Concise report

Maintenance of physical activity after Internet-based physical activity interventions in patients with rheumatoid arthritis

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Abstract

Objectives. To investigate the maintenance of physical activity 12 months after two 1-year Internet-based physical activity interventions in patients with RA.

Methods. This follow-up study was a randomized comparison of an Internet-based individualized training (IT) and a general training (GT) programme in sedentary RA patients. Outcome measures included physical activity (meeting public health recommendations for moderate physical activity, i.e. 30 min for at least 5 days/week; or vigorous physical activity, i.e. 20 min for at least 3 days/week), functional ability and quality of life (QoL).

Results. Of the 152 RA patients who completed the initial study, 110 (72%) were available at follow-up. At 24 months, the proportions of patients meeting public health recommendations for moderate intensity physical activity were significantly higher compared with baseline in both the IT and GT groups (19 and 24%, respectively, \( P < 0.05 \)), whereas the proportions of patients meeting the recommendation for vigorous activity was only significantly higher compared with baseline in the IT group (\( P < 0.05 \)) but not in the GT group. There were no differences between the IT and GT groups concerning proportions of patients meeting moderate or vigorous physical activity recommendations at 24 months. Apart from a significantly higher RAQoL score in the IT group at 24 months compared with baseline, there were no significant differences within or between the programmes regarding functional ability or QoL.

Conclusion. In RA patients, the effectiveness of both an individualized and a general 1-year Internet-based physical activity programme is sustained with respect to moderate intensity physical activity up to 12 months after the interventions.

Key words: Rheumatoid arthritis, Physical activity, Maintenance, Relapse, Internet-based interventions.

Introduction

Generally, in the general population, regular physical activity has various health benefits such as a reduced risk of coronary heart disease, diabetes, hypertension and colon cancer [1, 2]. In patients with RA, physical activity has a number of additional, disease-specific benefits such as improved functional ability [3], aerobic capacity, muscle strength and reduction of pain [4]. Despite these proven health benefits, such patients were less physically active than the general population [5–9].

So far, a number of studies evaluating interventions to promote physical activity in patients with arthritis have been published. In a meta-analysis of physical activity interventions for adults with arthritis, including 16 controlled studies specifically for RA, researchers concluded that these interventions have moderate positive effects on physical activity behaviour [10]. A randomized controlled trial compared a 1-year coaching programme with
rehabilitation as prescribed in patients with early RA showed no differences in reaching a healthy physical activity level (≥ 30 min, moderate intensity, most days of the week) between the groups directly after the intervention, although the improvements of perceived health status and muscle strength were larger in the intervention group than in the control group [11]. In addition, another randomized controlled trial found that, directly after intervention, a 1-year Internet-based physical activity intervention with the provision of individually tailored supervision, exercise equipment and group contacts was more effective in increasing the level of physical activity than a 1-year Internet-based programme without these additional elements in RA patients [12].

Regarding the maintenance of physical activity after physical activity interventions in RA patients, only a few studies are available and the results are conflicting [13–18]. Thus, the aim of this study was to evaluate whether RA patients could maintain physical activity levels 12 months after finishing two 1-year Internet-based physical activity interventions.

**Patients and methods**

**Study design and subjects**

All RA patients who completed a randomized controlled trial comparing two Internet-based physical activity programmes were eligible for the follow-up study at 24 months [12]. The original study, including 160 patients, was performed between 2002 and 2004 in the rheumatology outpatient clinics of three hospitals (Leiden University Medical Center, Haga-Leyenburg Teaching Hospital and Reinier de Graaf Hospital). Inclusion criteria were: RA according to the ACR (formerly the ARA) 1987 criteria for RA [19, 20]; not physically active on a moderate intensity level for 30 min in succession for at least 5 days/week; having a computer with Internet facilities; and able to cycle on a bicycle ergometer. In the present follow-up study, we excluded the two patients who did not meet the public health recommendations on physical activity at a moderate intensity level, but did meet the recommendations regarding vigorous physical activity. Patients were randomized to a general training (GT) group, receiving general information on physical activity by means of a web site and e-mail, or to an individualized training (IT) group, receiving individual guidance by means of a web site and e-mail, a bicycle ergometer and group contacts. The training program of the GT group as well as the training program of the IT group have a total duration of 12 months. The medical ethics committees in all three participating centres approved the initial study and the follow-up study, and patients gave consent to both studies.

**Outcome assessments**

Measurements for the follow-up study were carried out at 24 months (12 months after the intervention) by means of questionnaires. **Physical activity.** Physical activity was measured according to the proportion of patients meeting public health recommendations for physical activity [21]. For this purpose, two questions were posed. First, the participants were asked how many days a week they were physically active at a moderate intensity level for 30 min in succession, with physical activity at a moderate intensity level being defined as any form of physical activity that causes a small increase in breathing or heart rate (such as brisk walking, vacuuming or gardening) in the past 3 months. Second, participants were asked how many days a week they were physically active at a vigorous intensity level for 20 min in succession, with physical activity at a vigorous intensity level being defined as any activity that causes a large increase in breathing or heart rate (such as running, aerobics or heavy yard work) in the past 3 months. Based on these questions, the proportions of patients meeting the moderate and vigorous recommendations for physical activity were calculated.

**Functional ability.** Functional ability was assessed with the HAQ [22]. The HAQ covers 20 activities of daily living in eight dimensions, with the score of each activity ranging from 0 (without any difficulty) to 3 (unable to do). The total HAQ score is the average score of the eight dimensions [ranging from 0 (best possible function) to 3 (worst possible function)].

**Quality of life (QoL).** QoL was measured with the RAQoL questionnaire, consisting of 30 items with a yes/no (1/0) response format [23]. The overall score is the sum of the individual item scores, with a lower score indicating better QoL (range 0–30). In addition, a validated Dutch version of the RAND 36-Item Health Survey (SF-36) (RAND) was used, which included eight subscales [24]. Each subscale generated a score from 0 to 100, with higher scores indicating better health. The RAND can be converted into three summary scales: the physical and mental component summary scale.

**Health care.** Any changes in medication (DMARDs or NSAIDs, or both), the application of corticosteroid injection or surgery during the 12 months of follow-up were retrieved from the medical records. In addition, the use of health-care services and visits to various health professionals over the past 3 months were recorded via a questionnaire at 24 months.

**Statistical analysis**

Differences in the baseline characteristics, amount of physical activity, functional ability and QoL between the patients who did and who did not participate in the follow-up study were computed by means of the Mann–Whitney U or chi-squared test. For physical activity, the proportions of patients meeting the moderate and vigorous recommendations at 24 months were computed. Proportions within the IT and GT groups were compared between baseline and 24 months, between 12 and 24 months and between the
Results

Patient characteristics

Of the 152 RA patients who completed the 12-month interventions, 110 eligible patients filled in the follow-up questionnaires at 24 months (Fig. 1). The 110 respondents did not differ from the non-responders \((n=40)\) for sociodemographic or disease characteristics, physical activity levels, functional ability and QoL at baseline or at 12 months (data not shown).

In the baseline characteristics of the 110 participants in the follow-up study, their median (IQR) age was 50.6 (13.1) and 51.0 (10.9) years, duration of RA 8.0 (8.1) and 5.9 (12.4) years and BMI 25.7 (5.5) and 24.9 (6.7) in the IT and the GT groups, respectively. In the IT and GT groups, 43 (77%) and 40 (74%) patients were females; those with co-morbidity 26 (46%) and 20 (37%); living alone 10 (18%) and 7 (13%); and gainfully employed 32 (57%) and 31 (57%), respectively. No statistical differences were found in the baseline characteristics between the IT and GT groups.

Physical activity, functional ability and QoL

Table 1 shows the proportions of patients being physically active at a moderate and vigorous intensity level and the results for functional ability and QoL at 0, 12 and 24 months in the IT and GT groups.

Moderate physical activity level. At 24 months, the proportions of patients meeting the recommendation for physical activity at a moderate intensity level were similar in both groups \((P=0.366)\). In comparison with baseline, these proportions were significantly higher in both the IT group \([n \%(\text{GT group})=10 (19\%); P<0.05]\) and in the GT group \([n \%(\text{GT group})=13 (24\%); P<0.001]\). In comparison with 12 months, this proportion had decreased at 24 months in the IT group, whereas at that time point an increase was seen in the GT group. However, neither of these differences reached statistical significance \((P=0.206\) and 0.083, respectively).

Six patients (11%) in the IT group and four (7%) in the GT group were meeting the moderate recommendation for physical activity at a moderate intensity level at both the 12- and 24-month time points \((P=0.509)\).

Vigorous physical activity level. In comparison with baseline, at 24 months a significant increase in the proportion of patients meeting the vigorous physical activity level was found in the IT group \([n \%(\text{IT group})=4 (7\%); P<0.05]\) but not in the GT group \([n \%(\text{GT group})=1 (2\%); P=0.317]\). In comparison with 12 months, the proportion of patients meeting the vigorous physical activity level decreased significantly in the IT group at 24 months \([n=16 (30\%); P<0.001]\), but not in the GT group \([n=5 (9\%); P=0.059]\).
TABLE 1 Number (%) of RA patients physically active for 30 min in succession for at least 5 days/week, number (%) of RA patients vigorously active for 20 min in succession for at least 3 days/week, functional ability and QoL.

<table>
<thead>
<tr>
<th></th>
<th>Baseline</th>
<th>12 months</th>
<th>24 months</th>
</tr>
</thead>
<tbody>
<tr>
<td>Moderate activity</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>for 30 min in succession</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>for at least 5 days/week</td>
<td>IT group, n = 54, n (%)</td>
<td>0</td>
<td>14 (26)**</td>
</tr>
<tr>
<td></td>
<td>GT group, n = 54, n (%)</td>
<td>0</td>
<td>7 (13)*</td>
</tr>
<tr>
<td></td>
<td>P-value IT vs GT group</td>
<td>0.138</td>
<td>0.366</td>
</tr>
<tr>
<td>Vigorous activity</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>for 20 min in succession</td>
<td>IT group, n = 54, n (%)</td>
<td>0</td>
<td>20 (37)**</td>
</tr>
<tr>
<td>for at least 3 days/week</td>
<td>GT group, n = 54, n (%)</td>
<td>0</td>
<td>6 (11)*</td>
</tr>
<tr>
<td></td>
<td>P-value IT vs GT group</td>
<td>0.003</td>
<td>0.158</td>
</tr>
<tr>
<td>Functional ability by HAQ score</td>
<td>IT group, n = 55</td>
<td>0.75 (1.00)</td>
<td>-0.09 (-0.18, -0.01)*</td>
</tr>
<tr>
<td></td>
<td>GT group, n = 53</td>
<td>0.75 (0.69)</td>
<td>-0.08 (-0.17, 0.01)</td>
</tr>
<tr>
<td></td>
<td>P-value IT vs GT group</td>
<td>0.841</td>
<td>0.809</td>
</tr>
<tr>
<td>QoL by RAQoL score</td>
<td>IT group, n = 55</td>
<td>10.0 (9.5)</td>
<td>-1.5 (-2.51, -0.42)*</td>
</tr>
<tr>
<td></td>
<td>GT group, n = 53</td>
<td>10.0 (9.0)</td>
<td>-0.8 (-1.72, 0.08)</td>
</tr>
<tr>
<td></td>
<td>P-value IT vs GT group</td>
<td>0.196</td>
<td>0.481</td>
</tr>
<tr>
<td>QoL by RAND-36 score</td>
<td>Physical summary scale</td>
<td>IT group, n = 55</td>
<td>55.0 (41.9)</td>
</tr>
<tr>
<td></td>
<td>GT group, n = 54</td>
<td>54.7 (34.8)</td>
<td>4.2 (-0.6, 9.0)</td>
</tr>
<tr>
<td></td>
<td>P-value IT vs GT group</td>
<td>0.941</td>
<td>0.667</td>
</tr>
<tr>
<td></td>
<td>Mental summary scale</td>
<td>IT group, n = 55</td>
<td>75.3 (25.6)</td>
</tr>
<tr>
<td></td>
<td>GT group, n = 54</td>
<td>73.1 (30.5)</td>
<td>0.06 (-4.3, 4.4)</td>
</tr>
<tr>
<td></td>
<td>P-value IT vs GT group</td>
<td>0.924</td>
<td>0.990</td>
</tr>
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</table>

*Between-group differences were analysed with the chi-square test and within-group differences with the McNemar test. **Baseline values are given as the median [IQR (expressed as the net result of 75th percentile minus 25th percentile)]. Follow-up values are given as the mean (95% CI) change from baseline values. Between-group differences were analysed with the Mann–Whitney U-test and within-group differences with the Wilcoxon test. *P<0.05 vs baseline. **P<0.001 vs baseline.

Three patients (6%) in the IT group and zero patients in the GT group were meeting the recommendation for physical activity at a vigorous intensity level both at 12- and 24-month time points (P = 0.080).

Functional ability and QoL. At 24 months, there were no statistically significant differences between the two groups in the HAQ, RAQoL or RAND-36 physical and mental summary scales. At 24 months, the HAQ score and the RAND-36 physical and mental summary scales did not change significantly as compared with baseline within both groups. In the IT-group, however, the RAQoL score was significantly lower at 24 months than at baseline, whereas in the GT group no significant change of the RAQoL was seen. None of the differences between 12 and 24 months was statistically significant in either group.

No statistically significant differences were found in the baseline values or the change scores of the HAQ, RAQoL and RAND-36 or the baseline DAS28 scores between patients who did and who did not meet public health recommendations at 24 months or at any time point during the initial and follow-up studies. However, overall, a trend towards a greater improvement was seen for all variables in the patients who became physically active than in those who did not (data not shown).

Health care. There were no significant differences in the proportions of changes in medication, IA injections or surgery in the follow-up period or health care usage over the past 3 months between patients who did and who did not meet public health recommendations on physical activity at a moderate intensity level at 24 months (data not shown). The same results were obtained for the comparison of medical treatment and health care use between patients who did and who did not meet physical activity recommendations at any time point during the initial and follow-up studies.

Discussion

This study shows that 12 months after completing two Internet-based physical activity programmes, significantly more RA patients were physically active at a moderate intensity level than at baseline in both groups. The effect on the proportion of patients meeting the recommendations on physical activity at a vigorous intensity level was only sustained in the intervention group; however,
the proportion of patients meeting these criteria at any
time point was, overall, very small (<36%).

Six studies reported follow-up after a physical activity
intervention in patients with RA [13–18], two of which
reported their outcomes as proportions of patients
performing specific physical activities [13, 14]. One of
these studies was a randomized controlled trial com-
paring a 6-week self-management programme with no
intervention [13]. In this study, 12 months after inter-
vention, the percentage of RA patients performing flexibility
and strengthening exercises increased significantly
compared with baseline in the intervention group (an
increase of 73–84% engaging in flexibility exercises and
55–67% in strengthening exercises; both \( P < 0.001 \)),
whereas no significant changes were found in the control
group [14]. A second randomized controlled trial,
comparing a 9-day multidisciplinary programme aimed at
increasing physical activity with no intervention, showed
that 12 months after the intervention, the percentage of
RA patients performing regular gymnastics was signifi-
cantly higher compared with baseline in the intervention
group (an increase of 18–45%, \( P < 0.001 \)), whereas no
significant changes were found in the control group [13].
In both these studies and our study, 12 months after
the intervention the increase in the rate of physically
active people was \( \approx 20\% \). The comparison is, how-
ever, hampered by differences in the patient population (the
present study only included sedentary RA patients,
whereas in the two other trials a considerable proportion
of patients were already exercising at baseline). Moreover,
the studies varied with respect to the nature of
the intervention and the measurement of physical activity.

In the four studies including a follow-up of a physical
activity intervention using continuous outcome measures
for physical activity [15–18], in general a trend towards
the maintenance of physical activity levels after 4–
to 48-month follow-up was seen; only one study showed
the achieved physical activity level decreased
12 months after the intervention.

In the lack of long-term effectiveness of physical activity
interventions on functional ability and QoL, our findings
are in concordance with some studies in RA patients
[14, 16]. However, in some follow-up studies, the improve-
ment of functional ability was maintained [13, 15, 17].
Again, comparisons between studies are difficult due to
the variety in patient selection, interventions and outcome
measures used. The lack of effectiveness of the physical
activity programs on functional ability or QoL could
probably be explained by other factors, for example the
duration of the intervention. Perhaps a longer duration of
the interventions and/or follow-up are required for an
effect on functional ability or QoL.

Regarding the maintenance of physical activity
interventions that are delivered by means of the Internet,
no studies about RA patients are available for compari-
son. In healthy adults, a randomized controlled trial
comparing two 12-week Internet-based physical activity
interventions, consisting of weekly e-mail messages
including a walking programme, one general programme
and one individualized programme comprised a 12-month
follow-up [25]. In concordance with the results of our
study, this study showed that the total time spent walking
per week was significantly higher at 12-month follow-up
as compared with baseline, with no differences between
the two interventions. These results suggest that with
a relatively simple Internet-based physical activity, health
gains could be achieved in \( \approx 20\% \) of the subjects. A
substantial proportion of patients neither increased their
physical activity levels at all during the initial and follow-up
studies nor increased with the general or with the
individual intervention. A challenge for the future will be
to identify those sedentary persons for whom a general
Internet-based intervention is sufficient and those who will
need more intensive guidance by changing their physical
activity behaviour, either by an Internet-based intervention
or by using other means of delivery.

Our analysis, and that of other studies as well, was
based on comparisons of proportions of patients. With
regard to the level of individual patients, in our study,
11 and 7% of the patients in the IT and GT groups,
respectively, were physically active according to the
recommendation for physical activity at a moderate
intensity level at both 12 and 24 months. This indicates
that patients are switching their physical activity level at
various time points, which was also seen in a previous
study [14], in which 40 and 70% of the RA patients main-
tained their flexibility and strengthening exercises after a
12-month follow-up, 10 and 25% began performing these
exercises (again) and 2–5% stopped.

However, these data should be interpreted with care as
in that study, as well as in ours, patients were asked about
their physical activity level over the last week [14] or past
3 months [12], so that their response might not have
represented the whole time frame between the various
measurement points. Asking patients about their physical
activity behaviour in periods prior to >3 months might,
however, introduce recall bias. The accurate and valid
measurement of physical activity, either by questionnaires
or by performance measures such as pedometers, is still
a major challenge in health promotion [26, 27]. Another
limitation of the present study was that about a quarter
of the initial patient population was not available for
follow-up, limiting the generalizability of the results.
Furthermore, a measurement for disease activity was
not included, since this follow-up study was a home-
based survey and disease activity needs to be done in
the clinical setting. Therefore, to what extent the changes
in the level of disease activity could have influenced
the level of physical activity remain unknown.

In conclusion, our study shows that the impact of
12-month Internet-based physical activity interventions
on physical activity at a moderate intensity level is sus-
tained 12 months after the intervention in RA patients.
The provision of tailor-made physical activity interventions,
varying in their duration, frequency, intensity and mode
of delivery, according to the needs of individual patients
is a challenge for the future. Future research should also
explore the role of the various professionals involved in
the treatment of RA patients, including rheumatologists, clinical nurse specialists, physical therapists and rehabilitation specialists in guiding patients to achieve and maintain physical activity at the level of public health recommendations.

**Rheumatology key message**

- The level of physical activity is sustained 12 months after Internet-based physical activity intervention in RA patients.

**Acknowledgement**

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**References**