

Original Paper

Mobile Health Usage, Preferences, Barriers, and eHealth Literacy in Rheumatology: Patient Survey Study

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Abstract

Background: Mobile health (mHealth) defines the support and practice of health care using mobile devices and promises to improve the current treatment situation of patients with chronic diseases. Little is known about mHealth usage and digital preferences of patients with chronic rheumatic diseases.

Objective: The aim of the study was to explore mHealth usage, preferences, barriers, and eHealth literacy reported by German patients with rheumatic diseases.

Methods: Between December 2018 and January 2019, patients (recruited consecutively) with rheumatoid arthritis, psoriatic arthritis, and axial spondyloarthritis were asked to complete a paper-based survey. The survey included questions on sociodemographics, health characteristics, mHealth usage, eHealth literacy using eHealth Literacy Scale (eHEALS), and communication and information preferences.

Results: Of the patients (N=193) who completed the survey, 176 patients (91.2%) regularly used a smartphone, and 89 patients (46.1%) regularly used social media. Patients (132/193, 68.4%) believed that using medical apps could be beneficial for their own health. Out of 193 patients, only 8 (4.1%) were currently using medical apps, and only 22 patients (11.4%) stated that they knew useful rheumatology websites/mobile apps. Nearly all patients (188/193, 97.4%) would agree to share their mobile app data for research purposes. Out of 193 patients, 129 (66.8%) would regularly enter data using an app, and 146 patients (75.6%) would welcome official mobile app recommendations from the national rheumatology society. The preferred duration for data entry was not more than 15 minutes (110/193, 57.0%), and the preferred frequency was weekly (59/193, 30.6%). Medication information was the most desired app feature (150/193, 77.7%). Internet was the most frequently utilized source of information (144/193, 74.6%). The mean eHealth literacy was low (26.3/40) and was positively correlated with younger age, app use, belief in benefit of using medical apps, and current internet use to obtain health information.

Conclusions: Patients with rheumatic diseases are very eager to use mHealth technologies to better understand their chronic diseases. This open-mindedness is counterbalanced by low mHealth usage and competency. Personalized mHealth solutions and clear implementation recommendations are needed to realize the full potential of mHealth in rheumatology.

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KEYWORDS

mobile applications; eHealth; rheumatology; mHealth; eHEALS; telemedicine

Introduction

Rheumatoid arthritis, psoriatic arthritis, and axial spondyloarthritis are complex pathogenetic chronic diseases. These disease entities also require a complex treatment structure with interdisciplinary care by various specialists (rheumatologists, dermatologists, gastroenterologists, ophthalmologists, physiotherapists, etc), and intensive and regular disease monitoring is essential. With this complexity, affected patients often report a lack of understanding of their disease [1].

Mobile health (mHealth) holds promise to improve health care delivery and outcomes for people with chronic diseases [2]. Ideally, mHealth solutions, such as mobile apps and wearable sensors could empower patients, provide individual support, and lead to better outcomes than those available through standard care. Patients with chronic rheumatic diseases already have access to a broad range of mHealth solutions, starting from symptom checkers [3] or referral tools [4]. Once a diagnosis is established, mHealth tools enable patients to better monitor their symptoms passively through sensors [5] and actively by entering data [6,7]. Furthermore, electronic medication reminders can increase medication adherence [8,9], and supporting digital therapy can reduce pain [9] and improve important comorbidities (eg, depression) [10].

Recently the European League Against Rheumatism and Working Group Young Rheumatology of the German Society for Rheumatology (*Arbeitsgemeinschaft Junge Rheumatologie der Deutschen Gesellschaft für Rheumatologie*) published recommendations for the development of mobile apps in rheumatology [11,12]. The early integration of patients in the app development process was stressed in both papers. However, little is known about the patient perspective on mHealth solutions, as current literature focuses on rheumatologists [11,13,14]. To successfully integrate the various mHealth solutions into clinical routine, it is essential to identify barriers and the needs of patients.

The aim of this study was to explore mHealth usage, preferences, barriers, and eHealth literacy reported by German patients living with rheumatic diseases.

Methods

Between December 2018 and January 2019, consecutive patients seen at one rheumatology outpatient clinic of the University Hospital Erlangen were asked to complete a paper-based survey. This study was approved by the Ethics committee (No. 418-18B) and conducted referring to good clinical practice. All patients provided informed consent.

To create the survey ([Multimedia Appendix 1](#)), a broad literature review was carried out. Previous mHealth patient surveys in oncology [15] and rheumatology [16] served as a starting basis. The survey comprised four main parts: (1) sociodemographics and health characteristics, (2) mHealth preferences and usage, (3) eHealth literacy, and (4) communication and information preferences. The survey was pilot-tested with 10 patients to detect necessary formatting and wording changes. Minor

revisions were made accordingly. Foreign words and technical term explanations were provided in a footnote. Inclusion criteria were patients (1) aged ≥ 18 years, (2) who were literate in German, (3) who had the physical and mental ability to fill out a structured questionnaire, and (4) who fulfilled classification criteria for rheumatoid arthritis [17], axial spondyloarthritis [18], or psoriatic arthritis [19].

The sociodemographic and health characteristics included age; gender; residence; diagnosis; disease duration; patient global assessment of disease activity; and current usage of smartphones, tablets, activity trackers, and social media.

The mHealth preferences and usage section included questions about the preferred time and frequency for using a rheumatology app. Patients were asked to rate their preference of app features (5-point Likert scale) and rate the importance of app characteristics (10-point Likert scale). Inquiries were made on internet usage and perceived usefulness, willingness to share recorded app data, general perception about the utility of medical apps, web-based services for improving patient's health, and telemedicine.

Patients' eHealth literacy was measured using the validated German version [20] of the eHealth Literacy Scale (eHEALS) [21]; eHEALS has been translated and validated in multiple languages [20-22]. It is based on a 5-point Likert scale and includes 8 statements concerning self-perceived eHealth literacy.

Patients were asked to state their preferences concerning medication reminders, medical information format, digitally provided information structure, patient diary type, and physician communication type. Rankings did not have to be unique. Characteristics were summarized using means, standard deviations, counts, and percentages as appropriate. We used Pearson correlation to explore relationships between continuous variables. The relationship between the eHEALS score and internet use frequency was examined using a linear regression model with the eHEALS score as the dependent variable and internet use as an ordinal predictor encoded using orthogonal polynomials to characterize nonlinear effects. Relationships between eHEALS score and binary preferences were examined using logistic regression. All models included age and gender adjustments. Two-sided P values less than .05 were considered significant. We used Excel (Microsoft Corp) and R (version 3.5.3; R Foundation for Statistical Computing) for data manipulation and analyses.

Results

Patient Characteristics

In total, 224 patients were recruited. Only complete surveys ($N=193$) were considered for the final analysis. The number of patients rejecting participation was not measured. The study sample's demographics are shown in [Table 1](#). Mean age was 52.1 (SD 13.7) years, with 34.7% (67/193) being at least 60 years old; 59.6% (115/193) were female, and 53.9% (104/193) had been diagnosed with rheumatoid arthritis. The mean disease duration was 8.3 years (SD 8.0). Nearly all patients regularly used a smartphone (176/193, 91.2%), and nearly half of the patients regularly used a tablet (86/193, 44.6%) and social media

(89/193, 46.1%). Only a minority used activity trackers (20/193, 10.4%).

Table 1. Demographic and health characteristics.

| Characteristic | Values (N=193) |
|---|----------------|
| Age (years), mean (SD) | 52.1 (13.7) |
| Age (years), n (%) | |
| 18-39 | 46 (23.8) |
| 40-59 | 80 (41.5) |
| ≥60 | 67 (34.7) |
| Gender n (%) | |
| Female | 115 (59.6) |
| Male | 78 (40.4) |
| Diagnosis, n (%) | |
| Rheumatoid arthritis | 104 (53.9) |
| Axial spondyloarthritis | 37 (19.2) |
| Psoriatic arthritis | 52 (26.9) |
| Patient global assessment of disease activity (0-10), mean (SD) | 3.8 (2.4) |
| Disease duration (years), mean (SD) | 8.3 (8.0) |
| Disease duration (years), n (%) | |
| ≤1 | 42 (21.8) |
| 2-5 | 44 (22.8) |
| >5 | 107 (55.4) |
| Residence, n (%) | |
| Village | 74 (38.3) |
| Small city | 48 (24.9) |
| Midsized city | 35 (18.1) |
| Big city | 36 (18.7) |
| Regular usage, n (%) | |
| Smartphone | 176 (91.2) |
| Tablet | 86 (44.6) |
| Activity tracker | 20 (10.4) |
| Social media | 89 (46.1) |
| Medical apps | 8 (4.1) |

Medical App Acceptance and Willingness to Provide mHealth Data for Research Purposes

Preferences and attitudes regarding potential mHealth apps and data flow were addressed (Table 2). More than two-thirds of the patients (132/193, 68.4%) believed that medical apps are helpful for their health; however, only 4.1% (8/193) patients currently used medical apps, of which none were rheumatology specific apps. Increasing eHEALS scores were associated with a higher probability of expressing belief that apps were helpful after adjusting for age and gender (odds ratio [OR] 1.13, 95% CI 1.07 to 1.19, $P < .001$). Nearly all patients (188/193, 97.4%) were willing to transfer app data for research purposes, if data security would be ensured. The main barrier for sharing app data with the physician was that personal contact was considered

as sufficient (53/193, 63.9%). Second, patients (42/193, 50.6%) were concerned about data transfer. The majority of patients (174/193, 90.2%) wanted to be contacted in case an app detected an abnormality concerning their health, whereas 57.0% (110/193) were also willing to transfer app data to the treating physician. Concerns were data usage, storage, and transfer. Only 28.0% (54/193) were interested in comparing their medication adherence to the medication adherence of other patients. Regarding official app recommendations, 75.6% (146/193) of interviewed patients wanted advice from the national society of rheumatology. Weekly data entry was preferred by 30.6% (59/193) with durations of 5-15 minutes (65/193, 33.7%). Measured on a scale of 10, the most important app characteristics were security (mean 8.9, SD 2.5) and usability (mean 8.5, SD 2.5) (Table 2). Regarding preferred app functions,

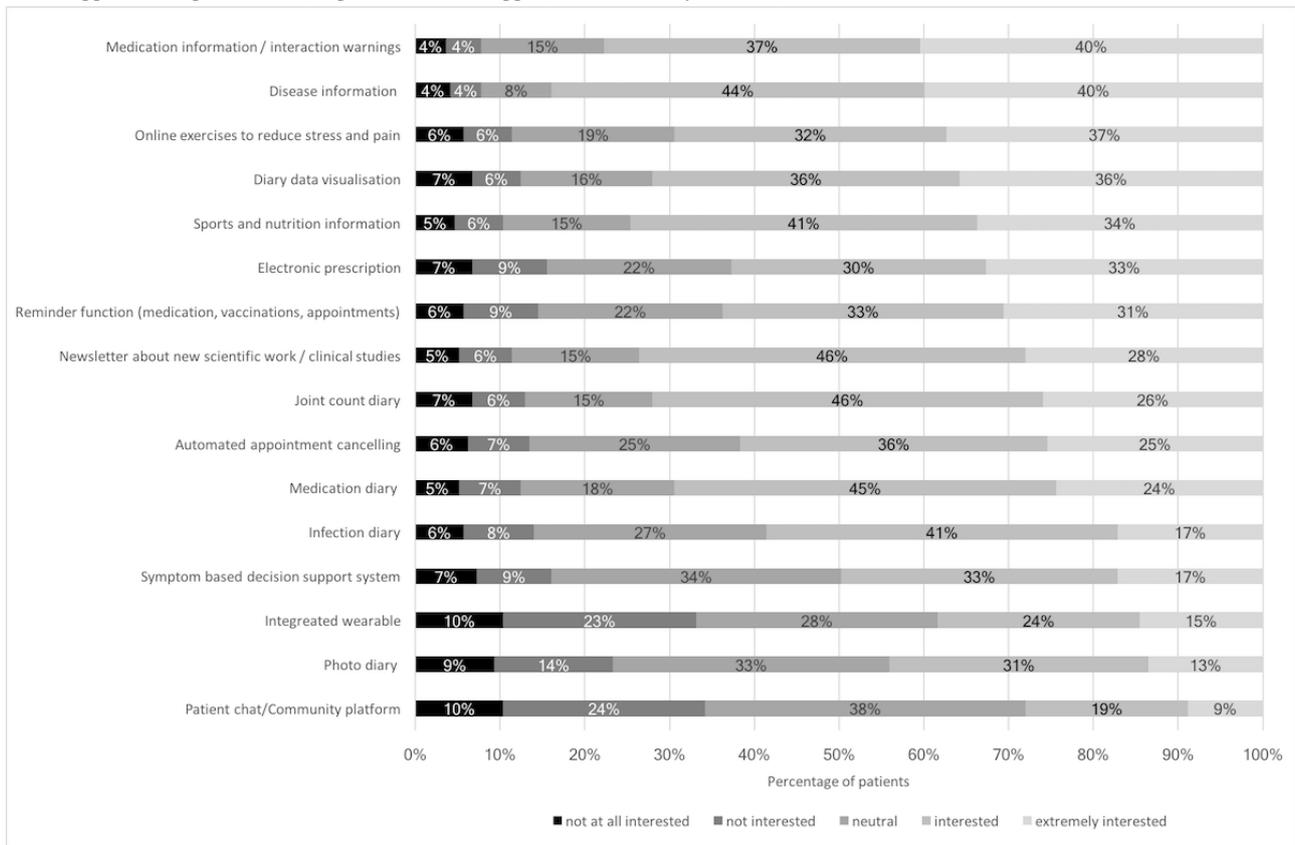
patients were most interested in information about medications and diseases and were least interested in direct exchange such as chats with peers with the same disease (Figure 1).

Table 2. Patient attitudes towards medical apps.

| Characteristic | Values (N=193) |
|---|----------------|
| Patients believing medical apps are helpful for their health, n (%) | 132 (68.4) |
| Patients willing to transfer app data for research purposes, n (%) | 188 (97.4) |
| Patients willing to transfer data to physician with app, n (%) | 110 (57.0) |
| Reason for not willing to transfer data to physician with app, n (%)^a | |
| I don't have a suitable device | 13 (15.7) |
| I don't have the technical skills | 23 (27.7) |
| I have concerns about data usage | 33 (39.8) |
| I have concerns about data storage | 31 (37.3) |
| I have concerns about data transfer | 42 (50.6) |
| I have concerns about data protection | 24 (28.9) |
| I only want personal contact with physician | 53 (63.9) |
| I don't find this useful | 11 (13.3) |
| Patients who want to be contacted in case of app-monitoring abnormalities | 174 (90.2) |
| Patients interested to compare medication adherence to other patients, n (%) | 54 (28.0) |
| Patients who want official app recommendations from national society of rheumatology, n (%) | 146 (75.6) |
| Preferred frequency of app usage, n (%) | |
| Not at all | 64 (33.2) |
| Daily | 11 (5.7) |
| Weekly | 59 (30.6) |
| Monthly | 37 (19.2) |
| Each 3 months | 18 (9.3) |
| Less frequently | 4 (2.1) |
| Preferred time of app usage (minutes), n (%) | |
| Not at all | 64 (33.2) |
| 0-5 | 45 (23.3) |
| 5-15 | 65 (33.7) |
| 15-30 | 18 (9.3) |
| >30 | 1 (0.5) |
| Importance of app characteristics (0-10), mean (SD) | |
| Interactivity | 4.5 (2.9) |
| Design | 4.7 (3.2) |
| Usability | 8.5 (2.5) |
| Data security | 8.9 (2.5) |

^aMultiple answers were possible.

Figure 1. App function preferences (responses to "What app functions would you like?").



Internet Usage and Perceived Usefulness

To address habits regarding information search, patients were questioned concerning internet usage. The majority of patients (168/193, 87.0%) had previously used the internet to obtain health information (Table 3), and the remaining patients (25/193, 13.0%) lacked the skills or motivation to do a search; 7/25 (28.0%) had no internet access, 7/25 (28.0%) did not think it would be helpful, 6/25 (24.0%) found the information from their physician sufficient, 2/25 (8.0%) did not know how to do a search, and 3/25 (12.0%) stated another reason. Some patients had previously communicated with a physician by email (56/193, 29.0%). Participation in an online health program was rare (3/193, 1.6%). Online support groups were used by patients

to post information (14/193, 7.3%), chat with other patients (19/193, 9.8%), or read information (85/193, 44.0%); 19.7% (38/193) were aware of the medication website of the German Society of Rheumatology (*Deutsche Gesellschaft für Rheumatologie*).

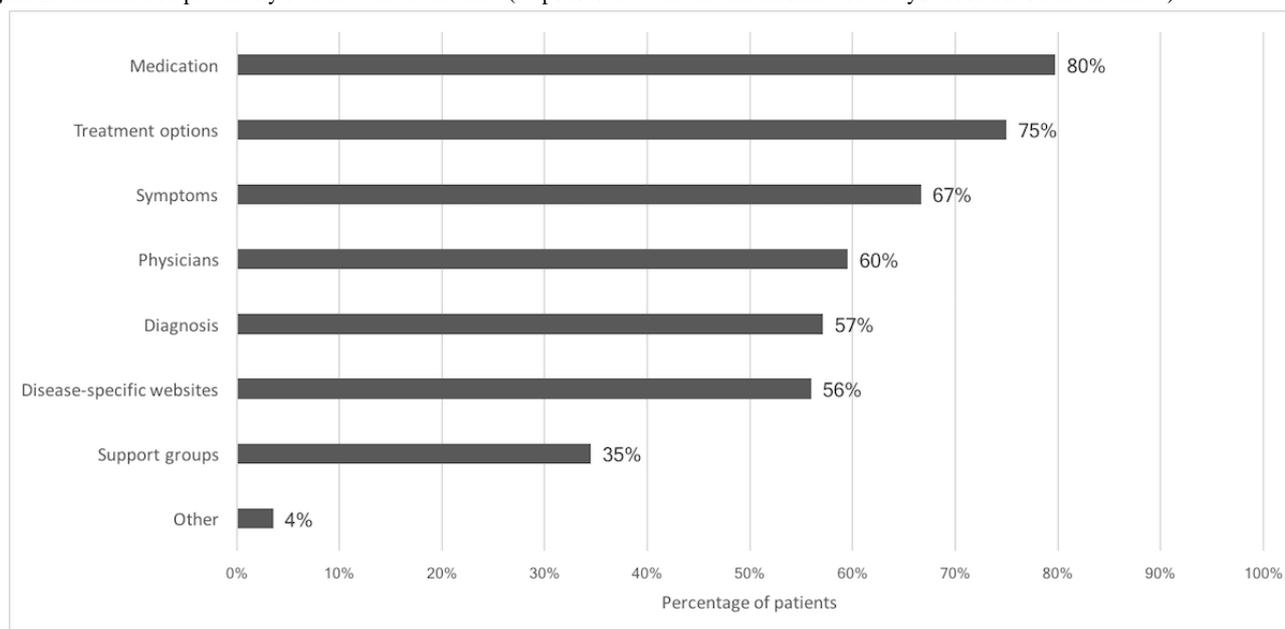
Figure 2 presents the type of health information searched on the internet. Most patients looked for medication information (134/168, 79.8%) whereas information on support groups was the least commonly searched (58/168, 34.5%); 124/193 (64.2%) patients preferred filling out medical questionnaires electronically before their clinical visits, 102/193 (52.8%) patients preferred receiving a doctor’s letter in an electronic format instead of paper, and 98/193 (50.2%) patients preferred communicating with their rheumatologist by a video call.

Table 3. Internet usage, perceived usefulness, and eHealth literacy.

| Characteristic | Values (N=193) |
|--|----------------|
| Did you previously look for health information on the internet? n (%) | |
| Yes | 168 (87.0) |
| No | 25 (13.0) |
| Did you previously communicate with a physician by email? n (%) | |
| Yes | 56 (29.0) |
| No | 137 (71.0) |
| Did you previously participate in an online health program? n (%) | |
| Yes | 3 (1.6) |
| No | 190 (98.4) |
| Did you use an online supporting group before to...?^a n (%) | |
| Post information | 14 (7.3) |
| Chat with patients | 19 (9.8) |
| Read information | 85 (44.0) |
| I never used one before | 103 (53.4) |
| Do you know useful rheumatology websites or apps? n (%) | |
| Yes | 22 (11.4) |
| No | 171 (88.6) |
| Do you know the DGRh^b medication information website? n (%) | |
| Yes | 38 (19.7) |
| No | 155 (80.3) |
| How useful do you find the internet to make health-related decisions? n (%) | |
| Not useful at all | 17 (8.8) |
| Not useful | 19 (9.8) |
| Unsure | 74 (38.3) |
| Useful | 72 (37.3) |
| Very useful | 11 (5.7) |
| eHealth literacy, mean (SD) | 26.3 (7.1) |

^aMultiple answers were possible.

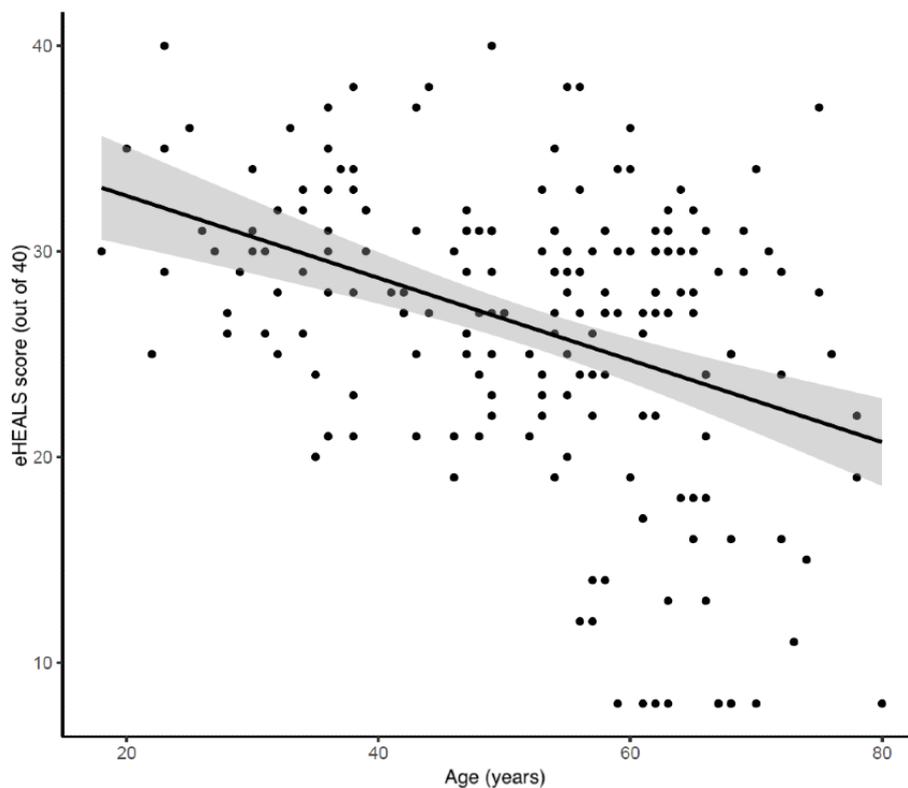
^bDGRh: Deutsche Gesellschaft für Rheumatologie (German Society of Rheumatology).

Figure 2. Information previously searched on the internet (responses to "What health information did you look for on the internet?").

eHealth Literacy

Mean eHealth literacy using eHEALS was 26.3 (SD 7.1) out of 40. Mean scores in women and men were 25.8 and 27.0, respectively, with a mean difference of -1.15 (95% CI -3.14 to 0.84) showing no important effect of gender. Age showed a negative correlation ($r=-0.38$, 95% CI -0.5 to -0.26) with the eHEALS score (Figure 3). Table 4 shows the distribution of responses to the 8 eHEALS items. The majority of the patients agreed that they know how to use the internet to answer their questions about health (82/193, 71.5%), and a considerable proportion of patients (82/193, 42.5%) felt uncomfortable using information from the internet to make health decisions. A lower eHEALS score was associated with a decreasing frequency of

internet usage; the regression analysis shows that, after adjustment for age and gender, the negative association with decreasing frequency of internet use and eHEALS score followed a second-order polynomial (linear: -8.87 , 95% CI -11.97 to -5.76 ; quadratic: -5.64 , 95% CI -8.37 to -2.92) meaning that each step of decrease in the use-frequency categories was associated with, not an equal, but a progressively greater decrease in the eHEALS score (Figure 4). Figure 5 shows the usage frequency of different health information sources during the last 3 months prior to the clinical visit. The internet was the most frequently used information source (144/193, 74.6%), with 9.3% (18/193) using it daily, 14.5% (28/193) weekly, and 19.7% (38/193) monthly.

Figure 3. Negative relationship between eHEALS score and age.**Table 4.** eHealth literacy.

| eHEALS item | Participants (N=193), n (%) | | | Score |
|--|-------------------------------|-----------|-------------------------|-----------|
| | Strongly disagree or disagree | Neutral | Agree or strongly agree | Mean (SD) |
| I know how to find helpful health resources on the Internet | 30 (15.5) | 50 (25.9) | 113 (58.5) | 3.5 (1.1) |
| I know how to use the Internet to answer my questions about health | 30 (15.5) | 25 (13.0) | 138 (71.5) | 3.6 (1.1) |
| I know what health resources are available on the Internet | 51 (26.4) | 68 (35.2) | 74 (38.3) | 3.1 (1.1) |
| I know where to find helpful health resources on the Internet | 47 (24.4) | 57 (29.5) | 89 (46.1) | 3.2 (1.1) |
| I know how to use the health information I find on the Internet to help me | 48 (24.9) | 49 (25.4) | 96 (49.7) | 3.2 (1.1) |
| I have the skills I need to evaluate the health resources I find on the Internet | 26 (13.5) | 30 (15.5) | 137 (71.0) | 3.8 (1.1) |
| I can tell high quality health resources from low quality health resources on the internet | 37 (19.2) | 52 (26.9) | 104 (53.9) | 3.4 (1.1) |
| I feel confident in using information from the Internet to make health decisions | 82 (42.5) | 82 (42.5) | 29 (15.0) | 2.6 (1.0) |

Figure 4. Association of eHEALS score and frequency of internet use.

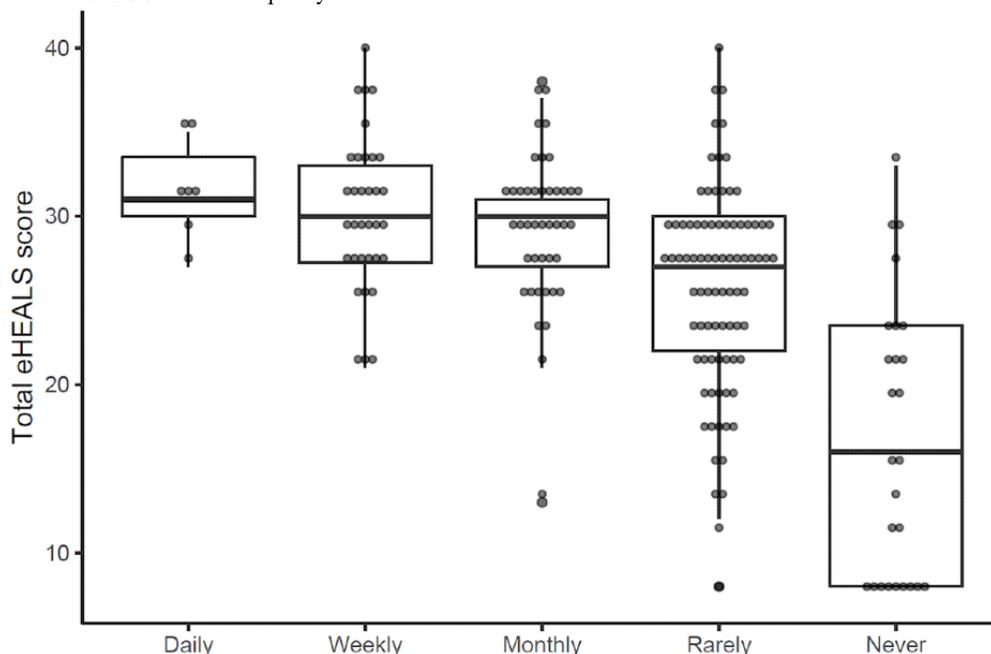
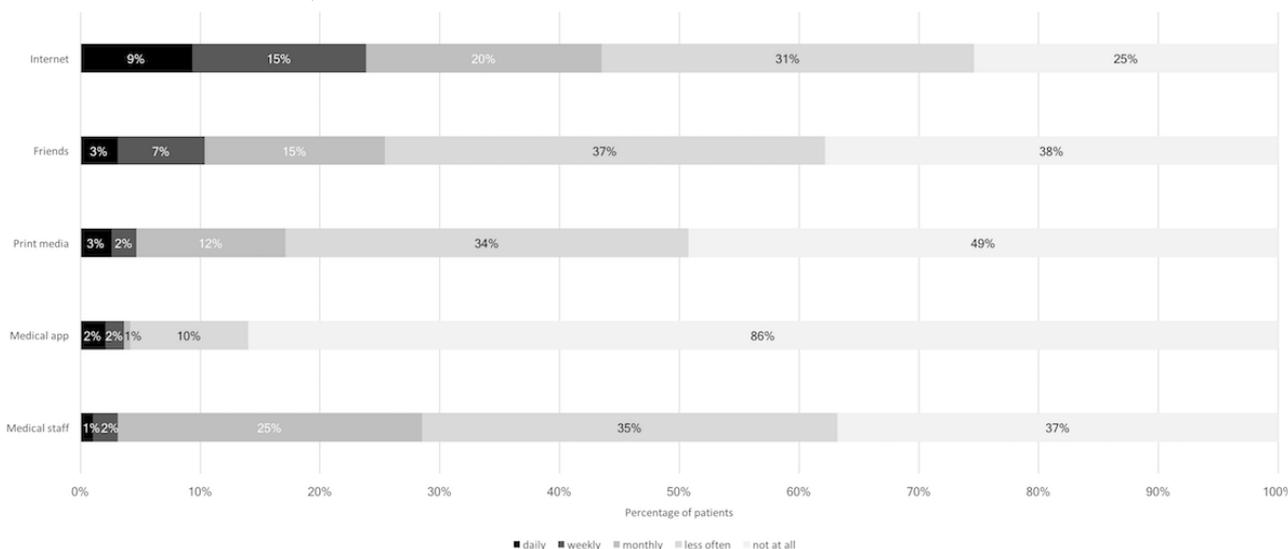


Figure 5. Health information sources used prior to clinical visits (responses to "How often did you use one of the following options to receive health information in the last three months?").



Conservative Communication Preferences

The preferred way to contact the treating rheumatologist was via telephone (136/196, 69.4%), email (42/196, 21.4%), and chat (8/196, 4.1%) (Table 5, last panel). Most patients wanted to be reminded of regular medication intake (198/260, 76.2%). The preferred method for reminders was via an app (118/260, 45.4%) (Table 5). The large majority of patients (173/188, 92.0%) wanted medical information and the preferred media

were paper (104/188, 55.3%), app (40/188, 21.3%), and website (29/188, 15.4%). Concerning digitally provided information, patients preferred plain text and images (160/196, 81.6%) over exchange functions (29/196, 14.8%) and game-based learning (7/196, 3.6%). The majority of patients preferred using a patient diary (167/190, 87.9%) (preference for paper was greater than that for an app, which was greater than that for a website). App usage preference increased over the last years (5.4% to 18.1% from 2014 to 2018, see Multimedia Appendix 2).

Table 5. Preferences for medication reminders, medical information format, digitally provided information structure, patient diary type, and physician communication type.

| Characteristic ^a | Preference (N=193), n (%) | | Score |
|--|---------------------------|------------|-----------|
| | First | Last | Mean (SD) |
| I would like to be reminded of the regular medication intake by...^b | | | |
| Short message (SMS) | 39 (15.0) | 13 (6.0) | 2.8 (1.4) |
| Mobile app | 118 (45.4) | 17 (7.9) | 3.1 (1.7) |
| Email | 18 (6.9) | 10 (4.6) | 3.2 (1.3) |
| Telephone call | 20 (7.7) | 28 (13.0) | 3.5 (1.6) |
| Not wanted | 62 (23.8) | 78 (36.1) | 3.8 (2.2) |
| Postcard | 3 (1.2) | 70 (32.4) | 4.9 (1.3) |
| I prefer medical information ...^c | | | |
| On paper | 104 (55.3) | 12 (6.2) | 1.8 (1.0) |
| On a website | 29 (15.4) | 16 (8.2) | 2.3 (0.8) |
| In an app | 40 (21.3) | 15 (7.7) | 2.4 (0.9) |
| Not wanted | 15 (8.0) | 151 (77.8) | 3.6 (0.9) |
| For digitally provided information (website/app) this would be important to me:^d | | | |
| Text- and image-based information | 160 (81.6) | 16 (8.1) | 1.3 (0.6) |
| Exchange with others | 29 (14.8) | 61 (31.0) | 2.2 (0.7) |
| Game-based learning | 7 (3.6) | 120 (60.9) | 2.6 (0.6) |
| I would document my state of health and tablet intake in a "patient diary" ...^c | | | |
| On paper | 92 (48.4) | 14 (7.2) | 1.9 (1.0) |
| In an app | 53 (27.9) | 19 (9.7) | 2.2 (0.9) |
| On a website | 22 (11.6) | 31 (15.9) | 2.6 (0.9) |
| Not wanted | 23 (12.1) | 131 (67.2) | 3.3 (1.1) |
| My preferred way to contact my rheumatologist is via...^c | | | |
| Telephone call | 136 (69.4) | 8 (4.0) | 1.5 (0.8) |
| Email | 42 (21.4) | 5 (2.5) | 2.0 (0.7) |
| Website/chat | 8 (4.1) | 32 (16.2) | 2.9 (0.7) |
| Not wanted | 10 (5.1) | 153 (77.3) | 3.6 (0.8) |

^aAnswer options could be ranked with the same preference level.

^b1=preferred option, 6=least preferred option.

^c1=preferred option, 4=least preferred option.

^d1=preferred option, 3=least preferred option.

Discussion

Main Findings

Patients with rheumatic and musculoskeletal diseases are ready and willing to use mHealth technologies. Patients believe in the potential of mHealth and are open to participating actively by sharing health data with their physicians and researchers. Structured electronic data acquisition holds great promise to increase data quality, increase quantity, and reduce missing data and bureaucracy. Patients preferred filling out questionnaires before clinical visits, using video calls, and receiving electronic doctor's letters. These measures could drastically improve the

clinical experience for patients, cutting down waiting time and long drives to the hospital. For clinicians, automatic data import could reduce administrative efforts. Furthermore, continuously obtained mHealth patient data increases the basis for shared personalized clinical decision making.

Some patients, however, prefer personal contact with their physician and were concerned about data storage and transfer. Also, at the time of the study, no single patient was using a rheumatology specific app, only 4.1% were using medical apps at all, and 11.4% were aware of useful rheumatology websites or apps. The currently scarce mHealth usage and low eHealth literacy highlight an important need for structured mHealth

guidance and patient-adapted information and education. The majority of patients clearly stated this by calling for official app recommendations from the national society of rheumatology. The most popular app features were information about medication and rheumatic diseases. The fact that 87.0% previously searched for various health information on the internet, and that the internet is the most frequently used source for health information, further supports the need for more, better, and personalized medical information. This information should be accurate and reliable, requiring rheumatologists and societies to actively lead and supervise mHealth in rheumatology. The opportunity to support therapeutic online health programs is currently not being fully utilized, despite promising study results [23]. Furthermore, our study shows an enthusiasm on the patients' side to improve medication adherence via mobile apps and diaries. Sharing of this mHealth data with a large research registry would represent an enormous potential to improve treatments and rheumatology research. These results may help patients, developers, clinicians, and researchers to use the full potential of mHealth in rheumatology.

Limitations

The cross-sectional design, self-reported data, and sampling method with relatively small sample size were the most important limitations of this study. Therefore, the results might not be generalizable, and actual mHealth usage might, for example, differ compared to self-reported usage.

Comparison With Prior Work

To our knowledge, this is the first work depicting a German mHealth patient perspective in rheumatology. This work may inform mHealth policy recommendations and adds to the growing body of eHealth rheumatology knowledge [11-14,24,25] by providing detailed patient preferences, needs, and barriers. Hence, we believe that the results of this study could help in devising mHealth solutions that can be integrated into the clinical routine of patients with rheumatic diseases. The importance of including patients in the app development process is stressed in various recommendations [11,12]. *Rheuma-Auszeit* was reported as the only app developed with major patient involvement and scored as the highest quality app [11]. It was also shown that the participation of patients in app development leads to high usage; for example, the ArthritisPower app was used by >18,000 patients with rheumatic diseases in 2018 [26].

Health literacy is critical for patient empowerment [27]. Our work confirms the lack of adequate eHealth skills in rheumatology patients [28], reflected by the borderline mean eHEALS score of 26.3 out of 40. Cutoffs for the eHEALS score show considerable variation in the literature [29-31]; however, a value of 26 was set in a previous study as the cutoff for low eHealth literacy [31]. eHealth literacy was associated with a greater belief in the usefulness of medical apps, and usage of the internet to obtain health information, similar to findings reported by Noblin et al [32]. A previous study [33] showed that younger age and higher eHealth literacy correlate with perceived effectiveness of medical apps. eHealth literacy can change over time [34], and supporting programs should be implemented to increase eHealth literacy [35]. Many mHealth

challenges could be overcome if more support was provided by health providers [36].

Patients demanded clear recommendations from the national society for rheumatology and expressed the highest confidence in an app developed by a rheumatic disease scientific society [25]. Our results suggest that patient app entries should take no longer than 15 minutes and should not be requested more often than weekly. Data transfer should be clearly explained to patients to eliminate this barrier. Customizable app features are needed, as preferences differ, and a one-size-fits-all approach seems to be less effective. App building blocks (videos, information, tools) should be provided so that redundant work is reduced, and a large variety of features can be provided. Ideally, the app content should be created in a joint effort by all stakeholders.

The discrepancy between app use and general belief in usefulness and interest reflect the currently unmet need of effective mHealth solutions, guidance, and education. This discrepancy is also highlighted by the dominance of conservative communication preferences. These results should carefully be interpreted, as most patients currently do not have experience with app-based communication.

In an effort to address this need, the French society for rheumatology recently developed the free patient app Hiboot, which provides patients with trustworthy information about medication and answers to frequently asked questions [37]. App usage was very low among patients (4.1%) compared to medical app usage among German rheumatologists (49%) [13] and an international group of rheumatic patients (79/394, 20%). In contrast to rheumatologists [13], and an international group of rheumatic patients (188/394, 47%) [25]; patients were not aware of any rheumatology specific apps. These results could partly be explained by the paper-based nature of the survey that enabled us to include elderly patients that might have been reluctant to join the study otherwise.

The lack of patient interest was previously identified as a major barrier to app prescription among general practitioners [38]. Besides education and careful evaluation of current mHealth solutions [11], solid evidence for the effectiveness and usability is needed to overcome current barriers and increase app prescription rate.

Concerning app feature preferences, our results were very much in line with previous research [16,25]. Patients do not prefer patient-to-patient communication features; however, patients are very interested in other app features, particularly those providing information.

As reported in previous studies [25,28], our work clearly shows that most patients regularly use the internet to retrieve medical information. In a previous study [3] published in 2016, 47% of the patients consulted the internet to investigate their symptoms. This proportion seems to be increasing, as in our study 67% and in another recent study [25] 95% of patients stated they did so. Compared to German oncology patients interviewed in 2016 [15], more rheumatic patients seem to use mobile devices regularly (69.6% compared to 91.2%); however, the information quality is very heterogeneous which could be misleading.

The obvious enthusiasm of patients to share app data for research purposes and their wish for such data to be made available to the treating rheumatologist for routine care underlines that an improvement to the science and practice of rheumatology could be realized using mHealth. A digital approach allows the inclusion of well-structured patient-generated data to improve clinical shared decision making and clinical research [39]. The interoperability of systems is crucial for the success of such mHealth tools. A part of patients want rheumatologists to review their app input. This could easily cause information overload and an additional workload to physicians; however, rationing appointments, earlier detection, and response to flares would also be possible [40]. In combination with wearable sensors and algorithms, patient monitoring could further be improved.

The medical community, public health system, and private sector need to increase their efforts to improve eHealth competencies and to provide safe and effective digital tools to leverage the way of mHealth into routine rheumatology care.

Conclusion

To our knowledge, this is the first study capturing a detailed mHealth perspective of patients with rheumatic diseases, which could guide rheumatology app development and implementation. Most patients included in this study possessed smartphones and believed that using medical apps could be beneficial for their health. A substantial majority was also willing to share app data for research purposes. The current usage of mHealth among rheumatic patients is, however, very limited and eHealth literacy was rather poor. We could successfully identify unmet needs and patient priorities, which can be used to accelerate and guide the way of mHealth into routine rheumatology care.

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Authors' Contributions

This work was performed to fulfill the requirements for obtaining the degree Dr med for AL and CR. JK, DS, AL, CR, KT, and AJH drafted the manuscript. KT and JK performed the statistical analysis. All authors reviewed the draft and provided comments for change. All authors approved the final manuscript.

Conflicts of Interest

None declared.

Multimedia Appendix 1

Original German survey.

[PDF File (Adobe PDF File), 347 KB-Multimedia Appendix 1]

Multimedia Appendix 2

2014 and 2018/2019 Preferences for medication reminders, medical information format, digitally provided information structure, patient diary type, and physician communication type of patients with rheumatoid arthritis.

[PNG File , 281 KB-Multimedia Appendix 2]

References

1. Kool MB, van Middendorp H, Lumley MA, Schenk Y, Jacobs JWG, Bijlsma JWJ, et al. Lack of understanding in fibromyalgia and rheumatoid arthritis: the Illness Invalidation Inventory (3*I). *Ann Rheum Dis* 2010 May 24;69(11):1990-1995. [doi: [10.1136/ard.2009.123224](https://doi.org/10.1136/ard.2009.123224)]
2. Kataria S, Ravindran V. Digital health: a new dimension in rheumatology patient care. *Rheumatol Int* 2018 Nov;38(11):1949-1957. [doi: [10.1007/s00296-018-4037-x](https://doi.org/10.1007/s00296-018-4037-x)] [Medline: [29713795](https://pubmed.ncbi.nlm.nih.gov/29713795/)]
3. Powley L, McIlroy G, Simons G, Raza K. Are online symptoms checkers useful for patients with inflammatory arthritis? *BMC Musculoskelet Disord* 2016 Dec 24;17(1):362 [FREE Full text] [doi: [10.1186/s12891-016-1189-2](https://doi.org/10.1186/s12891-016-1189-2)] [Medline: [27553253](https://pubmed.ncbi.nlm.nih.gov/27553253/)]
4. Urruticoechea-Arana A, León-Vázquez F, Giner-Ruiz V, Andréu-Sánchez JL, Olivé-Marqués A, Freire-González M, et al. Development of an application for mobile phones (App) based on the collaboration between the Spanish Society of Rheumatology and Spanish Society of Family Medicine for the referral of systemic autoimmune diseases from primary care to rheumatology. *Reumatol Clin* 2019 Nov 10 [FREE Full text] [doi: [10.1016/j.reuma.2019.09.001](https://doi.org/10.1016/j.reuma.2019.09.001)] [Medline: [31722849](https://pubmed.ncbi.nlm.nih.gov/31722849/)]
5. Gossec L, Guyard F, Leroy D, Lafargue T, Seiler M, Jacquemin C, et al. Detection of Flares by Decrease in Physical Activity, Collected Using Wearable Activity Trackers in Rheumatoid Arthritis or Axial Spondyloarthritis: An Application

- of Machine Learning Analyses in Rheumatology. *Arthritis Care Res (Hoboken)* 2019 Oct;71(10):1336-1343. [doi: [10.1002/acr.23768](https://doi.org/10.1002/acr.23768)] [Medline: [30242992](https://pubmed.ncbi.nlm.nih.gov/30242992/)]
6. Walker UA, Mueller RB, Jaeger VK, Theiler R, Forster A, Dufner P, et al. Disease activity dynamics in rheumatoid arthritis: patients' self-assessment of disease activity via WebApp. *Rheumatology (Oxford)* 2017 Dec 01;56(10):1707-1712 [FREE Full text] [doi: [10.1093/rheumatology/kex229](https://doi.org/10.1093/rheumatology/kex229)] [Medline: [28957553](https://pubmed.ncbi.nlm.nih.gov/28957553/)]
 7. Mollard E, Michaud K. A Mobile App With Optical Imaging for the Self-Management of Hand Rheumatoid Arthritis: Pilot Study. *JMIR Mhealth Uhealth* 2018 Oct 29;6(10):e12221 [FREE Full text] [doi: [10.2196/12221](https://doi.org/10.2196/12221)] [Medline: [30373732](https://pubmed.ncbi.nlm.nih.gov/30373732/)]
 8. Kang H, Park H. A Mobile App for Hypertension Management Based on Clinical Practice Guidelines: Development and Deployment. *JMIR Mhealth Uhealth* 2016 Feb;4(1):e12 [FREE Full text] [doi: [10.2196/mhealth.4966](https://doi.org/10.2196/mhealth.4966)] [Medline: [26839283](https://pubmed.ncbi.nlm.nih.gov/26839283/)]
 9. Yang J, Weng L, Chen Z, Cai H, Lin X, Hu Z, et al. Development and Testing of a Mobile App for Pain Management Among Cancer Patients Discharged From Hospital Treatment: Randomized Controlled Trial. *JMIR Mhealth Uhealth* 2019 May 29;7(5):e12542. [doi: [10.2196/12542](https://doi.org/10.2196/12542)]
 10. Economides M, Ranta K, Nazander A, Hilgert O, Goldin PR, Raevuori A, et al. Long-Term Outcomes of a Therapist-Supported, Smartphone-Based Intervention for Elevated Symptoms of Depression and Anxiety: Quasiexperimental, Pre-Postintervention Study. *JMIR Mhealth Uhealth* 2019 Aug 26;7(8):e14284 [FREE Full text] [doi: [10.2196/14284](https://doi.org/10.2196/14284)] [Medline: [31452521](https://pubmed.ncbi.nlm.nih.gov/31452521/)]
 11. Knitza J, Tascilar K, Messner E, Meyer M, Vossen D, Pulla A, et al. German Mobile Apps in Rheumatology: Review and Analysis Using the Mobile Application Rating Scale (MARS). *JMIR Mhealth Uhealth* 2019 Aug 05;7(8):e14991 [FREE Full text] [doi: [10.2196/14991](https://doi.org/10.2196/14991)] [Medline: [31381501](https://pubmed.ncbi.nlm.nih.gov/31381501/)]
 12. Najm A, Nikiphorou E, Kostine M, Richez C, Pauling JD, Finckh A, et al. EULAR points to consider for the development, evaluation and implementation of mobile health applications aiding self-management in people living with rheumatic and musculoskeletal diseases. *RMD Open* 2019 Sep 13;5(2):e001014. [doi: [10.1136/rmdopen-2019-001014](https://doi.org/10.1136/rmdopen-2019-001014)]
 13. Knitza J, Vossen D, Geffken I, Krusche M, Meyer M, Sewerin P, Arbeitskreis Junge Rheumatologen. [Use of medical apps and online platforms among German rheumatologists : Results of the 2016 and 2018 DGRh conference surveys and research conducted by rheumadocs]. *Z Rheumatol* 2018 Dec 12. [doi: [10.1007/s00393-018-0578-3](https://doi.org/10.1007/s00393-018-0578-3)] [Medline: [30542914](https://pubmed.ncbi.nlm.nih.gov/30542914/)]
 14. Grainger R, Townsley H, White B, Langlotz T, Taylor WJ. Apps for People With Rheumatoid Arthritis to Monitor Their Disease Activity: A Review of Apps for Best Practice and Quality. *JMIR Mhealth Uhealth* 2017 Feb 21;5(2):e7 [FREE Full text] [doi: [10.2196/mhealth.6956](https://doi.org/10.2196/mhealth.6956)] [Medline: [28223263](https://pubmed.ncbi.nlm.nih.gov/28223263/)]
 15. Kessel KA, Vogel MM, Kessel C, Bier H, Biedermann T, Friess H, et al. Mobile Health in Oncology: A Patient Survey About App-Assisted Cancer Care. *JMIR Mhealth Uhealth* 2017 Jun 14;5(6):e81 [FREE Full text] [doi: [10.2196/mhealth.7689](https://doi.org/10.2196/mhealth.7689)] [Medline: [28615159](https://pubmed.ncbi.nlm.nih.gov/28615159/)]
 16. van DVR, Drossaert CHC, Taal E, van DLMAFJ. Patient preferences for a hospital-based rheumatology Interactive Health Communication Application and factors associated with these preferences. *Rheumatology (Oxford)* 2011 Sep;50(9):1618-1626 [FREE Full text] [doi: [10.1093/rheumatology/ker161](https://doi.org/10.1093/rheumatology/ker161)] [Medline: [21551221](https://pubmed.ncbi.nlm.nih.gov/21551221/)]
 17. Aletaha D, Neogi T, Silman AJ, Funovits J, Felson DT, Bingham CO, et al. 2010 Rheumatoid arthritis classification criteria: an American College of Rheumatology/European League Against Rheumatism collaborative initiative. *Arthritis Rheum* 2010 Sep;62(9):2569-2581 [FREE Full text] [doi: [10.1002/art.27584](https://doi.org/10.1002/art.27584)] [Medline: [20872595](https://pubmed.ncbi.nlm.nih.gov/20872595/)]
 18. Rudwaleit M, Landewe R, van der Heijde D, Listing J, Brandt J, Braun J, et al. The development of Assessment of SpondyloArthritis international Society classification criteria for axial spondyloarthritis (part I): classification of paper patients by expert opinion including uncertainty appraisal. *Annals of the Rheumatic Diseases* 2009 Mar 17;68(6):770-776. [doi: [10.1136/ard.2009.108217](https://doi.org/10.1136/ard.2009.108217)]
 19. Taylor W, Gladman D, Helliwell P, Marchesoni A, Mease P, Mielants H. Classification criteria for psoriatic arthritis: Development of new criteria from a large international study. *Arthritis Rheum* 2006 Aug;54(8):2665-2673. [doi: [10.1002/art.21972](https://doi.org/10.1002/art.21972)]
 20. Soellner R, Huber S, Reder M. The Concept of eHealth Literacy and Its Measurement. *Journal of Media Psychology* 2014 Jan;26(1):29-38. [doi: [10.1027/1864-1105/a000104](https://doi.org/10.1027/1864-1105/a000104)]
 21. Norman CD, Skinner HA. eHEALS: The eHealth Literacy Scale. *J Med Internet Res* 2006 Nov;8(4):e27 [FREE Full text] [doi: [10.2196/jmir.8.4.e27](https://doi.org/10.2196/jmir.8.4.e27)] [Medline: [17213046](https://pubmed.ncbi.nlm.nih.gov/17213046/)]
 22. Chung S, Park BK, Nahm E. The Korean eHealth Literacy Scale (K-eHEALS): Reliability and Validity Testing in Younger Adults Recruited Online. *J Med Internet Res* 2018 Apr 20;20(4):e138. [doi: [10.2196/jmir.8759](https://doi.org/10.2196/jmir.8759)] [Medline: [29678800](https://pubmed.ncbi.nlm.nih.gov/29678800/)]
 23. Worm-Smeitink M, Janse A, van Dam A, Evers A, van der Vaart R, Wensing M, et al. Internet-Based Cognitive Behavioral Therapy in Stepped Care for Chronic Fatigue Syndrome: Randomized Noninferiority Trial. *J Med Internet Res* 2019 Mar 14;21(3):e11276 [FREE Full text] [doi: [10.2196/11276](https://doi.org/10.2196/11276)] [Medline: [30869642](https://pubmed.ncbi.nlm.nih.gov/30869642/)]
 24. Najm A, Gossec L, Weill C, Benoist D, Berenbaum F, Nikiphorou E. Mobile Health Apps for Self-Management of Rheumatic and Musculoskeletal Diseases: Systematic Literature Review. *JMIR Mhealth Uhealth* 2019 Nov 26;7(11):e14730. [doi: [10.2196/14730](https://doi.org/10.2196/14730)]
 25. Najm A, Lempp H, Gossec L, Berenbaum F, Nikiphorou E. Needs, Experiences, and Views of People With Rheumatic and Musculoskeletal Diseases on Self-Management Mobile Health Apps: Mixed Methods Study. *JMIR Mhealth Uhealth* 2020 Apr 20;8(4):e14351. [doi: [10.2196/14351](https://doi.org/10.2196/14351)]

26. Nowell W, Curtis D, Curtis J. Arthritis Power Reflects Optimal Characteristics of Apps for Rheumatoid Arthritis. *J Clin Rheumatol* 2019 Dec 09. [doi: [10.1097/RHU.0000000000001223](https://doi.org/10.1097/RHU.0000000000001223)] [Medline: [31834100](https://pubmed.ncbi.nlm.nih.gov/31834100/)]
27. Schulz P, Nakamoto K. Health literacy and patient empowerment in health communication: the importance of separating conjoined twins. *Patient Educ Couns* 2013 Jan;90(1):4-11 [FREE Full text] [doi: [10.1016/j.pec.2012.09.006](https://doi.org/10.1016/j.pec.2012.09.006)] [Medline: [23063359](https://pubmed.ncbi.nlm.nih.gov/23063359/)]
28. van DVR, Drossaert CHC, de HM, Taal E, van DLMAFJ. Measuring actual eHealth literacy among patients with rheumatic diseases: a qualitative analysis of problems encountered using Health 1.0 and Health 2.0 applications. *J Med Internet Res* 2013 Feb;15(2):e27 [FREE Full text] [doi: [10.2196/jmir.2428](https://doi.org/10.2196/jmir.2428)] [Medline: [23399720](https://pubmed.ncbi.nlm.nih.gov/23399720/)]
29. Milne RA, Puts MTE, Papadakos J, Le LW, Milne VC, Hope AJ, et al. Predictors of High eHealth Literacy in Primary Lung Cancer Survivors. *J Cancer Educ* 2015 Dec;30(4):685-692. [doi: [10.1007/s13187-014-0744-5](https://doi.org/10.1007/s13187-014-0744-5)] [Medline: [25355524](https://pubmed.ncbi.nlm.nih.gov/25355524/)]
30. Neter E, Brainin E. eHealth literacy: extending the digital divide to the realm of health information. *J Med Internet Res* 2012 Jan;14(1):e19 [FREE Full text] [doi: [10.2196/jmir.1619](https://doi.org/10.2196/jmir.1619)] [Medline: [22357448](https://pubmed.ncbi.nlm.nih.gov/22357448/)]
31. Richtering SS, Hyun K, Neubeck L, Coorey G, Chalmers J, Usherwood T, et al. eHealth Literacy: Predictors in a Population With Moderate-to-High Cardiovascular Risk. *JMIR Hum Factors* 2017 Jan 27;4(1):e4 [FREE Full text] [doi: [10.2196/humanfactors.6217](https://doi.org/10.2196/humanfactors.6217)] [Medline: [28130203](https://pubmed.ncbi.nlm.nih.gov/28130203/)]
32. Noblin AM, Wan TTH, Fottler M. The impact of health literacy on a patient's decision to adopt a personal health record. *Perspect Health Inf Manag* 2012;9:1-13 [FREE Full text] [Medline: [23209454](https://pubmed.ncbi.nlm.nih.gov/23209454/)]
33. Ernstring C, Stühmann LM, Dombrowski SU, Voigt-Antons J, Kuhlmeier A, Gellert P. Associations of Health App Use and Perceived Effectiveness in People With Cardiovascular Diseases and Diabetes: Population-Based Survey. *JMIR Mhealth Uhealth* 2019 Mar 28;7(3):e12179. [doi: [10.2196/12179](https://doi.org/10.2196/12179)]
34. Norman CD, Skinner HA. eHealth Literacy: Essential Skills for Consumer Health in a Networked World. *J Med Internet Res* 2006 Jun;8(2):e9 [FREE Full text] [doi: [10.2196/jmir.8.2.e9](https://doi.org/10.2196/jmir.8.2.e9)] [Medline: [16867972](https://pubmed.ncbi.nlm.nih.gov/16867972/)]
35. Xie B. Effects of an eHealth literacy intervention for older adults. *J Med Internet Res* 2011 Nov;13(4):e90 [FREE Full text] [doi: [10.2196/jmir.1880](https://doi.org/10.2196/jmir.1880)] [Medline: [22052161](https://pubmed.ncbi.nlm.nih.gov/22052161/)]
36. Vo V, Auroy L, Sarradon-Eck A. Patients' Perceptions of mHealth Apps: Meta-Ethnographic Review of Qualitative Studies. *JMIR Mhealth Uhealth* 2019 Jul 10;7(7):e13817. [doi: [10.2196/13817](https://doi.org/10.2196/13817)]
37. Hiboote. Société Française de Rhumatologie. 2019. URL: <https://hiboote.larhumatologie.fr/> [accessed 2019-12-30]
38. Byambasuren O, Beller E, Glasziou P. Current Knowledge and Adoption of Mobile Health Apps Among Australian General Practitioners: Survey Study. *JMIR Mhealth Uhealth* 2019 Jun 3;7(6):e13199. [doi: [10.2196/13199](https://doi.org/10.2196/13199)]
39. Ibfelt EH, Jensen D, Hetland ML. The Danish nationwide clinical register for patients with rheumatoid arthritis: DANBIO. *CLEP* 2016 Oct; Volume 8:737-742. [doi: [10.2147/clep.s99490](https://doi.org/10.2147/clep.s99490)]
40. Wang P, Luo D, Lu F, Elias JS, Landman AB, Michaud KD, et al. A Novel Mobile App and Population Management System to Manage Rheumatoid Arthritis Flares: Protocol for a Randomized Controlled Trial. *JMIR Res Protoc* 2018 Apr 11;7(4):e84. [doi: [10.2196/resprot.8771](https://doi.org/10.2196/resprot.8771)]

Abbreviations

eHEALS: eHealth Literacy Scale

mHealth: mobile health

OR: odds ratio

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