Integrated care programmes for sport and work participation, performance of physical activities and quality of life among orthopaedic surgery patients: a systematic review with meta-analysis

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ABSTRACT

Objectives Orthopaedic surgery is primarily aimed at improving function and pain reduction. Additional integrated care may enhance patient’s participation in sports and work, possibly improving performance of physical activities and quality of life (QoL). We aimed to assess the effectiveness of integrated care among orthopaedic surgery patients.

Design Systematic review with meta-analysis.

Data source Medline, EMBASE and CINAHL (until 17 June 2019).

Eligibility for selecting studies We searched for controlled studies on integrated care interventions consisting of active referral to case managers, rehabilitation with participation-based goals and/or e/ mHealth, with outcomes of sports and work participation, performance of physical activities and/or QoL. Outcomes were normalised to 0–100 scales and statistically pooled.

Results Seventeen articles (n=2494) of moderate quality were included reporting on patients receiving back, upper limb, knee or hip surgery. Only one study reported on return to sports and found no significant benefit. For return to work, one study did (96% vs 82%) and one did not (relative risk=1.18 (0.80 to 1.70)) observe significant benefits. Integrated care showed small effects for improving performance of physical activities (2.69 (–0.20 to 5.58); eight studies, n=1267) and QoL (2.62 (1.16 to 5.05); nine studies, n=1158) compared with usual care.

Summary/Conclusion We found insufficient and inconsistent evidence for the effectiveness of integrated care for orthopaedic surgery patients regarding sport and work participation. Small effects were found for performance of physical activities and QoL. High quality research on integrated care focusing on sports and work participation is needed before integrated care can be implemented for orthopaedic surgery patients.

INTRODUCTION

Orthopaedic surgery, such as hip or knee arthroplasty, ACL surgery, hamstring or rotator cuff repair, is primarily aimed at reducing pain and improving joint function. Usual care for patients eligible for orthopaedic surgery typically consists of the surgical procedure as well as presurgery evaluations, pharmaceutical treatments and postsurgery clinical check-ups and rehabilitation including physical therapy. However, usual care of most patients undergoing orthopaedic surgery is rarely explicitly aimed at participation in daily activities such as sports and work (eg, returning to previous levels of participation). This can be seen in core outcome definitions for orthopaedic conditions in the knee and hip, back and upper extremities. This is remarkable given
the importance of participation in sports and work for patients after orthopaedic surgery, extensively for patients who are of working age for whom resumption of societal participation is an important treatment goal. Moreover, return to sports and work is typically delayed and/or not successful for many of these patients. For instance, patients undergoing joint replacement surgery considered advice regarding participation to be inconsistent and not tailored to their individual circumstances, which often left them with the feeling that they would have been able to recover sooner than what they had actually accomplished.

Societal participation is considered of primary importance for orthopaedic surgery patients. Here, societal participation is both the performance of and the participation in daily activities such as sports and work. Participation in daily activities such as sports and work is highly relevant for many orthopaedic surgery patients in the general population, as inability to participate in society is accompanied by a significant impact on patients’ quality of life (QoL). In addition, apart from the medical costs associated with surgery, the economic burden largely consists of indirect costs such as work productivity loss due to absenteeism. In line with this evidence, and in accordance with the International Classification of Functioning, Disability and Health (ICF), activities and participation are thought of as a complex interplay between body functions and structures, personal and environmental factors, and health.

To facilitate participation in sports and work in orthopaedic surgery patients, which may thereby improve performance of physical activities and QoL, usual care could be enhanced by transmural integrated care programmes. Integrated care, according to a WHO definition, is ‘a concept bringing together inputs, delivery, management and organisation of services related to diagnosis, treatment, care, rehabilitation and health promotion’. Of this rather generic concept of integrated care, we can see various operationalisations related to improving participation of patient in sports or work, all of them adding value to the usual care. Common operationalisations of integrated care can include, and are not limited to:

1. Active referral of the orthopaedic surgeon to a case manager (eg, a sports or occupational physician, physical or occupational therapist or nurse), adding a professional in the patient care to work on issues (eg, sport and work participation) that are typically not addressed in usual care.
2. Rehabilitation programmes based on patient-specific and participation-based goal setting, such as goal attainment scaling.
3. e/mHealth, consisting of elements that go beyond the usual care, that is, not just replacing physical patient-physician usual care by electronic/mobile contact.

Currently, a systematic review summarising the evidence of integrated care interventions for patients undergoing orthopaedic surgery is lacking. The aim of this review is to assess the effectiveness of integrated care interventions compared with usual care on sports and work participation, performance of physical activities, and QoL among patients undergoing orthopaedic surgery from randomised and non-randomised controlled studies.

METHODS

For this systematic review, that we have a priori registered in Prospero, we used the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines. We have followed our registered protocol with the exception that we were not able to assess the impact of risk of bias on the reported findings, since only limited variation in risk of bias between studies was shown (see the Data analysis section).

Search for literature

We conducted systematic searches of the literature in Medline, EMBASE and CINAHL from database inception until 17 June 2019. With the support of a clinical librarian specialised in sports and occupational medicine, we have searched for terms describing (1) the population; for example, orthopaedic surgery, knee or hip arthroplasty, bone fracture reconstruction, ACL surgery, rotator cuff repair, spine; (2) intervention; integrated care consisting of elements such as active referral or case management, goal setting and/or e/mHealth; and (3) outcome; participation in sports or work, performance of physical activities and QoL. A validation of a prefinal version of our search was conducted with the use of a number of articles that were identified in a pilot search and were found to be eligible for the current review. From this validation procedure, it appeared that all a priori identified articles were found by the current database search in Medline, EMBASE and CINAHL. A detailed description of the search is given in online supplementary material 1.

We searched for additional trials and ongoing and unpublished trials using www.controlled-trials.com and http://clinicaltrials.gov. Moreover, we screened the reference lists of included articles, while also citation tracking of the included articles was conducted in Medline. Corresponding authors of protocol articles describing a relevant study design were contacted and asked for the results (published or non-published) of their trials.

Selection procedure

Two reviewers independently assessed identified records on eligibility, that is, meeting the relevant patient, intervention, control and outcome (PICO) elements. Title and abstracts were assessed after which full texts of potentially relevant records were screened. In case of disagreement, consensus was reached during a meeting.

We included studies on patients from the general population (ie, excluding professional athletes), who received an orthopaedic surgical procedure for an acute or chronic musculoskeletal disease and were of working age (ie, with most of the participants between 18 and
65 years), were resumption of societal participation is an important treatment goal. This included, but was not limited to, surgeries for knee or hip arthroplasty for end-stage osteoarthritis, spinal surgery, bone fracture reconstruction, ACL surgery, hamstring or rotator cuff repair surgery. We included studies describing integrated care interventions with at least a postoperative component that targeted participation, like in sports or work. Integrated care can consist of, but is not limited to, one or a combination of the following operationalisations: (1) active referral of the orthopaedic surgeon to a case manager, for example, a sports or occupational physician, physical or occupational therapist or nurse; (2) a rehabilitation programme based on patient-specific and participation-based goals, such as goal attainment scaling; and/or (3) an e/mHealth intervention, consisting of elements that go beyond the usual care, that is, not just replacing physical patient–physician usual care by electronic/mobile contact. We included studies comparing the above-mentioned intervention components to usual care, which is often limited to the surgical procedure, including presurgery evaluation, pharmaceutical treatment, postsurgery clinical check-ups and, depending on the patient, exercise-based rehabilitation. We included studies in which the following outcome measures were considered: sports or work participation, for example, expressed in return to sports or work, performance of physical activities, for example, measured by the Roland Morris or WOMAC questionnaires and/or QoL, for example, measured by the 36 item short-form (SF-36), 12 item short-form (SF-12) questionnaires or PROMIS.

We included randomised and non-randomised controlled trials, cohort studies with controls and case-control studies and pilot studies with controls, while studies without a control group were excluded. Only studies describing original research written in English or Dutch were included.

Data syntheses and risk of bias assessment
Two reviewers extracted relevant data from all selected papers, independently. The following variables of each included paper were obtained: first author and year of publication, study characteristics (ie, study name and design, information about the patient sample, including the orthopaedic condition and type of surgery, number of participants, relevant inclusion/exclusion criteria, percentages of females, age and country), intervention characteristics (ie, intervention description, element, start and duration of the intervention and number of measurement occasions), control condition, outcomes measures and effect sizes. In the case of multiple articles reporting on the same study, all information from these articles was used for further analysis.

To assess risk of bias, we used the Cochrane risk of bias tool for randomised intervention studies and the ROBINS-I risk of bias tool for non-randomised intervention studies, in accordance with recommendations provided in the Cochrane collaboration handbook. These tools are described in detail in online supplementary material 2 and 5. Risk of bias assessment was performed on the subgroup or outcome of relevance, and multiple assessments were made when required.

Data analysis
All studies were described according to their extracted data and risk of bias. In case of sufficient methodologically and clinically homogeneous data (as determined by considering study samples, interventions and outcome measures) but not statistical homogeneity, a meta-analysis was conducted. In order to do so, effect sizes were harmonised by transforming the respective outcome measure, that is, sports or work participation, performance of physical activities and QoL, into a scale from 0 to 100, with higher values depicting more positive outcomes. As such, effect sizes from similar constructs, which were measured with varying self-reported measurement tools, were harmonised.

Statistical heterogeneity of the findings was assessed using $I^2$ statistics and visual inspection of the forest plots. Since there was evidence of statistical heterogeneity ($I^2>50\%$ for some of the associations) random-effects modelling was used to pool effect sizes of individual studies using Review Manager (RevMan) V.5.3. Pooled effect sizes were presented in forest plots. In all quantitative analysis, effect sizes were expressed in mean differences.

Findings were reported stratified on (1) intervention component (ie, active referral, goal setting, and/or e/mHealth); (2) patient group (ie, specified into back, upper limb, knee or hip surgery patients); and (3) outcome (ie, sports or work participation, performance of physical activities and QoL). Although outlined in our a priori registered protocol, due to limited variation between studies, we were not able to stratify our findings by risk of bias. Moreover, results were classified based on the length of follow-up of the intervention into short (0–3 months postsurgery) and long-term (23 months postsurgery) effects, to differentiate potential short term biological recovery from longer term effects of the intervention.

RESULTS

Literature search
The literature search resulted in a total of 9833 records: 3688 in Medline, 4617 in EMBASE and 1528 in CINAHL (figure 1). After removing duplicates and adding an additional 3 articles that were found through forward and backward reference checking, 6325 records were screened on title and abstracts. A total of 82 full-text articles were retrieved, from which 65 articles were removed as they did not meet the inclusion criteria (online supplementary material 3).

Study descriptives
Eventually, 17 articles from 14 studies with a total 2494 participants were included. An overview of
Figure 1 PRISMA flow chart depicting the selection procedure of articles.

Extracted data of the included studies can be found in online supplementary material 4. Fifteen of the included articles from 12 studies described randomised controlled trials,23 24 26–33 35–39 while two articles described controlled before-after studies.25 34 Most studies were conducted in high-income countries (ie, Western Europe, USA or Australia) and two studies in China38 39 studying samples of patients undergoing surgeries to their back (ie, laminectomy, lumbar discectomy, disc surgery and spinal stenosis),23 24 26 28–31 34–39 upper limbs (ie, anterior shoulder dislocation repair),25 37 hips (ie, total hip arthroplasty)23 29 30 and knees (ie, ACL reconstruction and knee arthroplasty).27 32 35

Patient samples consisted of combinations of men and women, and the average age of the study samples ranged from 29 to 70 years, with an average (SD) of 51 (14) years.

Regarding relevant intervention components, five studies used an e/mHealth intervention.27 34–36 39 Active referral to a case manager was assessed by three studies.31 33 37 Six studies reported the effects of a combined intervention with two components, that is, active referral to a case manager and goal setting (in four studies), and e/mHealth (one study),32 and active referral and eHealth (one study).38 The intervention length ranged from 14 days33 to 36 months.34 In 12 studies, the control group received usual care only,25–31 33–39 while in two studies described in three articles, usual care also included an education programme on postoperative recovery and extra phone meetings.23 24 32

Regarding risk of bias (figure 2; online supplementary material 5-6), randomised controlled trials showed a low or unclear risk of bias regarding patient randomisation, allocation concealment, blinding of the outcome assessment and selective reporting. All studies showed high or unclear risk of bias regarding blinding of the participants and care providers while four studies had a high risk of bias due to incomplete outcome data. Also, there were other sources of bias indicated such as selection bias and poor intervention compliance. Out of the non-randomised studies, one study showed a high overall risk of bias and one study showed a low overall risk of bias.34

Figure 2 Risk of bias of all included studies. Risk of bias of randomised controlled studies (upper panels) and non-randomised controlled studies (lower panels) are shown.

| Archer, 2014 & 2016 | Low | Unclear | High | Low | Low | Low | Low |
|---------------------|-----|---------|------|-----|-----|-----|-----|
| Donceel, 1999       | Low | Unclear | High | Low | Unclear | Unclear | Low |
| Hou, 2019           | Low | Low     | High | High | Low | Low | Low |
| Levinger, 2017      | Low | Low     | High | Low | High | High | High |
| Martinez-Rico, 2018 | Low | Unknown | High | High | Low | Unclear | Low |
| McGregor, 2010 & 2011; Morris, 2011 | Low | Low | Unclear | Low | High | Low | High |
| Oestergaard, 2015   | Unclear | Unclear | Unclear | Unclear | Unclear | Unclear | Low |
| Paxton, 2018        | Unclear | Unclear | Unclear | Low | Low | Unclear | Low |
| Sandell, 2008       | Unclear | Unclear | Unclear | Low | Low | Unclear | High |
| Szöts, 2016         | Low | Low     | Low | Low | Low | Low | Low |
| Vesterby, 2017      | Unclear | Low     | Low | Low | Low | Unclear | High |
| Wang, 2018          | Unclear | Unclear | High | High | Low | Unclear | Low |

| Confounding | Selection of participants | Classification of interventions | Deviations from intended interventions | Missing data | Measurement of outcomes | Selection of the reported result |
|-------------|---------------------------|---------------------------------|--------------------------------------|--------------|------------------------|---------------------------------|
| Damkjaer, 2015 | Moderate | Moderate | Low | Low | Moderate | Serious | Moderate |
| Skolasky, 2018 | Low | Low | Low | Low | Low | Low | Low |
Performance of physical activities

Outcome measures

Performance of physical activities was measured in 10 studies using the Roland Morris Disability questionnaire and Oswesty Disability Index (ODI), SF-12 (using the physical functioning and role physical subscale), the Western Ontario Shoulder Instability (WOSI) index, the Oxford Shoulder Instability Score (OSIS), the Rowe score, the Knee Injury and Osteoarthritis Outcome Score (KOOS) activities of daily living subscale, the Nottingham Health Profile (NPH) physical subscale, the Arthritis Impact Score (AIS) using walking and bending, self-care tasks, household tasks and work subscales, the Harris hip score, Barthel index, the Western Ontario and McMaster Universities Osteoarthritis (WOMAC) Index, the ability to take part in three self-chosen activities and by physical activity measured with an accelerometer.

Quality of Life

QoL was measured in 11 studies using the SF-12, SF-36, the WOSI index on shoulder-related function and QoL, the QoL subscale of the KOOS, the NHP, EQ-5D-5L and EQ-5D. In the latter study, QoL was expressed in quality-adjusted life years (QALYs) gained.

Qualitative analysis

The non-statistically significant findings of one of the studies could not be pooled with the other study outcomes. In another study among patients receiving a Bankart repair surgery, QoL was measured using the quick DASH. In this study, the intervention consisting of referral to a nurse practitioner showed an improvement in QoL compared with a control group; however, no appropriate statistics were reported by the study authors.

Quantitative analysis

Nine studies with n=1158 patients could be pooled in a meta-analysis (table 2). Findings showed overall small significant effects (scale 0–100) of the intervention, when compared with the control group; short term (2.62 (95%CI 1.16 to 4.08); I²=17%) and long term (5.05 (95%CI 2.94 to 10.00); I²=59%) effects (online supplementary material 8). Two studies reported on patients undergoing knee surgery (short-term effect: 2.12 (95%CI −2.62 to 6.86); I²=0%). One study reported on patients undergoing surgery to their upper extremities (short-term effect: 0.97 (95%CI −10.90 to 12.85)).
Table 1  Summary of results from the quantitative analyses regarding performance of physical activities (eight studies with n=1267 participants reporting on short-term and long-term effects combined). Number of studies and participants, (pooled) effect sizes and, if applicable, I² statistics (depicting heterogeneity) are shown. Short-term and long-term effects are presented. Total results as well as results stratified by intervention component (active referral, e/mHealth and multicomponent interventions with a combination of elements) and patient category (back, knee, hip and upper extremity surgery) are shown.

|                  | Short term | Long term |
|------------------|------------|-----------|
|                  | Total      | Long term |
| N, n             | 7, 929     | 4, 986    |
| Effect size      | 2.69 (−0.20 to 5.58) | 5.77(2.84 to 8.70) |
| I²               | 76%        | 54%       |
| Forest plot      | Figure 3   | Figure 3  |
| Active referral  | –          | –         |
| e/mHealth        | 3, 311    | 1, 162    |
| Effect size      | −0.63 (−0.75 to 0.51) | 3.51(−0.67 to 7.69) |
| I²               | 0%         | 0%        |
| Forest plot      | Online supplementary material 7 | Online supplementary material 7 |
| Combined         | 3, 582    | 3, 824    |
| Effect size      | 4.26 (0.13 to 8.39) | 6.47(2.94 to 10.00) |
| I²               | 50%        | 59%       |
| Forest plot      | Online supplementary material 7 | Online supplementary material 7 |
| Back             | 2, 248    | 3, 586    |
| Effect size      | 0.52 (−2.36 to 3.41) | 4.97(1.45 to 8.49) |
| I²               | 76%        | 60%       |
| Forest plot      | Online supplementary material 8 | Online supplementary material 8 |
| Hip              | 2, 463    | 1, 200    |
| Effect size      | 5.79 (2.52 to 9.07) | 8.40(4.01 to 12.79) |
| I²               | 19%        | –         |
| Forest plot      | Online supplementary material 8 | Online supplementary material 8 |
| Knee             | 2, 149    | 1, 200    |
| Effect size      | 2.12 (−2.62 to 6.86) | –         |
| I²               | 0%         | –         |
| Forest plot      | Online supplementary material 8 | –         |
| Upper extremity  | 1, 96     | –         |
| Effect size      | 0.97 (−10.90 to 12.85) | –         |
| I²               | –          | –         |
| Forest plot      | Online supplementary material 8 | –         |

I², heterogeneity; N, number of studies; n, number of participants.
**Figure 3** Study findings (ie, effect sizes and risk of bias) for articles reporting on the effect of the intervention on performance of physical activities. Findings are stratified by timing (short-term vs long-term effects). Individual study and pooled effects are presented. IV, inverse variance.

(95% CI 2.64 to 7.46); I²=53%) (figure 4). A single study showed a non-significant small short-term effect of active referral as single component (2.87 (95% CI 3.84 to 9.58)); three studies reported on intervention elements of e/ mHealth, reporting significant short-term (1.98 (95% CI 1.38 to 2.58); I²=0%) and long-term (3.52 (95% CI 1.62 to 5.41); I²=0%) effects (online supplementary material 9). Three studies reported on a multicomponent intervention, showing significant short-term (5.13 (95% CI 2.33 to 7.90); I²=0%) and long-term (7.76 (95% CI 5.02 to 10.51); I²=0%) effects. Three studies reported on patients undergoing surgery to their back, reporting significant short-term (2.04 (95% CI 1.44 to 2.64); I²=0%) and long-term (5.22 (95% CI 2.18 to 8.26); I²=51%) effects (online supplementary material 10). Two studies reported on patients undergoing hip surgery, significant at short term (5.49 (95% CI 2.36 to 8.61); I²=0%) and non-significant at long term (4.37 (95% CI -1.58 to 10.31); I²=76%). Two studies reported on patients undergoing knee surgery with a non-significant short-term effect: 0.62 (95% CI -3.55 to 4.79); I²=0%. One study reported on patients undergoing surgery to their upper extremities also with a non-significant short-term effect: 1.48 (95% CI -5.60 to 8.56).

**DISCUSSION**

**Interpretation of findings**

This systematic review of 17 articles showed that limited studies are available regarding the effectiveness of integrated care interventions on sports and work participation. Only one study reported on return to sports and found no significant beneficial effects of the intervention. For return to work, one study did and one did not report significantly beneficial effects of the intervention, and a third study did not report on their (a priori proposed) return to work outcomes. An explanation for this might be that in the identified articles integrated care was not fully focused on return to sports or work given that only three reported on these specific outcomes. Another explanation may be that although the focus of usual care is not on return to sport or work per se, patients receiving such usual care do quite well in returning to sports or work. For example, one study among patients receiving a Bankart (shoulder) operation showed that 32% of those receiving usual care and 19% in the integrated care group returned to sport within 18 weeks after surgery.25 This phenomenon could be reinforced by the fact that there is no clear distinction between integrated care and usual care, and as such, also usual care can vary. In some of the studies included in our review,23 24 32 even in the control group elements of integrated care, such as an education programme on postoperative recovery and phone meetings were reported.

Our quantitative analysis showed that, compared with usual care, integrated care interventions had small effects on performance of physical activities and QoL with pooled effect sizes ranging from 2.64 to 5.77 on a scale from 0 to 100. Reported minimal clinically important differences for the outcome measures of our review vary substantially in the literature. It was, for example, reported that, for the widely adopted SF-36 to measure QoL, minimal clinically important differences vary a lot between knee and hip replacement patients and can be as much as 20 on a 0–100 scale.40 This renders the clinical relevance of the effect sizes from our quantitative analysis questionable. In contrast, clinically relevant improvements in QoL are described after integrated care interventions, compared with usual care, among non-surgical back pain patients.41 42
### Table 2

Summary of results from the quantitative analyses regarding quality of life activities (9 studies with 1158 participants reporting on short-term and long-term effects combined). Number of studies and participants, (pooled) effect sizes and, if applicable, I² statistics (depicting heterogeneity) are shown. Short-term and long-term effects are presented. Total results and results stratified by intervention component (active referral, e/mHealth and multicomponent interventions with a combination of elements) and patient category (back, knee, hip and upper extremity surgery) are shown.

|                          | Short term |                                    | Long term |                                    |
|--------------------------|------------|-------------------------------------|-----------|-------------------------------------|
|                          | N  | n      | Effect size (CI) | I² | Forest plot | N  | n      | Effect size (CI) | I² | Forest plot |
| **Total**                | 7  | 956    | 2.62 (1.16 to 4.08) | 17% | Figure 4 | 5  | 846    | 5.05 (2.64 to 7.46) | 53% | Figure 4 |
| **Active referral**      | 1  | 63     | 2.87 (−3.84 to 9.58) | –    | – Online supplementary material 9 | –  | –      | – | – Online supplementary material 9 |
| **e/mHealth**            | 3  | 311    | 1.98 (1.38 to 2.58) | 0%  | – Online supplementary material 9 | 3  | 360    | 3.52 (1.62 to 5.41) | 0%  | – Online supplementary material 9 |
| **Combined**             | 3  | 582    | 5.13 (2.33 to 7.90) | 0%  | – Online supplementary material 9 | 2  | 486    | 7.76 (5.02 to 10.51) | 0%  | – Online supplementary material 9 |
| **Back**                 | 2  | 248    | 2.04 (1.44 to 2.64) | 0%  | – Online supplementary material 10 | 3  | 373    | 5.22 (2.18 to 8.26) | 51% | – Online supplementary material 10 |
| **Hip**                  | 2  | 463    | 5.49 (2.36 to 8.61) | 0%  | – Online supplementary material 10 | 2  | 473    | 4.37 (−1.58 to 10.31) | 76% | – Online supplementary material 10 |
| **Knee**                 | 2  | 149    | 0.62 (−3.55 to 4.79) | 0%  | – Online supplementary material 10 | –  | –      | – | – Online supplementary material 10 |
| **Upper extremity**      | 1  | 96     | 1.48 (−5.60 to 8.56) | –    | – Online supplementary material 10 | –  | –      | – | – Online supplementary material 10 |

I², heterogeneity; n, number of participants; N, number of studies.
Figure 4 Study findings (ie, effect sizes and risk of bias) for articles reporting on the effect of the intervention on quality of life. Findings are stratified by timing (short-term vs long-term effects). Individual study and pooled effects are presented. IV, inverse variance.

and patients undergoing abdominal or gynaecological surgeries.34–45 Studies reporting on interventions of e/ mHealth34,35 and, in particular in combination with active referral or goal setting,24 showed additional effectiveness in reducing pain and pain interference. These pain reduction effects may explain the associated effects in QoL and performance of physical activities, since pain intensity and QoL are known to be highly correlated.46 The mentioned intervention components can provide effective elements for future intervention development.

For the outcome measures performance of physical activities and QoL, effect sizes appeared to be larger when considering long-term effects (>3 months postsurgery) compared with short-term effects (<3 months postsurgery). A plausible explanation is that in the first period after surgery, mainly physiological recovery with increase in function and reduction of pain takes place, while only after this initial post-surgery period patients start to focus on sport and work participation again. This is also supported by the two studies with the largest effect sizes, both evaluating active referral and goal setting, resulting in an increase of 11% more patients returning to work26 and more than 10% increase in QoL24 both after 3 months. It should be noted that when considering longer follow-up periods than the ones reported in the current review, stronger effects may be seen. This is in particular relevant for some type of surgeries, for example, ACL reconstruction surgery, where return to activities is typically seen only long after surgery. Moreover, future studies could consider to assess not just return to work or sport but also the successfulness of this return.

**Study limitations**

As far as we are aware, this is the first review to systematically evaluate the effectiveness of integrated care interventions on participation, that is, return to sports or work, performance of physical activities and QoL among patients receiving orthopaedic surgery. An asset of this study is that we have summarised the identified evidence, if possible, in a meta-analysis. Another strength of our study is the methodological quality of our work, by following the PRISMA guidelines and the preregistration of our systematic review, thereby dealing with publication bias. We have also aimed to identify unpublished work in another attempt to address publication bias.

A potential limitation of our study is the heterogeneity in the identified data, as indicated by $I^2$ (statistical heterogeneity) up to 76% among long-term effects in performance of physical activities. Moreover, we found evidence from different patient populations, intervention elements, outcome measures and follow-up durations, which can all have resulted in methodological and/or clinical heterogeneity. For this reason, study findings were stratified based on body area (ie, back, upper extremity, knee and hip) all showing effect sizes in the same direction. This is based on evidence from patients undergoing shoulder dislocation repair, hip and knee surgery, as well as surgery to their back, including such as laminectomy, lumbar discectomy, disc surgery and spinal stenosis. However, there was insufficient information to further stratify our findings according to these and other potential sources of heterogeneity. Also, the current findings cannot be extrapolated to patients with surgical procedures that have not been described in our study. As a result of this heterogeneity, in combination with the relatively limited amount of studies and participating
patients, the interpretation of the presented results should be done with due caution.

We have found various sources of bias in the studies in our review. While two studies were based on non-randomised study designs, in the randomised controlled trials high or unknown risk of bias regarding blinding of patients and personnel was seen. We acknowledge blinding is difficult in studies with integrated care interventions, especially for outcomes that are based on self-reports. For some objectively measured outcome variables, for example, return to work based on company data or device measured physical activity, blinding may be better feasible. Other potential sources of bias that were identified were incomplete outcome data indicating low compliance with the described interventions and small study samples with the risk of selection bias. Due to limited variation in risk of bias between studies, we were not able to assess the extent to which abovementioned sources of risk of bias have impacted on the reported findings which would have been in accordance to our a priori registered study protocol. Future research should consider these sources of bias.

Future research
In the articles identified in our review, integrated care was not fully focused on return to sports or work given that only three reported on these specific outcomes. As such, we encourage future research to consider designing interventions for and reporting on return to sports and work given the importance for numerous orthopaedic surgery patients. By doing this, stronger evidence will become available for practitioners and policy makers as to whether integrated care interventions should be implemented for this particular patient population.

Important sources of risk of bias that we identified were incomplete outcome data indicating low compliance with the described interventions and small study samples with the risk of selection bias. Such sources of bias should be addressed in future studies in order to build an evidence base with higher quality studies.

CONCLUSIONS
Orthopaedic surgery is primarily aimed at improving function and pain reduction. Additional integrated care may enhance patient’s participation in sports and work, thereby improving the performance of physical activities and QoL. From our systematic review, we found insufficient and inconsistent evidence for the effectiveness of integrated care interventions regarding sport and work participation for orthopaedic surgery patients. Only small effects of these interventions were found regarding performance of physical activities and QoL.

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Contributors JD designed the electronic database search, PC, PK and GH conducted literature screening and data extraction of all included papers. PC analysed the data. All authors (PC, GH, JD, RvG, GK, MvT, JH, JA and PK) analysed the data and reviewed the manuscript for important intellectual content. PK is the study guarantor.

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Competing interests JA intends to set up a spin-off company concerning the implementation of a mobile application concerning the idHerstel intervention in the Netherlands, holds a chair in Insurance Medicine paid by the Dutch Social Security Agency is stockholder of Evalua Received grants from ZonMw/NWO, Instituut Gak, UWV, SZW, WVS, Pflizer, Achmea, CVZ/Zorg Instituut outside the submitted work. All other authors declare no conflicts of interests, financial of other.

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REFERENCES
1 Carr AJ, Robertson O, Graves S, et al. Knee replacement. Lancet 2012;379:1331–40.
2 Singh JA, Dowsey MM, Doehn M, et al. Achieving consensus on total joint replacement trial outcome reporting using the OMERACT filter: endorsement of the final core domain set for total hip and total knee replacement trials for endstage arthritis. J Rheumatol 2017;44:1723–6.
3 Chiarotto A, Deo RA, Terwee CB, et al. Core outcome domains for clinical trials in non-specific low back pain. Eur Spine J 2015;24:1127–62.
4 Buchbinder R, Page MJ, Huang H, et al. A preliminary core domain set for clinical trials of shoulder disorders: a report from the OMERACT 2016 shoulder core outcome set special interest group. J Rheumatol 2017;44:1880–3.
5 Bardgett M, Lally J, Malviya A, et al. Patient-Reported factors influencing return to work after joint replacement. Occup Med 2016;66:215–21.
6 Witjes S, van Geenen RCI, Koenraadt KLM, et al. Expectations of younger patients concerning activities after knee arthroplasty: are we asking the right questions? Qual Life Res 2017;26:403–17.
7 Hoornetje A, Janssen KY, Bolder SBT, et al. The effect of total hip arthroplasty on sports and work participation: a systematic review and meta-analysis. Sports Medicine 2018;48:1695–726.
8 Hoornetje A, Witjes S, Kuijer PPFM, et al. High rates of return to sports activities and work after osteotomies around the knee: a systematic review and meta-analysis. Sports Medicine 2017;47:2219–44.
9 Kievit AJ, van Geenen RCI, Kuijer PPFM, et al. Total knee arthroplasty and the unforeseen impact on return to work: a cross-sectional multicenter survey. J Arthroplasty 2014;29:1163–8.
10 Stigmar K, Dahlberg LE, Zhou C, et al. SICK leave in Sweden before and after total joint replacement in hip and knee osteoarthritis patients. Acta Orthop 2017;88:152–7.
11 Wang X, Borgman B, Vertuani S, et al. A systematic literature review of time to return to work and narcotic use after lumbar spinal fusion using minimally invasive and open surgery techniques. BMC Health Serv Res 2017:17:446.
12 Ackerman IN, Bucknill A, Page RS, et al. The substantial personal burden experienced by younger people with hip or knee osteoarthritis. Osteoarthritis and Cartilage 2015;23:1276–84.
13 Wissel G, Burton AK. Is work good for your health and well-being? Norwich, England: The Stationery Office, 2006.
14 Hermans J, Koopmanschap MA, Bierma-Zeinstra SMA, et al. Productivity costs and medical costs among working patients with knee osteoarthritis. Arthritis Care Res 2012;64:653–61.
15 Swart E, Tulipan J, Rosenwasser MP. How should the treatment costs of distal radius fractures be measured? Am J Orthop 2017;46:E54–9.
16 Alvin MD, Miller JA, Lubelski D, et al. Variations in cost calculations in spine surgery cost-effectiveness research. Neurosurg Focus 2017;43:E3.
17 World Health Organization. International Classification of Functioning, Disability and Health (ICF). Geneva: World Health Organization, 2001.
18 Gröne O, Garcia-Barbero M. Trends in integrated care – reflections on conceptual issues. Copenhagen: World Health Organization, 2002.
19 Coenen P, Hulsge G, Daams J, et al. Integrated care programs for sick listed patients with chronic low back pain: a systematic review of interventions version 5.1.0, 2011. Available: www.cochrane-handbook.org [Accessed Mar 2011].
20 Sterne JAC, Hernán MA, Reeves BC, et al. ROBINS-I: a tool for assessing risk of bias in non-randomised studies of interventions. BMJ 2016;355:i4919.
21 Higgins JPT, Thompson S, Deeks J. Measuring inconsistency in meta-analyses. BMJ 2003;327:557–60.
22 Ancher K, Vanston S, Yoyama T, et al. Improving surgical spine outcomes through a targeted postoperative rehabilitation approach. The Spine J 2014;14:576–7.
23 Ancher KR, Devon CJ, Vanston SW, et al. Cognitive-Behavioral-Based physical therapy for patients with chronic pain undergoing lumbar spine surgery: a randomized controlled trial. The Journal of Pain 2017;16:77–89.
24 Danmokjær L, Petersen T, Juul-Kristensen B. Is the American Society of Shoulder and Elbow Therapists’ rehabilitation guideline better than standard care when applied to Bankart-operated patients? A controlled study. Clin Rehabil 2015;29:154–64.
25 Deconee P du Bois M, Lahaye D. Return to work after surgery for lumbar disc herniation. A rehabilitation-oriented approach in insurance medicine. Spine 1999;24:872–6.
26 Lefever P, Hallam K, Fraser D, et al. A novel web-support intervention to promote recovery following anterior cruciate ligament reconstruction, a pilot randomised controlled trial. Phys Ther Sport 2017;27:29–37.
27 McGregor AH, Doré CJ, Morris TP, et al. Function after spinal treatment, exercise and rehabilitation (faster): improving the functional outcome of spinal surgery. BMC Musculoskelet Disord 2010;11:17.
28 McGregor AH, Doré CJ, Morris TP, et al. ISSLS prize winner: function after spinal treatment, exercise, and rehabilitation (faster): a factorial randomized trial to determine whether the functional outcome of spinal surgery can be improved. Spine 2011;36:171–20.
29 Mikkelsen S, Morris TP, McGregor AH, et al. Function after spinal treatment, exercise, and rehabilitation: cost-effectiveness analysis based on a randomized controlled trial. Spine 2011;36:1807–14.
30 Oestergaard LG, Christensen FB, Bünger CB, et al. Can a case manager reduce functional disability and absence from work for lumbar spinal fusion patients? A clinical randomized study with a two years follow-up. Euro Spine 2015:69.
31 Paxton RJ, Forster JE, Miller MJ, et al. A feasibility study for improved physical activity after total knee arthroplasty. J Aging Phys Act 2018;26:133–3.
Correction: Integrated care programmes for sport and work participation, performance of physical activities and quality of life among orthopaedic surgery patients: a systematic review with meta-analysis

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