

Direct and Indirect Costs Attributable to Osteoarthritis in Active Subjects

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ABSTRACT. *Objective.* To estimate the direct and indirect costs of osteoarthritis (OA) in an active population, and to identify factors significantly influencing these expenditures.

Methods. A cohort of 3440 subjects employed by the Liège City Council was followed prospectively for 6 months. Subjects were asked to report monthly OA related health resource utilization (contacts with health professionals, medical examinations, drug consumption, etc.) and absence from work. Health related quality of life (HRQOL) was evaluated at baseline using the Medical Outcomes Study Short-form 36 (SF-36). Logistic regression analysis identified factors associated with the probability that the individual incurred costs, and multiple regression identified factors influencing the magnitude of these costs.

Results. A total of 1811 subjects filled in at least one questionnaire (response rate 52%). The mean duration of followup was 3.46 months. Self-reported prevalence of OA was 34.1%. The mean total direct costs were €44.5 per OA patient-month. Contacts with health professionals, medical examinations, drugs, and hospital stays accounted for €23.7, €8.7, €6.7, and €4.9, respectively, per OA patient-month. The average number of sick-leave days was 0.8 per OA patient-month. From a payer's perspective, this loss of productivity represented a mean cost of €64.5 per OA patient-month. We also recorded 0.02 mean days off work per active subject-month due to informal care by relatives, yielding a mean cost of €1.8 per active subject-month for the employer. Poorer scores for most of the dimensions of the SF-36 at baseline were significantly associated with greater likelihood of incurring direct and indirect costs and with higher costs among subjects who reported costs. If we consider the overall cohort of active subjects, the burden of OA related to the direct and indirect costs was €15.2 and €23.8, respectively, per active subject-month.

Conclusion. Direct and indirect costs attributable to OA are substantial, with productivity related costs being predominant. Poorer HRQOL was a major determinant of these expenditures. (J Rheumatol 2006;33:1152–8)

Key Indexing Terms:

WORKPLACE

INDIRECT COSTS

OSTEOARTHRITIS

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Osteoarthritis (OA) is one of the most common rheumatic diseases, accounting for a large percentage of physical disability worldwide. The economic and social burden of OA is

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substantial and results from a decreased quality of life, loss of productivity, and increasing costs of healthcare^{1,2}. Costs of illness estimates for OA are particularly high when all levels of the healthcare system are taken into account. In France, according to a report on socioeconomic data on OA in 2003, the annual costs attributable to OA were about €1.8 billion, representing an enormous burden for the French economy and the national healthcare system³. A recent review from national studies indicates that the economic costs of arthritis represent 1.5–2.5% of the gross national product (GNP), and total healthcare expenditure among those reporting arthritis approaches 3% of GNP⁴. The Australian Institute of Health and Welfare estimated that total health system costs of OA were AU \$624 million (€376 million) in 1993–94, about 21% of total expenditure on musculoskeletal disorders⁵.

Although the current disability and economic burden of OA is substantial, the prevalence of OA and the future burden will increase considerably with the increasing age of the population. While OA appears at an advanced age, a significant number of younger people, economically active, may suffer

from OA. Consequently, societies will be faced with an increasing part of their labor force affected by OA. In this context, the economic and social burden of OA, notably in the workplace, will definitely increase.

In the past decade, cost of illness studies became indispensable tools for optimizing the resources allocated by health authorities to OA management strategies. However, most of the studies were conducted in retired subjects, and consequently many focus on direct costs. Few data are available to evaluate the socioeconomic impact of OA on individuals in the workplace.

On the basis of a large sample of active subjects employed in the public work force, we assessed the direct and indirect costs attributable to OA and investigated whether demographic characteristics and quality of life were significant determinants of health resources utilization.

MATERIAL AND METHODS

Data collection. During 6 consecutive months, all staff members ($n = 3440$) of the City Council of Liège, Belgium, were requested to complete a health record, including a prospective log of data concerning OA related healthcare utilization. Information on demographic (age, sex, level of education, current marital status) and socioeconomic (professional status, category of income) characteristics was also collected. To assess comorbidity, we used a 23-item list of comorbid conditions and inquired whether the symptom/condition was present during the last 6 months. Subjects were asked to self-report the presence or absence of OA. For subjects reporting effects of OA, information was also collected about diagnosis, duration of disease, OA related contacts with general practitioners or specialists, and treatment specifically for OA during the last 6 months.

Data on the use of all healthcare resources attributable to OA covered the following items: (1) consultations with health professionals, including type of profession (general practitioner, specialist, nurse, physiotherapist, etc.) and the number of visits; (2) consultations with alternative medicine professionals, meaning all contacts referred to alternative therapy that may be used as adjuncts to conventional treatment, and of which the efficacy has not unequivocally been demonstrated, such as homeopathy, acupuncture, osteopathy, and chiropractic; (3) the number and type of medical examinations and tests performed such as radiographs, computed tomography, blood tests, etc; (4) the number of hospital stays and consultation in emergency units, including the duration of stay; and (5) all drugs taken (both prescribed and over the counter), including the duration of administration.

Data relating to indirect-cost estimates attributable to OA included: (1) the number of sick leave days; and (2) the number of days off work incurred by active subjects helping relatives or friends with OA.

Subjects were also asked to report information about the following items: (1) reduction of working time, i.e., part-time work; (2) reduction of other than occupational activities (i.e., leisure and sport); and (3) any help from friends or relatives received by the patient.

Health related quality of life (HRQOL) was assessed using the Medical Outcomes Study Short-form 36 (SF-36) health status survey at baseline. The questionnaire was administered only at the first month (January 2004) of the study period. The SF-36 is a generic HRQOL instrument consisting of 36 items that measure 8 dimensions of health status reported by patients. Four dimensions refer to physical health: limitations in physical functioning due to health, limitations in usual role activities due to physical health, bodily pain, and perceptions of health in general. Four dimensions allude to mental health: vitality (energy and fatigue), limitations in social activities due to physical or emotional health, limitations in usual role activities due to personal or emotional problems, and general mental health (psychological distress and well-being)^{6,7}. These dimensions are scored from 0 to 100, with lower scores indi-

cating lower levels of HRQOL. One of the strongest attributes of the SF-36 is its consistently high levels of reliability (test-retest and internal consistency) and validity (content, concurrent, criterion, construct, and predictive)^{8,9}. The SF-36 has been broadly applied and validated in the measurement of health outcomes in diverse languages (including French)^{9,10} and for various conditions including OA¹¹.

To optimize study quality and collect a maximum of data, we set up a reminder procedure. At the start of each month, an appropriate reminder letter was sent to employees who failed to send duly completed questionnaires within the allocated timeframe.

In order to check the representativeness of our sample, we compared the ages, sexes, and professional status of responders to the nonresponders. Employees are split into 3 categories: administrative, manual, and others. We also assessed the representativeness of our sample to the Belgian active population (2003 data; National Institute of Statistics, Liège) in terms of age and sex.

Direct costs. In Belgium, all refundable healthcare costs (either partially or completely), including for drugs, are listed in a nomenclature of health services, which gives the monetary value of the care as well as specific implementation rules. The amount of insurance intervention in the cost of the health service varies according to the characteristics of the service and the socioeconomic status of the patient.

The costs of consultations with health professionals not covered under the Belgian healthcare system, such as chiropractor and acupuncturist, were obtained from the relevant professional bodies.

Costs of drugs were calculated on the basis of wholesale prices listed in the *Répertoire commenté des médicaments* (Centre Belge d'Information Pharmacothérapeutique, Brussels, Belgium). Costs per unit were calculated by dividing the cost per package by the number of units contained. The overall cost of each drug per patient was calculated by multiplying the unit cost by the number of intakes.

The total direct costs reported here include costs covered by the Belgian healthcare system and the patient's out of pocket costs.

Productivity costs. Costs of productivity losses were calculated from a payer's perspective. This domain included sick-leave and days off work to help relatives or friends with OA. Costs for sick-leave and days off work for each subject were derived by the formula: number of lost work days \times (yearly income/220), with 220 reflecting the average number of working days per year in the Liège City Council. Yearly income for each professional status was given by Liège City Council. In Belgium, the employer covers payments for sick-leave periods depending upon the professional status; for a manual worker, the sick-leave period covered by the employer is 14 days, and for an administrative employee, 30 days. Payments for any sick-leave period that exceeds 14 or 30 days are covered by the national health insurance plan. Payments from the employer fulfil an employee's gross wages, while payments from the sickness fund cover up to 60% of gross wages.

Since enrolment and disenrolment occurred throughout the study period, person-months were used as the unit of analysis. Health resources utilization related to direct medical costs and productivity losses were calculated both on the basis of the number of affected subjects and on the basis of the overall cohort of active subjects in order to provide information on the societal effect of OA.

Statistical analysis. The OA group was compared to the control group for comorbid conditions and sociodemographic characteristics by chi-square test for qualitative variables and Student's t test for quantitative variables.

Two principal outcome measures are considered: direct cost and indirect cost. Multiple regression and logistic regression analyses were performed to estimate the influence of demographic characteristics and quality of life on direct and indirect costs. For each individual, a monthly average for the 2 outcomes was calculated. For the logistic regression analysis, we created a dichotomous variable for each cost ($0 = \text{€}0$; $1 = > \text{€}0$). Because costs were highly skewed, with individuals experiencing no cost or low costs and a few experiencing very high costs, we transformed costs from natural to logarithmic terms for the multiple regression analysis. The specific variables in the

regressions included: age, sex, number of comorbidities, marital status (married, divorced, widowed, single), education level (primary, lower secondary, higher secondary, university), annual average salary, financial difficulties (0 = no; 1 = yes), duration of OA (< 1 year, 1–5, 5–10, > 10 years), and the SF-36 values. To avoid colinearity, we performed a regression analysis for each dimension of the SF-36.

RESULTS

Characteristics of the study sample. Among the 3440 subjects employed by the Liège City Council in January 2004, 1811 (52.6%) completed at least one questionnaire. The mean duration of followup was 3.46 months. Responders had a mean age of 45.9 (\pm 9.8) years [vs 46.3 (\pm 10) for the nonresponders; $p = 0.22$] and included more women (57.4%) than the nonresponders (50.2%; $p < 0.05$). There was a significant difference in the professional status between responders and nonresponders. Among the responders, the number of subjects with administrative tasks (32.4%) was significantly higher ($p < 0.05$) compared to nonresponders (23.1%), whereas fewer manual workers responded (43.3% vs 61.3%). We also observed statistically significant differences in terms of age and sex between our sample and the Belgian active population. Responders were significantly older and included a larger proportion of women (57.4%) compared to the overall Belgian active population (43.1%).

The self-reported prevalence of OA at inclusion was 34.1% (Table 1). The mean age of the OA group (51 \pm 6.6 yrs) and the female to male ratio (1.65) were significantly higher ($p < 0.05$) compared to the group without OA (mean age 43.3 \pm 10.2 yrs; sex ratio 1.2). Subjects with OA reported a mean number of comorbidities (2.5 \pm 1.9) that was significantly higher than among healthy subjects (1.3 \pm 1.5; $p < 0.05$).

We found 96.3% of subjects reported that the diagnosis of OA was confirmed by a health professional. Diagnosis of OA

was based on radiographic findings in 80% of subjects; 58.2% of subjects had had OA for more than 5 years. Respectively, 43% and 31% of OA subjects were undergoing treatment by a general practitioner or a specialist at inclusion. During the last 6 months, a treatment for OA was taken by 47% of the OA subjects.

Costs. The mean total direct costs were €44.5 per OA patient-month. Expenses of €29.1 were covered by the Belgian healthcare system and €15.4 were paid out of pocket per patient. Among the 617 patients with OA, 43.8% reported they incurred no costs for OA related care during the followup; 44.5% of OA subjects spent less than €50 per month and 3.8% spent more than €100 per month for OA care.

Table 2 shows the disaggregated total OA related direct cost data. Physician visits accounted for €10.1 per OA patient-month. Further disaggregation was performed according to the 3 contributing physician groups: general practitioners accounted for €4.2 per OA patient-month, rheumatologists €2.7 per OA patient-month, and specialists other than rheumatologists €3.2 per OA patient-month. Mean total expenditures for paramedic visits were €10.5 per OA patient-month. Physical therapist visits accounted for 96% of these expenditures. Contacts with alternative medicine professionals such as acupuncturists and chiropractors accounted for €3.2 per OA patient-month. Medical examinations, drugs, and hospitalizations accounted for €8.7, €6.7, and €4.9, respectively, per OA patient-month.

During this 6-month study, a total of 1753 sick-leave days were recorded. The average for sick-leave was 0.8 days per OA patient-month. From a payer's perspective, the mean sick-leave cost was €64.5 per OA patient-month (Table 3). Altogether, the Belgian healthcare system refunded 25.9% of

Table 1. Demographic characteristics of the study sample.

	Control Group, n = 1194	OA Group, n = 617
Age, mean \pm SD	43.3 \pm 10.2	51 \pm 6.6
Sex, %		
Men	45.2	37.7
Women	54.8	62.3
Comorbidity, mean \pm SD	1.3 \pm 1.5	2.5 \pm 1.9
Marital status, %		
Married	47.4	57.8
Divorced	20.9	24.8
Widowed	2.2	3.1
Single	29.5	14.3
Education level, %		
Primary	7	10.2
Lower secondary	28.5	28.9
Higher secondary	34.7	37.2
University	29.8	23.7
Professional status, %		
Administrative staff	30.2	36.4
Manual worker	43.7	42.4
Others	26.1	21.2

Table 2. OA related direct costs (€) per OA patient-month by cost domains.

Cost Domains	Mean (€)	Percentage of Total Direct Costs
Visits to physicians		
General practitioners	4.2	9.5
Rheumatologists	2.7	6.1
Others	3.2	7.2
Visits to paramedics		
Physical therapist	10.1	22.9
Occupational therapist	0.2	0.4
Nurse	0.2	0.4
Contact with alternative medicine professionals	3.2	7.3
Medical examinations		
Radiographs	2.3	5.2
Bone scan	4.2	9.6
Computed tomography scan	1.5	3.3
Laboratory tests	0.1	0.2
Others	0.7	1.4
Hospitalizations and emergency room visits	4.9	11.2
Drugs	6.7	15.1

Table 3. OA related indirect costs (€) per OA patient-month by cost domain.

Cost Domains	Mean (€)	Percentage of Total Indirect Costs
Work disability	64.5	92.4
Informal care*	1.8	7.6

* Loss of productivity attributable to informal care was expressed by active subject-month.

all sick-leave payments, with the employer covering the remaining 74.1%. Among affected subjects, 19 reported a reduction in work hours due to OA. In most cases (62%), a part-time work schedule was arranged.

A total of 121 days' leave was incurred in active subjects during the study period to help friends or relatives with OA. For the employer, this loss of productivity represented a mean cost of €1.8 per active subject-month.

If we consider the overall cohort of active subjects, the utilization of health resources attributable to OA related to direct medical costs and total productivity losses represented expenses of €15.2 and €23.8, respectively, per active subject-month.

During the 6-month study, 22.6% of the OA subjects reported that they reduced their leisure activities because of OA; 10.3% of subjects reported receiving help from friends or relatives because of OA.

Determinants of costs. Age was a significant predictor of incurring direct medical costs during the followup (OR 1.03, 95% CI 1.002–1.05). Quality of life was also an important determinant of incurring direct and indirect costs. Poorer scores for all dimensions of the SF-36 (excepted for mental health) at baseline were significantly associated ($p < 0.05$) with a greater likelihood of incurring direct medical costs (Table 4) and work disability (Table 5).

By multiple regression analysis we identified that quality of life influenced the magnitude of the direct costs and loss of productivity. The magnitude of direct costs was significantly ($p < 0.05$) associated with poorer scores for all HRQOL dimensions (Table 6). As for costs attributable to loss of pro-

Table 4. Logistic regression summary. Association between the 8 dimensions of the SF-36 and the likelihood of incurring direct medical costs.

Dimensions	β	OR	95% CI
Physical functioning	−0.029*	0.97	0.96–0.98
Social functioning	−0.018*	0.98	0.97–0.99
Role physical	−0.014*	0.98	0.98–0.99
Role emotional	−0.01*	0.99	0.98–0.99
Mental health	−0.007	0.99	0.98–1.00
Vitality	−0.013*	0.99	0.97–0.99
Pain	−0.028*	0.97	0.96–0.98
General health	−0.018*	0.98	0.97–0.99

* $p < 0.05$.

Table 5. Logistic regression summary. Association between the 8 dimensions of the SF-36 and the likelihood of work disability costs.

Dimensions	β	OR	95% CI
Physical functioning	−0.03*	0.97	0.95–0.98
Social functioning	−0.021*	0.98	0.96–0.99
Role physical	−0.024*	0.98	0.96–0.98
Role emotional	−0.009*	0.99	0.98–0.99
Mental health	−0.008	0.99	0.98–1.00
Vitality	−0.016*	0.98	0.97–0.99
Pain	−0.042*	0.96	0.94–0.97
General health	−0.03*	0.97	0.95–0.98

* $p < 0.05$.

Table 6. Multiple regression summary. Association between the 8 dimensions of the SF-36 and direct medical costs and work disability costs.

Dimensions	β^\dagger	$\beta^{\dagger\dagger}$
Physical functioning	−0.018*	−0.009
Social functioning	−0.019*	−0.017*
Role physical	−0.015*	−0.014*
Role emotional	−0.01*	−0.01*
Mental health	−0.015*	−0.014
Vitality	−0.016*	−0.01
Pain	−0.025*	−0.02*
General health	−0.022*	−0.01

† Association between 8 dimensions of SF-36 and direct medical costs.

†† Association between 8 dimensions of SF-36 and work disability costs.

* $p < 0.05$.

ductivity, low scores for the social functioning dimensions, role physical, role emotional, and pain dimensions were associated ($p < 0.05$) with increasing costs (Table 6).

DISCUSSION

This was the first large-scale European study and one of the few designed to identify direct and indirect costs related to OA in the workplace. The overall strength of our analysis is that it is a prospective collection from a mixed group of subjects with OA, of varying health status, and including a younger OA population.

Results of previous studies were not directly comparable to ours for several reasons. In most studies, the perspective taken in the estimates of costs is not clearly defined. Differences in demographics and clinical characteristics, as well as differences between healthcare systems, also limit the comparability of our data with those from other burden of illness studies. Despite these methodological differences, some general comparisons can be made with other studies. The average total costs of OA care per OA patient-month, in our sample, was €44.5, which, if extrapolated to one year, came to €531 per OA patient annually. In a recent followup of Belgian patients diagnosed with Kellgren-Lawrence grade II–III knee OA, the annual health resources utilization linked to OA was evaluated at €602, a figure in accord with our results¹². These figures

validate the diagnosis of OA, self-reported in our cohort but confirmed by standardized radiographic procedures in the other trial. This finding is also similar to that in a recent Italian study, in which annual direct medical costs averaged €589 per OA patient¹³. It is also in agreement with outcomes reported by Lanes, *et al*, who calculated medical costs of €580 per patient per year¹⁴. However, in these 2 studies, hospitalizations were responsible for the largest component of costs, accounting for nearly half the total cost of OA care. In our study, hospital stays generated 11.9% of total medical costs. The low cost for hospital stays that we calculated may have several explanations. First, costs for hospital stays may have been underestimated. For calculation of costs for hospitalizations, only the costs attributable to hospital stays (including a fixed rate for drugs and medical examinations) were taken into account because data for surgical procedures and examinations performed during the hospital stays were not available. Another explanation might be that only 0.4% of the subjects reported hospital stays, which is low compared to hospitalization rates reported by others^{13,14}. However, OA patients in our study sample were relatively young (mean age 51 yrs), and consequently less likely to be candidates for total joint arthroplasty. According to a recent report of the "Union Nationale des Mutualités Libres," it was estimated that the mean age of patients receiving total joint arthroplasty in Belgium was 70 years; 50% of the operations were performed for patients between the ages of 63 and 76 years. This supports the perception that including surgical costs would not have significantly modified our findings.

The distribution of direct medical costs in our study was also comparable with results reported by Hawker, *et al*¹⁵. In that study, hospitalization costs represented only 19% of total direct expenditures and physician costs accounted for half of the healthcare system costs. We observed that visits to health professionals were responsible for the largest component of direct medical costs (54%). The dominating cost domain was for physical therapists (€10 per OA patient-month). Although only 6.7% (*n* = 145) visited a physical therapist, the cost was high because each patient had on average 8.5 sessions per month. This is not surprising since physiotherapy plays a central role in the management of patients with functional limitations and is often prescribed for many sessions. The second expenditure was due to requests for general practitioner (GP) visits. In our study sample, 0.2 GP visits per patient per month were recorded. On a yearly basis, it came to 2.4 GP visits per year per patient. This corresponds to the traditional medical consensus for followup of patients with OA¹⁶. Contacts with alternative medicine professionals were useless in our study. It is true that these practices are generally badly controlled and that their efficacy has not been demonstrated unequivocally¹⁷; however, we decided to include specific items about this type of contact in the questionnaire for 2 reasons. First, in Belgium, alternative medicine is very costly and expenses are not covered by the Belgian healthcare system. In the context of

rationalization of health resources, this information could be relevant. Second, in Belgium, use of alternative medicine is becoming more and more popular. According to a recent report from the World Health Organization about the use of alternative medicines¹⁸, 40% of the Belgian population have already used this type of practice at least once. According to another study¹⁹, one in 4 Belgians consult a complementary practitioner. These therapies obviously play an important role in the Belgian healthcare domain and generate high costs for which education of patients about their limitations would allow savings.

In our study sample, OA seemed to be very disabling, since a total of 1753 sick-leave days were recorded. The productivity losses attributable both to work disability and to informal care, evaluated at €23.8 per active subject-month in our study sample, were higher than the direct medical costs. As noted, a direct comparison with other studies cannot be made because of differences in the structure and the financing of the healthcare systems and in the characteristics of the study sample. Moreover, there are methodological differences in the calculation of lost productivity; the relationship between direct medical costs and indirect costs is highly dependent on the estimation methods used.

However, productivity losses caused by OA were high and were mainly due to the work disability experienced by active subjects (92.4% of total indirect costs) rather than the informal care provided by active subjects (7.6% of total indirect costs). Data about workday losses caused by OA confirm findings from other studies, which estimated that rheumatic diseases are an important cause of temporary disability³. The number of sick-leave days and the costs attributable to this loss of productivity are relevant both for employers and for health policy-makers. A forecast of the number of lost work days attributable to a disease and the cost of this loss of productivity in the overall workforce may be of interest to employers.

Our study reveals that the SF-36 results were directly linked to healthcare resources consumption. Lower HRQOL scores at baseline were significantly associated with a greater likelihood of incurring direct medical costs and work disability costs. As for factors influencing the magnitude of these costs, decreasing HRQOL was associated with increasing costs.

Associations between the 8 dimensions of the SF-36 and direct medical costs are consistent with results reported by Ethgen, *et al*²⁰. They showed that lower scores for HRQOL predicted increased consumption of healthcare resources²⁰. In our study, all dimensions except for mental health contributed significantly to the likelihood of incurring direct medical costs and lost productivity costs. As expected, the domains of physical health status (bodily pain, physical functioning, and role physical) play the most important role. This is in agreement with data appraised by Lapsley, *et al*²¹. They showed that the cost burden on individuals increased with impairment of

physical function. According to Liang, *et al*²², the cost for arthritis management was inversely related to the level of health; they concluded that functional capacity was an important determinant of arthritis related expenditures.

Limitations of our data should be taken into account. A possible limitation of our study relates to the self-report design of the cost diaries. About one-third of the study sample reported OA, which is high compared with self-reported prevalence in other population based surveys. The dataset generated by our study relates only to subjects' self-perceived health. The diagnoses were reported spontaneously and were not confirmed by any objective methodology. They are likely to include diagnoses derived by a GP without any measurements or by the individual patient, sometimes mistakenly. However, our questionnaire included 2 specific items on confirmation of diagnosis by a health professional and an objective diagnostic tool. The diagnosis of OA was made by a health professional in 96% of the OA patients, and 80% of the diagnoses of OA were confirmed by radiography. Further, it is well established that prevalence of disease from self-report is generally much higher than when estimated from physical examinations or interviews²³. Another limitation of our study that may explain the high prevalence of OA is the rate of non-responses. While the study was planned to evaluate direct and indirect costs and the impact on HRQOL induced by OA, it is likely that subjects with OA were more willing to participate than those without OA. However, OA was more commonly reported by women, and the prevalence increased with age, which is characteristic of an OA population. Another factor that may bias the self-reported prevalence of OA is that other diseases such as fibromyalgia may have a distorting effect. However, in our study, OA patients registered the lowest scores in all dimensions of the SF-36, with physical limitations as the main difference between OA and healthy subjects. These results are consistent with outcomes reported in other OA populations^{24,25}. Briggs, *et al*²⁴ showed that patients with OA had a lower HRQOL compared to healthy subjects, particularly in the domains of physical health status (bodily pain, physical functioning, and role physical). This is also in agreement with a study based on the Sickness Impact profile quality of life measure, which reported a significant limitation in overall function in OA patients and highlighted physical limitations as the main differences between OA patients and controls²⁵. Given the concordance with results from the literature, we may assume that it is unlikely that fibromyalgia had a distorting effect in our study. Moreover, we acknowledge that patients who completed the questionnaire may have had painful OA, and this may have biased the results for self-reported prevalence, use of healthcare, and costs.

According to some authors, self-report of healthcare utilization may lead to underestimation of the use of resources^{26,27}. In contrast, other researchers suggest that an expense diary can be an effective research tool²⁸. We designed a user-friendly expense diary in which subjects were asked to

report OA related healthcare utilization and absence from work. An advantage is that subjects completed diaries at the time of the resource use, in order to avoid memory bias. A disadvantage is the lower compliance in completing diaries over a long period. It is important that in our study there was no financial compensation; instead, a reminder procedure was set up so that respondents remain motivated throughout the reporting period and in order to optimize study quality and to collect a maximum of data. The response rate was high (52%) for this type of study. We also acknowledge that our sample was slightly older and included more women than the general Belgian population. These elements should be taken into consideration when extrapolating the data in a societal perspective. Moreover, there is a widespread perception that public sector workers are less work-enthusiastic than those in the private sector, and thus may be more likely to use healthcare services and to incur leave or days off. This may have biased the data toward a more costly process. In addition, this was a cohort study, and the weights and amounts of different costs could vary in other cohorts. The costs presented here may be over- or underestimated and comparisons with data from other studies and countries, and extrapolation of these data to other countries, may be difficult due to differences in health services organization. Further, the Belgian healthcare system is a universal system offering wide access to healthcare and reimbursements. In less favorable systems where copayment is more important, it is possible that the costs generated are also lower.

Our survey of a large sample of active subjects shows that direct and indirect costs attributable to OA are substantial, with the loss of productivity related costs being predominant. Poorer HRQOL was a major determinant of these expenditures. Our findings highlight the important economic burden induced by OA in the workplace. In the current environment of restricted resources allocated to public health, our findings may be of interest for healthcare decision-makers and payers.

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