Return to Work Following Knee Arthroplasty

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Take-Home Messages

- On average one in three patients do not return to work after knee arthroplasty
- Patients return to work around 12 weeks post-surgery, although large differences exist between patients and full return to work may take more than 6 months.
- The cause for not returning to work is multifactorial, but known prognostic factors are preoperative sick leave of more than 2 weeks, female sex, high body mass index (BMI), patient-reported work-relatedness of knee symptoms, and physically demanding jobs. Age and Knee Injury and Osteoarthritis Outcome Scores (KOOS) were not associated with no return to work.
- At present, no studies are available that evaluated the effect of exercise-based rehabilitation, active referral to an occupational physician or therapist, or other forms of multidisciplinary care for knee arthroplasty on return to work.
- Promising interventions for return to work are better expectation management by setting preoperative patient-centered realistic work-related activity goals, preoperative referral to an occupational physician or therapist to actively address prognostic factors hindering return to work, and the use of personalized e/mHealth including activity trackers to support KA patients on a daily basis in return to work.

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11.1 Introduction

If knee arthroplasty (KA) surgery has been successful and patients' pain is reduced and mobility returns, it becomes vital for both patients' health and society that patients return to normal daily life activities. For many patients, returning to work will require them to accept the fact that their "new" KA knee will not function as their healthy knee. The largest increase in primary KA demands is namely not among the classic knee arthroplasty population of patients aged 70 years and older but among patients of working age [1]. For instance, the number of patients aged 45–65 years who undergo total knee arthroplasty (TKA) has tripled (Swedish knee arthroplasty register) in the past 30 years. Germany – one of the leading countries in the prevalence of knee arthroplasty – foresees the highest increase in patients aged 50–65 years until 2050, and in a similar study using the same database, even among patients aged 40–49 years until 2040 [2, 3]. In several countries, the current proportion of knee arthroplasty patients under 65 years is already substantial at 30–40%. It is expected in 2030 that the USA will be the first country where the majority of these patients will be younger than 65 years, followed by the UK in 2035 [4, 5]. In addition, it was found that the combined loss of productivity plus medical costs for conservatively treated symptomatic knee osteoarthritis for those in paid employment in the Netherlands amounts to €871 per patient per month, with loss of productivity accounting for 83% and medical costs for 17% [6].

Previously little was known about return to work in either employed or self-employed patients undergoing TKA. Because the numbers of working patients undergoing TKA are increasing, it is important to find out which factors will help or hinder patients in returning to work following surgery in a swift and also effective manner. What is the impact of surrounding medical as well as social support, the type of work a patient performs, and the general health of the patient? How do these factors interact with one another?

There is sparsity although increasing data about the variety of outcomes regarding this working population. It seems that patients have varying expectations about returning to work after TKA surgery. Remarkably, it was found that only 72% of the patients expected that TKA would improve their ability to work prior to surgery. Six months after TKA, this was even further reduced to 28%. With respect to knee-demanding activities, only 34% expected severe difficulty in kneeling, 30% in crouching, and 17% in clambering at 6 months after TKA [7].

Rehabilitation with Goal Attainment Scaling (GAS) could be a useful tool to manage expectations of functional postoperative outcome. When preoperative goals are set as studied in unicompartmental knee arthroplasty (UKA) patients for postoperative daily life activity, work, and leisure time, it was found that 100% met these goals, compared to 82% of TKA patients [8]. When realistic goals are set and expectations are adjusted, this might improve perceived outcome.

More detailed knowledge about the impact of KA on ability to return to work can help in making better informed decisions about whether KA is the appropriate treatment for the patient's problem. Furthermore, no randomized or appropriately adjusted comparison has yet been made to find out whether UKA patients return to

work sooner or perform better than patients with TKA. UKA surgery is less invasive, and patients seem to function better and be more active and are even able to return to sport sooner despite reported higher revision rates, but the role of bias is unclear [9, 10].

There is increasing interest in the development of health care toward more outcome-oriented care in a broad sense, in which the choice of treatment looks at what best fits the specific situation of the patient instead of population-based objective group outcomes.

Outcome-oriented care can be defined as the outcome that really matters for the health and well-being of a specific patient. The goal is to focus care better on what matters to the patient which in turn can lead to better decision-making choices and more timely work-directed care. This is of importance given that the first prospective cohort study among working age TKA patients showed that even after 1 year, only 71% of workers had fully returned to work [11].

11.2 Patient-Reported Outcome Measures in Working KA Patients

To study patients' physical difficulty experienced in work before or following KA, the Work, Osteoarthritis or joint-Replacement Questionnaire (WORQ) was developed [6]. The WORQ (range 0–100, with a minimal clinically important difference of 13) assesses the experienced difficulty for 13 work-related activities, like kneeling, working with the hands below knee height, and walking on rough terrain. This 13-item questionnaire was tested for internal consistency by factor analysis, internal reliability (Cronbach's α), and construct validity. A test-retest reproducibility was performed for analyzing standard error of measurement (SEM agreement), reliability (ICC), and smallest detectable change (SDC) in individuals and groups. Lastly, responsiveness (standardized response means [SRM]), floor and ceiling effects, and interpretability (minimal important change [MIC]) were analyzed. It was shown that the WORQ is a reliable, valid, and responsive questionnaire following TKA that can be used to evaluate the impact of knee complaints on patients' ability to work [12].

Other patient-reported outcome measures (PROMs) commonly applied to TKA patients are the KOOS, Oxford, and the new Knee Society Scoring System questionnaires. These mainly assess home-life activities and do not look at specific activities that are necessary to return to the work. Gagnier et al. performed a review on PROMs for TKA to critically appraise, compare, and summarize their psychometric properties using accepted methods. Although not all psychometric properties were studied, they concluded that the WORQ had the highest overall ratings and thus could be a useful PROM for evaluating patients undergoing TKA [13, 14].

In an early cross-sectional survey, it was found that approximately one-third of TKA patients worked within 2 years prior to surgery [15]. When looking at these working patients, activities that most improved were operating foot pedals,

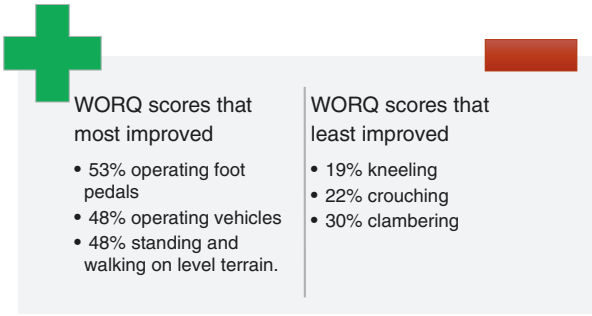

Fig. 11.1 WORQ score improvements in % performing work-related activities following knee arthroplasty between T0 (before the knee problems arose) and T2 (at 2 years after TKA) [15]

operating vehicles, and standing and walking on level terrain. Activities that least improved were kneeling, crouching, and clambering (Fig. 11.1).

Fifty patients scored 5 or less on the Work Ability Index (WAI), an index from 0 to 10 in which a patient can report how well they are able to perform their work with a TKA. TKA significantly, but unequally, reduces difficulties in carrying out knee-burdening work activities [15]. When UKA patients (median 60 years, 51% male) were compared to TKA patients (median 60 years, 49% male) (n.s.), it was found that WORQ scores improved similarly in both groups. The WAI score was also comparable between the groups. Dissatisfaction with work ability was comparable (UKA 15% versus TKA 18%) (n.s.). TKA and UKA patients have similar WORQ, WAI, and satisfaction scores [16].

11.3 Return to Work Timing Following TKA and UKA

Return to work between TKA and UKA patients has been reported to be around 70–80% (Table 11.1 [16]). In the same multi-center retrospective cohort study as mentioned above, the time period between stopping work and returning to work was assessed [10]. UKA patients (n = 157, median 60 years, 51% male) were compared to TKA patients (n = 167, median 60 years, 49% male) (n.s.). Of the 157 UKA patients, 115 (73%) returned to work within 2 years compared to 121 (72%) of TKA patients (n.s.). More UKA patients returned to work within 3 months (73% versus 48%) ($p < 0.01$) (Fig. 11.2) [16]. UKA patients return to work significantly sooner after surgery than TKA patients, which might improve their quality of life and allow them to re-participate more actively in society at an earlier time.

11.4 Prognostic Factors for Not Returning to Work

In the Netherlands, it has been studied what patient characteristics are associated with no return to work (RTW) [38]. Backward stepwise logistic regression analyses were performed to predict no RTW. One hundred and sixty-seven patients met the inclusion criteria, and 46 did not RTW. Preoperative sick leave of more than 2 weeks

Table 11.1 Summary of timing of return to work reported in a KSSTA study in 2020 [16]

Author	Journal	PubMed ID	Year	Total patients with TKA	Total patients with UKA	Age at operation of study group	Patients working pre-op	Patients returning to work post-op	% Returned	Interval return to work in median weeks	Definition
Kievit et al. [16]	KSSTA	31471724	2020		315	60	157	117	75	27% at 1 month, 73% at 3 months	Assessed at mean 3.1 years post-surgery
Jinnah et al. [17]	Surg Technol Int	29611158	2018		30		30			6.4 (mean)	Assessed at 2, 4, 6, and 12 weeks
Scott et al. [18]	Bone Joint J	28768780	2017	289		59.0	261	105	40	13.5 (mean)	Assessed at 2–4 years post-surgery
Stigmar et al. [19]	Acta Orthop.	27996342	2017	4421		55.0	996	857	86	15	Assessed until 24 months post-surgery (calculated from median sick leave of F:M 117:96 days)
Leichtenberg et al. [20]	Ann R Coll Surg Engl	27138849	2016	120		56.0	56	50	89	–	Assessed at 12 months post-surgery
Bardgett et al. [21]	BMJ Open	26832426	2016	10		54.0	10	10	100	9.4 (mean)	Assessed at 8–35 months post-surgery
Tilbury et al. [22]	Rheumatol Int.	26119221	2015	322		57.4	64	56	83	12.9 (mean)	Assessed at 12 months post-surgery

(continued)

Table 11.1 (continued)

Author	Journal	PubMed ID	Year	Total patients with TKA	Total patients with UKA	Age at operation of study group	Patients working pre-op	Patients returning to work post-op	% Returned	Interval return to work in median weeks	Definition
Kleim et al. [23]	Knee Surg Sports Traumatol Arthrosc	25193567	2015	127		54.0	50	41	82	13	Assessed at mean 21 months
Belmont et al. [24]	J Arthroplasty	25677939	2015	159		45.7	159	130	82		Assessed at 24 months post-surgery
Kievit et al. [15]	J Arthroplasty	24524779	2013	480		66	173	121	70	50.4% within 12 weeks	Assessed at 24–86 months
Glebus et al. [25]	J Arthroplasty	23830502	2013	20	2	45.0	22	?	86		Assessed at 4.5 years post-surgery
Sankar et al. [26]	Osteoarthritis Cartilage	23774473	2013	494		57.5	170	144	85	24% at 1 month. 57% at 3 months	Assessed until 1 year post-surgery
Lombardi et al. [27]	Clin Orthop Relat Res.	23761175	2013	661		54.0	494	482	98	8.9	Assessed at 12–36 months post-surgery
Clyde et al. [28]	J Arthroplasty	23583541	2013	98		55.0	98	64	65	15.5 (mean)	Assessed at 17–125 months
Husted et al. [29]	J Bone Joint Surg Br.	21357957	2011	421		68.3	82	46	56	–	Assessed at 24 months
Styron et al. [30]	J Bone Joint Surg Am.	21209263	2011	162		57.0	162	122	75	8.9	Assessed at 3 months

Author	Journal	PubMed ID	Year	Total patients with TKA	Total patients with UKA	Age at operation of study group	Patients working pre-op	Patients returning to work post-op	% Returned	Interval return to work in median weeks	Definition
Lyall et al. [31]	Ann R Coll Surg Engl	19344550	2009	56		57.9	41	40	98	10 (mean)	Assessed at 47–112 months post-surgery
Foote et al. [32]	Knee	19632120	2009	41		54.1	27	22	82	12	Assessed at 14–61 months
Foote et al. [32]	Knee	19632120	2009		31	52.6	22	18	82	11	Assessed at 14–61 months
Lombardi et al. [33]	Clin Orthop Relat Res.	19225852	2009	113	113	62	–	–	–	8	Assessed at 2–52 months post-surgery
Walton et al. [34]	J Knee Surg.	16642887	2006	120		71.5	21	17	81	–	
Jorn et al. [35]	Acta Orthop Scand.	10569263	1999	102	60	56.0	88	52	59	(54% within 26 weeks)	Assessed at 2 years post-surgery
Nielsen et al. [36]	Ugeskr Laeger	10434787	1999	926		–	51	40	78	–	Assessed at 1 year post-surgery
Weingarten et al. [37]	Am J Med.	9688019	1998	287		69.7	56	41	81	–	Assessed at 3–5 months
Sumarized				9429	551	58	3285	2575	78		

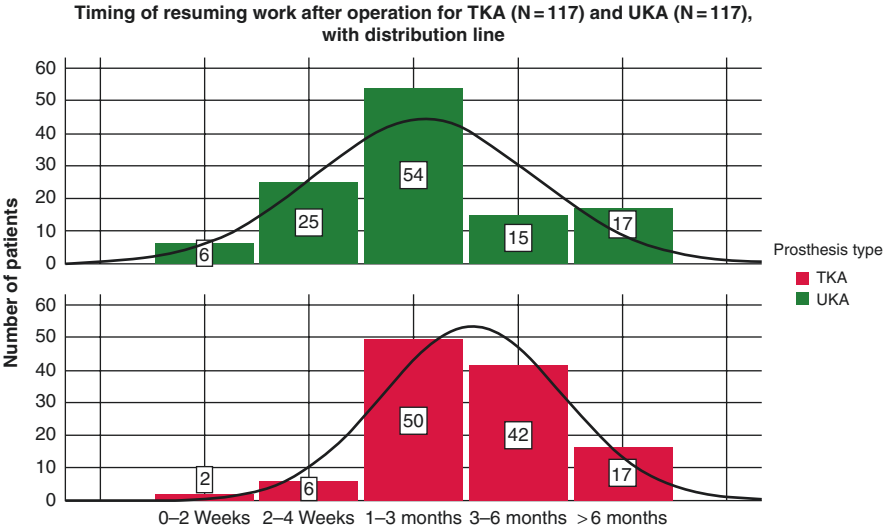

Fig. 11.2 Time when patients resumed work after unicompartmental (UKA, $N = 117$) and total knee arthroplasty (TKA, $N = 117$) in absolute numbers, with distribution line [16]

Fig. 11.3 Prognostic factors for not returning to work – stepwise logistic regression analyses [38]

(OR, 12.5; 90% CI 5.0–31.5) was most strongly associated with no RTW. Other associations found were female sex (OR, 3.2; 90% CI 1.3–8.2), BMI 30 (OR, 2.8; 90% CI 1.1–7.1), patient-reported work-relatedness of knee symptoms (OR, 5.3; 90% CI 2.0–14.1), and physically knee-demanding job (OR, 3.3; 90% CI 1.2–8.9). Age and KOOS scores were not associated with no RTW (Fig. 11.3). Especially obese female workers, with a preoperative sick leave duration >2 weeks who performed knee-demanding work and indicated that their knee symptoms were work related, had a high chance for no RTW after TKA. These results stress the importance of a timelier referral for work-directed care of patients at risk for no RTW after TKA.

In a qualitative study performed in 50 TKA patients by Bardgett et al., three key factors were identified that influenced RTW from the patients' perspective [39]. These patients reported an improved physical and psychological performance at

work after surgery in comparison to preoperative functioning. The three factors reported were that (1) patients did not receive specific advice to facilitate their RTW following surgery, (2) patients perceived that the current provision of information for joint replacement patients is focused on the needs of elderly patients and reported that more clarity and consistency are required regarding RTW advice, and (3) these patients reported a lack of support and adaptation in the workplace and described a negative influence on their experience of RTW although this was not reflected in increased duration of sickness absence [39].

Furthermore, patients who had a slower return to work often reported that comorbidities, especially musculoskeletal like low back pain or OA affecting other joints, prevented their RTW even when the surgical outcome was positive [40]. However, the most recent review on prognostic factors for return to work concluded that based on 14 studies and 3073 patients, the most important prognostic factors associated with a slower or no RTW were a more physically demanding job and preoperative absence from work [41].

11.5 Interventions Aimed at Improving Return to Work After KA

Remarkably, little to no evidence is available for effective return-to-work interventions for KA patients. Although the provision of exercise-based rehabilitation after KA is almost universal, a systematic literature review performed in Ovid Medline and EMBASE concluded that "no studies were found evaluating the effect of rehabilitation programmes for knee arthroplasty on return to work" [42]. To come to this conclusion, a detailed search was performed with the support of a clinical librarian specialized in the outcome work participation, and despite that, 3788 studies were independently assessed by two reviewers. If the search was broadened and also included integrated multidisciplinary care, like active referral to an occupational physician or an occupational therapist or including e/mHealth interventions, again no studies were found for KA patients and RTW [43]. Therefore, to develop an occupational advice intervention to support early recovery to usual activities including work that is tailored to the requirements of KA patients, Baker and colleagues performed an intervention mapping approach, including 110 stakeholder interviews and a survey of 152 practices [44]. The intervention included information resources, a personalized return-to-work plan, and coordination from the health-care team. To support delivery, a range of tools (e.g., occupational checklists, patient workbooks, and employer information), roles (e.g., return-to-work coordinator), and training resources were created. The intervention was assessed in 26 patients and staff and showed high rates of adherence to the defined performance objectives. The overall results demonstrated that the occupational advice intervention developed for KA patients is deliverable. However, the intervention warrants a randomized controlled trial to assess its clinical effectiveness and cost-effectiveness to improve rates and timing of return to work. Two other promising return-to-work interventions for KA patients and using limited health-care resources are Goal Attainment Scaling (GAS)

and the use of a personalized e-Health application, iRecover (in Dutch: ikHerstel) [45, 46]. GAS personalizes exercise-based rehabilitation by setting patient-specific, activity-oriented rehabilitation goals in close collaboration between the patient and the physical therapist, thereby setting realistic patient expectations and securing close monitoring of these goals during the rehabilitation period. A randomized controlled trial (RCT) among 120 working-age KA patients showed that GAS resulted in higher patient satisfaction with work activities compared to care as usual in the control group: an increase of 11 points on a scale from 0 to 100 with a 98% confidence interval of 2–19 points [45]. For the iRecover application, multidisciplinary consensus on recommendations regarding the resumption of 27 activities of daily life, including work, has been reached among a multidisciplinary expert panel of six orthopedic surgeons, three physical therapists, five occupational physicians, and one physician assistant for fast, average, and slow recovery [46]. These consensus recommendations are integrated into the algorithm of the iRecover application (Fig. 11.4) [47]. In combination with the use of an activity tracker and GAS for work-related activities, this intervention is currently evaluated in the so-called Active RCT among 368 patients (https://www.trialregister.nl/trial/8525).

11.6 Discussion

11.6.1 Cost-Effectiveness of KA From a Personal and Societal Perspective

Despite good results with respect to return to work for most of the KA patients, a large proportion of these patients do not return to work. Also within this population, when patients return to work, not all aspects of functional recovery improve, but patients' overall satisfaction can still be high. Information regarding time to return to work including what work-related activities will improve most after KA is of primary importance for patients and care providers, as meeting preoperative expectations is key for satisfaction [48, 49]. This is especially true for patients approaching their retirement age. As, on average, patients return to work 3 months after KA, it is still unclear if the cost of the 3-month sick leave in addition to the cost of KA weighs up to the potential improvement of productivity from a societal economical perspective. This may be relatively easy in patients who are already on full sick leave and unable to perform their job because of OA-related knee complaints as they can only improve. Such a simple cost-benefit analysis is less straightforward in patients who are still able to perform their work, but in a less productive manner. Will they improve sufficiently from surgery? As shown earlier, activities like kneeling and crouching only improved marginally. Therefore, KA will probably improve general quality of life but not necessary productivity for most plumbers, gardeners, and builders getting close to pension age as the "return of investment" time is too short. On the other hand, if a patient's work mainly consists of driving a vehicle, such as is the case in taxi drivers or lorry drivers, it might be advantageous to perform arthroplasty surgery earlier on as these activities do seem to improve. It needs

Fig. 11.4 An example of a dashboard of the iRecover app, providing knee arthroplasty patients tailored guidance on resumption of activities of daily life, including work. Guidance on the resumption of activities and the recovery status of these activities (upper two panels) can be provided, while wearable devices can be used to provide patients with feedback on their physical activities, helping them to work toward self-chosen (work-directed) goals [47]

to be further investigated what timings are advantageous for specific working groups and whether active referral to an occupational physician or therapist might be advantageous for return to work, as well as for professions in order to find work-related solutions for activities that improve less after KA.

11.6.2 UKA or TKA?

It seems that UKA patients return to work sooner than TKA patients. Despite the fact that prosthetic survival of a UKA is shorter than that of TKA, a well-informed decision can be made in the case of anteromedial osteoarthritis. If it is paramount for a patient to return to work as soon as possible, UKA could be the prosthesis of choice. This can be the case for patients who are self-employed. However, if a patient finds it most important to receive an arthroplasty which will last longer, a TKA can be chosen despite the longer return-to-work interval. Future research will focus on translating research data into optimal decision-making in the workplace. It will be interesting to see if patients will be more satisfied if they are better informed on what to expect from return to work after TKA or UKA surgery. With better insight into what a specific patient needs to be able to return to work, better coaching on the choice and timing of treatment can be provided. Specific physiotherapy could be focused to prioritize the performance of work activities to see if patients can return sooner. Interventions can be tested for effectiveness by assessing WORQ scales prior to surgery as well as post-surgery. Future research will need to focus not only on outcome but also on cost-effectiveness. As the combined loss of productivity plus medical costs for conservatively treated symptomatic knee osteoarthritis for those in paid employment in the Netherlands amounts to €871 per patient per month (with loss of productivity accounting for 83% and medical costs for 17% [6]), better assessment of cost-benefit and cost-effectiveness will become possible. One might expect that arthroplasty surgery may reduce these costs. If arthroplasty surgery would reduce the loss of productivity to zero at the moment of return to work at 3 months, and the total cost of arthroplasty surgery is on average around €10.000 [50], surgery would accrue positive cost-benefit outcome if absence from work could be shortened by 12 months (=10.000/871) or more. However, these rough estimates ignore the fact that three out of ten patients do not return to work and that surgery will produce adverse outcomes in others. To make an accurate assessment of when is the best time to perform surgery for specific patients, new comparative prospective studies should be performed. Challenges for future research are the difference between the intervention and the control arm, not only with respect to the choice and timing of surgery but also with respect to other covariates such as management of expectations, quantification of medical and societal costs (such as loss of productivity), and adequate as well as feasible follow-up. The results of one study demonstrated that the total economic cost to society for treatment of severe knee osteoarthritis in a relatively young working person is markedly lower with TKA than it is with non-operative treatment [51]. As furthermore stated by the authors of this paper:

The results of this model illustrate the need to account for the implications of treatment choices, not only at the individual patient level, but also for society at large. When deciding among available treatment options, patients, physicians, payers, and policymakers must consider individual treatment cost and effectiveness but also should account for future potential earnings generated when a treatment may restore a patient's ability to contribute to society [51].

11.7 Conclusion

Knee arthroplasty is becoming more and more important to keep patients active as members of the workforce. Therefore, not only in clinical practice and in research but also in guideline development, this important outcome should be more often addressed, especially regarding effective multidisciplinary care.

References

1. Kuijer PPF, Burdorf A. Prevention at work needed to curb the worldwide strong increase in knee replacement surgery for working-age osteoarthritis patients. Scand J Work Environ Health. 2020;46(5):457–60.
2. Klug A, Gramlich Y, Rudert M, Drees P, Hoffmann R, Weißenberger M, et al. The projected volume of primary and revision total knee arthroplasty will place an immense burden on future health care systems over the next 30 years. Knee Surg Sports Traumatol Arthrosc. 2020:1–12.
3. Rupp M, Lau E, Kurtz SM, Alt V. Projections of primary TKA and THA in Germany from 2016 through 2040. Clin Orthop Relat Res. 2020;478(7):1622–33.
4. Kurtz S, Ong K, Lau E, Mowat F, Halpern M. Projections of primary and revision hip and knee arthroplasty in the United States from 2005 to 2030. J Bone Joint Surg Am. 2007;89(4):780–5.
5. Culliford D, Maskell J, Judge A, Cooper C, Prieto-Alhambra D, Arden NK. Future projections of total hip and knee arthroplasty in the UK: results from the UK Clinical Practice Research Datalink. Osteoarthr Cartil. 2015;23(4):594–600.
6. Hermans J, Koopmanschap MA, Bierma-Zeinstra SM, van Linge JH, Verhaar JA, Reijman M, et al. Productivity costs and medical costs among working patients with knee osteoarthritis. Arthritis Care Res (Hoboken). 2012;64(6):853–61.
7. van Zaanen Y, van Geenen RCI, Pahlplatz TMJ, Kievit AJ, Hoozemans MJM, Bakker EWP, et al. Three out of ten working patients expect no clinical improvement of their ability to perform work-related knee-demanding activities after total knee arthroplasty: a multicenter study. J Occup Rehabil. 2019;29(3):585–94.
8. Witjes S, Hoorntje A, Kuijer PP, Koenraadt KL, Blankevoort L, Kerkhoffs GM, et al. Goal setting and achievement in individualized rehabilitation of younger total and unicondylar knee arthroplasty patients: a cohort study. Arch Phys Med Rehabil. 2019;100(8):1434–41.
9. Kleeblad LJ, van der List JP, Zuiderbaan HA, Pearle AD. Larger range of motion and increased return to activity, but higher revision rates following unicompartmental versus total knee arthroplasty in patients under 65: a systematic review. Knee Surg Sports Traumatol Arthrosc. 2018;26(6):1811–22.
10. Witjes S, Gouttebarge V, Kuijer PP, van Geenen RC, Poolman RW, Kerkhoffs GM. Return to sports and physical activity after total and unicondylar knee arthroplasty: a systematic review and meta-analysis. Sports Med (Auckland, NZ). 2016;46(2):269–92.
11. Hylkema TH, Stevens M, van Beveren J, Rijk PC, Brouwer RW, Bulstra SK, et al. Recovery courses of patients who return to work by 3, 6 or 12 months after total knee arthroplasty. J Occup Rehabil. 2021.

12. Kievit AJ, Kuijer PPFM, Kievit RA, Sierevelt IN, Blankevoort L, Frings-Dresen MHW. A reliable, valid and responsive questionnaire to score the impact of knee complaints on work following total knee arthroplasty: the WORQ. J Arthroplasty. 2014;29(6):1169–75.
13. Terwee CB, Bot SD, de Boer MR, van der Windt DA, Knol DL, Dekker J, et al. Quality criteria were proposed for measurement properties of health status questionnaires. J Clin Epidemiol. 2007;60(1):34–42.
14. Gagnier JJ, Mullins M, Huang H, Marinac-Dabic D, Ghambaryan A, Eloff B, et al. A systematic review of measurement properties of patient-reported outcome measures used in patients undergoing total knee arthroplasty. J Arthroplasty. 2017;32(5):1688–97.e7.
15. Kievit AJ, van Geenen RCI, Kuijer PPFM, Pahlplatz TMJ, Blankevoort L, Schafroth MU. Total knee arthroplasty and the unforeseen impact on return to work: a cross-sectional multicenter survey. J Arthroplasty. 2014;29(6):1163–8.
16. Kievit AJ, Kuijer P, de Haan LJ, Koenraadt KLM, Kerkhoffs G, Schafroth MU, et al. Patients return to work sooner after unicompartmental knee arthroplasty than after total knee arthroplasty. Knee Surg Sports Traumatol Arthrosc. 2020;28(9):2905–16.
17. Jinnah AH, Augart MA, Lara DL, Jinnah RH, Poehling GG, Gwam CU, et al. Decreased time to return to work using robotic-assisted unicompartmental knee arthroplasty compared to conventional techniques. Surg Technol Int. 2018;32:279–83.
18. Scott CEH, Turnbull GS, MacDonald D, Breusch SJ. Activity levels and return to work following total knee arthroplasty in patients under 65 years of age. Bone Joint J. 2017;99-b(8):1037–46.
19. Stigmar K, Dahlberg LE, Zhou C, Jacobson Lidgren H, Petersson IF, Englund M. Sick leave in Sweden before and after total joint replacement in hip and knee osteoarthritis patients. Acta Orthop. 2017;88(2):152–7.
20. Leichtenberg CS, Tilbury C, Kuijer P, Verdegaal S, Wolterbeek R, Nelissen R, et al. Determinants of return to work 12 months after total hip and knee arthroplasty. Ann R Coll Surg Engl. 2016;98(6):387–95.
21. Bardgett M, Lally J, Malviya A, Deehan D. Return to work after knee replacement: a qualitative study of patient experiences. BMJ Open. 2016;6(2):e007912.
22. Tilbury C, Leichtenberg CS, Tordoir RL, Holtslag MJ, Verdegaal SH, Kroon HM, et al. Return to work after total hip and knee arthroplasty: results from a clinical study. Rheumatol Int. 2015;35(12):2059–67.
23. Kleim BD, Malviya A, Rushton S, Bardgett M, Deehan DJ. Understanding the patient-reported factors determining time taken to return to work after hip and knee arthroplasty. Knee Surg Sports Traumatol Arthrosc. 2015;23(12):3646–52.
24. Belmont PJ Jr, Heida K, Keeney JA, Hamilton W, Burks R, Waterman BR. Return to work and functional outcomes following primary total knee arthroplasty in U.S. Military Servicemembers. J Arthroplasty. 2015;30(6):968–72.
25. Glebus GP, Feather TW, Hsu JR, Gerlinger TL. Return to duty and deployment after major joint arthroplasty. J Arthroplasty. 2013;28(8):1270–3.
26. Sankar A, Davis AM, Palaganas MP, Beaton DE, Badley EM, Gignac MA. Return to work and workplace activity limitations following total hip or knee replacement. Osteoarthr Cartil. 2013;21(10):1485–93.
27. Lombardi AV Jr, Nunley RM, Berend KR, Ruh EL, Clohisy JC, Hamilton WG, et al. Do patients return to work after total knee arthroplasty? Clin Orthop Relat Res. 2014;472(1):138–46.
28. Clyde CT, Goyal N, Matar WY, Witmer D, Restrepo C, Hozack WJ. Workers' compensation patients after total joint arthroplasty: do they return to work? J Arthroplasty. 2013;28(6):883–7.
29. Husted H, Troelsen A, Otte KS, Kristensen BB, Holm G, Kehlet H. Fast-track surgery for bilateral total knee replacement. J Bone Joint Surg Br. 2011;93(3):351–6.
30. Styron JF, Barsoum WK, Smyth KA, Singer ME. Preoperative predictors of returning to work following primary total knee arthroplasty. J Bone Joint Surg Am. 2011;93(1):2–10.
31. Lyall H, Ireland J, El-Zebdeh MY. The effect of total knee replacement on employment in patients under 60 years of age. Ann R Coll Surg Engl. 2009;91(5):410–3.
32. Foote JA, Smith HK, Jonas SC, Greenwood R, Weale AE. Return to work following knee arthroplasty. Knee. 2010;17(1):19–22.

33. Lombardi AV Jr, Berend KR, Walter CA, Aziz-Jacobo J, Cheney NA. Is recovery faster for mobile-bearing unicompartmental than total knee arthroplasty? Clin Orthop Relat Res. 2009;467(6):1450–7.
34. Walton NP, Jahromi I, Lewis PL, Dobson PJ, Angel KR, Campbell DG. Patient-perceived outcomes and return to sport and work: TKA versus mini-incision unicompartmental knee arthroplasty. J Knee Surg. 2006;19(2):112–6.
35. Jorn LP, Johnsson R, Toksvig-Larsen S. Patient satisfaction, function and return to work after knee arthroplasty. Acta Orthop Scand. 1999;70(4):343–7.
36. Nielsen MB, Kristensen PW, Lamm M, Schroder HM. Knee alloplasty and working ability. The significance of knee alloplasty for working ability of patients who were working prior to surgery. Ugeskr Laeger. 1999;161(18):2666–9.
37. Weingarten S, Riedinger MS, Sandhu M, Bowers C, Ellrodt AG, Nunn C, et al. Can practice guidelines safely reduce hospital length of stay? Results from a multicenter interventional study. Am J Med. 1998;105(1):33–40.
38. Kuijer PP, Kievit AJ, Pahlplatz TM, Hooiveld T, Hoozemans MJ, Blankevoort L, et al. Which patients do not return to work after total knee arthroplasty? Rheumatol Int. 2016;36(9):1249–54.
39. Bardgett M, Lally J, Malviya A, Kleim B, Deehan D. Patient-reported factors influencing return to work after joint replacement. Occup Med (Oxford, England). 2016;66(3):215–21.
40. Hylkema TH, Brouwer S, Stewart RE, van Beveren J, Rijk PC, Brouwer RW, et al. Two-year recovery courses of physical and mental impairments, activity limitations, and participation restrictions after total knee arthroplasty among working-age patients. Disabil Rehabil. 2020:1–10.
41. Van Leemput D, Neirynck J, Berger P, Vandenneucker H. Return to work after primary total knee arthroplasty under the age of 65 years: a systematic review. J Knee Surg. 2021.
42. Kuijer P, van Haeren MM, Daams JG, Frings-Dresen MHW. Better return to work and sports after knee arthroplasty rehabilitation? Occup Med (Oxford, England). 2018;68(9):626–30.
43. Coenen P, Hulsegge G, Daams JG, van Geenen RC, Kerkhoffs GM, van Tulder MW, et al. 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. BMJ Open Sport Exerc Med. 2020;6(1):e000664.
44. Baker P, Coole C, Drummond A, Khan S, McDaid C, Hewitt C, et al. Occupational advice to help people return to work following lower limb arthroplasty: the OPAL intervention mapping study. Health Technol Assess (Winchester, England). 2020;24(45):1–408.
45. Hoorntje A, Waterval-Witjes S, Koenraadt KLM, Kuijer P, Blankevoort L, Kerkhoffs G, et al. Goal attainment scaling rehabilitation improves satisfaction with work activities for younger working patients after knee arthroplasty: results from the randomized controlled ACTION trial. J Bone Joint Surg Am. 2020;102(16):1445–53.
46. Straat AC, Coenen P, Smit DJM, Hulsegge G, Bouwsma EVA, Huirne JAF, et al. Development of a personalized m/ehealth algorithm for the resumption of activities of daily life including work and sport after total and unicompartmental knee arthroplasty: a multidisciplinary delphi study. Int J Environ Res Public Health. 2020;17(14):4952.
47. Coenen P, Straat C, Kuijer PP. Knee arthroplasty: a window of opportunity to improve physical activity in daily life, sports and work. BMJ Open Sport Exerc Med. 2020;6(1):e000822.
48. Swarup I, Henn CM, Gulotta LV, Henn RF 3rd. Patient expectations and satisfaction in orthopaedic surgery: a review of the literature. J Clin Orthop Trauma. 2019;10(4):755–60.
49. Deakin AH, Smith MA, Wallace DT, Smith EJ, Sarungi M. Fulfilment of preoperative expectations and postoperative patient satisfaction after total knee replacement. A prospective analysis of 200 patients. Knee. 2019.
50. ZorgkaartNederlandR. Watkosteentotaleknieprothese?2015.Availablefrom:https://www.zorgkaartnederland.nl/aandoeningen/knievervanging/artikelen/wat-kost-een-totale-knieprothese.
51. Bedair H, Cha TD, Hansen VJ. Economic benefit to society at large of total knee arthroplasty in younger patients: a Markov analysis. J Bone Joint Surg Am. 2014;96(2):119–26.