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The longitudinal association of hand osteoarthritis with paid and unpaid work restrictions and related societal costs: The Hand Osteoarthritis in Secondary Care cohort

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SUMMARY

Objectives: To investigate the course of restrictions in paid and unpaid work and corresponding societal costs in patients with hand osteoarthritis (OA).
Methods: Patients with data of at least baseline and one follow-up moment (year one up to year eight) of the Dutch Hand OSTeoArthritis in Secondary care cohort (HOSTAS) were included. The Health and Labour Questionnaire was used to assess over the last two weeks hand OA-related restrictions for paid and unpaid work. Societal costs of productivity loss were estimated with Dutch government data on 2021.
Results: 351 patients were included (mean age 60 years, 84% women). At baseline, 166/351 (47%) had paid work, decreasing to 54/164 (33%) at year eight. Loss of productive time over the two-week period was reported by 32/166 (19%) patients with paid work at baseline, 17/104 (16%) at year four, among whom 12/104 (11%) patients at both moments. Any restrictions over this two-week period were experienced by 89/166 patients (54%) at baseline and 41/104 (39%) at year four for those with paid work.

Regarding unpaid work, 157/351 (45%) reported replacement of tasks by others at baseline and 72/164 (44%) at year eight. 205/351 (59%) reported restrictions at baseline, and 99/164 (60%) at year eight.

Mean total societal costs for loss of paid and unpaid work were, per patient, €89/two weeks (95% confidence interval 52;127) at baseline and €47/two weeks (26;69) at year eight.
Conclusions: The proportion of patients with paid work decreases during follow-up, but restrictions at paid and unpaid work seem mostly stable.

Introduction

Osteoarthritis (OA) is a highly prevalent disorder,[1] resulting in chronic pain, disability, loss of quality of life and restrictions in paid and unpaid work participation[2–4] among which productivity loss. Paid work restrictions are for example sick leave (absenteeism), productivity loss at work (presenteeism) and hinder at paid work,[5,6] but also underemployment, premature retirement from work or a change in or loss of occupation (work transitions).[7,8] In knee and hip OA it has been shown that work restrictions lead to high societal costs.[9] Unpaid work restrictions can be due to symptoms leading to hinder when performing tasks (e.g. shopping for daily groceries or household chores), and the necessity of replacement of unpaid work tasks by others.[10] A prevalent OA phenotype is hand OA, for which we previously demonstrated significant absenteeism, presenteeism, hinder at paid work and need for replacement of unpaid work by others, leading to considerable societal costs[5].

Longitudinal studies on OA and paid and unpaid work restrictions are scarce,[11] despite OA being a chronic, progressive disease. One

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	Total study population (n = 351)	Patients with paid work (n = 166, 47%)
General patient characteristics		
Age, years	60.2 (8.4)	55.1 (5.8)
Sex, women, *n (%)*	292 (83)	138 (83)
BMI, kg/m^2	27.5 (4.9)	27.4 (4.9)
Living with a partner, *n (%)*	287 (82)	140 (84)
Education, high[a], *n (%)*	97 (28)	54 (33)
Hand-specific characteristics		
Fulfilling ACR hand OA criteria, *n (%)*	317 (90)	141 (85)
Erosive hand OA, *n (%)*	109 (31)	40 (24)
Symptom duration, years[b]	5.5 (2.0;13.0)	4.2 (1.6;8.3)
AUSCAN hand pain(0–20)	9 (4)	9 (5)
AUSCAN hand function(0–36)	16 (8)	15 (9)
Tender joint count(0–30)[b]	3 (1;6)	3 (1;6)
General burden		
Any comorbidity present, *n (%)*	156 (44%)	55 (34%)
Fulfilling ACR hip OA criteria, *n (%)*	28 (8)	8 (5)
Fulfilling ACR knee OA criteria, *n (%)*	58 (17)	26 (16)
HADS anxiety score(0–21)	4 (2;7)	4 (2;6)
HADS depression score(0–21)	2 (1;5)	2 (1;5)
Work characteristics		
Retired, *n (%)*	116 (33)	-
Full work disability, *n (%)*	24 (7)	-
Full work disability due to hand OA, *n (%)*	8 (2)	-
Partial work disability, *n (%)*	11 (3)	7
Partial work disability due to hand OA, *n (%)*	6 (2)	3
Predominantly manual profession[c], *n (%)*	12 (3)	12 (6)

Numbers represent mean unless otherwise specified. Erosive hand OA was defined as a joint in Verbruggen-Veys (VV) anatomical phases E ("erosive") or R ("remodeling") [36,37]. Fulfillment of the American College of Rheumatology (ACR) criteria for hand OA was calculated [38]. Abbreviations: OA = osteoarthritis, SD = standard deviation, BMI = Body Mass Index, HADS = Hospital Anxiety and Depression Scale, ACR = American College of Rheumatology, AUSCAN = Australian Canadian Hand OA Index.

[a] Defined as having completed university level education.

[b] median (IQR).

[c] Defined as a score of 5 or 6 on the scale by de Zwart et al.[21]

Table I Osteoarthritis and Cartilage

Baseline characteristics of our present study population (n = 351), and of patients with paid work at baseline (n = 166).

longitudinal study in 490 patients with arthritis showed that over 4.5 years, 63% of patients (mean baseline age 51.1 years) with paid work remained employed, and 77% reported work transitions[7]. As dexterity is essential to perform all types of paid and unpaid work tasks,[12] longitudinal data on specifically hand OA is warranted. Such knowledge is crucial to gain insight in the development of the impact of hand OA on individuals and society, and into potential economic benefit of adequate treatment.

Therefore, we aimed to investigate the longitudinal development of hand OA-related restrictions (paid work absenteeism, presenteeism, work transitions, paid and unpaid work hinder and unpaid work task replacement by others) and related societal costs for paid and unpaid work, as well as work transitions in hand OA patients.

Methods

Study population

Annual data from the Hand OSTeoArthritis in Secondary care study (HOSTAS) were used, a cohort on primary hand OA, as diagnosed by the treating rheumatologist[13]. Data were collected up to year eight, between 2011 and 2022 (no data were collected at year seven).[10] Patients who filled in the Health and Labour Questionnaire (HLQ) at baseline and at least one follow-up moment were included. As we had loss to follow-up in the long run, and quite some patients retired over time, most paid work-related analyses were performed for baseline up to year four. Written informed consent was obtained from all participants. The study was approved by the Leiden University Medical Center Ethical Committee.

Patients also completed questions on education (categorized as lower (no schooling, primary school only or lower vocational education), middle (lower general secondary education or secondary vocational education) or high (all higher education)),[14] hand pain and function (Australian Canadian Hand OA Index (AUSCAN)[15] and depression and anxiety (Hospital Anxiety and Depression Scale (HADS) score ≥8).[16–18] Symptom duration was based on self-reported date of first symptoms and the presence (yes/no) of comorbid diseases were collected through a modified Charlson index (including osteoporosis).[19] Bilateral distal interphalangeal (DIP), proximal interphalangeal (PIP), interphalangeal of the thumb (IP), metacarpophalangeal (MCP) and first carpometacarpal (CMC) hand joints were physically assessed for the presence of bony swelling, soft swelling and tenderness upon palpation (range 0–30).[13]

General work characteristics

Part of the annual questionnaire was paid work status (paid work yes/no, hours/week, retired, (partial) work disability etc.). In case of retirement, we determined if this was before the Dutch state pension age (65 years to 66 years and ten months, dependent on date of birth). Physical and mental intensity of paid work was categorized using the classification by de Zwart et al.,[20] which places each job type on a spectrum from one (mentally demanding work, not physically demanding) up to six (physically demanding work, not mentally demanding).

Paid work	Baseline (n = 166)	Year four (=104)	Year eight (n = 54)
Hours of paid work per week, mean (SD)	26 (12)	26 (12)	26 (12)
Absenteeism due to hand OA			
Any absenteeism	8 (5%)	0 (0%)	2 (4%)
Hours of absenteeism, if any[a]	45 (37;80)	-	26 (17;35)
Unproductiveness at work due to hand OA			
Any unproductive hours at work	28 (17%)	17 (16%)	1 (2%)
Hours of unproductiveness at work, if any[a]	4 (2;6)	4 (2;11)	5 (n/a)
Overall work productivity loss (= sum of absenteeism and unproductive hours)			
Any work productivity loss	32 (19%)	17 (16%)	3 (6%)
Hours of work productivity loss due to hand OA, if any[a]	12 (4;29)	4 (2;11)	4 (2;6)
Hinder at work due to hand OA			
Any form of hinder at work due to hand OA	89 (54%)	41 (39%)	18 (33%)
Hinder score complaints at work (6 – 24)[a]	7 (6;8)	6 (6;8)	6 (6;7)
Impaired concentration due to hand OA (often or always)	3 (2%)	1 (2%)	0 (0%)
Needing to slow down work pace due to hand OA (often or always)	17 (10%)	7 (7%)	5 (9%)
Needing to seclude oneself due to hand OA (often or always)	3 (2%)	1 (1%)	0 (0%)
Difficulties in making decisions due to hand OA (often or always)	1 (1%)	1 (1%)	1 (2%)
Inability to complete work due to hand OA (often or always)	3 (2%)	4 (4%)	1 (2%)
Needing assistance at work due to hand OA (often or always)	8 (5%)	2 (2%)	1 (2%)

Unpaid work	Baseline (n = 351)	Year four (n = 256)	Year eight (n = 164)
Hours performed, total[a]	25 (17;35)	21 (14;33)	22 (15;33)
Household activities[a]	15 (10;20)	12 (7;20)	12 (7;20)
Groceries[a]	4 (3;6)	4 (2;6)	3 (2;5)
Chores[a]	2 (0;5)	2 (1;5)	2 (1;5)
Activities with own children[a]	0 (0;4)	0 (0;4)	0 (0;4)
Any replacement of tasks by others	157 (45%)	109 (43%)	72 (44%)
Hours replaced, if any[a]	4 (2;7)	4 (3;7)	5 (2;9)
Unpaid work hinder score (range: 0–8)[a]	1 (0;2)	1 (0;2)	1 (0;3)
Any hinder during unpaid work	205 (58%)	158 (62%)	99 (60%)
Any hinder during:			
Household activities	100 (29%)	87 (34%)	54 (33%)
Groceries	143 (43%)	115 (45%)	68 (41%)
Chores	101 (38%)	71 (28%)	55 (34%)
Activities with own children	71 (20%)	56 (22%)	43 (26%)

Numbers represent number (percentage) unless specified otherwise. Abbreviations: OA = osteoarthritis, SD = standard deviation, IQR = inter quartile range.
[a] median (IQR).

Table II Osteoarthritis and Cartilage

Paid and unpaid work outcomes of the Health and Labour Questionnaire over time, concerning the last two weeks.

The Health and Labour Questionnaire

Using the validated Dutch HLQ, self-reported quantitative data of the impact of hand OA on paid and unpaid work restrictions in the last two weeks was acquired.[10] It addresses absenteeism (sick leave from paid work), presenteeism (lost productivity and/or hinder at paid work), and unpaid work restrictions in the form of replacement of unpaid work by others and/or hinder due to hand OA. To assess absenteeism in those with paid work, the number of half days absent from work in the past two weeks was collected. Further, loss of productivity while at work, defined as "extra hours of work needed to catch up work due to hand OA" was collected. Paid work productivity loss is measured by the sum of hours absent from work and unproductive hours at work due to OA in the last two weeks. Additionally, hinder while at paid work is quantified using a hinder score (range 6 to 24; max hinder) comprising six hand OA-related paid work impediments, such as loss of concentration and impaired decision making.

Unpaid work productivity loss is quantified as the total number of hours in the last two weeks others needed to replace tasks such as household activities, shopping, odd jobs, chores and taking care of own children (score range 0 to 2 per activity). A hindrance score (range 0 to 8; max hinder) represents the level of experienced hinder while performing these tasks.

Costs per hour of paid work lost are estimated based on the average gross salary per hour of the general country-specific population of the same age category and sex, converted to price levels of 2021, using consumer price indices (Supplementary file 1 provides price level conversion factor).[21] Using a weight factor from Dutch government data, we converted this gross salary to societal costs (= all costs made by an employer to hire an employee, which includes taxes and premiums, resulting in hourly societal costs between €25.55 to €41.03/hour, Supplementary file 1).[22] Costs of unpaid labor replacement are estimated at €12.50 per hour, which are the costs of a Dutch paid household help in 2021).[23] Total societal costs of lost productivity are calculated by multiplying the number of hours of work lost by the costs per hour and resulting in total costs related to absenteeism and unproductive hours at work due to hand OA, plus the total costs of unpaid labor loss. When reporting societal costs, the mean (95% confidence interval (CI)) was provided as well as the median (interquartile range (IQR), as both are informative.[24]

Determinants of the course of hinder and productivity loss

Patients with paid work were categorized as "worse paid work outcome" in case of an increase in productivity loss of at least one hour and/or an increased paid work hinder score of at least one

Characteristic	Worse paid work outcome (n = 21)	Equal or better paid work outcome (n = 81)	Worse unpaid work outcome (n = 117)	Equal or better unpaid work outcome (n = 135)
Age	54.2 (5.6)	54.4 (4.7)	61.7 (8.2)[a]	59.5 (7.7)
Sex, women, *n (%)*	15 (71%)	70 (86%)	97 (83%)	105 (78%)
BMI	27.7 (4.9)	27.1 (4.4)	27.2 (4.5)	27.5 (4.9)
Any comorbidity, *n (%)*	13 (62%)[a]	29 (36%)	61 (52%)	69 (51%)
Erosive hand OA, n (%)	7 (33%)	16 (20%)	40 (34%)	46 (34%)
Hand OA Symptom duration[b]	4.3 (2.3;8.4)	3.8 (1.6;7.3)	7.1 (3.4;15.6)[a]	4.9 (1.7;11.9)
AUSCAN total pain score (0–20)	11 (4)[a]	9 (5)	9 (4)	9 (5)
AUSCAN total function score (0–20)	17 (7)	14 (8)	15 (8)	15 (9)
HADS anxiety score (0–21)	8 (4;12)	5 (3;9)	6 (3;10)	7 (4;11)
HADS depression score (0–21)	3 (1;4)	2 (1;3)	2 (1;4)	2 (1;4)
Paid work, n (%)	-	-	57 (48%)	75 (56%)
Unpaid work replacement, n (%)	10 (48%)	33 (41%)	49 (42%)	56 (41%)

Numbers represent mean (standard deviation) unless specified otherwise. Paid work analyses involve solely those with paid work at both baseline and year four.
Abbreviations: BMI = Body Mass Index, OA = osteoarthritis, AUSCAN = Australian Canadian Osteoarthritis Hand Index, HADS = Hospital Anxiety and Depression Scale, IQR = inter quartile range (odds ratio in manuscript text).
[a] Statistically significant difference (odds ratio in manuscript text).
[b] median (IQR).

Table III

Osteoarthritis and Cartilage

Comparison of baseline characteristics of patients with worse versus similar or improved paid and unpaid work outcome at year four versus baseline.

point. The others were categorized as “similar or improved paid work outcome”.

Similarly, for unpaid work outcomes, we categorized patients that had more hours of replacement of tasks by others at year four and/or a worse unpaid work hinder score as “worse unpaid work outcome”. The others were categorized as “similar or improved unpaid work outcome”.

Statistical analysis

All analyses solely included patients for whom information on the concerning outcome was available for the concerning time-points. The number of missing values at baseline was assessed and did not exceed 5% for any variable, except for “hours of unpaid work spent on activities with own children” (8%). Odds ratios with 95% CI were calculated using logistic regression models for dichotomous outcome variables. Mean differences with 95% CI were calculated using linear regression models in case of non-dichotomous outcome variable. For the models concerning loss to follow-up, univariate regression models were used. The exposure variable was “lost to follow-up at year eight” (yes/no), and the outcome variables were from our generalized estimating equations (GEE) models all exposure variables, outcome variables and potential confounders (AUSCAN pain and function, paid and unpaid work hinder score, age, sex and BMI). For the models concerning “worse paid work outcome” and “worse unpaid outcome”, univariate regression models were used with “worse paid work outcome” or “worse unpaid work outcome” as exposure variables, and all variables listed in Table III as outcome variables.

In order to study the association between AUSCAN hand OA pain and function (exposure variables), and paid and unpaid work hinder score (continuous outcome variables) from baseline to year four (paid work), and baseline to year eight (unpaid work), GEEs were used to adjust for within patient effects (after year four insufficient data were available for paid work). Analyses were done crude, and adjusted for potential confounders (baseline age, sex and BMI). These potential confounders were chosen as these were assessed to likely have impact on hand OA pain, and paid and unpaid work hinder, based on previous literature. Assumptions required for regression analysis were verified.[25] Analyses were repeated for those under the state pension age on which Dutch persons usually retire, in order to allow comparison with other studies that investigate patients of working age. Costs per two weeks were extrapolated to costs per year by using a conversion factor of 26.09.[26] R Studio 1.4.1717 and SPSS software for Windows, version 25.0 (IBM, Armonk, NY, USA) were used.

Results

Study population

Of 388 patients who received the HLQ at baseline, 381 completed the questionnaire. Of these patients, 351 also filled in the HLQ at follow-up and were therefore included in this longitudinal study. 256 patients had data on year four, and 164 on year eight (flowchart for each year in Supplementary file 2). Compared with patients with data on year eight (n = 164), patients without data on year eight (n = 187) were older (mean age 62.5 vs 59.2 at baseline, mean difference 3.3 (95%CI 1.5;5,0)), more often women (88% vs 78%, OR (95%CI) 2.0 (1.1;3.6)) and less often had paid work (OR 0.4 (0.2;0.6), but had a comparable BMI, and baseline paid and unpaid work hinder score, as well as AUSCAN pain and function score (Supplementary file 2 for details). Patient characteristics of the study population at baseline are shown in Table I.

Paid work

At baseline, 247/351 patients (70%) were below the Dutch state pension age, and 47% had paid work (67% of all patients below Dutch state pension age[27]). The number of patients with paid work decreased over the years to 33% at year eight (Fig. 1). Out of 166 patients with paid work at baseline, 8 (5%) stopped working without retiring at year four, five (3%) became partially or fully incapacitated (of whom four among those that stopped working without retiring), 15 (9%) retired before reaching retiring age and 33 (20%) were lost to follow-up. This total group (n = 57) had a similar baseline AUSCAN

Fig. 1 Osteoarthritis and Cartilage

The distribution of paid work hinder and unproductive hours over the years.

Fig. 2 Osteoarthritis and Cartilage

Heatmap of the course of paid work restrictions for each follow-up moment (baseline, 1, 2, 3, 4, 5, 6 and 8 years of follow-up), for patients with paid work at baseline (n = 166).

pain (both mean 9), AUSCAN function (mean 14 versus 15), median paid work hinder score (both 7) and unpaid work hinder score (both 1) as the other patients with paid work at baseline (n = 109). Three patients (2%) started working at year four. Of patients that had paid work at baseline and year four (n = 102), 30 (30%) worked less hours per week at year four compared with baseline, while 18/102 (18%) worked more hours and the rest (51, 52%) worked the same hours (three had missing data on hours/week).

Concerning absenteeism (HLQ), 5% of patients with paid work reported absenteeism at baseline, decreasing to 0% at year four, and subsequently increasing to 4% at year eight. Unproductive hours at work were present for 19% at baseline, decreasing to 16% at year four and 2% at year eight (Table II). The proportion of patients reporting hinder at paid work decreased, being 56% with paid work at baseline, 40% at year four and 33% at year eight. The median hinder score remained stable (Table II).

Regarding paid work outcomes at year four for those with paid work at baseline and year four (n = 102), 21 had "worse paid work outcome" at year four, and 81 "equal or better paid work outcome" (two did not have enough data to calculate the hinder score). Patients with "worse paid work outcome" had a worse baseline AUSCAN pain (mean difference (95% CI) 2.1 points (0.0;4.3), and more often any comorbidity (odds ratio 3.2 (1.1;8.8) (data shown in Table III).

Furthermore, in the linear GEE analyses, mean number of follow-up moments with data available was 2.4 per patient for paid work and 5.7 per patient for unpaid work. No relevant interactions with time were found. Therefore, the interaction terms were removed from these GEE models. We found that AUSCAN pain was positively associated with paid work hinder score (beta: 0.10 point on the paid work hinder score per point on the AUSCAN pain scale adjusted for age, sex, BMI and follow-up moment (CI 0.03;0.16)) (Supplementary file 3 for number of patients in the GEE analyses, coefficients of the models and QQ plots). Similarly, AUSCAN function was positively associated with paid work hinder score (beta adjusted: 0.06 (0.02;0.11)). Follow-up moment had no relevant effect in these analyses.

At individual patient level, paid work outcomes fluctuated over time (Fig. 2). For example, out of the eight patients reporting absenteeism at baseline, two still reported absenteeism at year one, three had paid work without absenteeism, one retired and two had missing data.

Results were generally similar for those under the Dutch state pension age (n = 247) compared with the total study group (n = 351) (Supplementary file 4), as few patients aged above state pension age had paid work (eight at baseline). However, mean paid work-related societal costs per patient were higher than in the complete population, as the proportion of patients with paid work was higher (158 out of 247 (64%) instead of 166/351 (47%)). For example, the total societal costs of paid work production loss at baseline were €77/patient per two weeks in those under state pension age versus €55 in the complete study group.

Unpaid work

Patients performed less unpaid work at year eight compared with baseline (median: 22 hours versus 25, Table II). More patients reported unpaid work replacement by others, as 45% reported this at baseline and 44% at year eight. In case of any replacement, a median of five hours in two weeks was replaced at baseline (IQR (2;7), as well as at year eight (IQR 2;9). The proportion of patients reporting any unpaid work hinder was stable (58% at baseline versus 60% at year eight), as well as the median hinder score (Table II).

Regarding the course of adverse unpaid work outcomes at baseline compared with year four, we categorized 117 patients as "worse unpaid work outcome" at year four, and 135 as "equal or better unpaid work outcome". Of these two groups, the "worse unpaid work outcome" group was older on average (mean difference (95%CI) 2.2 years (0.2;4.2), and had a longer hand OA symptom duration (2.2 years (0.4;4.0) (Table III). Among those with paid work (n = 102), 8 (8%) solely had "worse paid work outcome" and had no "worse unpaid work outcome", and 35 patients (34%) solely "worse

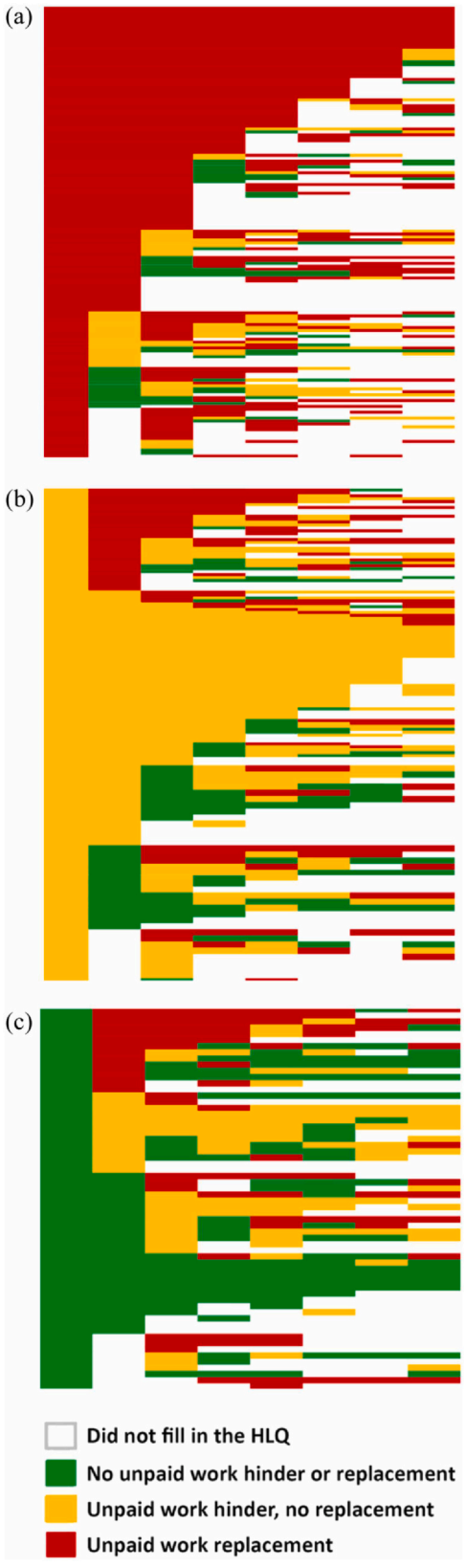

Fig. 3 Osteoarthritis and Cartilage

Heatmap of unpaid work status for each patient at each time point (baseline, year 1, 2, 3, 4, 5, 6 and 8 of follow-up), for all patients (n = 351). a) patients with unpaid work replacement at baseline, b) unpaid work hinder but no replacement at baseline, c) no unpaid work hinder or replacement at baseline

unpaid work outcome". Both "worse paid work outcome" and "worse unpaid work outcome" were present for 13 patients (13%).

Furthermore, in the GEE analyses regarding unpaid work, we found no relevant interactions with time (Supplementary file 3 for all unpaid work models). Therefore, the interaction term was removed from the GEE models. In these models, AUSCAN pain was negatively associated with the unpaid work hinder score (beta: −0.07, CI −0.12;−0.03) (adjusted for age, sex and BMI and follow-up moment). Similarly, AUSCAN function was negatively associated with unpaid work hinder score (adjusted beta: −0.05 (CI −0.08;−0.02)). Follow-up moment had no relevant effect on in these analyses (Supplementary file 3).

Large variations on individual level were seen over time, since several patients needed unpaid work replacement or developed hinder over eight years, while others did not report hinder and/or replacement anymore (Fig. 3).

Societal productivity costs of productivity loss

In the total population, hand OA-related societal costs due to paid work productivity loss (absenteeism and presenteeism) were incurred by 32/351 patients (9%) at baseline, 17/256 (7%) at year four and 3/164 (2%) at year eight. Mean costs per patient decreased from €55 (95% CI 19;91) per two weeks at baseline (n = 351), to €12 (5;19) at year four and €11 (−6;29) at year eight. The development of societal costs over time is visualized in Fig. 4, and detailed societal costs are shown in Table IV.

For unpaid work, societal costs of productivity loss were stable, being €33/two weeks (n = 351, CI 25;40) at baseline, €31 (n = 256, 95% CI 24;37) at year four and €36 (n = 164, 95% CI 25;47) at year eight. The proportion of patients incurring societal costs was also stable over time.

Mean total societal costs due to loss in paid and unpaid work productivity in all patients were at baseline €89/two weeks (95% CI

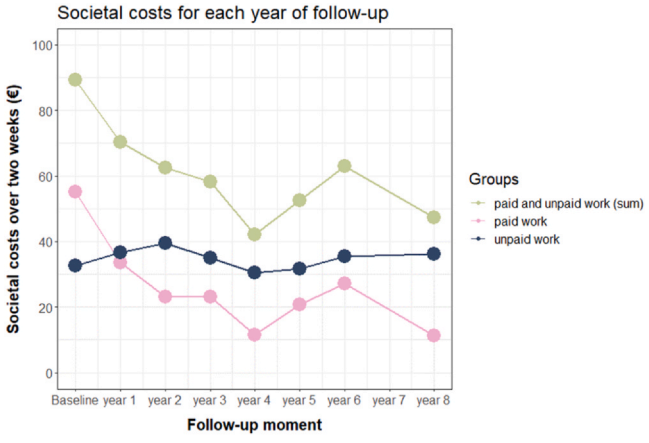

Fig. 4 Osteoarthritis and Cartilage

Line chart of mean societal costs of hand OA over time regarding paid work, unpaid work and the sum of these two per patient (baseline to year eight, €/ two weeks).

Cause of costs (total number of patients at follow-up moment)	Estimated costs per patient per two weeks (€)	Estimated costs per patient, extrapolated to one year (€)	Estimated costs per two weeks only for patients generating any costs (€) (number of patients incurring costs)[a]
Paid work absenteeism			
Baseline (n = 351)	44 (9;77)	1118 (230;2006)	1472 (1204;2842) (n = 8)
Year four (n = 256)	-	-	- (n = 0)
Year eight (n = 164)	10 (−7;28)	267 (−184;717)	840 (552;1127) (n = 2)
Unproductive hours at paid work			
Baseline (n = 351)	12 (6;18)	318 (230;2006)	136 (65;199) (n = 27)
Year four (n = 256)	12 (5;19)	302 (120;484)	129 (64;353) (n = 17)
Year eight (n = 164)	1 (−1;3)	26 (−25;76)	163 (163;163) (n = 1)
Paid work production loss (=absenteeism + unproductive hours at work)			
Baseline (n = 351)	55 (19;91)	1439 (506;2372)	197 (66;464) (n = 32)
Year four (n = 256)	12 (5;19)	302 (120;484)	129 (64;353) (n = 17)
Year eight (n = 164)	11 (−6;29)	293 (−161;747)	265 (214;840) (n = 3)
Unpaid work replacement by others (paid or unpaid household help)			
Baseline (n = 351)	33 (25;40)	848 (654;1042)	50 (25;88) (n = 157)
Year four (n = 256)	31 (24;37)	795 (627;962)	50 (38;88) (n = 109)
Year eight (n = 164)	36 (25;47)	941 (655;1227)	59 (25;113) (n = 72)
Total of paid and unpaid work production loss			
Baseline (n = 351)	89 (52;127)	2322 (1349;3295)	63 (29;125) (n = 171)
Year four (n = 256)	42 (32;52)	1096 (835;1358)	50 (38;113) (n = 115)
Year eight (n = 164)	47 (26;69)	1233 (665;1801)	63 (25;116) (n = 72)

All societal costs are adjusted to 2021 consumer price indices. Numbers represent mean (95% confidence interval). Abbreviations: OA = osteoarthritis, n = number.
[a] median (Interquartile Range).

Table IV

Societal costs of paid and unpaid work due to hand OA.

Osteoarthritis and Cartilage

52;127) (€2327/year (1351;3302)), at year four decreasing to €42/two weeks (95% CI 32;52) (€1099/year (837;1350), mostly due to a decline in paid work-related costs, and remained stable up to year eight, where costs were €47/two weeks (26;70) (€1236/year (666;1767)) (Fig. 4).

Discussion

In this study on the disease burden experienced by patients with hand OA over a period of eight years, we found that patients with hand OA experience substantial impairment in paid and unpaid work participation over time, which translates into substantial societal costs. The proportion of patients in the study with paid work decreased over time, mostly due to retirement.

Despite hand OA being regarded a progressive disease, we found some adverse work outcomes (such as paid work productivity loss) actually improving over time. However, most adverse work outcomes were stable on group level in those retaining work. This could be due to hand OA-related pain being stable over time on group level in our cohort.[28] Musculoskeletal pain is one of the core symptoms of hand OA, and is a determinant of presenteeism and absenteeism, as well as unpaid work hinder.[5,29,30] Therefore, this stable pain might explain stable paid and unpaid work outcomes. Potentially, the relatively slow progression of radiographic damage in OA over time could also play a role.[31] Another explanation could be that patients choose to work less hours, change their job or function or retire earlier in case of hand OA complaints or get lost to follow-up, evading worsening hinder and unproductive hours ("healthy worker effect").[32] On this line, we confirmed that patients with more severe hand OA complaints over time might be more at risk for loss to follow-up than those with less severe complaints. This is underscored by the worse AUSCAN pain and function in those who did not complete year eight of follow-up. Other explanations could be a regression to the mean-effect of adverse work outcomes after baseline, or that starting or intensifying hand OA treatment during follow-up made patients avoid worsening work-related outcomes.

Using GEE models, we found that worse baseline AUSCAN pain and function were associated independent of follow-up moment with worse paid work hinder scores, but with better unpaid work hinder scores. However, effect sizes appear small, and no minimal clinical important difference for these paid and unpaid work hinder scores are known. Therefore, these results should be interpreted with caution. Perhaps, replacement of tasks due to pain and/or functional problems lead to better unpaid work hinder scores for some patients. Of note, 45% (157/351) of patients received help from others for unpaid work, while replacement of paid work tasks was uncommon (5% with paid work reported "often or always" at baseline).

The fluctuations of paid and unpaid work impairment on individual level we found (e.g. in Fig. 2 and Fig. 3) could also be explained by the aforementioned possible changes in paid or unpaid work situation and in hand OA treatment. Also, it might be due to hand OA pain fluctuating on individual level in our cohort.[28]

The paid work-related societal costs in our study decreased over the years on group level. This can be explained by the fact that less patients had paid work over time (48% at baseline versus 33% at year eight). Therefore, less patients could incur any paid work-related societal costs. Also, it is possible that those some patients lost to follow-up would have incurred costs. Concerning societal costs of unpaid work, these generally remained stable.

We did not find any longitudinal studies specifically on hand OA and paid and unpaid work and related societal costs. However, we did find longitudinal studies on other rheumatic diseases than hand OA and paid work. One study investigated paid work transitions and absenteeism in 490 Canadian patients with arthritis (67% with OA of any joint, 43% with inflammatory arthritis, mean age 50.9, 78%

women).[7] In line with our study, paid work transitions were common. The study found that between baseline and year 4.5, 63% remained employed, 30% stopped working and 7% stopped working but started working again. In our study, out of patients with paid work at baseline and data on year four (n = 133), 101 (74%) remained employed at year four, 32 patients with paid work at baseline stopped working at year four (24%), and 3 started working (2%). The study also found that any arthritis-related absenteeism was present for 28% of patients with paid work at year 1.5, decreasing to 20% at year 4.5. This decrease is in line with our study. However, the proportion of patients with any absenteeism we found was lower, as 5% of patients at baseline with paid work had OA-related absenteeism and 0% at year four. This might be due to a difference in recall period; the HLQ investigates absenteeism in the last two weeks, while the study investigated it on the last six months, or due to the HLQ being a relatively conservative questionnaire.[6]

Our study has several strengths. It is the first study that investigates disease-related paid and unpaid work impairment longitudinally using a validated labour questionnaire, as well one of the first to study societal costs longitudinally for any rheumatic disease. Other strengths are the long follow-up time of eight years, and the large size of the cohort.

Besides these strengths, our study also has some limitations. The most evident limitation is that several patients were lost to follow-up, which is inherent to longitudinal studies. At year eight, 187/351 patients (53%) baseline patients were lost. However, since many patients were already elderly when included in the study, after eight years of follow-up a high proportion of those patients lost to follow-up is above retiring age. Therefore, it is likely that the loss to follow-up in our study has limited impact on paid work outcomes. Another limitation is the generalizability of our outcomes to populations outside of the Netherlands. As different countries have different work cultures and social welfare systems,[33] incentives for e.g. having productivity loss or retiring differ, as well as the official retirement age and incentives for retiring. Generalization of societal costs is also limited, as these costs are based on salaries, which differ strongly between countries.[34] Also, that the HLQ did likely not capture all societal costs in our study, as societal costs of for example working less hours per week, retiring earlier, getting incapacitated or due to choosing a less ambitious career path due to hand OA (which would have been included in the human capital approach) are likely present, but could not be accounted for. Furthermore, assumptions required for regression analysis were nearly fulfilled, yet residuals did not entirely follow the normal distribution (see QQ plots in Supplementary file 3). However, we expect this slight violation to have limited impact on our results. Also, the hinder score variables are not entirely continuous, but limited to integer numbers. Finally, as we have no control population without hand OA, we cannot be sure that impairment attributed by patients to hand OA, is definitely due to hand OA.

In conclusion, hand OA is associated with substantial impairment in paid and unpaid work participation, which translates into substantial societal costs. Impairment and costs fluctuate on individual level but seem to generally remain stable on group level in those that remain in the study, possibly due to a “healthy worker” effect. Hand OA-related pain and function impairment are associated with worse paid work outcomes over time. These findings underscore the social and economic impact of hand OA, by shedding light on the impact of hand OA on work.

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Author contributions

Each author contributed to design of the study, interpretation of the data and critically revising the article. All authors gave final approval of the submitted article.

Conflict of interest

A.E.R.C.H. Boonen received a research grant from Abbvie and consultancy fees to her department from Novartis, Lilly, Galapagos and Abbvie. G. Kloppenburg received grants/research support for the submitted work, all paid to the institution.

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Appendix A

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Appendix B. Supporting information

Supplementary data associated with this article can be found in the online version at doi:10.1016/j.joca.2024.10.013.

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