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The Knee



Are patient-related pre-operative factors influencing return to work after total knee arthroplasty

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ABSTRACT

Background: Osteoarthritis is one of the leading causes of disability in working-age patients. The total number of working-age patients undergoing total-knee arthroplasty (TKA) is continuously increasing. The purpose of this study was to identify predictive factors related to general health, health risk behaviors and socioeconomic status influencing the rate of return to work after a TKA.

Methods: Overall there were 151,901 patients included in the Finnish Public Sector (FPS) study. The response rate varied between 65 and 73% during the study period. We used Cox proportional hazard models to examine patient-related predictive factors that may influence the rate of return to work after TKA in a cohort of patients ($n = 452$; $n = 362$ female; mean age 56.4 years). Predictive factors were measured on average 3.6 years before the operation.

Results: Of the patients, 87% returned to work within one year after TKA at a mean of 116 calendar days. In multivariate analysis, patients at sick-leave ≤ 30 days during the last year before surgery were 2.2 times (95% confidence interval 1.72–2.92) more likely to return to work compared with those with > 30 days of sick-leave. Compared with patients in manual work, those in higher or lower level non-manual work showed a 2.6-fold (1.95–3.52) and 1.5-fold (1.15–1.92) increased probability of returning to work. Age, sex, health risk behaviors, obesity, physical comorbidities, common mental disorders, and other studied health-related factors were not associated with the rate of return to work.

Conclusions: Non-manual job, good self-rated general health and preoperative sick leave ≤ 30 days are associated with a higher rate of return to work.

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1. Introduction

Osteoarthritis is one of the leading causes of disability in working-age patients [1,2]. Total knee arthroplasty (TKA) is a cost-effective treatment modality that relieves pain, restores function, improves mobility, and improves health-related quality of life of patients with

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end-stage osteoarthritis when conservative treatment modalities fail [3–6]. In western countries, the total number of patients undergoing total hip or knee arthroplasty has increased dramatically during the last decades, and it has been estimated that the annual rate of TKA in 2030 will be nearly seven times the rate in 2005 [7–9]. In developed countries, e.g., Finland and Australia, every fifth to seventh man and woman undergoes TKA during their lifetime [10].

Of the patients undergoing total hip or knee arthroplasty, 15–45% are people of working age [11]. In 2009, it was projected that demand for TKA in patients below age 65 years would exceed 50% of all patients by 2016 in the USA [12]. In the past, total joint arthroplasty has been associated with inferior results in younger and physically active patients. However, the advances in surgical techniques and prosthesis models has led to expanding clinical indications for arthroplasty to meet physically active younger people who are suffering from osteoarthritis [13–16].

Return to work is an important marker of successful TKA for patients [1,11,17–19]. Return to work affects positively patients' physical and mental health and is beneficial socially and economically for the patients, the employers and the society [20–22]. It has been suggested that on average 70% of patients in working age undergoing TKA return to work and up to 50% return to work within three months [23]. With increasing numbers of TKA in younger age groups combined with policies to extend work careers to avoid 'the pensions crisis' and higher expectations for mobility after TKA among patients, there is growing need for evidence on the predictors of return to work after a knee replacement. Rapid increase in obesity, a risk factor of osteoarthritis and surgical complications [24,25], further increases the need to identify factors that predict the outcome of knee replacement. Thus far, the majority of studies have examined predictors of the clinical outcome and the risk of complications related to TKA [4,26–30]. In contrast, less is known on the predictors of return to work after knee replacement [11,31].

The objective of this study was to identify predictive factors related to general health, health risk behaviors, and socioeconomic status associated with the rate of return to work after TKA in a large nation-wide cohort of public-sector employees.

2. Methods

The population was from the Finnish Public Sector (FPS) study [32]. The cohort comprises employees of 10 municipalities and six hospital districts. The participants had been employed for minimum of six months in the participating organizations between 1991 and 2005 ($n = 151,901$). The cohort covered a wide range of occupations – from city mayors and doctors to semi-skilled cleaners, nurses, and teachers. Since 1997, repeat survey data has been collected from all permanent and long-term temporary employees with two- to four-year intervals. Information on baseline characteristics before the surgery was derived from repeated surveys, employers' records, and national health registers. All participants have been linked to surgical data on TKA from the National Care Register for Health Care, maintained by the National Institute for Health and Welfare as well as the national sickness absence register maintained by the Social Insurance Institution of Finland. The ethics committee of the Hospital District of Helsinki and Uusimaa approved the study.

2.1. Type of surgery and patient characteristics

Of the FPS cohort participants, 1996 underwent a single total knee replacement between 1999 and 2011 (Figure 1). Of them, we selected for this study those 452 ($n = 90$ male; $n = 362$ female; mean age 56.4 years, standard deviation (SD) 5.1) participants who had responded to a survey before the surgery (Figure 1). The response rate varied between 65% and 73% during the study period. Predictive factors were measured on average 3.6 (SD 2.1) years before the operation. The mean time from operation the end of follow-up was 4.3 years (SD 2.6). The type of surgery was defined as NGB10, NGB20, NGB30, NGB40, NGB50, NGB60, or

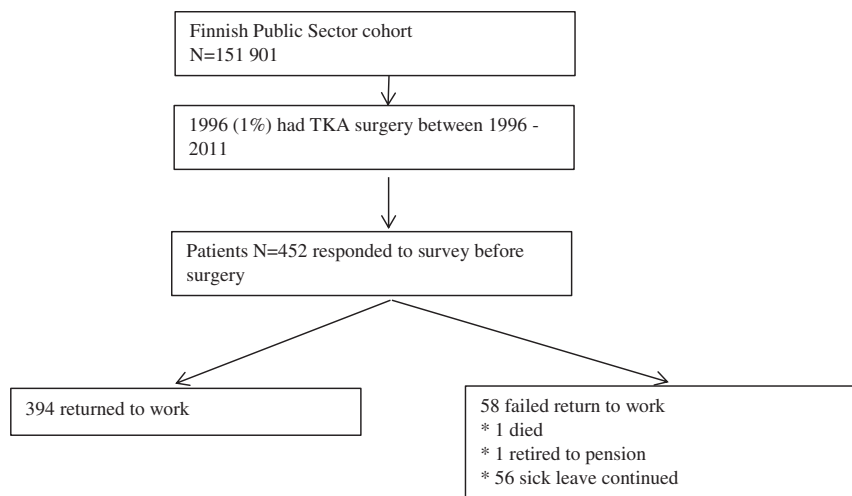


Figure 1. Flow chart of the selection of the analytical sample.

NGB99 according to the NOMESCO (Nordic Medico-Statistical Committee) Classification of Surgical Procedures Version 1.14 by NOMESCO.

2.2. Return to work

Return to work was determined as the number of days between the date of discharge and the date of the end of the sick leave within one year. One patient died, one patient had a disability pension, and in 56 patients, sick leave continued after the first postoperative year (Figure 1). Survey responses were linked to the national sickness absence register kept by the Social Insurance Institution of Finland using personal identification numbers. Finnish residents aged 16–67 years are legitimized to receive daily allowances due to medically certified sickness absence. After a qualifying period of the first nine days of illness, compensation is paid based on salary for a maximum of one year. All sickness absence periods are medically certified, and they are encoded to the register with start and end dates. Overlapping and consecutive periods of sick leave were merged. The linkage data were available until 31 December 2011.

2.3. Predictors of return to work

The participants' sex, age, and occupational grade at the time of the surgery were obtained from the employers' registers. Based on the International Classification of Occupations (ISCO), we grouped the occupations into 'higher-grade non-manual workers' (= ISCO classes 1–2; including, e.g., managers, teachers, and physicians), lower-grade non-manual workers (ISCO classes 3–4, e.g., registered nurses, technicians), and manual workers (ISCO classes 5–9, e.g., cleaners, maintenance workers) [33]. Marital status (married or cohabiting vs. single, divorced, or widowed) was obtained from the baseline questionnaire.

Information on behavioral health risks and perceived health was obtained from the baseline questionnaire. Physical activity was defined as average weekly hours of leisure-time physical activity (walking, brisk walking, jogging and running, or respective), including commuting, during the previous year [34]. The hours per week spent on activity at each intensity level were multiplied by the average energy expenditure of each activity expressed as metabolic equivalent of task (MET). Physical activity was categorized into two groups, 'low' (≤ 14 MET h/week) and 'high' activity (> 14 MET h/week). Alcohol consumption was categorized according to the habitual frequencies of drinking beer, wine and spirits as 'none', 'moderate', and 'heavy' consumption. The cut-off for heavy alcohol consumption was set as 210 g/week [35]. Smoking status was dichotomized as 'currently smoking' vs. 'quitted or never smoked'. Self-reported body weight and height were used to calculate a body mass index (BMI) in kg/m^2 , which was used to identify obese ($\text{BMI} \geq 30 \text{ kg}/\text{m}^2$) and non-obese ($\text{BMI} < 30 \text{ kg}/\text{m}^2$) participants. Psychological distress was measured with the 12-item version of the General Health Questionnaire (GHQ) [36] with three or more positive responses set as a cut-off point of psychological distress ('no' vs. 'yes'). Participants rated their state of health on a five-point scale (1 = good, ... 5 = poor), and the self-rated health was then dichotomized by categorizing response scores 1 and 2 as good health and scores 3–5 as poor health.

Prevalent diabetes, coronary heart disease, asthma, chronic obstructive pulmonary disease, and rheumatoid arthritis were derived from the Drug Reimbursement Register, which contains information on all persons entitled to special reimbursement for treatment of chronic health conditions. The presence of comorbidity was then dichotomized as 'yes' vs. 'no'.

2.4. Statistical analysis

The participants were followed from the date of discharge to the date when an employee returned to work, was granted a disability pension, an old-age pension, died, or the end of the study (31 December 2011), whichever came first. Cox proportional hazard models were used to study the associations between baseline characteristics and return to work. We first examined the associations separately for each predictor adjusted for age and sex. Then we examined the associations mutually adjusted in a single model including all the predictors simultaneously. The results were presented as hazard ratios (HRs) and their 95% confidence intervals (95% CI). Survival plot analyses (Figure 2) of preoperative sickness absence (a), occupational status (b) and self-reported health (c) were Kaplan–Meier graphs prepared using Proc Lifetest. All analyses were performed using the SAS statistical software, version 9.1.3 (SAS Institute, Inc., Cary, NC, USA).

3. Results

Of the FPS cohort ($n = 151,901$) participants, 1996 patients underwent a single total knee replacement between 1999 and 2011 (Figure 1). Of them, 452 participants who had responded to a survey before the surgery (average response rate 65–73% during the study period) were included in the study. Predictive factors were measured on average 3.6 (SD 2.1, range 1.0–12.0) years before the operation. The mean time from operation the end of follow-up was 4.3 years (SD 2.6, range 0.2–12.4).

The characteristics of the 452 patients are shown in Table 1. The majority (80%) were women, and 52% were employed in manual jobs. The average age at the time of surgery was 56.4 (SD 5.1) years. About 40% of the participants were obese or physically inactive, rated their general health as poor, and were psychologically distressed at baseline. One-fifth had a comorbid chronic medical condition. After the surgery, 87% ($n = 394$) of patients returned to work on average after 116 (SD 53, range 28–356) days of sickness absence. For the whole study population, mean time of return to work was 142 days (SD 92, range 21–366).

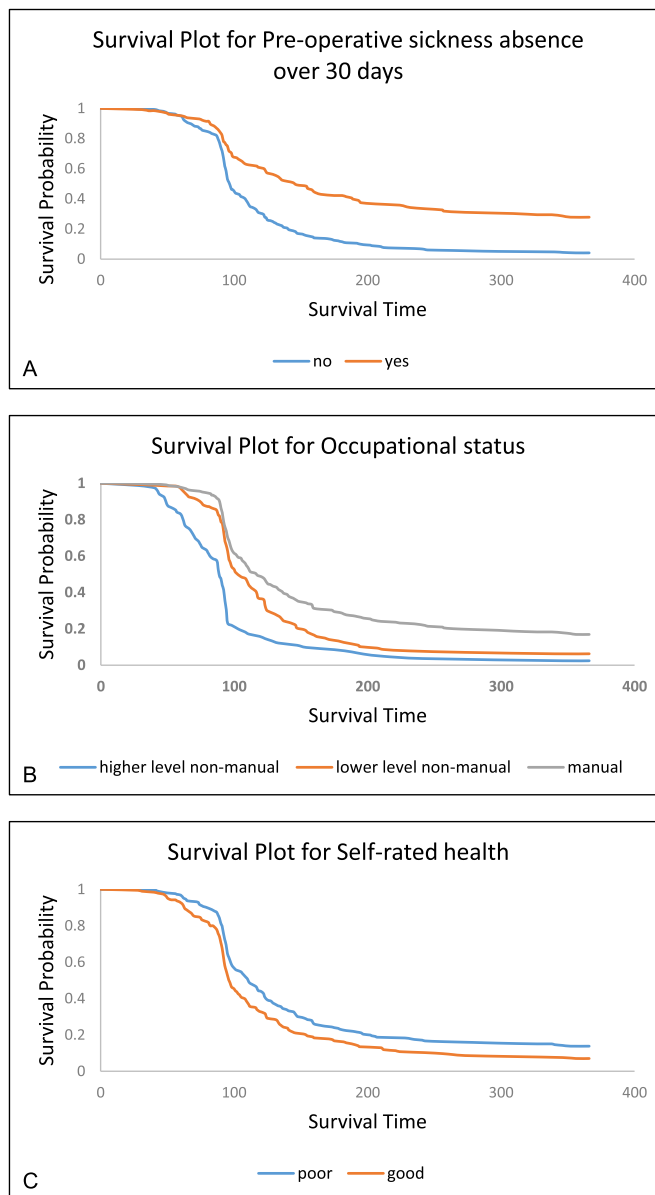


Figure 2. Survival plot analyses of preoperative sickness absence (a), occupational status (b) and self-reported health (c). For patients with >30 days of sickness absence within the one-year period preceding the operation, the median postoperative sick leave was 146 days; and for patients with <30 days of preoperative sickness absence the median postoperative sick leave was 96 days. The median postoperative duration of sickness absence based on occupational status were: higher-level non-manual 89 days; lower-level non-manual 101 days; manual 115 days. Patients with good self-rated health the median postoperative sick leave was 96 days and for patients with poor self-rated health 110 days.

3.1. Predictors of return to work

As shown in Table 1, patients with higher non-manual occupational status had 2.8 (95% CI 2.2–3.7) times higher rate of return to work as compared with patients with manual labor occupational status adjusted for age and sex (Figure 1). The respective rate ratio for those with lower-grade non-manual occupations was 1.5 (95% CI 1.2–1.9). Low level of sickness absence (<30 days) before the surgery was associated with a 2.4 (95% CI 1.9–3.0) times higher rate of return to work as compared with patients with longer sickness absence. Those patients whose self-rated health was good were 1.4 (95% CI 1.1–1.7) times more likely to return to work comparing to those with poor self-rated general health (Figure 1). In contrast, socioeconomic factors (age, sex, and marital status), health-behavior factors (smoking, physical activity, high alcohol consumption, and obesity), chronic medical comorbidities (asthma, diabetes mellitus, rheumatoid arthritis, and coronary artery disease), and psychological distress were not associated with return to work. The results

Table 1

Baseline characteristics of the patient and their associations with the rate of return to work after total knee arthroplasty.

	TKA	Separately analyzed*			Mutually adjusted		
	n (%)	Hazard ratio	95% Confidence intervals	P	Hazard ratio	95% Confidence intervals	P
Age [†] (missing n = 0)	56.5 (SD 5.1)	1.01	0.99, 1.03	0.58	1.01	0.99, 1.03	0.40
Sex (missing n = 0)							
Men	90 (19.9)	1.00	0.78, 1.29	0.99	1.13	0.84, 1.52	0.43
Women	362 (80.1)	1.00			1.00		
Married or cohabiting (missing n = 8)							
No	108 (24.3)	0.88	0.70, 1.11	0.26	0.94	0.72, 1.21	0.61
Yes	336 (75.7)	1.00			1.00		
Obese (BMI >30 kg/m ²) (missing n = 16)							
No	251 (57.6)	1.12	0.91, 1.37	0.28	0.94	0.75, 1.18	0.60
Yes	185 (42.4)	1.00			1.00		
Current smoking (missing n = 16)							
No	368 (84.4)	1.06	0.80, 1.40	0.67	0.96	0.71, 1.30	0.80
Yes	68 (15.6)	1.00			1.00		
High alcohol consumption (missing n = 3)							
No	397 (88.4)	1.06	0.75, 1.48	0.75	1.23	0.85, 1.80	0.28
Yes	52 (11.6)	1.00			1.00		
Comorbidities (missing n = 0)							
No	369 (81.6)	1.26	0.97, 1.64	0.09	1.10	0.82, 1.48	0.51
Yes	83 (18.4)	1.00			1.00		
Psychological distress (missing n = 5)							
No	322 (72.0)	1.18	0.94, 1.47	0.16	1.15	0.90, 1.47	0.26
Yes	125 (28.0)	1.00			1.00		
Self-rated health (missing n = 5)							
Good	191 (42.7)	1.40	1.14, 1.72	0.0012	1.18	0.93, 1.50	0.19
Poor	256 (57.3)	1.00			1.00		
Physically active (MET-hours over 14 h/week) (missing n = 5)							
Yes	253 (56.6)	1.12	0.92, 1.37	0.27	0.94	0.75, 1.18	0.61
No	194 (43.4)	1.00			1.00		
Occupational status (missing n = 4)							
Higher level non-manual	82 (18.3)	2.84	2.18, 3.71	<0.000	2.62	1.95, 3.52	<0.0001
Lower level non-manual	134 (29.9)	1.50	1.19, 1.89	1	1.49	1.15, 1.92	0.0023
Manual	232 (51.8)	1.00		0.0006	1.00		
Preoperative sickness absence [‡] (missing n = 0)							
No	322 (71.2)	2.35	1.85, 2.99	<0.0001	2.24	1.72, 2.92	<0.0001
Yes	130 (28.8)	1.00			1.00		
Year of surgery (missing n = 0)							
2007–2011	277 (61.3)	1.12	0.92, 1.38	0.27	1.16	0.93, 1.45	0.20
1998–2006	175 (38.7)	1.00			1.00		

Hazard ratios and their 95% confidence intervals are derived from Cox proportional hazard analyses. BMI, body mass index; SD, standard deviation; TKA, total knee arthroplasty.

* Age and sex adjusted if appropriate.

[†] Increase in age.

[‡] >30 days of sickness absence within the 1-year period preceding the operation.

from an analysis including all predictors in the same model essentially replicated the results obtained from age and sex-adjusted models with one exception – self-rated health was not associated with return to work in the mutually adjusted model.

4. Discussion

The purpose of the current study was to evaluate the rate of return to work and to analyze patient-related factors influencing the rate of return to work after TKA. Almost 90% of the patients returned to work after a total knee replacement on average 116 days after operation. Favorable predictive factors were non-manual work, low number of preoperative sickness absence days, and good self-rated health. Surprisingly, patients that were in many ways in better physical shape did not return to work earlier than other patients. Indeed, other socioeconomic factors (age, sex, and marital status), behavior-related risk factors (smoking, physical inactivity, high alcohol consumption, and obesity), chronic medical comorbidities (asthma, diabetes mellitus, rheumatoid arthritis, and coronary artery disease), and poor mental health were not associated with return to work.

Total joint arthroplasty is an effective treatment modality for severe pain and functional disability when non-surgical methods fail to provide adequate relief of symptoms due to end-stage osteoarthritis [37,38]. Continued advances in surgical techniques and prosthesis models have expanded clinical indications even for more active people suffering from arthritis [12]. Based on the

Finnish Arthroplasty register (FAR) in 2015 36.2% and in 2016 34.5% of primary TKAs were performed for patients under the age of 65 years. The rise in retirement age in western countries is further increasing the number of working-age patients. In a systematic review, Bieleman et al. [39] reported that patients with hip and knee osteoarthritis generally are able to stay at work, but it is also reported that patients undergoing total hip arthroplasty or TKA are significantly more often on sick leave than the general population both before and after surgery [37,40,41].

Successful return to work has been identified as a crucial outcome marker for patients after TKA [1,11,17,18]. Return to work after TKA is influenced by several determinants including state of patient's general health and presence of comorbid diseases, psychosocial and motivational factors, rate of work-related knee demand, and possibility to make adjustments to work tasks. In addition, Hoorntje et al. reported that also patient beliefs and preoperative expectations influence return to work after TKA [42]. Predictors of successful return to work after knee replacement have not been thoroughly studied. To evaluate these contributing factors is especially important for TKA. This is because TKA patients have been reported to have more sick leave in the year before surgery and also because they return to work slower than total hip arthroplasty patients [37,38]. Additionally, TKA patients have reported inferior work performance rates to total hip arthroplasty patients [43,44].

The results of the present study are in line with some previous studies, which have found socioeconomic status, knee demanding work, and the duration of sick leave before surgery to be associated with returning to work after knee replacement [37,45–49]. For clinical work, this is highly noteworthy as osteoarthritis and related disability is common in patients of a low socioeconomic status [16,50,51]. While the rates of TKA are high among those of a low socioeconomic status [52], they have inferior satisfaction rates with surgery outcome and experience more residual symptoms after TKA [53]. Our results partly agree with two previous systematic reviews that suggested age, socioeconomic status, workplace conditions, preoperative sick leave duration, workplace accessibility, participation in workers' 'compensation program to be related to patients' return to work after knee arthroplasty [11,54]. Scott et al. [45] reported that all working patients <50 years returned to work after knee replacement, while only half of those of 50–60 years did. As the vast majority of patients in our study were aged 50 years or more, we do not know what the prognosis would have been among young patients. In some aspects, our results contradicted recent findings suggesting that also female sex, obesity, self-reported work-related symptoms, and mental health symptoms explained failing to return to work [1,46].

The reasons for differences between the results of the present and previous studies remain unclear. Part of the reasons might be methodological, e.g., some studies collected predictor data retrospectively several years after the surgery and used self-reports to measure return to work [46]. Societal factors, e.g., differences in national insurance systems may explain part of the diversities. It is possible that sets of relevant predictors may vary in different subgroups, e.g., based on age on sex distribution.

4.1. Strengths and weaknesses

The generalizability of these findings may be affected by the differences in national welfare, pension, and workers' compensation schemes [45]. The studied cohort was limited to public-sector employees in a Scandinavian welfare state. The sex distribution of our study participants (80% women) is the same as in our source population (the Finnish Public Sector cohort) [55] and the whole public sector, with few men in the most common occupations, such as teachers, registered nurses, and practical nurses. No data on workplace adjustments before or after the surgery were available. Based on the current data, we were not able to determine whether patients had previous lower limb surgery to the limb that was included the current study. The motivation to return to work, a potentially important factor, remained unknown. However, psychological distress, a correlate of negative emotional traits, was not associated with return to work in our study. No data on possible complications or re-operations, which may have a significant influence on return to work, were available. A further limitation is that that we were not able to assess post-surgery predictive factors, such as patients' activity levels, satisfaction with the outcome, or functional outcome scores. Patient's pre-surgery expectations as well as the patient–healthcare-provider interaction were not known [20]. Compared to previous literature, our study has notable strengths. The large patient sample was drawn from a well-characterized occupational cohort and represented a wide range of occupations with comprehensive data on health and health risk behaviors well before the surgery. All data were linked to reliable national health registers including detailed information on the operation and the beginning and ending dates of all periods of sickness absence enabling accurate estimation of the timing of return to work. Many predictors of return to work, such as occupational status, sickness absences before the operation and comorbid medical conditions, were measured objectively from the registers. In our opinion, the three presented occupational grades provide a good overall classification of occupations' physical natures. However even among different manual occupations, the amount of knee-demanding duties may vary, and the used classification may partly fail to describe these differences. Further population-based research is needed to confirm these findings in other national and occupational settings. Further research may reveal whether the associations found in this study are robust for all subgroups of patients with knee implants especially, for example, concerning different age groups, different types of prosthesis designs, and factors related to primary indication for surgery such as work-related post-traumatic state.

5. Conclusions

Nearly nine of 10 working-aged patients returned to work after TKA. Non-manual job, good self-rated general health and preoperative sick-leave ≤ 30 days predicted a higher rate of return to work. Manual workers with prolonged sick leave before the total knee replacement were at increased risk of not returning to work after the surgery. These risk factors are to be taken into account when planning TKA and post-surgery rehabilitation. Orthopedic surgeons should consider referring patients at risk for no return to work for additional work-directed care.

Conflict of interest

Each author certifies that he or she has no commercial association (e.g., consultancies, stock of ownership, equity interest, patent/licensing arrangements, etc.) that might pose a conflict of interest in connection with this article. M. Kivimäki is supported by NordForsk, the Academy of Finland (311492) and a Helsinki Institute of Life Science Fellowship.

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