%)	44 (31.7%)
Working status	Never	265 (6.1%)	258 (6.1%)	7 (5%)
	Retired	2784 (63.6%)	2687 (63.4%)	97 (69.8%)
	Current	1331 (30.4%)	1296 (30.6%)	35 (25.2%)
Marital status	Married	3377 (77.1%)	3272 (77.2%)	105 (75.5%)
	Widowed	664 (15.2%)	642 (15.1%)	22 (15.8%)
	Divorced	162 (3.7%)	158 (3.7%)	4 (2.9%)
	Single	135 (3.1%)	131 (3.1%)	4 (2.9%)
	Others	26 (0.6%)	22 (0.5%)	4 (2.9%)
	Missing	16 (0.4%)	16 (0.4%)	0 (0%)
Living arrangement	Living with someone	3657 (83.5%)	3539 (83.5%)	118 (84.9%)
	Living alone	568 (13%)	549 (13%)	19 (13.7%)
	Missing	155 (3.5%)	153 (3.6%)	2 (1.4%)
Preexisting disease	No	2136 (48.8%)	2083 (49.1%)	53 (38.1%)
	Yes	2244 (51.2%)	2158 (50.9%)	86 (61.9%)
Self-rated health	Good	3924 (89.6%)	3803 (89.7%)	121 (87.1%)
	Bad	419 (9.6%)	402 (9.5%)	17 (12.2%)

	Missing	37 (0.8%)	36 (0.9%)	1 (0.7%)
ADL	Independent	4122 (94.1%)	3991 (94.1%)	131 (94.2%)
	Dependent	117 (2.7%)	113 (2.7%)	4 (2.9%)
	Missing	141 (3.2%)	137 (3.2%)	4 (2.9%)
Depression	Non-depression	3505 (80%)	3398 (80.1%)	107 (77%)
	Depression	737 (16.8%)	707 (16.7%)	30 (21.6%)
	Missing	138 (3.2%)	136 (3.2%)	2 (1.4%)
Population density	Metropolitan	2056 (46.9%)	1986 (46.8%)	70 (50.4%)
	Urban	1326 (30.3%)	1287 (30.4%)	39 (28.1%)
	Semi-urban	570 (13%)	552 (13%)	18 (13%)
	Rural	428 (9.8%)	416 (9.8%)	12 (8.6%)

Participants with missing data in Internet use (2016), socioeconomic status (2016), and diabetes (2016 and 2019) were excluded.
Participants with diabetes at baseline (2016) were excluded.

Table 2 Effects of Internet use on the associations between socioeconomic status and health outcomes

		Depression (n = 4254)				Self-rated health (n = 4741)			
		Model 1		Model 2		Model 1		Model 2	
		OR [95%CI]	P value	OR [95%CI]	P value	OR [95%CI]	P value	OR [95%CI]	P value
Income	Lower	1.28 [1, 1.64]	0.05	1.19 [0.93, 1.52]	0.16	1.48 [1.14, 1.93]	<0.00	1.41 [1.08, 1.84]	0.01
	Intermediate	1.29 [0.99, 1.68]	0.06	1.27 [0.98, 1.64]	0.07	1.37 [1.03, 1.81]	0.03	1.35 [1.02, 1.8]	0.04
	Higher	Ref.		Ref.		Ref.		Ref.	
Educational attainment	-9 years	1.52 [1.18, 1.95]	<0.00	1.3 [1.03, 1.65]	0.03	1.25 [0.95, 1.63]	0.11	1.13 [0.86, 1.49]	0.39
	10-12 years	1.04 [0.84, 1.29]	0.72	0.98 [0.79, 1.21]	0.85	0.99 [0.76, 1.28]	0.94	0.95 [0.74, 1.23]	0.70
	13 years-	Ref.		Ref.		Ref.		Ref.	
Working status	Never	1.35 [0.85, 2.14]	0.20	1.31 [0.82, 2.1]	0.26	1.19 [0.72, 1.98]	0.49	1.17 [0.71, 1.94]	0.54
	Retired	0.91 [0.73, 1.13]	0.38	0.92 [0.74, 1.15]	0.47	1.08 [0.83, 1.42]	0.57	1.1 [0.84, 1.44]	0.49
	Current	Ref.		Ref.		Ref.		Ref.	
Internet use	No	-		Ref.		-		Ref.	
	Yes (A few times or more a month)	-		0.60 [0.5, 0.72]	<0.00	-		0.72 [0.57, 0.91]	0.01

In model 1, age, sex, marital status, living arrangement, preexisting disease (hypertension, diabetes, cardiovascular disease, stroke, cancer, respiratory disease), self-rated health, ADL, depression, and population density were including.
In model 2, Internet use was added.

Cont. Table 2 Effects of Internet use on the associations between socioeconomic status and health outcomes

		Hypertension (n = 2896)				Diabetes (n = 4380)			
		Model 1		Model 2		Model 1		Model 2	
		OR [95%CI]	P value	OR [95%CI]	P value	OR [95%CI]	P value	OR [95%CI]	P value
Income	Lower	1.37 [1.01, 1.86]	0.04	1.35 [0.99, 1.83]	0.06	0.83 [0.53, 1.32]	0.44	0.78 [0.49, 1.23]	0.28
	Intermediate	1.15 [0.86, 1.55]	0.34	1.15 [0.86, 1.54]	0.35	0.87 [0.57, 1.32]	0.52	0.86 [0.56, 1.31]	0.48
	Higher	Ref.		Ref.		Ref.		Ref.	
Educational attainment	-9 years	1.57 [1.22, 2.03]	<0.00	1.51 [1.14, 2]	<0.00	1.46 [0.97, 2.21]	0.07	1.22 [0.79, 1.88]	0.36
	10-12 years	1.19 [0.9, 1.57]	0.22	1.17 [0.88, 1.56]	0.28	1.12 [0.77, 1.64]	0.55	1.04 [0.72, 1.51]	0.82
	13 years-	Ref.		Ref.		Ref.		Ref.	
Working status	Never	0.4 [0.21, 0.73]	<0.00	0.39 [0.21, 0.73]	<0.00	1.16 [0.52, 2.59]	0.73	1.12 [0.5, 2.52]	0.79
	Retired	0.76 [0.62, 0.92]	0.01	0.76 [0.62, 0.93]	0.01	1.42 [0.99, 2.02]	0.06	1.44 [1, 2.06]	0.05
	Current	Ref.		Ref.		Ref.		Ref.	
Internet use	No	-		Ref.		-		Ref.	
	Yes (A few times or more a month)	-		0.88 [0.67, 1.14]	0.33	-		0.59 [0.41, 0.86]	0.01

In model 1, age, sex, marital status, living arrangement, preexisting disease (hypertension, diabetes, cardiovascular disease, stroke, cancer, respiratory disease), self-rated health, ADL, depression, and population density were including.
In model 2, Internet use was added.

(Table1) Internet access and subsequent risks for the decline in Instrumental and higher -level Activities of Daily Living (ADL) among Japanese older people: Association with socio-economic conditions

Table1-1 Characteristics of participants

		IADL (independence) n=1,501		IADL (decline) n=762		The Instrumental Self-Maintenance subscale (independence) n=5,273		The Instrumental Self-Maintenance subscale (decline) n=260		The Intellectual Activity subscale (independence) n=3,692		The Intellectual Activity subscale (decline) n=651		The Social Role subscale (independence) n=2,116		The Social Role subscale (decline) n=812	
		n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%
Internet use	No	442	29.4	266	34.9	1,915	36.3	143	55.0	1,233	33.4	269	41.3	698	33.0	314	38.7
	Yes	1,059	70.6	496	65.1	3,358	63.7	117	45.0	2,459	66.6	382	58.7	1,418	67.0	498	61.3
Household equivalised income （Million yen）	Low	407	27.1	244	32.0	1,801	34.2	94	36.2	1,074	29.1	238	36.6	653	30.9	266	32.8
	Middle	513	34.2	259	34.0	1,754	33.3	93	35.8	1,282	34.7	221	33.9	719	34.0	272	33.5
	High	581	38.7	259	34.0	1,718	32.6	73	28.1	1,336	36.2	192	29.5	744	35.2	274	33.7
Sex	Male	496	33.0	357	46.9	2,411	45.7	179	68.8	1,745	47.3	338	51.9	748	35.3	406	50.0
	Female	1,005	67.0	405	53.1	2,862	54.3	81	31.2	1,947	52.7	313	48.1	1,368	64.7	406	50.0
Age	65-69	546	36.4	280	36.7	1,923	36.5	68	26.2	1,288	34.9	237	36.4	759	35.9	277	34.1
	70-74	502	33.4	221	29.0	1,616	30.6	64	24.6	1,134	30.7	188	28.9	700	33.1	233	28.7
	75-79	313	20.9	173	22.7	1,114	21.1	63	24.2	795	21.5	126	19.4	453	21.4	193	23.8
	80-84	121	8.1	67	8.8	494	9.4	40	15.4	373	10.1	77	11.8	172	8.1	76	9.4
	85-	19	1.3	21	2.8	126	2.4	25	9.6	102	2.8	23	3.5	32	1.5	33	4.1
Body Mass Index	Underweigh	93	6.2	45	5.9	328	6.2	20	7.7	243	6.6	30	4.6	117	5.5	46	5.7

	t																
（kg/㎡）	Normal	1,068	71.2	542	71.1	3,779	71.7	182	70.0	2,661	72.1	469	72.0	1,512	71.5	574	70.7
	Overweight	299	19.9	159	20.9	1,001	19.0	47	18.1	689	18.7	133	20.4	428	20.2	171	21.1
	Obese	32	2.1	9	1.2	109	2.1	6	2.3	71	1.9	12	1.8	41	1.9	13	1.6
	Missing	9	0.6	7	0.9	56	1.1	5	1.9	28	0.8	7	1.1	18	0.9	8	1.0
Marital status	Married	1,170	77.9	607	79.7	4,023	76.3	213	81.9	2,910	78.8	514	79.0	1,629	77.0	634	78.1
	Widowed	247	16.5	103	13.5	818	15.5	32	12.3	541	14.7	86	13.2	363	17.2	117	14.4
	Divorced	42	2.8	28	3.7	212	4.0	8	3.1	115	3.1	23	3.5	65	3.1	34	4.2
	Never married	35	2.3	21	2.8	172	3.3	3	1.2	99	2.7	20	3.1	44	2.1	23	2.8
	Others	5	0.3	1	0.1	25	0.5	2	0.8	12	0.3	5	0.8	8	0.4	2	0.2
	Missing	2	0.1	2	0.3	23	0.4	2	0.8	15	0.4	3	0.5	7	0.3	2	0.2
Educational attainment	Low(>10)	243	16.2	156	20.5	1,122	21.3	92	35.4	629	17.0	171	26.3	436	20.6	172	21.2
(years)	Middle(10-12)	717	47.8	347	45.5	2,403	45.6	91	35.0	1,687	45.7	288	44.2	977	46.2	383	47.2
	High(≤13)	533	35.5	258	33.9	1,718	32.6	76	29.2	1,358	36.8	189	29.0	693	32.8	254	31.3
	Other	4	0.3	1	0.1	11	0.2	1	0.4	8	0.2	1	0.2	6	0.3	2	0.2
	Missing	4	0.3	0	0.0	19	0.4	0	0.0	10	0.3	2	0.3	4	0.2	1	0.1
Occupational status	Employed	417	27.8	215	28.2	1,428	27.1	62	23.8	988	26.8	173	26.6	612	28.9	229	28.2
	Retired/Not employed	841	56.0	441	57.9	2,970	56.3	149	57.3	2,135	57.8	370	56.8	1,143	54.0	470	57.9
	Never employed	78	5.2	32	4.2	274	5.2	16	6.2	180	4.9	37	5.7	109	5.2	33	4.1
	Missing	165	11.0	74	9.7	601	11.4	33	12.7	389	10.5	71	10.9	252	11.9	80	9.9
Living arrangement	Living with someone	1,255	83.6	640	84.0	4,321	81.9	232	89.2	3,103	84.0	547	84.0	1,759	83.1	679	83.6

	Living alone	182	12.1	97	12.7	753	14.3	17	6.5	452	12.2	82	12.6	265	12.5	103	12.7
	Missing	64	4.3	25	3.3	199	3.8	11	4.2	137	3.7	22	3.4	92	4.3	30	3.7
Diseases being treated	No	663	44.2	308	40.4	2,210	41.9	89	34.2	1,575	42.7	254	39.0	926	43.8	330	40.6
	Yes	769	51.2	422	55.4	2,842	53.9	161	61.9	1,950	52.8	375	57.6	1,100	52.0	448	55.2
	Missing	69	4.6	32	4.2	221	4.2	10	3.8	167	4.5	22	3.4	90	4.3	34	4.2
Activities of Daily Living	Independence	1,420	94.6	724	95.0	4,937	93.6	228	87.7	3,461	93.7	609	93.5	1,985	93.8	764	94.1
	Not independence	20	1.3	8	1.0	94	1.8	18	6.9	70	1.9	10	1.5	34	1.6	14	1.7
	Missing	61	4.1	30	3.9	242	4.6	14	5.4	161	4.4	32	4.9	97	4.6	34	4.2

Table1-2 Characteristics of participants

		IADL (independence) n=1,501		IADL (decline) n=762		The Instrumental Self-Maintenance subscale (independence) n=5,273		The Instrumental Self-Maintenance subscale (decline) n=260		The Intellectual Activity subscale (independence) n=3,692		The Intellectual Activity subscale (decline) n=651		The Social Role subscale (independence) n=2,116		The Social Role subscale (decline) n=812	
		n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%
Self - rated health	Good	1,392	92.7	703	92.3	4,716	89.4	203	78.1	3,332	90.2	562	86.3	1,952	92.2	738	90.9
	Poor	80	5.3	51	6.7	458	8.7	52	20.0	289	7.8	78	12.0	126	6.0	63	7.8
	Missing	29	1.9	8	1.0	99	1.9	5	1.9	71	1.9	11	1.7	38	1.8	11	1.4

Depression	No	1,344	89.5	665	87.3	4,269	81.0	175	67.3	3,111	84.3	511	78.5	1,874	88.6	695	85.6
	Yes	116	7.7	82	10.8	824	15.6	76	29.2	458	12.4	123	18.9	184	8.7	100	12.3
	Missing	41	2.7	15	2.0	180	3.4	9	3.5	123	3.3	17	2.6	58	2.7	17	2.1
Receiving emotional support	No	9	0.6	17	2.2	241	4.6	17	6.5	122	3.3	31	4.8	14	0.7	21	2.6
	Yes	1,478	98.5	736	96.6	4,976	94.4	238	91.5	3,527	95.5	612	94.0	2,087	98.6	781	96.2
	Missing	14	0.9	9	1.2	56	1.1	5	1.9	43	1.2	8	1.2	15	0.7	10	1.2
Receiving instrumental support	No	28	1.9	15	2.0	240	4.6	7	2.7	113	3.1	24	3.7	42	2.0	19	2.3
	Yes	1,454	96.9	740	97.1	4,970	94.3	250	96.2	3,535	95.7	622	95.5	2,047	96.7	787	96.9
	Missing	19	1.3	7	0.9	63	1.2	3	1.2	44	1.2	5	0.8	27	1.3	6	0.7
Frequency of meeting friends	<once/week	426	28.4	320	42.0	2,504	47.5	157	60.4	1,670	45.2	338	51.9	621	29.3	370	45.6
	≥ once/week	1,060	70.6	433	56.8	2,700	51.2	98	37.7	1,973	53.4	306	47.0	1,477	69.8	430	53.0
	Missing	15	1.0	9	1.2	69	1.3	5	1.9	49	1.3	7	1.1	18	0.9	12	1.5
Population density	Metropolitan	603	40.2	368	48.3	2,528	47.9	107	41.2	1,765	47.8	301	46.2	818	38.7	396	48.8
	Urban	483	32.2	216	28.3	1,587	30.1	84	32.3	1,085	29.4	207	31.8	688	32.5	228	28.1
	Semi-urban	260	17.3	85	11.2	665	12.6	38	14.6	508	13.8	76	11.7	348	16.4	98	12.1
	Rural	155	10.3	93	12.2	493	9.3	31	11.9	334	9.0	67	10.3	262	12.4	90	11.1

(Table2) Internet access and subsequent risks for the decline in Instrumental and higher -level Activities of Daily Living (ADL) among Japanese older people: Association with socio-economic conditions

	IADL					The Instrumental Self-Maintenance subscale					The Intellectual Activity subscale					The Social Role subscale				
	IRR	95%Cl		P		IRR	95%Cl		P		IRR	95%Cl		P		IRR	95%Cl		P	
2016 Independence （Household equivalised income）	0.91	0.79	1.04	0.171		0.66	0.49	0.88	0.005	*	0.87	0.75	1.01	0.060		0.87	0.75	1.00	0.055	
2016 Independence （Subjective social economic status）	0.89	0.79	1.00	0.042	*	0.62	0.48	0.81	0.000	**	0.84	0.74	0.96	0.009	*	0.85	0.74	0.97	0.013	*

(Table1) Impact of Internet use frequency on IADL change among Japanese healthy older adults: Difference in difference analysis using JAGES 3 years' panel data

Table1 Characteristics of the respondents

	Year	2016	2019	p-value
	N	6840	6840	
Internet use frequency	several times in a month or less	4000 (58.5%)	4000 (58.5%)	1.00
	2-3 times/week or more	2840 (41.5%)	2840 (41.5%)	
Socially isolated*	No	3507 (51.3%)	3507 (51.3%)	1.00
	Yes	3333 (48.7%)	3333 (48.7%)	
Sex	Men	3247 (47.5%)	3247 (47.5%)	1.00
	Women	3593 (52.5%)	3593 (52.5%)	
Age group (by 5 years)	65-59	2312 (33.8%)	634 (9.3%)	<0.001
	70-74	2044 (29.9%)	2389 (34.9%)	
	75-79	1536 (22.5%)	2062 (30.1%)	
	80-84	723 (10.6%)	1204 (17.6%)	
	85-	225 (3.3%)	551 (8.1%)	
IADL5s_, mean (SD)**		4.9 (0.4)	4.9 (0.6)	<0.001
Marital status	married	5152 (75.3%)	4858 (71.0%)	<0.001
	widowed	1117 (16.3%)	1357 (19.8%)	
	separated	267 (3.9%)	263 (3.8%)	
	unmarried	222 (3.2%)	205 (3.0%)	
	others	45 (0.7%)	50 (0.7%)	
	missing	37 (0.5%)	107 (1.6%)	
Income (Quantile)	low	1934 (28.3%)	1910 (27.9%)	<0.001
	middle	1933 (28.3%)	2157 (31.5%)	
	high	1874 (27.4%)	1965 (28.7%)	
	missing	1099 (16.1%)	808 (11.8%)	
Educational attainment	other	20 (0.3%)	38 (0.6%)	<0.001
	-9yrs	1669 (24.4%)	1620 (23.7%)	
	10-12yrs	2978 (43.5%)	2956 (43.2%)	
	13-yrs	2135 (31.2%)	2099 (30.7%)	
	missing	38 (0.6%)	127 (1.9%)	
Employment status	never	363 (5.3%)	446 (6.5%)	<0.001
	past worker	3753 (54.9%)	4304 (62.9%)	
	current worker	1814 (26.5%)	1581 (23.1%)	

missing	910 (13.3%)	509 (7.4%)

* Social isolation was defined by the frequency of meeting people: those who met people less than once a week in 2016 were defined as socially isolated.

** IADL was calculated by asking those questions (Yes: 1 point, No: 0 point). :
1) Do you use public transportation such as buses or trains by yourself (including a private car)?
2) Do you usually buy food or commodities by yourself?
3) Do you prepare the meal by yourself?
4) Do you pay bills by yourself?
5) Do you draw or put money from your bank account?

(Table2) Impact of Internet use frequency on IADL change among Japanese healthy older adults: Difference in difference analysis using JAGES 3 years' panel data

Table 2. Results from multivariable analysis

Outcome: IADL 5 points

Model1		**Before**	**95% CI**		**After**	**95% CI**		**p**
	Control	4.89	4.87	4.90	4.82	4.81	4.84	0.001
	Treated	4.95	4.93	4.97	4.93	4.91	4.94	
Model2		**Before**	**95% CI**		**After**	**95% CI**		**p**
	Control	4.89	4.88	4.91	4.83	4.82	4.85	0.001
	Treated	4.94	4.93	4.96	4.92	4.90	4.94	
Model3		**Before**	**95% CI**		**After**	**95% CI**		**p**
	Control	4.90	4.88	4.91	4.83	4.82	4.85	0.001
	Treated	4.94	4.92	4.96	4.92	4.90	4.93	

Model1: Age and sex adjusted