The use of wearables and health apps and the willingness to share self-collected data among older adults

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ABSTRACT

Objectives: The aim of this study was to examine the extent to which older adults utilize mobile health tracking tools in everyday life and their willingness to share the collected health-related data with doctors, health insurance companies, or research institutions.
Methods: This study used a survey to assess mobile device use (smartphone, tablet, fitness tracker, and smartwatch), health app use (e.g., health insurance apps, fitness apps), and willingness to share health-related data in 1,149 Swiss adults aged $\geq$ 65 years.
Results: 75.0% of the participants used at least one mobile device; 22.9% used health-related apps. Younger individuals and those with a strong interest in new technology had a higher likelihood of using health apps. Participants were more often willing to share their data with doctors than with health insurance companies or researchers; this willingness was also influenced by an affinity for technology.
Discussion: These results support the promotion of mHealth adoption among older adults by developers and policymakers.

Introduction

The acceptance and use of current information and communication technologies (ICTs), such as mobile devices (e.g., smartphones), have become a key societal theme across all life domains. Although ICT usage levels are high in Europe and most other developed countries, there is a persistent digital divide between younger (aged < 65 years) and older age groups (aged $\geq$ 65 years) [1,2]. This gap between younger and older adults can also be found in the use of tablets and fitness trackers [3], smartwatches [4], and mobile health apps [5]. While mobile devices and health-related apps can be good tools for health tracking [6,7], little is known about the current everyday life use of mobile devices and apps for collecting and sharing health-related data among people aged 65 years and older. Furthermore, it is not well known whether older people who are using mobile devices and health-related apps are willing to share their self-collected data with medical institutions (doctors or hospitals), health insurance companies, or research institutions.

The tracking and documentation of one's own health status and physical activity are one way of monitoring and motivating oneself to engage in a healthy lifestyle. Wearable tracking technologies, such as smartwatches and other wristband sensors (e.g., fitness trackers), and applications on smartphones and tablets have become popular for the mobile

tracking of parameters of health and well-being [8]. Although the use of tracking technologies and applications has been found to have positive effects on health behavior and well-being among older adults [9], knowledge regarding the potential benefits and drawbacks of mobile health tracking remains limited [10–12]. Furthermore, to date, the research on tracking technologies has underrepresented the everyday life use of mobile health apps in specific population groups, such as older adults [13]. However, older adults, in particular, might benefit from innovative mobile health approaches, such as physical activity tracking, as an appropriate level of physical activity contributes to healthier aging processes in a life stage of age-related health restrictions and multimorbidity [e.g., 14]. Moreover, an increasing number of older individuals have already begun using wearables and health apps [3].

Health-related data are becoming increasingly relevant for gerontological research. This is highlighted by the theoretical model of healthy aging proposed by the World Health Organization [15], which conceptualizes healthy aging as an ongoing interaction between a person's characteristics and those of the environment. The WHO's definition of health assumes that biological factors, individual characteristics, individual activities, and environmental conditions systematically interact within each person to produce the stabilization of functional health. As such, measuring and understanding healthy aging requires access to

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data collected by older adults on their own devices. However, considerations of the future of healthy aging research beg the question of whether older users of mobile tracking devices are willing to share their recorded data with scientists. Furthermore, self-collected health data from older adults can assist health professionals (e.g., doctors, medical personnel) in providing older individuals with a better care plan to manage, for example, chronic diseases. However, only a few studies have focused on the issue of the general population's willingness to share self-collected health data [16–21]. A major drawback of these studies is that the analyses were based either on a younger sample or dealt with small non-representative sample sizes. To the best of our knowledge, no study to date has investigated, in a nationally representative sample, the willingness of individuals aged 65 years and older to share such data.

Therefore, the aim of this study was to examine the extent to which older adults aged 65 years and over are (1) using mobile health tracking tools (i.e., smartphones, tablets, fitness trackers, and smartwatches); (2) using health-related smartphone apps; and (3) willing to share the data from these devices and apps with doctors, health insurance companies, or researchers.

Methods

Data

For this study, a survey comprising a sample of older Swiss adults aged ≥ 65 was made available for secondary analysis [22]. This survey originally examined the Internet use of older adults in Switzerland, including an assessment of information about mobile devices and health-related apps. In August and September of 2019, 1,149 people aged ≥ 65 were interviewed from all the language regions (Italian: n = 109; French: n = 261; German: n = 779) of Switzerland. Computer-assisted telephone interviews (CATI) were used, supplemented by a paper-and-pencil survey for households without a telephone connection. A standardized questionnaire with multiple-choice questions was used. A random sample of the permanent resident population of Switzerland aged ≥ 65 was selected using the AZ-Direct database (address pool based on phone book entries). There were no restrictions on upper age, current Internet use, nationality, or type of housing. The response rate was 42.6%. All the participants provided verbal informed consent, and the study was conducted according to the guidelines of the Ethics Committee of University of Zurich. The interview (telephone-based interview) had an average length of 28.2 minutes. Participants were not compensated in any way for participating. The interviews were conducted by an established swiss survey company. About 20 interviewers worked on the project; all of whom were individual trained.

Measures

First, the participants were asked about the use and frequency of use of mobile devices (i.e., smartphone, tablet, fitness tracker, and smartwatch) in order to track and collect health-related information in their everyday life. Each device yielded a binary variable (1 = ownership; 0 = no ownership). To collect data on the frequency of use, the response options were "daily", "weekly", "monthly", and "rarely (less than monthly)".

Second, participants who used the Internet ("onliners") were asked to "Please indicate whether you use the following apps or functions on a mobile device (e.g., smartphone, tablet)." Participants who did not use the Internet ("offliners") were addressed as follows: "Mobile technology offers the possibility to collect and store health information. Please indicate whether you would like to try the following apps or functions (i.e., health insurance apps, apps for measuring vital functions, fitness apps, apps for communication with medical personnel, apps for medication reminders) on a mobile device (e.g., smartphone, tablet)". The response options for the onliners were "I currently use it", "I have used it before", "I have never used it but would try it", and "I have never

used it and would not want to try it". The response options for offliners were "I would like to try it" and "I would not want to try it". Two binary variables were calculated out of these two variables, separating the information on the current use of health-related apps (1 = "I currently use it" (onliners only), 0 = all other answers) from interest in their use (1 = "I would like to try it" (onliners and offliners), 0 = all other answers).

Third, the participants were asked about their willingness to share their self-recorded health-related data: "If you use, or would use, one of the previously mentioned health apps, to what extent would you be willing to share your data with the following professionals or organizations via the app?": a) doctors or hospitals, b) health insurance companies, and c) (public) research institutions. The answers were collected using a 5-point Likert-scale format (1 = "not willing to share" to 5 = "fully willing to share"). Two dummy-variables were calculated out of this information in order to subdivide the evaluation: people who are rather or very willing to share (values 4 and 5) vs. all other people (values 1 to 3).

A set of predictor variables established in previous research [3,5] was considered in order to explain the use of mobile devices and health-related apps and the willingness to share the self-collected data. The following socio-demographic variables were included in the analyses: gender (1 = female; 0 = male), age (in years), education (1 = compulsory education; 2 = secondary level; 3 = tertiary level), monthly household income (1 = under "Swiss Francs" CHF 4,001; 2 = CHF 4,001–8,000; 3 = > CHF 8,000), living situation (1 = living alone; 0 = not living alone), and residential area (1 = rural area; 0 = non-rural area). Similar to previous research [21], interest in new technology was measured by a self-report question "I'm strongly interested in new technology" measured on a 5-point Likert scale (1 = "does not apply at all" to 5 = "applies fully"). To measure satisfaction with personal health, a self-report question ("My health is still very good for my age") was used and measured on a 5-point Likert scale (1 = "does not apply at all" to 5 = "applies fully"). The full questionnaire in German is available [22].

Data analysis

SPSS (version 26) was used for the statistical analyses. In addition to descriptive analyses, six binary logistic regression analyses were performed to evaluate significant mobile device and health-related app use predictors at standard explanation levels, including standard demographic factors (age, gender, education, income), factors related to the participants' living situations and health (living alone, living in rural areas, subjective health), and information about the participants' affinity for technology (interest in technology). Three linear regressions (separated by type of professional/organization: doctors or hospitals, health insurance companies, and research institutions) were conducted to analyze, in a multivariate format, predictors of the willingness to share self-collected health-related data via mobile devices.

Results

Sample description

The sample (1,149 people aged ≥ 65) included a good representation of older adults living in private households across all age groups ≥ 65 years, although there was a marginal underrepresentation of those ≥ 85 years old: In our sample, 91.5% were 65 to 84 years old, and 8.5% were 85 years old or older (the Swiss official population relation is 86.0%/14.0%). The respondents ranged from 65 to 101 years of age, with a mean age of 74.1 years (SD: 6.69). Altogether, 51.0% of the sample were female and 49.0% male (the Swiss 65+ population relation is 55.6%/44.4%). Within the sample, 33.6% of the participants had a tertiary education. Most of them lived with someone (69.1%) in a non-rural area of Switzerland (85.2%). Furthermore, 80.2% (n = 922) used the Internet (called "onliners"), while 19.8% (n = 227) did not (called

Table 1

Mobile health applications.

Apps	Only Onliners (people who use the Internet)				Only Offliners (people who do not use the Internet)	
	I currently use it	I have used it before	I have never used it but would like to try	I have never used it and would not like to try	I would like to try	I would not like to try
	%	%	%	%	%	%
Health insurance apps	12.7	7.9	18.2	61.3	18.0	82.0
Apps for measuring/collecting vital functions (e.g., blood sugar, pulse, calories)	5.4	4.0	20.3	70.3	16.7	83.3
Fitness apps (e.g., pedometer, sports activities)	17.8	9.3	12.4	60.4	10.3	89.7
Apps for communication with medical personnel	2.1	1.6	24.4	71.8	12.9	87.1
Apps for medication reminders	1.4	1.3	23.6	73.8	17.2	82.8

"offliners"); therefore, more participants use the internet than do not use it (χ^2 (1, N = 1149) = 766.64, p < .001).

Use of mobile devices and health-related apps

Regarding the use of mobile devices, 68.7% of the sample stated that they had a smartphone, 43.1% owned a tablet, 7.6% owned a digital fitness tracker (such as a wristband to track activities digitally), and 3.3% owned a smartwatch. Across all types of devices, 75.0% of the participants used at least one mobile device, and 25.0% did not use a device at all. The majority of those who used one or more mobile devices used it daily. For example, 80.7% of the smartphone users used this device daily. However, the daily use of tablets, fitness trackers, and smartwatches was around 60%. Of those participants who used at least one mobile device, 47.4% used one, 44.7% used two, 6.6% used three, and 1.3% used all four types of devices. The participants in the sample used an average of 1.6 devices.

Fitness apps (17.8%) were the most frequently used apps among onliners (n = 922), and 18% of offliners indicated that they would be interested in using a health insurance app (see Table 1). Apps for communicating with medical personals were the least frequently used apps (2.1%) among onliners, while offliners reported that fitness apps (10.3%) were the least interesting apps to try. Overall, few participants (among the onliners) used the listed apps, with non-use ranging from 61.3 to 73.8%. After merging onliners and offliners, 22.9% reported using a health-related app, and 40.4% were interested in their use.

At the multivariate level, age, income, and interest in technology were the only significant predictors of smartphone use (Table 2). A larger number of younger participants, those with higher incomes, and those with higher levels of affinity for technology were more likely to be smartphone users compared to those who were older, had lower levels of income, and had a lower affinity for technology. The model for tablet use revealed that age and interest in technology were significant predictors; people of a younger age and those who reported having a greater interest in technology were more likely to be tablet users. The models for fitness tracker and smartwatch use revealed that only interest in technology was a significant predictor; participants with a greater interest in new technologies were more often fitness tracker and smartwatch users.

Age and interest in technology were significant predictors of health-related app use; younger participants and those who were particularly interested in technology were more often health-related app users (Table 2). When we included only those who indicated that they were using at least one of the four mobile devices (smartphone, tablet, fitness tracker, or smartwatch), only interest in new technologies was a significant predictor (OR = 1.758, p = 0.001). Age, living area, and interest in technology were significant predictors for those who did not use, but were interested in using, health-related apps; younger participants, those living in non-rural areas, and those who were interested in technology were more often interested in health-related apps.

Willingness to share data

In terms of the entire sample, more people indicated that they would share their self-collected health-related data with their doctors or hospitals (45.6%) than they would with health insurance companies (29.2%) or research institutions (31.1%) (Table 3). Mobile device users were significantly more open to sharing their data with medical or research institutions than non-users of mobile devices. Further, people who used or were interested in health-related apps were significantly more willing to share their data than those who did not use them or were not interested in them. Participants who used mHealth apps before (n = 170) were also willing to share they data (doctors: 55.6%, health insurance companies: 36.1%, research institutions: 37.4%).

In addition to examining the willingness to share health-related data from mobile devices, we used linear regression models to assess the predictors of this willingness (Table 4). The first model (doctors or hospitals) revealed that only income and interest in technology were significant predictors; people who reported being interested in technology and those with higher incomes were more likely to be willing to share their data with medical institutions. The second model (health insurance) was statistically significant and revealed that only interest in technology was a significant predictor: those who reported being interested in technology were more likely to be willing to share their data with health insurance companies. The last model (research) revealed that education and interest in technology were significant predictors; people who reported being interested in technology and those who had obtained a higher education qualification were more likely to be willing to share their data with research institutions.

Discussion

The aim of the study was to add to a growing research field that addresses mobile health app use among older adults and these adults' willingness to share self-collected data. A major but not unexpected finding was that older adults reported a substantial level of smartphone (68.7%) and tablet (43.1%) use. Nevertheless, the same group of older adults showed fairly low levels of fitness tracker (7.6%), smartwatch (3.3%), and health-related (22.9%) app use. In addition, the study showed that a large number of participants were willing to share the health-related data on their mobile devices with doctors or hospitals (45.6%) or research institutions (31.1%).

This study's first research question addressed the use of mobile devices that make it possible for older adults to track, collect, and share their health-related data. Compared to an older study [3], which was also conducted in Switzerland, an increasing trend in smartphone (2016: 45.7%) and tablet (2016: 35.2%) use among people aged 65 years and older was visible in the present study. Therefore, many older adults have the tools to use health-related apps, a trend also found in other studies [13]. However, our study showed that mobile device use was lower

Table 2
Predicting device and app use based on binary logistic regression analysis.

Predictors	Smartphone OR	Tablet OR	Fitness Tracker OR	Smartwatch OR	*Health App* OR	*Interested in Health App* OR
Age	.870***	.933***	.966	.954	.940***	.955***
Female (ref. male)	1.058	1.175	.874	.457	.868	.992
Tertiary education (ref. lower)[1]	1.388	1.022	.590	.675	1.076	.872
Income > CHF 8,000 (ref. lower)[2]	1.718*	.915	.978	1.836	1.324	1.107
Living alone (ref. not living alone)	.811	.793	.828	.919	.906	1.073
Rural area (ref. non-rural area)	.867	.989	1.565	1.318	.871	.567**
High subjective health (ref. lower health)[3]	1.227	.902	1.162	1.202	.892	1.247
High interest in technology (ref. lower interest)[4]	3.424***	1.877***	2.546***	4.637**	2.139***	1.336*
Model fit	CS = 212.400; p < .001; df = 8; NR^2 = 0.301; n = 903	CS = 65.441; p < .001; df = 8; NR^2 = 0.094; n = 895	CS = 21.621; p = .006; df = 8; NR^2 = 0.059; n = 899	CS = 28.483; p < .001; df = 8; NR^2 = 0.123; n = 899	CS = 61.142; p < .001; df = 8; NR^2 = 0.097; n = 905	CS = 33.593; p < .001; df = 8; NR^2 = 0.049; n = 905

Notes: Independent variables:
[1] Education (1 = tertiary, 0 = secondary or primary level);
[2] Household income (1 = over CHF 8,000, 0 = under CHF 8,000);
[3] Self-rated health (1 = values 4 "is more likely to apply" and 5 "applies fully", 0 = values 1 to 3);
[4] Interest in technology (1 = values 4 "is more likely to apply" and 5 "applies fully", 0 = values 1 to 3). CS = chi square; NR^2 = Nagelkerke's R^2;
* p < 0.05;
** p < 0.01;
*** p < 0.001; OR = odds ratio.

Table 3
Willingness to share self-collected health-related data.

Means of Willingness	All	All	Mobile device users	Non-mobile device users	People who currently use health apps	People who do not currently use health apps	People who would like to use health apps	People who would not like to use health apps
N	1149	1149	862	287	263	886	464	685
	High willingness to share (%)	*M*	*M [SD]*	*M [SD]*	*M [SD]*	*M [SD]*	*M [SD]*	*M [SD]*
Doctors or hospitals	45.6†	2.99	3.07 [1.72]**	2.72 [1.75]**	3.42 [1.66]***	2.85 [1.73]***	3.56 [1.58]***	2.57 [1.72]***
Health insurance	29.2††	2.45	2.49 [1.61]*	2.32 [1.57]	2.69 [1.64]**	2.38 [1.58]**	2.81 [1.59]***	2.19 [1.56]***
Research	31.1†††	2.55	2.64 [1.62]**	2.27 [1.55]**	2.83 [1.65]**	2.46 [1.58]**	2.94 [1.57]***	2.27 [1.58]***

Note: T-Test:
* p < 0.05;
** p < 0.01;
*** p < 0.001; High willingness to share only includes those who answered '4' and '5' on the Likert scales. Chi-square test:
† p < 0.05;
†† p < 0.01;
††† p < 0.001

Table 4
Predicting willingness to share self-collected health-related data based on linear regression analysis.

Predictors	Doctors or Hospitals Beta	Health Insurance Beta	Research Beta
Age	-.027	.003	-.005
Female (ref. male)	-.061	-.073	-.068
Education[1]	.068	.001	.112**
Income[2]	.086*	.013	.045
Living alone (ref. not living alone)	-.032	-.014	.029
Rural area (ref. non-rural area)	-.016	-.035	-.013
Subjective health[3]	-.063	-.032	-.007
Interest in technology[4]	.079*	.090*	.090***
Mobile device users (ref. non-users of mobile devices)	.011	.002	.050
Model fit	*F* (9, 835) = 4.697; p < .001; corrected R^2 = .038	*F* (9, 835) = 2.013; p = .035; corrected R^2 = .011	*F* (9, 823) = 4.828; p < .001; corrected R^2 = .040

Notes: Independent Variables:
[1] Education (3 = tertiary, 2 = secondary, 1 = primary level);
[2] Household income (4 = over CHF 8,000, 3 = 4,001–8,000, 2 = 2,000–4,000, 1 = under CHF 2,000);
[3] Subjective health (1 "does not apply at all" to 5 "fully applies");
[4] Interest in technology (1 "does not apply at all" to 5 "fully applies").
* p < 0.05;
** p < 0.01;
*** p < 0.001.

among older adults aged 80 and older, the age group that would potentially benefit the most from mobile health interventions [10].

Age was a significant predictor of smartphone and tablet use, whereas interest in technology was a significant predictor of all mobile devices. This underscores the importance of individuals' own perceptions of technology. The importance of interest in technology in the use of modern mobile devices among older adults has also been found in other studies [2,3].

The second research question addressed the use of and interest in health-related apps. The study showed that of the sample of people aged 65 years and older, 22.9% used at least one health-related app, with 40.4% being interested in their use. This level of health app use is low, and given the high use of smartphones and tablets in this population and the potential for health apps to improve health and behavioral outcomes [23], there should be efforts aimed at increasing health app use among older adults. Younger people and those who reported an interest in technology were more likely to use health apps. Studies show that app literacy skills are important for uptake a smartphone app for health-related use; therefore, potential barriers in the skills among older adults have to be addressed [24]. Similar results for using health apps were found in another study [3]; however, further research is needed to evaluate the individual needs for health apps among older adults [8,10].

The final research question addressed the willingness of older adults to share self-collected health-related data. The study revealed that a considerable number of older adults were willing to share their data. This willingness to share was higher for doctors or hospitals than it was with research institutions or health insurance companies. Nevertheless, research institutions also received a high positive response, thereby corroborating the results of another Swiss study [25]. Participants who already used mobile devices and health-related apps or were interested in their use were more open to sharing their data compared to those who did not have a mobile device, did not use one, or did not have an interest in the use of health-related apps. Likewise, people with a higher interest in technology, a higher income, and a higher education were more willing to share their health-related data. While these outcomes seem logical and intuitive, we were not aware of other studies with which we could compare these outcomes, hence the need for more research in this area.

In order to use participants' self-recorded data, discussions need to be held around issue of practical data and sharing management as well as around legal, ethical, social, and technical framework conditions [11]. This discussion should also include issues such as informed consent, data privacy, data security, and data ownership [26]. These concerns may require new models of participant involvement, with the goal of creating a trusted relationship between data providers and institutions working with data.

Strengths and limitations

This study's findings are based on a sample of 1,149 Swiss residents aged 65 years and older. We showed the everyday life use of mobile devices for health tracking and the willingness to share data, both of which represent empirical findings that were hitherto missing from the literature.

However, every study comes with limitations, and ours is no exception. The data only provided a cross-sectional view of the phenomenon under investigation. As it is likely that there will be further increases in mobile device and health-related app use among older individuals, the current findings may not reflect future trends. Due to the limited scope of the questionnaire, no other data were collected in relation to the use of mobile devices and health apps or data sharing (e.g., motivations for using/not using these devices and apps) or data on important background factors—such as technological knowledge, history of use, breadth of daily use, opinion on data sharing, and privacy preferences —were unavailable. Furthermore, the effect size of the regression analyses for willingness to share own data (see Table 4) is limited – especially

for health insurance–, nevertheless our analyses include important variables. However, there is a need for studies with a wider range of variables and longitudinal designs to examine this topic in greater detail.

Conclusion

The present findings show a breadth and diversity of mobile device (smartphone, tablet, fitness tracker, and smartwatch) use among older adults. Although use of smartphones and tablets is increasing in this population, the use of fitness trackers and health apps has remained low, as the latter are used for health-related apps, even by those who own a smartphone or tablet. Furthermore, a substantial proportion of older adults were willing to share their self-recorded data with doctors/hospitals or researchers. The findings also indicate small barriers to sharing these data in terms of socio-demographic variables (i.e., education, income) and affinity for technology but not in relation to age, gender, or self-rated health.

Declaration of Competing Interests

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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