

# Public perceptions and engagement in mHealth: a European survey on attitudes toward health apps use and data sharing

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## Abstract

This study investigates public perceptions and engagement with mobile health (mHealth) across eight European countries: Italy, the Netherlands, France, Germany, Spain, Poland, Romania, and Hungary. The focus is on attitudes toward health app usage and data sharing, addressing data privacy and security concerns while highlighting generational and educational differences. A cross-sectional survey was conducted with 6581 participants from the selected countries. The survey assessed current usage of health apps, interest in future use, willingness to share health data, and concerns about data privacy. Demographic factors such as age, education level, and geographical location were analyzed to determine their influence on mHealth engagement. The survey revealed that 21.87% of respondents currently use health apps, while 42.71% expressed interest in future use. Regarding data sharing, 52.82% were willing to share health data with healthcare providers, and 25.48% with public and private research institutions. However, concerns about data misuse (72.34%) and hacking (63.68%) were prevalent. Significant generational differences emerged, with older generations showing lower adoption rates of health apps. Education level was a key factor; individuals with tertiary education were more likely to use health apps and demand transparency. The findings emphasize the need for targeted strategies to improve digital literacy, address privacy concerns, and ensure equitable access to mHealth technologies across Europe. Tailored interventions are essential to bridge generational and educational gaps in mHealth engagement while fostering trust in data security measures.

## Introduction

Mobile Health (mHealth) is a transformative approach leveraging mobile devices, such as smartphones and wearables, to enhance medical and public health practices. This encloses several types of health apps, such as patient education apps, medication reminders, and telemedicine apps, that have seen a significant rise in recent years [1]. This has been accompanied by an increased adoption of electronic health records (EHRs), comprehensive digital systems [2] used by healthcare providers to store, manage, and access patients' medical information [3, 4]. Integrated with EHRs are patient portals, online applications that allow patients access to their health information on medical records, schedule appointments, and securely communicate with health professionals [5].

mHealth and EHRs depend on patients' consent for the sharing of health data for professionals and third parties. User-centric health data sharing safeguards users' privacy while also fostering trust [6]. Users support health data sharing, provided that there is transparency in data control, access, and purpose of use [7], and research-oriented apps, especially when data are handled by state-funded or governmental institution [8]. Primary health data use pertains to its sharing for individual benefit, distinguishing it from the secondary use for research and policymaking purposes [9]. Collective involvement and individual participation leads to improved research outcomes [10].

Previous studies have addressed some determinants and predictors of health app adoption and data sharing, in individual countries or small samples [11]. The “European network staff eXchange for integrating precision health in the Health Care Systems” (ExACT) project disseminated a cross-sectional survey involving 6581 participants from eight European countries: Italy, the Netherlands, France, Germany, Spain, Poland, Romania, and Hungary, investigating their attitudes toward personalized medicine, mHealth, and health data sharing. This research builds on earlier studies, including the Your DNA Your Say (YDYS) project and an Italian survey addressed to the general public [12, 13]. This study explores the European population's comprehension and perspectives regarding health apps and health data sharing, investigating the role of social generations [14, 15].

## Methods

### Questionnaire

A 37-question web questionnaire (available in the [Supplementary File](#)) was designed. Researchers hired the private company YouGov to disseminate the survey using YouGov's polling platform (<https://yougov.co.uk/about/panel-methodology>). The survey was distributed over a period of 2 weeks in April 2023. Participants were invited based on demographic information to reflect the population

distribution of their respective countries in terms of gender, age, and education level. Ethical approval for this study was obtained from the Policlinico Universitario ‘Agostino Gemelli’ Ethics Committee in Rome (ID 5047) and Amsterdam UMC (reference 2022.0214). The survey’s design and delivery methods have been comprehensively described in a previous publication [16]. In this study, we analyze six questions targeting mHealth (Questions 16–21).

### Development of composite indicators

In alignment with the methodology previously employed in other analogous surveys [13, 17, 18], we developed four specific indicators. “Current Health App Usage” is a dichotomous classification of current app users versus non-users. “Indicator for positive attitudes toward using health apps and data sharing” is a composite score (0–3 points) from questions about app usage intention and data sharing preferences, with scores  $\geq 2$  indicating positive attitudes. “Higher Information Requests” is a binary indicator based on the number of information types requested before app use, with a 25% cutoff threshold between high and low information requests. “Distrustful Attitude toward Health Apps” is a binary classification based on the number of perceived risks, using a 25% cutoff threshold. All indicators are detailed in Table 1.

### Data analysis

The statistical analysis was performed using STATA 18.0 software (Stata Corporation, College Station, TX, USA).

We applied descriptive statistics to analyze the results, using absolute frequencies and percentages for categorical variables and means and standard deviations (SDs) for continuous variables.

To investigate the association between the indicators detailed in the previous section and gender, social generation, geographical region, and education, we applied multivariable logistic regression models [19]. Social generation categories were determined based on the following cutoffs: 1928–45 for the Silent Generation, 1946–64 for Baby Boomers, 1965–80 for Generation X, 1981–96 for Millennials, and 1997–2005 for Generation Z, in line with the cutoffs of the Pew Research Center [20]. Education levels were dichotomized as having

achieved tertiary education or not. The geographical area was categorized as follows: Eastern Europe (Poland, Hungary, and Romania); Southern Europe (Italy and Spain), and Central Europe (the Netherlands, Germany, and France). Each variable was examined by univariable analysis and was included in the multivariable logistic model when the  $P$  values were  $<.15$ . The influence of the independent variables on each binary outcome investigated was expressed as odds ratios (ORs) and 95% confidence interval (CI).

### Ethics approval and consent to participate

Ethical approval for this study was obtained from the Policlinico Universitario ‘Agostino Gemelli’ Ethics Committee in Rome (ID 5047) and Amsterdam UMC (reference 2022.0214).

All participants were informed about the purpose of the study and their rights as participants, including the voluntary nature of their involvement. Consent was obtained prior to participation, ensuring that respondents understood their data would be used for research purposes while maintaining confidentiality and anonymity. Participants were also made aware of their right to withdraw from the study at any time without any consequences.

## Results

### Demographics

The total number of respondents was 6581, with females comprising 52.55% of the sample. The age distribution ranged from 18 to 89 years (mean = 48.5 years, median = 49 years, SD = 15.96 years). The participants’ demographics are detailed in Table 2.

### Interest in using health apps

Precisely, 21.87% of the respondents were already using health apps, whereas 42.71% expressed interest in future use despite not currently engaging with these technologies (Table 3). Spain stands out with the highest percentage of current users of health apps at 29.51%, whereas France had the lowest (14.29%). Italy featured with the highest percentage of respondents who might be interested in using

**Table 1.** Components of the indicators<sup>a</sup>

Indicator	Questions	Coding
Current health app usage	<ul style="list-style-type: none"> <li>• Would you be interested in using personal healthcare apps monitoring your health (e.g. heart rate, exercise, response to medications)?</li> </ul>	<ul style="list-style-type: none"> <li>• Yes, I already use such apps → Current User</li> <li>• Yes, I might use such apps in the future/No, I am not interested/Don’t know → Non-user</li> </ul>
Indicator for positive attitudes toward using health apps and data sharing	<ul style="list-style-type: none"> <li>• Would you be interested in using personal healthcare apps monitoring your health (e.g. heart rate, exercise, response to medications)? (0–1)</li> <li>• If it were possible in your country to share the data from your personal health apps with your medical record/health portal so your healthcare provider or doctor would have access, would you be willing to share your data? (0–1)</li> <li>• And would you be willing to share the data from your personal health apps with research institutes or biobanks? (0–1)</li> </ul>	<p>The cutoff for positive or negative attitudes toward using health apps and data sharing was set at 67%.</p> <ul style="list-style-type: none"> <li>- Positive attitudes if <math>&gt; 2/3</math></li> <li>- Negative attitudes if <math>\leq 2/3</math></li> </ul>
Higher information requests	<ul style="list-style-type: none"> <li>• What information would you like to be provided to you before using these health apps? Please select all that apply. (0–7)</li> </ul>	<ul style="list-style-type: none"> <li>• 0–2 requested information → Low requested information</li> <li>• 3–7 requested information → High requested information</li> </ul>
Distrustful attitude toward health apps	<ul style="list-style-type: none"> <li>• Which, if any, of the following do you perceive as potential risks related to sharing your data in health apps? Please select all that apply. (0–8)</li> </ul>	<ul style="list-style-type: none"> <li>• 0–2 perceived potential risks → Low potential risks perceived</li> <li>• 3–8 perceived potential risks → High potential risks perceived</li> </ul>

a: In the Questions column, the italic number in brackets indicates the score assigned to each question.

**Table 2.** Demographic and general information

Demographic information (N = 6581)	No.	%
Gender		
Male	3123	47.5
Female	3458	52.5
Age (years)	Average = 48.5	SD = 16.0
Social generation		
Generation Z	715	10.86
Millennials	1747	26.55
Generation X	2050	31.15
Baby Boomers	1954	29.69
Silent Generation	115	1.75
Achieved tertiary education		
No	4086	62.1
Yes	2495	37.9
Country		
France	1008	15.3
Germany	1009	15.4
Hungary	510	7.7
Italy	1022	15.5
Netherlands	1012	15.4
Poland	509	7.7
Romania	508	7.7
Spain	1003	15.3
Geographic area		
Central Europe	3029	46.03
Eastern Europe	1527	23.20
Southern Europe	2025	30.77

health apps in the future, at 51.17%, whereas the Netherlands had the lowest (32.04%). Those not interested in using health apps were the most represented category among respondents from Germany (36.47%), with Hungary having the least uninterested respondents (14.51%) ([Supplementary Material](#)).

### Sharing data from health apps with patient portals and research institutes or biobanks

When asked whether they would share the data from their personal health apps with their medical record or health portal for their healthcare provider or physician to have access, most (52.82%) responded affirmatively ([Table 3](#)). Romania (62.40%) had the most respondents open to sharing their data, and France (29.07%) showed the most unwilling respondents ([Supplementary Material](#)).

Respondents' willingness to share personal health app data with research institutes or biobanks varies depending on whether it is a public or private institution. Precisely, 25.48% are willing to share with both public and private organizations; conversely, 22.32% would share their data only with public research institutions, and 8.98% would share exclusively with private entities ([Table 3](#)). Different countries show fluctuating levels of willingness ([Supplementary Material](#)).

### Requested information and transparency for the use of health apps

When investigating information deemed relevant before using health apps, the most emphasized detail was data usage and access (52.59%) and a clear description of the app's purposes (46.06%) followed by the right to delete personal data (44.02%) and by details on privacy policies (43.69%) and data storage (43.29%). Information on data portability to other devices or platforms and the release of information about the developers were less frequently considered relevant (29.11% and 23.10%, respectively) ([Table 3](#)).

### Perceived potential risks connected to health apps

The most perceived risk related to sharing data from health apps is data misuse (72.34%), including data being used for personal identification, for discriminatory purposes by the government, for health-related stigma (e.g. on the workplace or in obtaining an

**Table 3.** Interest in using health apps for health monitoring and data sharing

Would you be interested in using personal healthcare apps monitoring your health (e.g. heart rate, exercise, response to medication)?	No.	%
Yes, I already use such apps	1439	21.87
Yes, I might use such apps in the future	2811	42.71
No, I am not interested	1569	23.84
Don't know	762	11.58
If it were possible in your country to share the data from your personal health apps with your medical record/health portal so your healthcare provider or doctor would have access, would you be willing to share your data?	No.	%
Yes	3476	52.82
No	1514	23.01
Don't know	1591	24.18
Would you be willing to share the data from your personal health apps with research institutes or biobanks?	No.	%
Yes, only public	1469	22.32
Yes, only private	591	8.98
Yes, both	1677	25.48
No	1409	21.41
Don't know	1435	21.81
Requested information related to the use of health apps (multiple-select questions)	No.	%
Data usage and access	3461	52.59
Description of the app's purposes	3031	46.06
Right to delete personal data	2897	44.02
Privacy policies details	2875	43.69
Data storage information	2849	43.29
Data portability to other devices/platforms	1916	29.11
Information about the developers	1520	23.10
Other information	93	1.41
Number of citizens perceiving data hacking, being wrongfully reported, or being misused, in connection to the use of health apps use	No.	%
Data misuse	4761	72.34
Data hacking	4191	63.68
Data being wrongfully reported	2607	39.61

insurance), or for commercial gain. Following closely is the perception of data being hacked (63.68%) and used for unauthorized purposes or leading to identity theft. Finally, perceived risks included data being wrongfully reported or, in the case of genetic data, being linked to a crime (39.61%) ([Table 3](#)).

### Predictors of current health app usage

The probability of using health apps is negatively associated with older social generations. This trend becomes more pronounced with each successive older generation: Generation X (OR 0.74, 95% CI 0.60–0.90), Baby Boomers (OR 0.54, 95% CI 0.44–0.66), and the Silent Generation (OR 0.47, 95% CI 0.27–0.81). Geographical differences also play a significant role. Compared to respondents from Central Europe, those from Eastern Europe are more likely to use health apps (OR 1.47, 95% CI 1.26–1.70), as are respondents from Southern Europe (OR 1.40, 95% CI 1.22–1.61). Additionally, individuals with tertiary education are more likely to use health apps (OR 1.41, 95% CI 1.25–1.59) ([Table 4](#)).

### Predictors of positive attitudes toward using health apps and data sharing

Females show lower odds of displaying positive attitudes (OR 0.82, 95% CI 0.73–0.92). The Silent Generation is more likely to have positive attitudes toward the use of health apps and data sharing (OR 2.38, 95%

**Table 4.** Predictors of current health app usage, positive attitudes toward health apps use and data sharing, higher information requests, and a distrustful attitude toward health apps in Europe

Predictors of current health app usage	
Predictor	OR (95% CI)
Gender ( <i>reference = Male</i> )	
Female	1.12 (0.99–1.26)
Social generation ( <i>reference = Generation Z</i> )	
Millennials	0.87 (0.71–1.06)
Generation X	0.74 (0.60–0.90)
Baby Boomers	0.54 (0.44–0.66)
Silent Generation	0.47 (0.27–0.81)
Geographical area ( <i>reference = Central Europe</i> )	
Eastern Europe	1.47 (1.26–1.70)
Southern Europe	1.40 (1.22–1.61)
Education level ( <i>reference = Education level below tertiary</i> )	
Tertiary education	1.41 (1.24–1.58)
Predictors of positive attitudes toward using health apps and data sharing	
Predictor	OR (95% CI)
Gender ( <i>reference = Male</i> )	
Female	0.82 (0.73–0.92)
Social generation ( <i>reference = Generation Z</i> )	
Millennials	0.95 (0.78–1.17)
Generation X	0.90 (0.74–1.09)
Baby Boomers	1.13 (0.92–1.38)
Silent Generation	2.38 (1.36–4.16)
Geographical area ( <i>reference = Central Europe</i> )	
Eastern Europe	1.72 (1.48–1.98)
Southern Europe	1.99 (1.73–2.27)
Education level ( <i>reference = Education level below tertiary</i> )	
Tertiary education	1.21 (1.07–1.36)
Predictors of higher information requests	
Predictor	OR (95% CI)
Gender ( <i>reference = Male</i> )	
Female	1.15 (1.04–1.27)
Social generation ( <i>reference = Generation Z</i> )	
Millennials	1.12 (0.94–1.35)
Generation X	1.57 (1.31–1.87)
Baby Boomers	2.11 (1.77–2.52)
Silent Generation	1.61 (1.07–2.40)
Geographical area ( <i>reference = Central Europe</i> )	
Eastern Europe	1.45 (1.28–1.65)
Southern Europe	1.18 (1.05–1.33)
Education level ( <i>reference = Education level below tertiary</i> )	
Tertiary education	1.61 (1.45–1.78)
Predictors of a distrustful attitude toward health apps	
Predictor	OR (95% CI)
Gender ( <i>reference = Male</i> )	
Female	1.13 (1.02–1.24)
Social generation ( <i>reference = Generation Z</i> )	
Millennials	1.31 (1.09–1.56)
Generation X	1.89 (1.59–2.26)
Baby Boomers	2.45 (2.05–2.92)
Silent Generation	2.19 (1.47–3.27)
Education level ( <i>reference = Education level below tertiary</i> )	
Tertiary education	1.49 (1.34–1.65)

CI 1.36–4.16). Respondents from Eastern Europe have significantly higher odds of displaying positive attitudes toward health app use and data sharing than those from Central Europe (OR 1.72, 95% CI 1.48–1.98) as those from Southern Europe, with an OR of 1.99 (95% CI 1.73–2.27). Tertiary education is associated with higher odds of displaying positive attitudes, with an OR of 1.21 (95% CI 1.07–1.36). The results for this section are reported in [Table 4](#).

### Predictors of higher information requests

Compared to Generation Z, individuals from older generations were more likely to request information, with the likelihood increasing

progressively from Generation X (OR 1.57, 95% CI 1.31–1.87) to Baby Boomers (OR 2.11, 95% CI 1.77–2.52), and then slightly decreasing in the Silent Generation (OR 1.61, 95% CI 1.07–2.40). Females are more likely to request additional information than males (OR 1.15, 95% CI 1.04–1.27). Furthermore, individuals with higher education levels are more likely to request more information before using health apps (OR 1.61, 95% CI 1.45–1.78) ([Table 4](#)).

### Predictors of a distrustful attitude toward health apps

Compared to Generation Z, individuals from older generations were more likely to have a distrustful attitude toward health apps. Specifically, Baby Boomers had an OR of 2.45 (95% CI 2.05–2.92), and the Silent Generation had an OR of 2.19 (95% CI 1.47–3.27). Females had an OR of 1.13 (95% CI 1.02–1.24), and individuals with tertiary education had an OR of 1.49 (95% CI 1.34–1.65).

## Discussion

Our study comprehensively overviews public perceptions and engagement in mHealth technologies across eight European countries.

### Generational differences in technology adoption

Younger generations demonstrate greater enthusiasm for adopting mHealth. Wellness apps have garnered significant traction among younger demographics, with younger, healthier individuals more inclined to share certain health information, such as weight, diet, and lifestyle data [21].

In contrast, health app usage among older generations remains considerably lower, highlighting an underutilization of mHealth potential in managing chronic conditions, prevalent among older demographics [22].

Our findings suggest that older adults of the Silent Generation exhibit a greater propensity to embrace mHealth than Generation Z. This could be attributed to increasing awareness of health concerns among older adults, leading to a more significant perceived benefit in utilizing health apps and sharing health data to maintain well-being. They also demonstrate concerns about potential risks associated with health app usage, which should be addressed with education and reassurance regarding data privacy and security [23].

### Educational and geographical disparities

The current study and prior research agree that higher education levels are associated with greater mHealth adoption and positive data-sharing attitudes [11, 13]. However, this study extends existing knowledge by linking education to both adoption and a greater demand for transparency and detailed information regarding app functionality. Citizens with a tertiary level of education use health apps more frequently, as previously found in the literature [24], and are more likely to share their data with health portals. These trends suggest greater knowledge of the associated benefits and better digital literacy [25].

Achieving tertiary education is a positive predictor of using health apps and is strongly associated with a generally positive attitude toward them and data sharing. This suggests that the general public's positive attitudes toward mHealth and data sharing are positively influenced by their confidence and capability in handling information. Informing citizens about the possibilities connected to mHealth and data sharing, along with a thorough description of any attached strings, will play a key role in fostering positive attitudes.

We previously observed that Eastern and Southern Europe consistently have higher knowledge levels and positive attitudes toward data sharing than Central Europe [26]. This heterogeneity persists in the adoption of mHealth, with respondents in Eastern and Southern Europe being more likely to use health apps than those in Central Europe.

### Data privacy and security concerns

Concurrently, data being hacked or used for commercial purposes were the most common perceived risks. Respondents appear to be more reluctant if the recipient is a for-profit researcher, company, or government; existing literature suggests this is related to a lack of information on how the data will be used and how privacy will be guaranteed, and it is consistent with the findings in our research [12, 27]. Our respondents highlighted significant concerns about data privacy and security when using health apps, with data misuse being the most frequently cited risk. This finding aligns with existing literature, which consistently underscores that privacy concerns, including fears of data misuse and hacking, remain critical barriers to the adoption of mHealth technologies [11]. A public consultation from the European Commission led to the realization of the “Privacy Code of Conduct on mobile health apps” [28]. Nonetheless, some health apps on the market still have poor data privacy, sharing, and security standards [29]. Moreover, earlier studies on genomic data sharing emphasized “genetic exceptionalism,” where genetic data are viewed as unique and requiring special protections [12]; our findings emphasize that trust in data handling significantly influences the willingness to share both genomic and general health app data.

A substantial minority of respondents were unwilling to share their data, likely concerned about their health data’s privacy and security [30]. Our findings suggest that individuals are discerning about sharing health data with different institutions. Male participants showed a greater willingness to share, and those with tertiary education were less prone to share exclusively with private entities. Country-wide variations were pronounced.

### Future perspectives

The digital transformation of healthcare systems, accelerated by the COVID-19 pandemic, underscores the significance of health data as a pivotal asset and places digital health solutions at the forefront of modern healthcare [31]. mHealth solutions empower professionals to deliver care in traditional face-to-face settings and remotely [32].

Inherent risks of mHealth are digital exclusion, misinformation proliferation, and promotion of unhealthy behaviors [33], while evidence of their effectiveness and cost-effectiveness remains limited. Evaluations should consider the broad goals of health systems, including quality, efficiency, equity, and patient empowerment. A European repository of evaluation frameworks, methods, and evidence could facilitate knowledge exchange and continuous improvement. Given the rapid pace of innovation, flexible and adaptable evaluation approaches and efforts to align decentralized decision-making with overall health system objectives are required [34].

Patient engagement is associated with better health outcomes, especially in managing chronic conditions such as diabetes and hypertension [35, 36]. Feedback on one’s progress and the ability to set goals and receive rewards are essential [37]. The significant association of increasing age and education levels with increased requests for information and higher perceived potential risks underlines the need for transparency when disclosing information on health app functioning, including artificial intelligence (AI). Opacity and potential biases in “black box” algorithms mandate transparency in AI-driven software and apps to mitigate these risks while ensuring ethical compliance, including the need for safe data-sharing protocols to avoid data leaks [38].

### Study limitations

This survey was administered on an online platform, making it inaccessible to a share of the population. Participation in the survey was voluntary, resulting in self-selection bias. The perspectives of those who chose to participate may differ from those who opted not to participate, skewing the representation of opinions. Additionally, self-selection bias may have been reinforced by the survey’s broader

focus on personalized medicine, genetic testing, and health data sharing, which could have inadvertently excluded or underrepresented respondents specifically interested in sharing their views on mHealth.

### Conclusion

This study reveals a notable willingness among the public to engage with mHealth technologies, especially among those with higher educational levels and older generations. However, it also underscores significant concerns regarding data privacy and security, which are top priorities for users. These findings call for a multifaceted approach to address these concerns, enhance digital health literacy, and ensure equitable access to mHealth. Policymakers and healthcare providers must prioritize the development of robust, transparent, and user-friendly digital health platforms that respect user privacy and foster trust. By addressing these key areas, the potential of mHealth to revolutionize healthcare delivery and patient outcomes can be fully realized, paving the way for more personalized, efficient, and accessible healthcare systems across Europe.

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### Supplementary data

Supplementary data are available at *EURPUB* online.

Conflict of interest: The authors declare no conflict of interest.

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### Key points

- Generational and educational differences influence health app adoption, with younger and more educated individuals showing higher engagement.
- Public concerns about data privacy and misuse remain significant barriers to mHealth adoption.
- Clear communication about data usage and strong privacy protections are essential to building trust in mHealth.
- Policymakers should develop targeted strategies to improve digital literacy and ensure equitable access to mHealth technologies across diverse populations.

## Data availability

The dataset used for this study has been uploaded to Figshare and is accessible at the following link: 10.6084/m9.figshare.28485518.

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