Original research

Effectiveness of the Coordinated Return to Work model after orthopaedic surgery for lumbar discectomy and hip and knee arthroplasty: a register-based study

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ABSTRACT

Objectives This study examined the effectiveness of an individualised Coordinated Return to Work (CRtW) model on the length of the return to work (RTW) period compared with a standard prescription of 2–3 months RTW during recovery after lumbar discectomy and hip and knee arthroplasty among Finnish working-age population.

Methods Cohorts on patients aged 18–65 years old with lumbar discectomy or hip or knee arthroplasty were extracted from the electronic health records of eight Finnish hospital districts in 2015–2021 and compiled with retirement and sickness benefits. The overall effect of the CRtW model on the average RTW period was calculated as a weighted average of area-specific mean differences in RTW periods between 1 year before and 1 year after the implementation. Longer-term effects of the model were examined with an interrupted time series design estimated with a segmented regression model.

Results During the first year of the CRtW model, the average RTW period shortened by 9.1 days (95% CI 4.1 to 14.1) for hip arthroplasty and 14.4 days (95% CI 7.5 to 21.3) for knee arthroplasty. The observed differences were sustained over longer follow-up times. For lumbar discectomy, the first-year decrease was not statistically significant, but the average RTW had shortened by 36.2 days (95% CI 33.8 to 38.5) after 4.5 years.

Conclusions The CRtW model shortened average RTW periods among working-age people during the recovery period. Further research with larger samples and longer follow-up times is needed to ensure the effectiveness of the model as a part of the Finnish healthcare system.

WHAT IS ALREADY KNOWN ON THIS TOPIC

⇒ Sick-related absences from work are 2–3 times longer in Finland than in comparable countries.

⇒ In Finland, long sickness absences are a major challenge impacting the productivity of work and for example, health insurance benefits.

WHAT THIS STUDY ADDS

⇒ Sickness absences after lumbar discectomy surgeries and hip and knee arthroplasty were shortened after the implementation of the Coordinated Return to Work (CRtW) model in the general Finnish working-age population.

⇒ Sickness absences were on average shorter already after the first year of implementation and the effect was sustained in longer-term analyses over 1–4.5 years.

HOW THIS STUDY MIGHT AFFECT RESEARCH, PRACTICE OR POLICY

⇒ Shorter sickness absences result in increased productivity in the whole society, in addition to the decrease in social security benefits paid by the National Social Insurance Institution.

⇒ Other countries should evaluate whether CRtW can be implemented in their occupational healthcare system.

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INTRODUCTION

Sickness absence from work is a significant challenge for modern societies globally since it reduces the level of productivity.[1 2] For example, in Finland, absenteeism alone has been estimated to result in an annual productivity loss of around 3.4 billion euros (around 1.4% of the GDP).[3] In Finland, the number of work days lost due to sickness has been observed to be 2–3 times higher than in many other Western countries.[4] For example, in 2021, more than 4.3 billion euros in health insurance benefits were paid in Finland, of which sickness benefits accounted for 24%.[5] The average length of sickness benefit periods in musculoskeletal disorders has increased over the past decade.[6 7] Therefore, from the societal point of view, policies and interventions that support faster and sustained return to work (RTW) are urgently needed.

Globally, the rates of hip and knee arthroplasty[8] and lumbar discectomy[9] are increasing, reflecting the rising incidence of musculoskeletal disorders. These surgeries improve the patient's quality of life,[10–13] yet their ultimate success is also contingent on effective postoperative care and rehabilitation which pave the way for a faster RTW. The process of RTW plays a pivotal role in the spheres of the productivity of working people, social inclusion and personal well-being. A prompt and sustained reintegration into the workforce can substantially expedite the recovery process, bolstering self-confidence, preserving skills and ensuring financial stability[14] both for the employee and employer.

In Finnish clinical practices of hospitals, the previously unquestioned norm has been to prescribe all patients with standard 2–3 month sickness absences after hip or knee arthroplasty[15] regardless of age, working status, etc. In a Finnish cohort of patients who returned to work within 1 year of total hip arthroplasty, the mean time of RTW was 103 days (from 10 to 354 days).[16] Among patients who underwent total knee arthroplasty, the mean time of RTW was 116 days (from 28 to 356 days).[17] Time to RTW after lumbar discectomy has varied in previous studies. In a small Korean study of 67 participants, the mean time of RTW after lumbar discectomy was 36 days,[18] while in a Danish study, the median time of RTW after lumbar discectomy was around 64–69 days.[19]

In the Coordinated Return to Work (CRtW) model,[7] a collaboration of several public hospital care and private occupational health service providers was implemented to shorten the time of RTW. In the CRtW model, a hospital physician in charge of discharge of the patient makes an electronic referral to occupational health services, the occupational healthcare meets the patient shortly after, and work capacity and support actions are individually evaluated. The model was first implemented for patientslumbar discectomy, and a national priority is to implement the model for a wide range of other working-age patients. This study aimed to examine the effectiveness of the CRtW on time of RTW after lumbar discectomy and hip or knee arthroplasty. It aimed to show the potential of a coordinated and integrated approach in patient processes to facilitate faster and more sustained RTWs.

MATERIAL AND METHODS

The CRtW model and its implementation

All Finnish residents are covered by tax-financed public healthcare. In the CRtW model, employed patients with occupational health services are referred from public healthcare to private occupational health services. These are financed by employers and employees. At the time of discharge from the public specialised healthcare, the physician prescribes a short (2 weeks after lumbar discectomy, and 4 weeks after hip or knee arthroplasty) sickness absence and writes an electronic referral to occupational health services. A case manager in occupational health services arranges an evaluation of a patient's work capacity. Working ability is individually assessed, and actions to support RTW are carefully evaluated, including adjustments in working time, physical demands, task limitations and changes to the work environment. Collaboration with occupational health specialists, such as physiotherapists, is emphasised. These actions complement regular rehabilitation efforts, with a specific focus on work-related factors in the post-surgery recovery process, such as working postures and ergonomic changes in the workplace.

During this study, Finland was divided into 21 hospital districts which organised health and social services for the residents of its area by tax funding from the national level. The CRtW model was developed and first implemented in the hospital district of Central Finland for patients with lumbar discectomy in June 2017. Thereafter, the model has been extended to also cover hip and knee arthroplasty since November 2018. After the implementations in Central Finland, the model was implemented in the hospital district of South Karelia for patients with lumbar discectomy in January 2020 and for hip and knee arthroplasty in November 2020. Of the hospitals in the hospital district of Helsinki and Uusimaa (HUS), Peijas Hospital implemented the model for hip and knee arthroplasty in September 2020 while elsewhere in the HUS the model was not implemented during the follow-up time. In the hospital district of North Ostrobothnia, the model implementation started in October 2019 for hip and knee arthroplasty, but exceptionally without using electronic referrals. HUS is the largest area by number of operated patients with 1.7 million residents while North Ostrobothnia has 416 000, Central Finland 272 000 and South Karelia 125 000 residents.[20] The adequate functioning of the agreed protocol was monitored by twice-a-year clinical auditing of randomised patients in Central Finland.

Study population

Electronic health records (EHRs) of eight Finnish hospital districts of Central Finland, HUS, Lapland, North Karelia, North Ostrobothnia, North Savo, Ostrobothnia and South Karelia were used to identify cohorts of working-age (ie, 18–65 years old) patients who had undergone microsurgical or open technique lumbar discectomy or primary hip arthroplasty or knee arthroplasty (total or partial) due to osteoarthritis during January 2015–December 2021. Information on the date of the surgery and the corresponding diagnostic codes according to the International Classification of Diseases 10th version together with hospital admission and discharge dates were gathered from the EHRs (online supplemental table 1). EHR data were compiled with the national sickness benefits register maintained by the Social Insurance Institute of Finland. Full-time retired patients at the date of the surgery were excluded. In Finland, patients are eligible to receive sickness benefits starting after 9 days of sickness absence and until 300 business days thereafter, that is, around 1 year. Only patients with a record of full-time sickness absence in the sickness benefits register were included. All register data were linked with personal identification numbers unique to every Finnish resident.

Length of sickness absence

The length of the RTW period was determined as the difference between the date of the surgery and the last day of full-time sickness absence. Sickness absences starting within 15 days after discharge were included, and the diagnosis for the surgery had to correspond to the diagnostic code of the sickness absence. Part-time sickness absence was considered as RTW and was not included in the calculation of the length of sickness absence. Consecutive sickness absences with the same diagnostic code and a maximum of 15 days gap between the end of the former and the start of the latter were considered to represent the same sickness absence.

Statistical analyses

The effectiveness of the CRtW model on the length of the RTW period was defined as the difference between the average lengths of RTWs of patients operated on within 1 year prior and 1 year after the implementation of the model (ie, a pre-post analysis). Mean differences were calculated as the mean RTW 1 year after the CRtW model implementation minus the mean RTW 1 year before the implementation for each of the areas that had implemented the CRtW model. The overall effect of the CRtW model was calculated as a mean of area-specific mean differences that were weighted with reciprocals of the variances.

To examine the longer-term effectiveness of the CRtW model on the average RTW period and compare it with control areas that had not implemented the model at the study time, an interrupted time series (ITS) design[21 22] was used. ITS is the strongest quasi-experimental design and is suitable for estimating the effects of policy changes that impact rapidly on the outcomes. Effects are evaluated by the changes in intercepts and slopes of a time series and secular trends are controlled by the design. Control areas can be used to further increase internal validity by controlling for confounding omitted variables. The design assumes population characteristics to remain unchanged throughout the follow-up and that no other interventions are occurring simultaneously. ITS requires data to be summarised at regular, evenly-spaced intervals. As a result, it provides an intuitive graphical presentation of the time series. It is suggested to have at least eight time windows before and eight time windows after the intervention to examine changes statistically and enough observations within each time window to achieve an acceptable level of variability within each time window.[21 23]

To conduct ITS, the follow-up was divided into several pre-implementation and post implementation time windows. As the calendar times of CRtW model implementation and sizes of patient groups differed between the areas, the length and number of the applied time windows also differed between the areas. Thus, 1-month time windows were used for HUS Peijas Hospital which was the largest area by number of operated patients. Analogously, 3-month time windows were used for North Ostrobothnia and 4-month time windows for Central Finland. Within each of the time windows, the average length of RTW for the surgeries conducted during the period was calculated. The number of patients operated in South Karelia was not sufficient for ITS analyses and this area was omitted from these analyses. ITS was estimated with segmented regression models. The applied model was of the form:

$$Y_t = \begin{aligned} &\beta_0 + \beta_1 T_t + \beta_2 X_t + \beta_3 X_t T_t + \beta_4 Z \\ &+ \beta_5 Z T_t + \beta_6 Z X_t + \beta_7 Z X_t T_t + \varepsilon_t \end{aligned} \qquad (1)$$

where Y_t is the average time of RTW in time window t, T is the time window t since the start of the study, X is an indicator presenting the implementation of the CRtW model at time window t, X_tT_t is an interaction term between the implementation of the CRtW model and time window t, Z is an indicator for CRtW model area, ZT_t is an interaction term between the CRtW model area and time window t, ZX_t is an interaction term between the CRtW model area and implementation of the model at time window t and ZX_tT_t is an interaction term between the CRtW model area, implementation of the model at time window t and time window t. Finally, ε_t is the random error assumed to be normally distributed with zero mean. However, when autocorrelation was detected based on Durbin-Watson statistics, an autoregressive error model was used to correct for serial correlation. In equation (1), parameters $\beta_0\beta_3$ represent the control area and $\beta_4\beta_7$ the CRtW model area. Manual stepwise backward elimination was used to reduce the fitted model to include only statistically significant parameter estimates. P values <0.05 were considered statistically significant.

Sensitivity analyses were also performed. First, the effect of excluding the HUS from the control area was examined because of the dominative number of patients operated compared with other control areas in lumbar discectomy analyses. Second, sensitivity analyses against the outcome definition were performed by rerunning all the ITS models by restricting the length of RTW to <180 days. Long sickness absence is exceptional and typically indicates complications or other problems in the recovery after the surgery.

All the statistical analyses were performed with RStudio V.2022.07.2+576 and SAS V.9.4.

RESULTS

Characteristics of the patient groups operated from June 2015 to December 2021 by the eight areas are presented in table 1.

One-year overall results

Mean differences in average RTW periods between 1 year before and 1 year after the implementation of the CRtW model are presented in figure 1 and online supplemental table 2. In the overall analyses combining all the CRtW model areas, the mean difference (values after minus values before) was −5.8 days (95% CI −19.5 to 7.8) for lumbar discectomy, −9.1 days (95% CI −14.1 to −4.1) for hip arthroplasty and −14.4 days (95% CI −21.3 to −7.5) for knee arthroplasty.

Hospital district-specific analyses for lumbar discectomy

Results of the most parsimonious ITS segmented regression models with statistically significant parameter estimates are presented graphically in figures 2–4 but the parameter estimates can be found from online supplemental table 3. In the pre-implementation period in Central Finland (figure 2), average RTW period after lumbar discectomy shortened from 84.3 days (95% CI 52.5 to 116.0) to 76.9 days (95% CI 46.0 to 107.8)

Table 1 Characteristics of the patients operated during June 2015–December 2021 by areas

	Central Finland	South Karelia	HUS	North Ostrobothnia	Lapland	North Karelia	North Savo	Ostrobothnia
Lumbar discectomy	CRtW area	CRtW area	Control area	Control area	Control area	Control area	Control area	Control area
n	483	214	2188	920	110	372	688	112
Female, n (%)	203 (42.0)	84 (39.3)	1037 (47.4)	400 (43.5)	61 (55.5)	167 (44.9)	294 (42.7)	52 (46.4)
Mean age (SD)	41.6 (10.4)	42.6 (10.3)	41.1 (10.0)	41.7 (10.5)	42.7 (10.7)	42.2 (10.7)	42.7 (10.8)	41.9 (10.1)
Hip arthroplasty	CRtW area	CRtW area	CRtW area*	CRtW area	Control area	Control area	NA	Control area
n	418	238	1645	723	267	259	NA	243
Female, n (%)	204 (48.8)	129 (54.2)	926 (56.3)	349 (48.3)	135 (50.6)	135 (52.1)	NA	134 (55.1)
Mean age (SD)	55.4 (6.6)	56.7 (5.2)	55.6 (6.2)	55.4 (6.1)	56.8 (5.3)	56.7 (5.0)	NA	55.4 (6.4)
Knee arthroplasty	CRtW area	CRtW area	CRtW area*	CRtW area	Control area	Control area	Control area	Control area
n	482	309	1656	866	370	307	863	245
Female, n (%)	312 (64.7)	198 (64.1)	1053 (63.6)	530 (61.2)	226 (61.1)	198 (64.5)	564 (65.4)	144 (58.8)
Mean age (SD)	57.6 (4.8)	57.1 (4.8)	56.7 (5.3)	57.4 (4.4)	57.9 (4.5)	57.9 (4.2)	57.2 (4.7)	58.4 (4.1)

The study includes 8 out of 21 Finnish hospital districts.
*Only Peijas Hospital is included from the HUS area.
CRtW, Coordinated Return to Work; HUS, hospital district of Helsinki and Uusimaa; NA, not available.

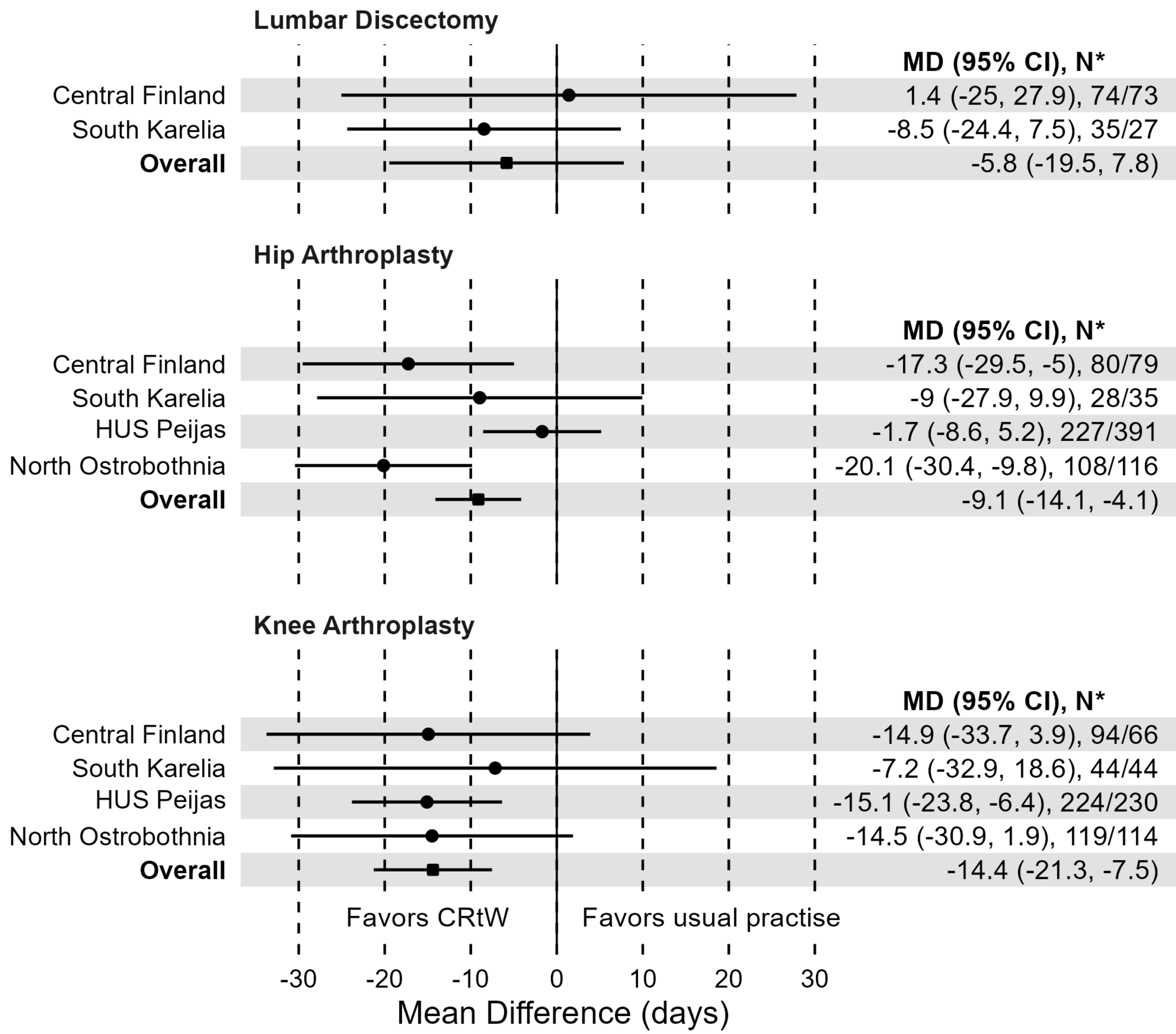

Figure 1 Mean differences in the lengths of sickness absences between 1 year periods before and after the implementation of the CRtW model in the areas separately and together. Horizontal lines around the point estimates present the 95% CIs for the mean differences. CRtW, Coordinated Return to Work; HUS, hospital district of Helsinki and Uusimaa; MD, mean difference; N*, sample size 1 year before/sample size 1 year after.

at the time of the CRtW model implementation similarly than in control area consisting of areas without the CRtW (HUS, Lapland, North Karelia, North Ostrobothnia, North Savo and Ostrobothnia). During the post implementation period, the time of RTW had shortened by 36.2 days (95% CI 33.8 to 38.5) within Central Finland leading to 19.0 days (95% CI 18.6 to 19.5) shorter time of RTW than in the control area after 4.5 years of implementation.

Hospital district-specific analyses for hip arthroplasty

The pre-implementation time of RTW after hip arthroplasty was 95.6 days (95% CI 75.6 to 115.6) both in Central Finland and in the control area (figure 3A). In all ITS analyses for hip arthroplasty, the control area consisted of Lapland, North Karelia and Ostrobothnia. During the 3-year post implementation period, sickness absences were on average 15.9 days (95% CI 8.9 to 22.9) shorter in Central Finland than in the control area. In HUS Peijas Hospital, the average RTW period was 92.9 days (95% CI 88.0 to 97.7) throughout the 3.5 year follow-up and on average 9.0 days (95% CI 2.1 to 15.8) shorter when compared with the control area (figure 3B). During the pre-implementation period in North Ostrobothnia, the average RTW period shortened from 105.4 days (95% CI 84.3 to 126.5) to 95.4 days (95% CI 74.7 to 116.1) similar to in the control area (figure 3C). During the 2-year post implementation period, the average RTW period was shortened by 20.7 days (95% CI 19.9 to 21.5) in North Ostrobothnia being 74.7 days (95% CI 53.2 to 96.2) at the end of the follow-up. Time to RTW was 15.1 days (95% CI 6.6 to 23.5) shorter after the post implementation period in North Ostrobothnia than in the control area.

Hospital district-specific analyses for knee arthroplasty

In Central Finland, the pre-implementation time of RTW after knee arthroplasty was 112.9 days (95% CI 109.0 to 116.8) and on the same level as in control area (figure 4A). In all ITS analyses for knee arthroplasty, the control area consisted of Lapland,

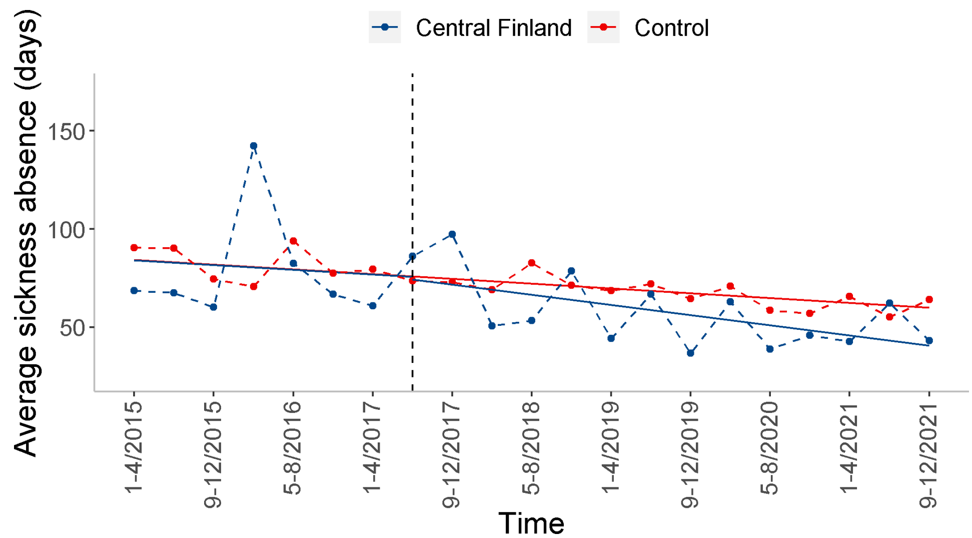

Figure 2 The effect of the CRtW model implementation on the estimated length of sickness absence after lumbar discectomy surgery in Central Finland. The solid line indicates the estimated trend line and the dashed line the observed values. The vertical dashed line indicates the time of the CRtW model implementation. The control area consists of HUS, Lapland, North Karelia, North Ostrobothnia, North Savo and Ostrobothnia which had not implemented the CRtW model at the time of the study. All the presented changes from the baseline level since the start of the follow-up and differences between the areas are statistically significant. CRtW, Coordinated Return to Work; HUS, hospital district of Helsinki and Uusimaa.

North Karelia, North Savo and Ostrobothnia. An immediate change in level occurred at the time of the model implementation and the average RTW period was 11.5 days (95% CI 4.0 to 19.1) shorter in Central Finland than in the control area throughout the 3-year post implementation period. In HUS Peijas Hospital, average RTW periods were 11.3 days (95% CI 4.2 to 18.4) shorter than in the control area during the pre-implementation period (figure 4B). At the time of the CRtW

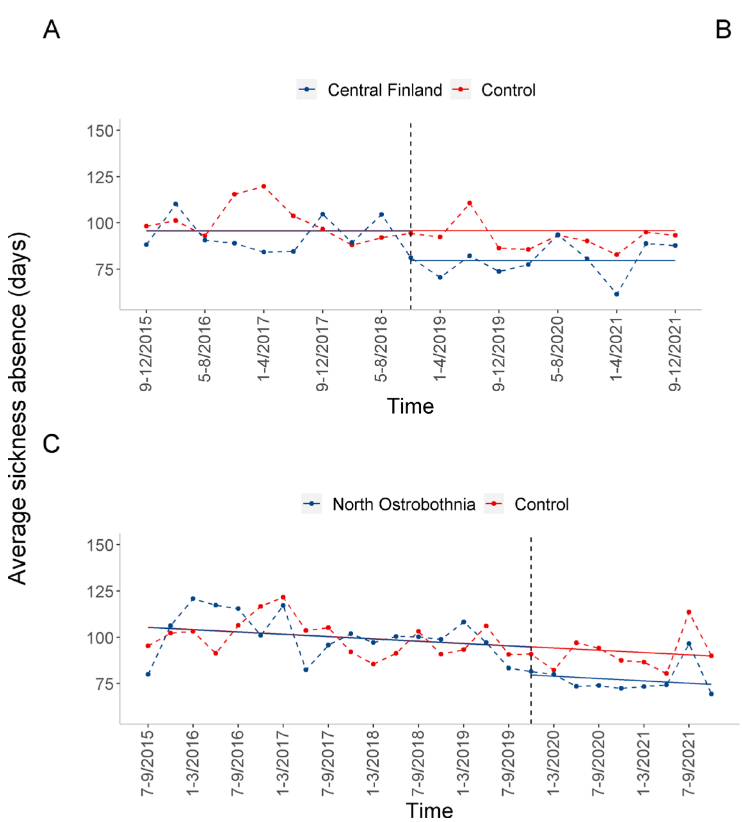

Figure 3 The effect of the CRtW model implementation on the estimated average length of sickness absence after hip arthroplasty in (A) Central Finland, (B) HUS Peijas Hospital and (C) North Ostrobothnia. The solid line indicates the estimated trend line and the dashed line the observed values. The vertical dashed line indicates the time of the CRtW model implementation. In each of the parts (A)–(C), the control area consists of Lapland, North Karelia and Ostrobothnia which had not implemented the CRtW model at the time of the study. All the presented changes from the baseline level since the start of the follow-up and differences between the areas are statistically significant. CRtW, Coordinated Return to Work; HUS, hospital district of Helsinki and Uusimaa.

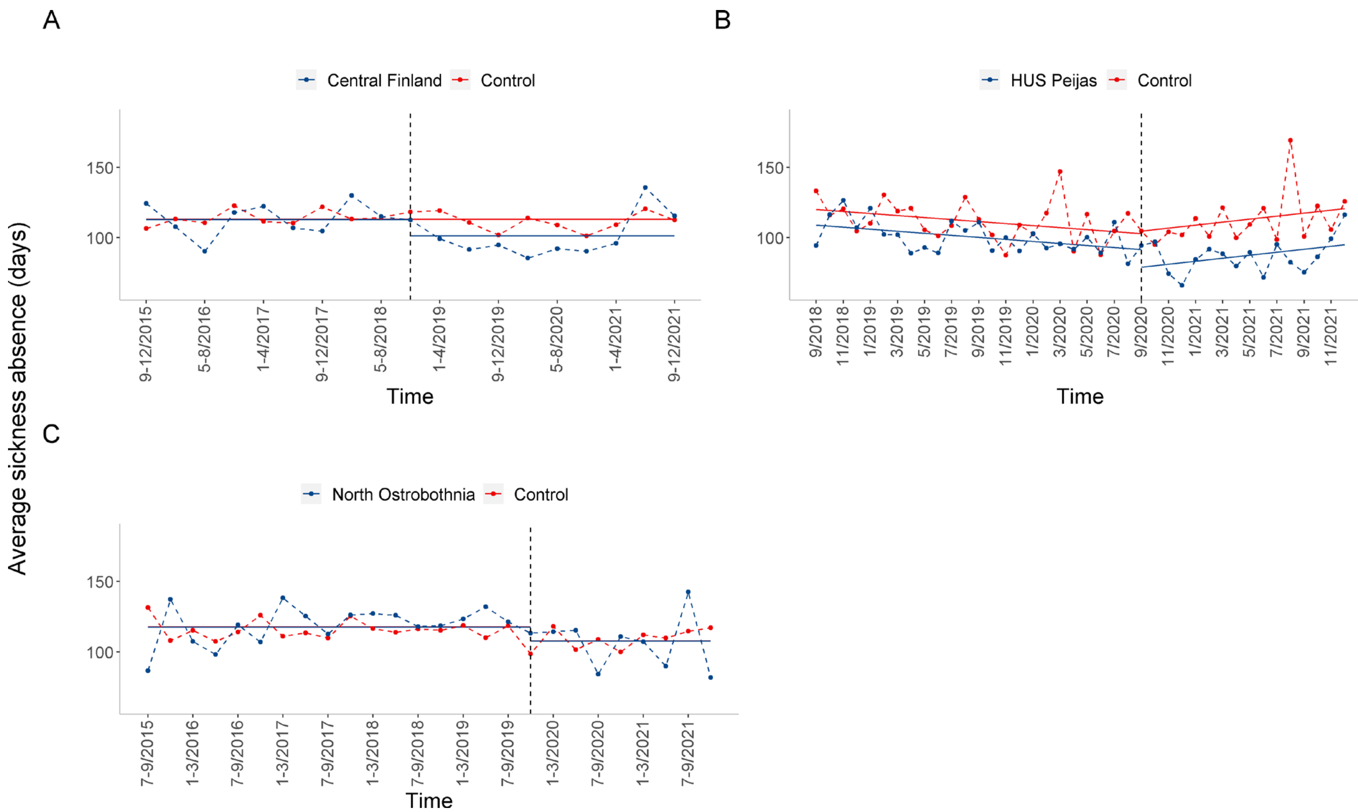

Figure 4 The effect of the CRtW model implementation on the estimated average length of sickness absence after knee arthroplasty in (A) Central Finland, (B) HUS Peijas Hospital and (C) North Ostrobothnia. The solid line indicates the estimated trend line and the dashed line the observed values. The vertical dashed line indicates the time of the CRtW model implementation. In each of the parts (A)–(C), the control area consists of Lapland, North Karelia, North Savo and Ostrobothnia which had not implemented the CRtW model at the time of the study. All the presented changes from the baseline level since the start of the follow-up and differences between the areas are statistically significant. CRtW, Coordinated Return to Work; HUS, hospital district of Helsinki and Uusimaa.

model implementation, the average length of RTW started to increase in both areas. However, the average RTW periods were 14.3 days (95% CI 3.8 to 24.9) shorter in HUS Peijas Hospital than in the control area over the 16-month post implementation period. In North Ostrobothnia, the average length of RTW was 117.5 days (95% CI 113.5 to 121.5) and on the same level as in the control area over the pre-implementation period (figure 4C). However, at the time of the model implementation, there was a 9.8-day (95% CI 3.0 to 16.5) immediate drop in the average RTW period in both areas.

Sensitivity analyses

According to the sensitivity analyses, the differences between Central Finland and the control area became larger already at the start of follow-up when excluding HUS from the control area in lumbar discectomy analyses (online supplemental figure 1). In the second sensitivity analysis against the outcome definition, the results of the sensitivity analyses resembled those from the primary analyses (online supplemental figures 2–4).

DISCUSSION

Principal findings

The CRtW model was effective in shortening the average RTW periods after hip and knee arthroplasty already 1 year after its implementation among the Finnish working-age population and the effects were sustained in longer-term analyses over 1–4.5 years. For lumbar discectomy, the effect of the CRtW model was not seen after the first year of implementation but it became evident in Central Finland later after 4.5 years of implementation. Finally, the average RTW periods were shorter in every CRtW area and patient group at the end of the follow-ups after 1–4.5 years of CRtW implementation when compared with the control areas without the CRtW, except in patients with knee arthroplasty of North Ostrobothnia.

This study shows the CRtW model being effective in shortening average sickness absences and this will have a direct impact on reducing productivity losses[3] at the societal level. Based on the ITS analyses, the average RTW periods in CRtW areas were on average 19 days shorter after 4.5 years of CRtW model implementation for patients with lumbar discectomy in Central Finland, 9–16 days shorter after 1–3 years of CRtW model implementation for patients with hip arthroplasty and 0–14 days shorter after 1–3 years for patients with knee arthroplasty than in areas without the CRtW. As the unit cost of one sickness absence day for the society is 420€ in Finland, the shortening effect has clear economic significance in reducing productivity losses.[24] RTW periods after all the three surgeries were mainly comparable to those from previous studies[16–19] for time before the CRtW model, and shorter after the model implementation.

The effects of the CRtW model can be seen especially in Central Finland, where the model was started in 2017–2018 and therefore the post implementation period was the longest. In South Karelia and HUS Peijas Hospital, the CRtW model was implemented in the autumn of 2020 for hip and knee arthroplasty. The results obtained in these areas are for a shorter post implementation period (16 months at the longest) and should get more profound with longer follow-up times thanks to local clinical auditing activities. According to previous studies, it takes 3–5 years to get the implemented model into full effect and as a 'new normal'.[25] After hip and knee arthroplasty, sickness absences were shorter in HUS Peijas Hospital than in the control area already in the pre-implementation period. This may be because in Peijas Hospital, physicians have often prescribed 2-month sickness absences instead of 3-month absences unlike in many other areas. In North Ostrobothnia, the CRtW model was implemented without electronic referrals contrary to the other CRtW model areas. Instead of using referrals, patients were advised to contact occupational health services. Despite this, the effect of model implementation was seen for hip arthroplasty where the model had an immediate, downward effect on the average sickness absences.

This study indicates the importance of support from occupational health services and from workplaces in RTW after orthopedical surgery. Occupational health services are closely connected to the workplaces and thereby have the potential to assess work capacity and to recommend modified work. There are no prior studies on the effectiveness of initiatives comparable to the CRtW model. However, in a Dutch study, consulting an occupational medicine specialist within 3 months after total knee arthroplasty surgery did not shorten the sickness absence.[26] To note, the model of collaboration differed from the more active CRtW applied in this study.

The CRtW model provides a multidimensional approach promising a wide range of benefits for employees, healthcare providers, occupational healthcare, employers and society at large. Recall that the CRtW model has focused on patients who have access to occupational health services. In Finland, it is statutory for employers to arrange occupational health services for all employees, and most employees use occupational health services as their primary healthcare. However, the special healthcare, such as these surgeries, is mainly handled in public healthcare anyway, and only the postsurgical care takes place in occupational healthcare in the CRtW. In Finland, around 72% of working-age (15–64 years old) people are employed[20] and around 60% have occupational healthcare. Our analyses were conducted among the general working-age population including unemployed and employed patients with and without occupational healthcare. In addition, only 80% of the customers of occupational health services in the HUS region were included in the model implementation process during the study period. These factors have decreased the observed effects of the CRtW model. The results of this study are a conservative reflection of the effectiveness of the model in the general social and healthcare system—not the optimal effect among the more targeted group of employed patients with occupational healthcare. The CRtW model is possible to extend outside Finland to countries, where the occupational healthcare system is commonly used among employees, and where it is possible to use occupational healthcare services in this kind of activity. This study showed that combining occupational healthcare with postsurgical recovery is beneficial.

Strengths of the study

The strength of our study was the utilisation of register-based data allowing us to avoid recall bias and use data from all patients operated during study time in the selected areas. ITS design is generally unaffected by the typical confounding factors and by using the control group unmeasured or unknown time-varying confounding (eg, possible concurrent events) is controlled for. At the start of the COVID-19 pandemic in March 2020, less critical activity in social and healthcare was partly run down to ensure sufficient capacity for the care of COVID-19 cases.[27] Although in the HUS area, the incidence of COVID-19 cases was higher than elsewhere in Finland, the number of operated patients decreased within all patient groups and areas during the lockdown in the spring of 2020. As the selection process of patients operated during the lockdown was assumably similar across all areas (ie, only the acute cases were operated), the effect of the pandemic on sickness absences is similar in the CRtW model areas as in the control areas.

Limitations of the study

This study also had some limitations. First, we were not able to select and use only one area as a control area because of a shortage in patients within the areas. We had to combine patients from all control areas into one group of patients to achieve large enough sample sizes for ITS design. Meanwhile HUS area is the largest area by number of operated patients and was the main driver in lumbar discectomy analyses. Therefore, we conducted the sensitivity analysis excluding the HUS from the controls. Second, it takes at least several months or even years to get the CRtW model working and, thereafter, the process may stabilise to its new routine. We were unable to account for this kind of run-in period in our ITS analyses because of a shortage of data. Third, only linear models were used to estimate the trends of RTW periods.

CONCLUSIONS

This study shows that the CRtW model is effective in shortening sickness absences in the general working-age Finnish population. Further research with larger sample sizes and longer follow-up times will show the effectiveness of CRtW on the productivity of the Finnish workforce.

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Contributors JM planned the research project. PL, JH and KJ drafted the first version of the manuscript. PL, KJ, JH, SV and A-VL register data wrangling. PL and A-VL performed statistical analyses. PL acts as guarantor (had full access to data) and supervised statistical analyses. PL, JH, KJ, A-VL, SV, PK, KH, IV and JM revised the draft version and accepted the final version.

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REFERENCES

1 Antczak E, Miszczyńska KM. Causes of sickness absenteeism in Europe-analysis from an intercountry and gender perspective. *Int J Environ Res Public Health* 2021;18:11823.
2 Hah JM, Lee E, Shrestha R, *et al*. Return to work and productivity loss after surgery: a health economic evaluation. *Int J Surg* 2021;95:106100.
3 Rissanen M, Kaseva E. Cost of lost labour input [Ministry of Social Affairs and Health, Department for Occupational Safety and Health]. 2014. Available: https://stm.fi/documents/1271139/1332445/Cost+of+lost+labour+input_en.pdf/d5790088-8e3e-4d13-a5cd-56c23b67de0c/Cost+of+lost+labour+input_en.pdf?t=1442323144000
4 OECD. Sick-related absences from work. In: *Society at a Glance 2006 OECD Social Indicators*. Paris: OECD Publishing, 2007.
5 The Social Insurance Institution of Finland. Kelan Sairausvakuutustilasto 2021. Helsinki The Social Insurance Institution of Finland; 2022. Available: http://urn.fi/URN:NBN:fi-fe2022092660160
6 Vohlonen I, Vehviläinen A, Virta LK, *et al*. Development of length of hospital stay and absence from work among working-age patients undergoing orthopaedic surgery[In Finnish with English abstract]. *Finnish Medical Journal* 2017;72:1085–90.
7 Piitulainen K, Korhonen I, Husman K, *et al*. New support for return to work of temporarily incapacitated workers: results of operational integration of occupational health and other health services[In Finnish with English abstract]. *Finnish Medical Journal* 2019;17:1048–53.
8 Mayor S. Registry data show increase in joint replacement surgery. *BMJ* 2017;358:j4324.
9 Grotle M, Småstuen MC, Fjeld O, *et al*. Lumbar spine surgery across 15 years: trends, complications and reoperations in a longitudinal observational study from Norway. *BMJ Open* 2019;9:e028743.
10 Miettinen HJA, Mäkirinne-Kallio N, Kröger H, *et al*. Health-related quality of life after hip and knee arthroplasty operations. *Scand J Surg* 2021;110:427–33.
11 Ferretti F, Coluccia A, Gusinu R, *et al*. Quality of life and objective functional impairment in lumbar spinal stenosis: a protocol for a systematic review and meta-analysis of moderators. *BMJ Open* 2019;9:e032314.
12 Silverplats K, Lind B, Zoega B, *et al*. Health-related quality of life in patients with surgically treated lumbar disc herniation: 2- and 7-year follow-up of 117 patients. *Acta Orthop* 2011;82:198–203.
13 Lubelski D, Senol N, Silverstein MP, *et al*. Quality of life outcomes after revision lumbar discectomy. *SPI* 2015;22:173–8.
14 Waddell G, Burton AK, Kendall N. Vocational rehabilitation: what works, for whom, and when? (Report for the Vocational rehabilitation task group). London TSO; 2008.
15 Remes V. Good treatment in hip and knee arthroplasty, 1st ed. In Finnish. Joensuu Finnish Arthroplasty Society; 2022.
16 Laasik R, Lankinen P, Kivimäki M, *et al*. Return to work after primary total hip arthroplasty: a nationwide cohort study. *Acta Orthop* 2019;90:209–13.
17 Lankinen P, Laasik R, Kivimäki M, *et al*. Are patient-related pre-operative factors influencing return to work after total knee arthroplasty. *Knee* 2019;26:853–60.
18 Kang S-H, Yang JS, Cho SS, *et al*. A prospective observational study of return to work after single level lumbar discectomy. *J Korean Neurosurg Soc* 2020;63:806–13.
19 Paulsen RT, Rasmussen J, Carreon LY, *et al*. Return to work after surgery for lumbar disc herniation, secondary analyses from a randomized controlled trial comparing supervised rehabilitation versus home exercises. *Spine J* 2020;20:41–7.
20 Statistics Finland's free-of-charge statistical databases. Population aged 15-74 by labour force status and region, 2011-2022. Available: https://statfin.stat.fi/PxWeb/pxweb/en/StatFin/StatFin__tyti/statfin_tyti_pxt_13al.px/ [Accessed 28 Jun 2023].
21 Penfold RB, Zhang F. Use of interrupted time series analysis in evaluating health care quality improvements. *Acad Pediatr* 2013;13:S38–44.
22 Linden A. Conducting interrupted time-series analysis for single- and multiple-group comparisons. *Stata J* 2015;15:480–500.
23 Wagner AK, Soumerai SB, Zhang F, *et al*. Segmented regression analysis of interrupted time series studies in medication use research. *J Clin Pharm Ther* 2002;27:299–309.
24 Heiskanen J, Vehkala S, Martikainen J. The unit cost of one sick leave day in Finland (in Finnish with English summary) [University of Eastern Finland]. 2024. Available: https://studentuef.sharepoint.com/sites/www-documents/Jaetut%20asiakirjat/Forms/AllItems.aspx?id=%2Fsites%2Fwww%2Ddocuments%2FJaetut%20asiakirjat%2FPOLICY%20BRIEF%20Sairauspoissaolopa%CC%88iva%CC%88n%20yksikko%CC%88kustannus%20Suomessa%20%2DraporttiUEF%5F2024%5F%5B83%5D%2Epdf&parent=%2Fsites%2Fwww%2Ddocuments%2FJaetut%20asiakirjat&p=true&ct=1705327507492&or=Teams%2DHL&ga=1&LOF=1 [Accessed 16 Jan 2024].
25 Kinnunen J, Lindström K. Rakenteellisen ja toiminnallisen muutoksen vaikutukset HUSin johtamiseen ja henkilöstön hyvinvointiin. In Finnish. Finland University of Kuopio; 2005.
26 van Zaanen Y, Kievit AJ, van Geenen RCI, *et al*. Does consulting an occupational medicine specialist decrease time to return to work among total knee arthroplasty patients? A 12-Month prospective multicenter cohort study. *J Occup Rehabil* 2023;33:267–76.
27 Tiirinki H, Tynkkynen L-K, Sovala M, *et al*. COVID-19 pandemic in Finland - Preliminary analysis on health system response and economic consequences. *Health Policy Technol* 2020;9:649–62.