

Manuscript Title: Web-based rehabilitation interventions for people with rheumatoid arthritis: a systematic review

Running head

Web-based rehabilitation interventions

Article category

Review

Authors & Affiliations

Cynthia Srikesavan¹, Catherine Bryer², Usama Ali³, and Esther Williamson¹

¹Centre for Rehabilitation Research in Oxford, University of Oxford, Oxford, United Kingdom

²Oxford Health NHS Foundation Trust, Oxford, United Kingdom

³Centre for Statistics in Medicine, Oxford Clinical Trials Research Unit & Centre for Rehabilitation Research in Oxford, University of Oxford, Oxford, United Kingdom

Correspondence information

Cynthia Srikesavan

Centre for Rehabilitation Research in Oxford

Nuffield Department of Orthopaedics, Rheumatology & Musculoskeletal Sciences

Botnar Research Centre, University of Oxford

Windmill Road, Headington, Oxford, OX3 7LD

Telephone: +44 01865 737907 | Email: cynthia.srikesavan@ndorms.ox.ac.uk

Declaration of interest

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Abstract

Background

Rehabilitation approaches for people with rheumatoid arthritis include joint protection, exercises, and self-management strategies. Health interventions delivered via web have the potential to improve access to health services overcoming time constraints, physical limitations, and socioeconomic and geographic barriers. The objective of this review is to determine the effects of web-based rehabilitation interventions in adults with rheumatoid arthritis.

Methods

Randomised controlled trials that compared web-based rehabilitation interventions to usual care, waiting list, no treatment or another web-based intervention in adults with rheumatoid arthritis were included. The outcomes were pain, function, quality of life, self-efficacy, rheumatoid arthritis knowledge, physical activity and adverse effects. Methodological quality was assessed using the Cochrane Risk of Bias tool and quality of evidence with the Grading of Recommendations Assessment, Development and Evaluation approach.

Results

Six source documents from four trials (n= 567) focusing on self-management, health information, or physical activity were identified. The effects of web-based rehabilitation interventions on pain, function, quality of life, self-efficacy, rheumatoid arthritis knowledge, and physical activity are uncertain because of the very-low-quality of evidence mostly from small single trials. Adverse effects were not reported.

Conclusion

Large, well-designed trials are needed to evaluate the clinical and cost-effectiveness of web-based rehabilitation interventions in rheumatoid arthritis.

Key words

Evidence; Online health; Rheumatoid arthritis; Web-based rehabilitation.

Introduction

Rheumatoid arthritis (RA) is a chronic inflammatory joint disease and is the second most common form of arthritis in the UK [1]. RA affects a person's overall function and quality of life by limiting their activities of daily living and restricting their ability to work or participate in social and leisure activities [2]. A multi-disciplinary treatment approach [3] is recommended in RA that includes pharmacological, non-pharmacological, and/or surgical interventions. The core components of rehabilitation including exercise, joint protection advice and self-management strategies [4, 5] are prescribed to improve function and quality of life and thereby reduce disability. In people with long-term conditions such as RA, regular rheumatology clinic appointments and timely access to recommended treatments may not always be feasible due to waiting time from referrals to treatment, transportation difficulties, physical limitations, time constraints and geographical barriers [6]. A possible solution to address these challenges is to provide clinically effective health interventions via the internet that are easily accessible to a larger number of end-users [7, 8] at low cost [9].

The world internet usage statistics report as of June 2017 [10] shows approximately 3.9 billion people using the internet worldwide. In the past two decades, health interventions delivered through the internet have grown rapidly with increased access to internet services and prevalent use of a range of telecommunication devices e.g. tablets, iPad, and smartphones [11, 12]. There are a variety of web-based health interventions

developed for a range of chronic health conditions including diabetes, cardiovascular disease, chronic obstructive pulmonary disease, cancer and psychiatric disorders [13-16]. A small number of web-based programmes have also been developed for people with RA [17-24].

Objectives

To determine the effects of web-based rehabilitation interventions on the outcomes of pain, function, quality of life, self-efficacy, RA knowledge, physical activity, and adverse effects in adults with RA.

Methods

Protocol and registration

The systematic review protocol was registered on the international prospective register of systematic reviews [25], bearing registration number

CRD 42016042698.

Eligibility criteria

Types of trials

Only randomised and quasi-randomised controlled trials published in peer-reviewed journals in English were included.

Types of participants

Adults (aged above 18 years) with a clinical diagnosis of RA were included. Trials that included participants with different types of arthritis without providing separate data for participants with RA or involved participants with mixed arthritis diagnoses (e.g. RA and Osteoarthritis) were excluded.

Types of interventions

All forms of clinician-guided or self-directed interventions delivered via internet or e-mail was included. Any web-based clinician decision aids, pharmacological, psychological, or post-surgical interventions were excluded.

Types of comparisons

Passive controls of waiting list or no treatment; and active controls such as usual care or another web-based intervention were included.

Types of outcomes

Trials reporting at least one of the following outcomes were included: pain, function, quality of life, self-efficacy, RA knowledge, physical activity, and adverse effects (reports of injuries, severe pain or increased disease activity due to the intervention). Outcomes were extracted at three time-periods from the point of randomisation: short-term (from 0-3 months); medium-term (4-11 months); and long-term (12 months or more). If a trial included multiple assessment points within the above time periods, the longest follow-up was chosen for reporting

Information sources

Further to a previous search in February 2017, an updated search in the electronic databases of Embase (From 1974), MEDLINE (From 1946), Allied and Complementary Medicine Database (From 1985), PsycINFO (From 1967), Scopus, Physiotherapy Evidence Database, Cumulative

Index of Nursing and Allied Health Literature, SportsDiscus, the Cochrane Central Register of Controlled Trials and Google Scholar was conducted on 29 January 2018 for full-text articles published up to January 2018. A search strategy (Supplementary file 1) with search terms specific for different databases was developed by a health sciences librarian. The electronic trial registries of ClinicalTrials.gov and World Health Organisation International Clinical Trials Registry Platform portal were also searched for any ongoing or recently completed randomised controlled trials.

Study selection

After removing duplicates, two reviewers (CS and CB) independently screened the titles and abstracts. The full-texts of potentially eligible studies were retrieved and were further assessed for eligibility. Trials fulfilling the eligibility criteria were included and reference lists of these trials were also checked. Any discrepancies in selecting the trials were resolved by discussing with a third reviewer (EW) as required.

Data collection process

Data extraction forms prepared by the review team were used to extract features of the interventions (content, dosage and modes of delivery), participant characteristics, and outcomes from the included trials.

Methodological quality rating

Reviewers (CS and CB) independently assessed the methodological quality of the included trials using the Cochrane's risk of bias tool [26]. The risk of bias tool includes domains of selection bias (random sequence generation, allocation concealment), performance bias (blinding of participants and personnel), detection bias (blinding of outcome assessment), attrition bias (incomplete outcome data) and reporting bias (selective reporting) and other sources of bias, which are not covered in the above domains (e.g. baseline variability). With most subjective outcomes in the trials, selection bias, performance bias, and detection bias were considered as key domains for risk of bias assessments in this review.

In each trial, the risk of bias across each risk of bias domain was graded as low, unclear or high based on the information provided in the included trials. The summary risk of bias for each outcome across each trial was classified as at low risk of bias if they had key domains at low risk of bias; unclear risk of bias if one or more key domains had an unclear risk of bias; and high risk of bias if one or more key domains had a high risk of bias. The summary assessment of the risk of bias for each outcome across trials were classified at low risk of bias if most information came from trials with low risk of bias; unclear risk of bias if most information came from trials at unclear risk of bias; and high risk

of bias if most information came from trials at high risk of bias. Any disagreements with quality ratings were settled by consulting the third reviewer (EW).

Measures of treatment effect

A meta-analysis was performed wherever possible. Clinical heterogeneity was determined if participants, interventions, and outcome measures varied considerably between groups. When data could not be pooled due to heterogeneous web-based rehabilitation and control groups, treatment estimates were determined between each individual comparison. Treatment effects for continuous outcomes were expressed as mean difference 95% confidence interval and risk ratio 95% confidence interval for dichotomous outcomes.

Grading the quality of evidence

The quality of evidence was graded as high, moderate and low and very low [27] following the Grading of Recommendations Assessment, Development and Evaluation recommendations: High quality: Further research is very unlikely to change our confidence in the estimate of effect; Moderate quality: Further research is likely to have an important impact on our confidence in the estimate of effect and may change the estimate; Low quality: Further research is very likely to have an important impact on our confidence in the estimate of effect and is likely to change the estimate; Very low quality: We are very uncertain about the estimate.

The overall quality of evidence for each outcome was downgraded by one level if the trials had an unclear or high risk of bias in at least one of the following Grading of Recommendations Assessment, Development and Evaluation factors: 1) limitations in study design, 2) inconsistent results, 3) indirectness of evidence, 4) imprecision of findings and) publication or selective reporting bias [27, 28].

Results

Characteristics of randomised clinical trials included

The Preferred Reporting Items for Systematic review and Meta-Analysis Protocols flow diagram [29] was used to represent the study flow in Figure 1. A total of four trials [17-20] were identified, of which two focused on self-management [19, 20], one on patient information [17] and the other on physical activity [18]. One trial was reported in three separate publications [18, 21, and 22], thus comprising 6 source documents. Allam 2015 [17]

This study aimed to test the effects of online social support and gamification features of a web-based intervention called ONESELF which was developed to provide patient information and to promote health outcomes in people with RA. A total of 157 people who had a diagnosed RA were randomised into four interventional groups - one group had access to information sections only; another had access to information plus social support (forum, chat rooms) only; another had access to information plus gaming features (points to collect badges and medals) only; and the final group had access to all the sections, and the control group did not have access to the website. The study measured physical activity, health care utilisation, medication overuse, RA knowledge and empowerment two months after starting the intervention and further two months later. The study found improvements in physical activity levels and empowerment and decreased health care utilisation over time in those having

access to gaming features with or without social support; and decreased health care utilisation and medication overuse, and improved empowerment in those who had access to social support section alone. There were no significant changes in RA knowledge levels over time for any of the intervention groups.

Berg 2006 [18]

This study evaluated two internet-based physical activity interventions in 160 physically inactive RA patients over a period of 12 months. Eligible participants were assigned to two different parts of the same website at www.cybertraining.nl. The intervention group had access to personalised; equipment-based physical activity training schedule posted on the website and received weekly remote supervision from physiotherapists in addition to an online discussion forum, telephone support, e-newsletters and group meetings once in three months. The control group had access to the website with general information on exercise and physical activity only. The study looked into the physical activity (proportion of people meeting the Dutch public health recommendations for physical activity and number of days people reported to be physically active, and physical activity measured by an activity monitor), function, quality of life and disease activity at 3, 6, 9 and 12 months. The proportion of people and number of days people were physically active were significant in favour of the intervention group while physical activity measured by activity monitor, and other outcomes were not significant between groups.

Another published article of the same study [21] assessed user engagement and satisfaction in 82 participants who were randomised to receive the individualised internet-based physical activity programme. Satisfaction with the frequency of contact with the supervising physiotherapist

through e-mails, telephone or face-to-face sessions was measured by a questionnaire at the end of 12-month intervention and engagement was measured by recording the amount of physical activity schedules returned by users. Between 85% and 95% of the users were satisfied with the frequency of contacts they had through e-mail, telephone, or face-to-face meetings. The average number of people logging in to the website at least once a week was 53; the median return rate of physical activity schedules was 55%; and the median number of group meetings attended was 3 over the 12 month period. An average of 34 participants was engaged in telephone contacts at least once a month or lower; 20 participants used the email contacts once a week or more ; 23 participants used e-mail contacts either once every 2 to 3 weeks or once a month; and 22 participants used less than once a month.

Around 72% of those who completed the 12-month study were available for follow-up assessment at 24 months. An extended report of the same study [22] reported that the proportion of people who were moderately active were significantly higher in both intervention and control groups compared to baseline while those who were vigorously active were higher in the intervention group. However, there were no differences between both groups at 24 months. There were no within or between group differences in terms of function and quality of life.

Lorig 2008 [19]

This study evaluated the Internet-based Arthritis Self-Management Program in people with rheumatoid arthritis, osteoarthritis or fibromyalgia. The internet-based intervention was interactive –based and involved weekly content aimed to improve self-efficacy, pain management and physical activity by providing online education, exercise guidance and symptom management techniques. A total of 855 participants were

randomised to the intervention group or the usual care control group. The study assessed health indicators by using six measures including pain, health distress, self-reported global health, disability, activity limitation, and fatigue; health behaviours; self-efficacy; and health care utilisation at six months and one year and provided change scores in outcomes for the RA group (72 in each group) at one year. There were significant between group differences in only 2 of the 6 health indicators but no differences were seen in health behaviours, self-efficacy, and healthcare utilization.

Shigaki 2013 [20]

This study evaluated a 10-week online self-management group programme called 'RAHelp' that was supported with social networking features and one-to-one weekly telephone contacts with the team leader. A total of 106 people were randomised to the intervention group or the waiting list control group. The study assessed health status due to RA, self-efficacy, and quality of life post-intervention and at 9-month follow-up. The study found improvements in self-efficacy and quality of life in favour of the intervention group, while majority of the sub-scales that measured health status were non-significant.

The characteristics of trials included are presented in Table 1. The components of web-based rehabilitation interventions from these trials were mapped to the Capability, Opportunity and Motivation-Behaviour model of the Behaviour Change Wheel [30] and are presented in Table 2. All the interventions focused on increasing participants' knowledge of RA condition; used social support and personalised features to motivate participants to complete the intervention; included different environmental contexts such as forums for interaction with other participants and provision of individualised care; and used audio-visual materials for modelling patient education and providing behavioural support. Two trials

used ‘enablers’ such as email reminders and action plans, and online communities to reduce barriers to intervention adherence or to build engagement with other members.

Participants

The four trials included a total of 567 randomised eligible participants ranging from 54 to 115 participants in web-based intervention groups and from 40 to 125 in control groups. Participants were recruited through outpatient clinics or through online newsletters, websites and discussion forums. Two trials [17, 20] reported the mean age of participants in web-based intervention groups between 50.3 and 53.2 years and between 49.3 and 69.3 years in control groups. One trial [18] reported participants’ median age of 49.5 and 49.8 years in web-based intervention and control groups respectively, while another trial [19] did not report the demographics of the RA group. Trials reported that participants’ RA diagnosis was confirmed either by participant’s physician, rheumatologist, or medical records. However, whether participants had a mix of RA presentation or specific to some joints of the body was not clear across trials. One trial [19] involved people with RA, Osteoarthritis, and Fibromyalgia. Only two trials [17, 20] reported the mean of disease duration of participants which ranged from 7.4 and 18.11 years. The median number of years since diagnosis reported in another trial [18] ranged from 5.5 to 7.6 years. The proportion of female participants ranged from 29% to 93% in web-based intervention groups and from 77% to 95% in control groups. Two trials [17, 19] included having access to computer and Internet, and ability to navigate the Internet as eligibility criteria for participation. Approximately, 61% to 72% of participants in web-based intervention groups and 48% to 90.3% participants in control groups had high school to graduate level of education, with one trial having 81%

and 90.3% participants with college/graduate level educational background in web-based intervention and control groups. Around 55% to 62% of participants in web-based intervention groups and 10% to 69% participants in the control groups were employed. Participants completed online questionnaires in two trials [17, 19]; outcomes were measured by assessors in one trial [18], while there was no clear information regarding data collection methods in another trial [20].

Methodological quality rating

Only two trials [17, 18] provided sufficient information on using acceptable methods for generating the random sequence. All trials were rated at unclear risk as they did not provide sufficient information on allocation concealment methods. Three trials [17, 19, and 20] compared web-based interventions to the waiting list, non-web based usual care, or no treatment while study personnel providing co-interventions were not blinded in another trial [18]. Therefore, all trials were rated at high risk of performance bias and detection bias for subjective or objective outcomes. One trial [20] was rated at high risk of incomplete outcome data as it did not use intention to treat analysis. All four trials were at low risk of bias in selective reporting. Three trials were at high risk of other bias such as small sample sizes [17], missing data [18], and multiple outcomes with a risk of producing Type 2 statistical error [19]. All trials acknowledged their source of funding. As all the included trials had more than one risk of bias key domain rated at high risk of bias, the overall risk of bias for each trial was rated 'high'.

Treatment effects on outcomes

Pain

Two trials [19, 20] reported the effects of web-based self-management interventions on pain (Table 3). In one trial [20], the Arthritis Impact Measurement Scale-2 symptoms scale and the Rapid Assessment of Disease Activity in Rheumatology scale were used to measure pain. For this review, the Arthritis Impact Measurement Scale-2 scale was used as it measured pain across past four weeks while the Rapid Assessment of Disease Activity in Rheumatology measured 'pain today'. In this trial, the self-management group compared to waiting list showed a small non-significant effect on the Arthritis Impact Measurement Scale-2 symptoms scale at short-term and medium-term. The other trial [19] showed a small non-significant effect in change scores from baseline at long-term, compared to usual care.

Function

Two trials [18, 19] provided data on function (Table 3). Both trials used the health assessment questionnaire while Berg 2006 trial [18] also used the McMaster Toronto Arthritis patient preference questionnaire. The health assessment questionnaire scores were considered for pooling as it is one of the core outcome measures proposed by the Cochrane musculoskeletal review group for reviews in RA. However, the data could not be pooled due to clinical heterogeneity between treatment comparisons [web-based physical activity training versus web-based general information

[18] and web-based self-management versus usual care [19]. Therefore, the treatment effect estimates for each trial are presented separately. The Berg 2006 trial [18] provided mean change scores from baseline 95% confidence interval data for short, medium and long-term effects. Standard deviations were calculated from the 95% confidence interval following the guidance in the Cochrane handbook of systematic reviews. At all time-points, there were no significant differences in change scores from baseline of the health assessment questionnaire between the two web-based programmes. The Lorig 2008 trial [19] that compared web-based self-management to usual care also showed no significant differences in function between groups at long-term.

Quality of life

Two trials, one on web-based physical activity programme [18] and the other on a web-based self-management [20] provided data on quality of life (table 3). Both used four different outcome measures, RA Quality of Life and Research AND Development 36 questionnaires in [18] and (Role subscale of Arthritis Impact Measurement Scale-2 and Quality of Life Scale [20]. For reasons of clinical heterogeneity between treatment comparisons [web-based physical activity training versus web-based general information [18] and web-based self-management versus waiting list [20], the data was not pooled. Therefore, the treatment effects for each individual comparison were determined. In Berg 2006 trial [18], the RA Quality of Life scores were used rather than the physical and mental sub-scales of the Research AND Development questionnaire. Mean changes from baseline showed small, non-significant effects for the individualised physical activity training group on quality of life at short, and

long-term compared to general information on physical activity. The changes were significant in the medium and long-term. In Shigaki 2008 trial [20], the Quality of Life Scale scores were used rather than the Role Arthritis Impact Measurement Scale -2 as the later reflected 'work' related role rather than the quality of life. Results showed small non-significant effects for self-management group compared to the waiting list at short-term and medium-term (Table 3).

Self-efficacy

Two trials on web-based self-management [19, 20] provided data for short, medium and long-term effects on self-efficacy (Table 4). One trial [20] showed significant effects on the Arthritis Self-Efficacy Scale favouring the self-management group in the short-term and medium-term, compared to the waiting list. Another trial [19] found a small significant long-term effect on the change scores of the Arthritis Self-Efficacy Scale favouring the self-management group compared to usual care.

RA knowledge

One trial [17] that compared four different intervention groups involving web-based information only; information with social support; information with gamification features; and information with social support and gamification features to a control that did not have access to the website examined the benefits on RA patient knowledge at short-term and medium-term. With a multi-level linear modelling technique, the trial reported that the RA knowledge did not change over time for any of the intervention groups. For this review, raw data from each intervention

group were extracted for direct comparison with the control group. A significant effect was noted in patient RA knowledge in most of these comparisons favouring the intervention groups at both time points (Table 4).

Physical activity

Physical activity was measured in two trials [17, 18]. The Allam 2015 trial [17] measured time spent on physical activity using the Exercise behaviours scale. The Berg 2006 trial [18] measured the quantity of physical activity in three ways (proportion of patients who were physically active; the number of days per week on which patients were physically active; and amount of physical activity using an activity monitor). For reasons of clinical heterogeneity in treatment comparisons and outcome measures used, pooling was not possible. The treatment effects of web-based rehabilitation interventions on physical activity are estimated separately from the average time spent on exercise and physical activity [17] and proportion of participants who self-reported to be active [18].

The Allam 2015 trial [17] used a predictive model and found that the mean minutes spent on physical activity increased over time in participants (n=28) who had access to web-based information with social support and gaming features compared to the control group that did not have any access to the website (n=40). When all four intervention groups were compared at short-term (table 5), the control group was significantly better than the intervention groups that included information with social support, and information with social support and gamification features. No

differences were seen with the other two interventions compared to control group. In medium-term (table 5), the control group was significantly better than the interventions that included information only and information with social support and gamification features. No differences were seen with the other two interventions compared to control group.

The Berg 2006 trial [18] which compared a web-based individualised physical activity programme to a web-based general information on physical activity and exercises showed the proportion of patients who were physically active at a moderate intensity level (30 minutes in succession on at least 5 days a week) to be slightly higher in the individualised training group compared to the general training group at medium-term. There were no clear differences between groups at long-term (Table 5).

The proportion of patients who were physically active at a vigorous intensity level (for 20 minutes in succession on at least 3 days/ week) showed a positive trend towards the individualised training group at short, medium, and long-term (Table 5).

Physical activity was also measured by the total number of days the participants reported being moderately or vigorously active (data not shown). The average number of days participants were moderately active was significantly better in the individualised training group at 6 months with no significant differences between groups at 3, 9 and 12 months. The average number of days' participants who were vigorously active was significantly higher in the individualised training group at 3, 6, 9 and 12 months. No data was available for 24 months follow-up. An

objective activity monitor was also used to measure changes in physical activity levels during the 1-year intervention at baseline, 6 and 12 months (data not shown). The trial found no differences between groups at 6 and 12 months and no data were available for 3 and 9 months and 24 months follow-up.

Adverse effects

None of the included trials reported this outcome.

Quality of the evidence

The findings for each outcome included in this review came from single trials that were graded at high risk of bias across key risk of bias domains. The limitations in study design were mainly with the selection of participants, blinding, incomplete data reporting, and lack of intention to treat analysis. In addition, there was a lack of precision due to a low number of study participants which will have influenced the treatment effects. Therefore, the quality of evidence was downgraded to very low for all outcomes (tables 3, 4, & 5) and hence the estimates of the effects for all outcomes are very uncertain.

Discussion

This systematic literature review reports on what is currently known about the effects of web-based interventions pain, function, quality of life, self-efficacy, RA knowledge, physical activity, and adverse effects in people with RA. Four randomised controlled trials with interventions targeting self-management, health information and physical activity were identified. The findings suggest that the effects of web-based rehabilitation interventions on the clinical outcomes are very uncertain as the quality of evidence was very low. Adverse effects of web-based interventions have not been evaluated. The trials had smaller sample sizes, the risk of selection bias, and risk of non-blinding to allocation and assessments, influencing the confidence on the estimates of effects.

Some demographic characteristics of participants varied widely across trials. For example, the age range of participants in web-based intervention groups was much lower (50-53 years) than those in the control groups (49-69 years) in two of the included trials; the mean average RA disease duration reported in two trials ranged from 7.4 to 18.1 years. It is not known whether the age discrepancies may have influenced the treatment effects or if the web-based interventions were tailored to consider the intervention needs for people being newly diagnosed to those living with RA for many years.

As in conventional rehabilitation trials, unblinding of participants is inevitable in web-based interventions too. It is easy for participants to guess their treatment allocation when the comparator is the waiting list, usual care, or a no treatment group. Therefore, there is always some risk of response bias as participants are outcome assessors themselves when completing patient-reported outcomes. Blinding of study personnel may be less important in web-based intervention trials when participants complete online questionnaires and are free from researcher-influence or social desirability bias.

Only two outcomes [self-efficacy and RA patient knowledge] showed significant improvements with web-based rehabilitation interventions but the quality of this evidence was very low. In addition, it is not clear whether the treatment estimates indicate an important clinical benefit as the minimal clinically important differences are not available for the measures used. For physical activity, the findings from Berg 2006 [18] showed discrepancies between self-reported and objective physical activity measures, for example, at 6 months, physical activity measured by the activity monitor showed no difference between groups while both self-reported physical activity levels favoured the web-based individualised training group. Some possible reasons could be over-estimation of self-reports or the activity monitor used in the trial did not capture water-based physical activity such as swimming.

There were substantial limitations to design and conduct of the trials which included:

Variations in interventions and outcomes

The interventions evaluated varied greatly between trials and were, therefore, not directly comparable. In terms of outcomes, different and multiple outcome measures for the same constructs were used across trials. Core outcomes for RA clinical trials [31] recommended by the Outcome Measures in Rheumatology and additional radiographs for long-term trials should be considered in the future.

Lack of generalisability

There was over-representation of women in the trials included. Participants also had higher levels of computer literacy than the general population because the inclusion criteria in two trials eliminated participants who had limited access or limited capability to use online programs or websites or who didn't have a computer. All the trials were conducted in high-income countries, and therefore may not fully represent a diverse range of users worldwide

Interventions were neither theory-based nor pilot tested in RA population

Except for one trial [20] in which the self-management intervention was designed based on social learning theory and cognitive behavioural approach; interventions in the other three trials were not based on any theoretical framework. Only one trial [17] reported preliminary testing of the intervention in different patient populations. No trials reported involving end-users in the design and development of the intervention, nor did usability or feasibility evaluation in people with RA.

No sample size estimation and power calculation

Except for one trial [18] sample sizes or statistical power were not determined in any of the other trials.

Implications for future research

The current evidence base for the effectiveness of web-based rehabilitation interventions in people with RA is very limited. A few rehabilitation trials identified in the trial registries are currently being undertaken. There is further need for adequately powered randomised controlled trials to evaluate clinical and cost-effectiveness of web-based interventions in people with RA.

In addition, standardised trial reporting [34] is necessary and researchers need to ensure that web-based interventions are based on sound theoretical models and that the end-user is involved from the early stages of development and evaluation. Using quantitative and qualitative research methods would capture users' perspectives and expectations of using web-based interventions. User engagement and feedback during development, testing and piloting would help inform content, visual appeal, navigation and accessibility of developing a user-specific web-based intervention which is also feasible and acceptable when disseminated on a large scale.

The Medical Research Council framework [35] that suggests a structured plan for developing, evaluating and implementing complex interventions should be adopted towards implementing web-based interventions that 'actually work' into routine practice. It is also important to use valid and reliable objective and subjective measures specific for RA to make standardised reporting and pooling of data easy and possible. Investigations into the barriers and facilitators in study processes, participant adherence and retention would be useful in understanding how best to implement web-based interventions more effectively.

Conclusion

The available evidence on web-based interventions for people with RA seems to indicate that there is a viable space for web-based interventions, however, to date, they are not adequately developed or evaluated to recommend their use in people with RA. Fully powered trials with theory-based and patient centred interventions and with long-term follow-ups are needed.

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Declaration of interests

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Table 1. Web-based rehabilitation interventions in included trials

| Author & Year Country | Randomised n | Control intervention | Web-based rehabilitation intervention | Frequency | Treatment duration/Assessments | Outcomes relevant to the review |
|---|-----------------|--|--|---|---------------------------------------|--|
| Allam 2015 [17] Switzerland | 157 | No access to ONESELF website | ONESELF-Four different web-based intervention groups targeted to provide information only; information+ social support features; information+ gamification; information+ social support +gamification for people with RA to improve health outcomes. Intervention included informational text on RA; instructional videos on coping with RA; patient testimonies; physician interviews on pain management Features- Online forum and chat room; patient blog space and gamification features like reward points. | 1 hour per week | 2 months 2 & 4 months | Physical activity: Exercise Behaviour Scale (average time spent on exercise) RA knowledge: Patient Knowledge Questionnaire (Higher scores mean more RA knowledge) |
| Berg 2006 [18, 21, and 22] Netherlands | 160 | Access to web pages with information on exercises and physical activity updated once a month | Physical activity programme -www. cybertraining.nl. Intervention included Personalised physical activity schedule, new weekly schedules, weekly remote therapist supervision emails, group meetings every three months. Features- Discussion forums and tailored self-management strategies | 5 times per week | 52 weeks 3, 6, 9 12, 24 months | Physical activity: Proportion of patients moderately or vigorously active & Activity monitor to measure the number of days patient was active Function: McMaster-Toronto Arthritis Patient Preference Disability Questionnaire & Health Assessment Questionnaire (0-3) (lower scores mean better function) Quality of life: RA Quality of Life (0-30, lower scores mean higher quality of life), RAND36 questionnaires |
| Lorig 2008 [19] USA | 144 | Usual care | A self-management programme targeted to reduce pain and improve function in people with RA and fibromyalgia. Intervention included tailored exercise programme, information on cognitive techniques such as relaxation, distraction; managing negative emotions, action planning; and healthy eating Features- Bulletin boards, monitoring tools such as medication diaries and exercise logs; online discussion centre, and self-assessment options | 3 sessions per week, total 1-2 hours per week | 6 weeks 6 weeks, 6 & 12 months | Pain: 0-10 Numeric Scale (higher scores mean more pain) Function: Health Assessment Questionnaire Self-efficacy: Arthritis Self-Efficacy Scale (1-10, higher scores mean higher self-efficacy) |
| Shigaki 2013 [20] USA | 106 | Waiting list | RA Help.org: A self-management programme targeted to improve self-efficacy and ability to manage RA. Theory based intervention to encourage self-management Features- Educational modules, personalised to-do list, resource library, self-monitoring tools such as a home work journal, one to one weekly telephone support, and online community activities like discussion board, scheduled chats, and secured message system | Weekly modules | 10 weeks 10 weeks & 9 months | Pain: Arthritis Impact Measurement Scale-2 symptoms (0-10) & Brief Rapid Assessment of Disease Activity in Rheumatology, (higher scores mean more pain) Quality of Life: Quality of Life Scale (0-100, higher scores mean higher quality of life) Self-efficacy: Arthritis Self-Efficacy Scale (0-10, higher scores mean higher self-efficacy) |

Table 2. Mapping web-based rehabilitation intervention functions with the components of the Capability, Opportunity, Motivation - Behaviour model of the behaviour change wheel

| Web-based rehabilitation intervention functions | Allam 2015 [17] | Berg 2006 [18] | Lorig 2008 [19] | Shigaki 2013 [20] |
|---|--|--|---|---|
| Education | Information about exercise and physical activity | Information on about exercise and arthritis | Arthritis help book | Patient educational modules Resource library for information from online sources posted by the clinician or forwarded by participants |
| Persuasion | Patient's blog section to contribute to the website Gamification features to encourage website use | Discussion forum to facilitate contact between members | Self-monitoring tools-medication diaries, exercise logs | Personalised to do list Self-monitoring tools |
| Incentivisation | Points, badges and medals as rewards for participants' contributions to the website | X | X | X |
| Coercion | X | X | X | X |
| Training | X | X | X | X |
| Restriction | X | X | X | X |
| Environmental restructuring | Discussion forum Chat room | Individual supervision & feedback via email Group meetings & contacts among group members | Pre-programmed content Bulletin boards to discuss arthritis related issues | Social networking applications Weekly one-to-one phone calls 'RAHelp' village community area with features-online chats, discussion boards and SMS facility |
| Modelling | Videos for coping techniques in RA; Patient testimonies and clinician interviews about ways of dealing RA | Exercise demonstrations by therapists | Moderators modelled action planning, problem solving | X |
| Enablement | X | X | Email reminders to non-participants Action plan posted online for each week activities | 'RAHelp village' community feature for community engagement and skill building |

Table 3. Outcomes: Pain, Function, & Quality of Life

| Outcomes | Comparisons | Time points | No. of participants (studies) | Effect estimates MD [95% CI] | Quality of the evidence (GRADE) |
|-----------------|--|--|---|--|---------------------------------|
| Pain | Web-based rehabilitation (Self-management) vs Waiting list [20] | Short-term Medium-term | 93 (1 study) 88 (1 study) | -0.5 [-1.44, 0.44] -0.2 [-1.27, 0.87] | ⊕⊕⊕⊕ Very low ¹ |
| | Web-based rehabilitation (Self-management) vs Usual care [19] | Long-term | 144 (1 study) | -0.45 [-1.20, 0.31] | ⊕⊕⊕⊕ Very low ² |
| Function | Two web-based rehabilitation (Individualised Physical activity & General information on exercise & physical activity) [18] | Short-term Medium-term Long-term | 155 (1 study) 155 (1 study) 108(1 study) | 0.03 [-0.04, 0.10] -0.02 [-0.09, 0.05] -0.01 [-0.11, 0.09] | ⊕⊕⊕⊕ Very low ³ |
| | Web-based rehabilitation (Self-management) vs Usual care [19] | Long-term | 144 (1 study) | -0.03 [-0.15, 0.09] | ⊕⊕⊕⊕ Very low ¹ |
| Quality of life | Two web-based rehabilitation (Individualised Physical activity & General information on exercise & physical activity) [18] | Short-term Medium-term Long-term | 155 (1 study) 152 (1 study) 108 (1 study) | -0.7 [-1.59, 0.19] -1.7 [-2.62, -0.78] -1.5 [-2.71, -0.29] | ⊕⊕⊕⊕ Very low ³ |
| | Web-based rehabilitation (Self-management) vs Waiting list [20] | Short-term Medium-term | 93 (1 study) 88 (1 study) | 3.5 [-1.85, 8.85] 4.9 [-0.96, 10.76] | ⊕⊕⊕⊕ Very low ¹ |

Footnotes: ¹ Risk of bias (unclear risk of selection bias, high risk of performance, detection, and attrition bias) and imprecision (total sample size less than 400); ² Risk of bias (unclear risk of selection bias, high risk of performance and detection biases, risk of Type II error) and imprecision (total sample size less than 400); ³Risk of bias (unclear risk of selection bias, high risk of performance and detection biases, missing data) and imprecision (total sample size less than 400).

Table 4. Outcomes: Self-efficacy & RA knowledge

| Outcomes | Comparisons | Time points | No. of participants (studies) | Effect estimates MD [95% CI]/Risk ratio [95% CI] | Quality of the evidence (GRADE) |
|---------------|---|---------------------------|-------------------------------|--|---------------------------------|
| Self-efficacy | Web-based rehabilitation (Self-management) vs Waiting list [20] | Short-term Medium-term | 93 (1 study) 88 (1 study) | 15.4 [6.73, 24.07] 15.5 [7.13, 23.87] | ⊕⊕⊕⊕ Very low ¹ |
| | Web-based rehabilitation (Self-management) vs Usual care [19] | Long-term | 144 (1 study) | 0.54 [0.06, 1.02] | ⊕⊕⊕⊕ Very low ² |
| RA knowledge | Web-based rehabilitation (Information) vs No access to website [17] | Short-term | 69 (1 study) | 0.79 [-0.31, 1.89] | ⊕⊕⊕⊕ Very low ³ |
| | Information + social support features vs No access | | 69 (1 study) | 1.62 [0.68, 2.56] | |
| | Information + gamification features vs No access | | 68 (1 study) | 1.77 [0.73, 2.81] | |
| | Information + social support + gamification features vs No access | | 68 (1 study) | 1.06 [-0.01, 2.13] | |
| | Web-based rehabilitation (Information) vs No access to website [17] | Medium-term | 68 (1 study) | 1.63 [0.65, 2.61] | |
| | Information + social support features vs No access | | 63 (1 study) | 2.12 [1.12, 3.12] | |
| | Information + gamification features vs No access | | 66 (1 study) | 2.11 [1.15, 3.07] | |
| | Information + social support + gamification features vs No access | | 66 (1 study) | 1.22 [0.22, 2.22] | |

Footnotes: ¹ Risk of bias (unclear risk of selection bias, high risk of performance, detection, and attrition bias) and imprecision (total sample size less than 400); ² Risk of bias (unclear risk of selection bias, high risk of performance and detection biases, risk of Type II error) and imprecision (total sample size less than 400); ³ Risk of bias (unclear risk of selection bias, performance and detection bias) and imprecision (total sample size less than 400); ³ Risk of bias (unclear risk of selection bias, high risk of performance and detection biases, missing data) and imprecision (total sample size less than 400).

Table 5. Outcomes: Physical activity & Adverse effects

| Outcome | Comparisons | Time points | No. of participants (studies) | Effect estimates MD [95% CI]/Risk ratio [95% CI] | Quality of the evidence (GRADE) |
|--|--|-------------|--|--|---------------------------------|
| Physical activity: Average time spent on exercise | Web-based rehabilitation (Information) vs No access to website [17] Information + social support features vs No access Information + gamification features vs No access Information + social support + gamification features vs No access | Short-term | 69 (1 study) 69 (1 study) 68 (1 study) 68 (1 study) | -10.76 [-22.36, 0.84] -16.02 [-28.58, -3.46] -10.82 [-24.44, 2.80] -15.91 [-27.91, -3.91] | ⊕⊕⊕⊕ Very low ¹ |
| | Web-based rehabilitation (Information) vs No access to website [17] Information + social support features vs No access Information + gamification features vs No access Information + social support + gamification features vs No access | Medium-term | 68 (1 study) 63 (1 study) 66 (1 study) 66 (1 study) | -14.76 [-24.81, -4.71] -10.54 [-24.53, 3.45] -7.98 [-22.61, 6.65] -13.75 [-26.22, -1.28] | |
| Proportion of participants moderately active | Two web-based rehabilitation (Individualised Physical activity & General information on exercise & physical activity) interventions [18, 22] | Short-term | No data | Not applicable | ⊕⊕⊕⊕ Very low ² |
| Proportion of participants vigorously active | | Medium-term | 152 (1 study) | 3.62 [1.67, 7.83] | |
| | | Long-term | 108 (1 study) | 0.77 [0.37, 1.6] | |
| | | Short-term | 155 (1 study) | 1.58 [0.93, 2.69] | |
| | | Medium-term | 152 (1 study) | 1.28 [0.82, 2.02] | |
| | | Long-term | 108 (1 study) | 4 [0.46, 34.64] | |
| Adverse effects | No trials reported this outcome | | | | Not applicable |

Footnotes:¹Risk of bias (unclear risk of selection bias, high risk of performance and detection biases, missing data) and imprecision (total sample size less than 400); ² Risk of bias (unclear risk of selection bias, high risk of performance and detection biases, missing data) and imprecision (total sample size less than 400)

Figure 1: Study flow diagram

