ORIGINAL ARTICLE

Occupational Strain as a Risk for Hip Osteoarthritis

A Systematic Review of Risk Assessment

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SUMMARY

Background: Multiple epidemiological studies have revealed an association between occupational physical strain and the risk of developing hip osteoarthritis.

Methods: To determine the association between the lifting and carrying of heavy loads or other physically demanding work and the risk of hip osteoarthritis (HOA) or total hip replacement (THR), we systematically searched the literature for primary studies on the effects of exposure to physical strain and meta-analytically reviewed the results that were amenable to comparisons across studies. We separately assessed studies that had hip pain as an endpoint.

Results: 5 cohort studies and 18 case-control studies were found suitable for inclusion. The lifting of heavy loads increases the risk of HOA or THR: exposure doubles the risk in men (relative risk [RR] 2.09, 95% confidence interval [1.4; 3.1]) and increases it by roughly 40% in women (RR 1.41 [1.0; 1.9]). Physically demanding work consisting of a combination of activities of various kinds (dealing with heavy loads, heavy manual work, or prolonged walking and standing) increases the risk by roughly 150% in men (RR 2.46 [1.3; 4.8]) and 40% in women (RR 1.38 [0.9; 2.2]). Hip pain was also reported more commonly in the exposed groups.

Conclusion: The studies are moderately to highly heterogeneous. An association exists between years of lifting heavy loads or other kinds of physical strain on the job and the risk of developing osteoarthritis of the hip. The greater the exposure, the greater the risk. The evidence base for risk assessment in women is currently inadequate.

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Osteoarthritis of the hip (HOA) can cause severe pain and impairs quality of life. The burden on the healthcare system is considerable, and HOA has a negative effect on employment (1). While there are no robust data on the prevalence of HOA specific to Germany, a representative study (e1) found a lifetime prevalence of 2% for both men and women in Europe as a whole. International epidemiological studies show that the prevalence of HOA in women is 1 to 3% in the age group 45 to 75 years—depending on region and diagnostic criteria—and rises steeply thereafter. In men up to 75 years of age the reported prevalence of HOA varies between 2.5 and 8.5% (2–4). Alongside predisposing factors, the risk is increased by hip defects, age, overweight, and injury (5, 6).

The guidelines stipulate diagnosis of HOA, also known as coxarthrosis, on the basis of the triad of joint pain, impaired mobility, and radiological findings. Internationally, the most commonly used systems are the American College of Rheumatology criteria (7), the Kellgren and Lawrence radiological score (8), and function-related scoring systems such as the Western Ontario and McMaster Universities Osteoarthritis Index (WOMAC) (9) and the Harris Hip Score (10). Radiological signs of arthrosis, e.g., narrowing of the joint space, do not always go hand in hand with pain and functional impairment. Only around 25 to 45% of cases of hip pain are attributable to HOA (11, 12). The overall importance of HOA will increase with the aging of the population (13).

Aim of study

The published reviews (14, 15) conclude that there is a basic link between occupations involving physically demanding work and the development of HOA. Owing to the nature of the searches and the restriction to certain types of study design, the numbers of studies included in these reviews were relatively small. Some of the searches were carried out more than 10 years ago. Meta-analyses and statements on the dose-response relationship are conspicuous by their absence. Therefore, we decided to carry out a new systematic survey of the literature with an expanded search string

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BOX 1

Inclusion criteria

- **Population**
 - Adult men and women, currently or previously employed
- **Exposure**
 - Precise data on lifting of loads and physically demanding tasks
- **Endpoints**
 - Osteoarthritis of the hip on clinical or radiological examination
 - Implantation of a hip joint prosthesis (total hip replacement)
 - Also: Self-reported hip pain or impairment of mobility
- **Study design**
 - Cohort studies
 - Case-control studies
 - Cross-sectional studies, provided task or occupation performed for at least 10 years
 - Studies published in German or English from 1990 onward

and including all types of studies. Study quality was assessed in uniform fashion and the data for men and women were analyzed separately. Our aim was to identify ways of preventing occupational HOA.

Methods

A systematic survey of the databases Medline, CENTRAL, Embase, and HSE-Line was carried out in March 2015. The search strategy was based on a combination of MeSH terms and text words as recommended by Mattioli in 2010 (16). We also conducted a manual search of the tables of contents of occupational medicine journals, the abstracts of international orthopedic conferences, and the references of all studies selected for inclusion. The inclusion criteria are listed in *Box 1*. At the beginning of the study the protocol was registered in PROSPERO (registration number CRD42015016894).

Study selection

Two independent reviewers scrutinized and evaluated titles and abstracts (AB, AF, DK, MF), extracted data, and assessed the quality of the included studies (AB, DK, SU, UBA). In the case of disagreement, a third reviewer (AS) was consulted.

Quality assessment

The quality criteria were developed separately for cohort studies and case-control studies on the basis of the Newcastle-Ottawa Quality Assessment Scale (17) and the Cochrane Handbook (18). The assessment cat-

BOX 2

Quality criteria

- **Cohort studies (max. score 19 points)**
 - **Selection (max. 5 points)**
Representativeness of cohorts, selection of nonexposed probands, baseline participation rate, osteoarthritis of hip excluded at baseline
 - **Exposure (max. 4 points)**
Validity and accuracy of data acquisition, same method for exposed and nonexposed probands
 - **Comparability, confounding (max. 4 points)**
Adjustment for age, sex, body mass index; full report of hypotheses, risk estimators separate for men and women
 - **Diagnosis of hip osteoarthritis (max. 6 points)**
Validity of diagnosis, blinding, duration and quality of follow-up
- **Case-control studies (max. 15 points)**
 - **Selection of cases and controls (max. 6 points)**
Validity of diagnosis, representativeness of cases and controls, response rate
 - **Comparability, confounding (max. 4 points)**
Adjustment for age, sex, body mass index; full report of hypotheses, risk estimators separate for men and women
 - **Exposure (max. 5 points)**
Validity and accuracy of data acquisition, blinding to diagnosis, same method for cases and controls

egories are shown in *Box 2*. A detailed description of the quality criteria can be found in *eTables 1* and *2*.

Statistical analysis

To estimate the risk of HOA we compared, in each study, the highest and the second highest exposure category with the lowest exposure category. The individual studies reported odds ratios (OR), relative risks (RR), or hazard ratios (HR) with 95% confidence intervals (95% CI). Owing to the low prevalence of HOA, these estimators of effect do not differ widely from one another, so we interpreted all relative effect estimators as estimated relative risks. The effect estimators of the individual studies were merged with the random effects model in meta-analyses to produce pooled RR for the various endpoints (STATA version 14, metan procedure).

We performed separate meta-analyses for studies on the lifting/carrying of loads and studies on physically demanding work, with separate evaluation of data for men, women, and sex-undifferentiated groups. Some studies investigated several of these categories and

were therefore included in various subanalyses. Four studies in which pain was the sole diagnostic criterion were not included in the meta-analyses but were evaluated separately.

The absolute risks of HOA (19) were calculated from the pooled RR and the lifetime prevalences of 1.9% for men and 2.1% for women (e1). The heterogeneity of the effect estimators was interpreted substantively and described using the I^2 statistic (18).

Results

A total of 3419 titles and abstracts were scrutinized and 247 full texts were read. After exclusion of all publications that did not fulfill our criteria, five cohort studies (eTable 3) and 18 studies with evaluation according to case-control status (eTable 4) were included (Figure).

Participants in primary studies

The 23 studies selected for inclusion were mostly carried out in Europe (n = 19), predominantly in the Scandinavian countries, the Netherlands, or the UK.

In the five cohort studies the duration of follow-up varied from 2 to 22 years. The participants were mostly of working age (20 to 70 years). Their mean age at the time of investigation was usually over 45 years. The proportions of men and women varied widely among the occupational groups. Four studies (e2–e5) included only men, and in one study (e6) all the participants were women. All of the studies included in our analysis adjusted for age and sex, and 11 of the case-control studies and four cohort studies also adjusted for body mass index or other significant confounders.

Exposure

Eleven case-control studies and one cohort study investigated the exposure effect for the lifting of loads. In five of these case-control studies (e1, e7–e10) men and women were analyzed separately. Two of the case-control studies included only men (e4, e5), while one was restricted to women (e6). Five of the case-control studies evaluated men and women together (e7, e8, e11–e13). Two of the case-control studies and one cohort study diagnosed HOA on the basis of pain and were therefore analyzed separately, because pain is not a reliable diagnostic criterion (e11, e14, e15). The degree of exposure was determined by means of questionnaires or interviews: the loads ranged from 5 kg (e16) to more than 40 kg (e4). One study (e17) could not be included in the meta-analysis owing to a lack of sufficient data on categories of exposure.

Five case-control studies and three cohort studies did not describe the loads lifted or carried in concrete terms but instead defined criteria for “physically demanding work.” The definition of physically demanding work usually comprised a combination of various characteristics of activity, e.g., handling loads, heavy manual activity, and long periods of standing or walking. A sedentary occupation was gen-

FIGURE

Flow chart of literature survey

erally defined as light manual labor. Some studies classified occupations as involving light or heavy physical strain. Five studies investigated the risk for men (e2, e3, e16, e18, e19), two were restricted to women (e18, e19), and one did not differentiate by sex (e20). Two cohort studies used pain as diagnostic criterion (e14, e21).

Diagnosis

The studies included in meta-analysis employed various criteria for the diagnosis of HOA:

- Implantation of a hip joint prosthesis (total hip replacement, THR) (e4, e6–e8, e11, e13, e18, e19)
- Clinical and radiological diagnostic criteria or THR (e1, e5, e9, e15, e17)
- Exclusively clinical or radiological diagnostic criteria (e3, e10, e12, e16, e20, e22, e23).

Quality assessment

The five cohort studies selected for inclusion scored 12 to 15 quality points on a scale of 0 to 19 (eTable 3).

Three population-based studies met all the quality criteria with regard to selection of participants. Two studies inquired about the weight of the loads lifted or carried. One frequently occurring limitation was joint analysis of men and women. The diagnosis was established by valid means in two studies, while in all other

THE CLINICAL PERSPECTIVE

What can the company physician and family physician do?

● Early diagnosis of hip osteoarthritis*¹

History

- Hip pain (localized in groin, radiating pain)
- Morning stiffness (over 30 min but under 60 min)
- Impaired mobility of hip in daily life

Examination

- Limping, one side shorter than the other
- Internal rotation <15°
- Inguinal pressure and trochanter percussion pain

Radiography

- Joint space between femoral head and acetabulum <2 mm
- Osteophytes and sclerosis

● Preventive occupational medicine*²

Medical check up offered by employer for workers performing tasks associated with greatly elevated health risks for the musculoskeletal system, e.g., the lifting, holding, carrying, pushing, or dragging of heavy objects

Preventive examination by employee request

- In the presence of symptoms that are otherwise connected with the task concerned
- The employer must offer the prevention scheme; participation is voluntary. Only with the employee's agreement is the outcome communicated to the employer.

● Assistance and rehabilitation

Those affected should take advantage of the support services provided for by law as early as possible, in order to alleviate their symptoms and adapt their workplace accordingly. In addition to the prescription of physiotherapy, the following options exist:

- Prescription of **rehabilitative exercise and functional training** off budget, via the health insurance provider
- **Out-of-hospital preventive measures** for employees with early functional impairments, via the pension insurance fund
- **Outpatient and inpatient medical rehabilitation** via the pension insurance fund with subsequent participation in the aftercare program IRENA
- **Support in the workplace**, via the pension insurance fund: funding for technical aids, occupational rehabilitation
- Support for the **disabled**, via the local integration agency

*¹ According to the criteria of the American College of Rheumatology (7) and the radiological scoring systems described by Kellgren and Lawrence (8) and Croft (e5)

*² As stipulated by the Ordinance on Occupational Health Care (Verordnung zur arbeitsmedizinischen Vorsorge, ArbMedVV)

studies it rested on information provided by the probands.

The 18 included case-control studies scored 5 to 14 quality points on a scale of 0 to 15 (*eTable 4*). Seven studies attained at least 5 of a possible 6 points for “selection and representativeness” of the cases and control subjects. Seven studies scored maximum points for

“comparability of cases and controls”. Only one study (e7) scored maximum points for determination of exposure. This study was based on assessment of exposure using a job exposure matrix (JEM). Four studies (e1, e7, e9, e11) inquired about load weight and the duration and frequency of lifting/carrying events, permitting estimation of the cumulative dose.

Study results

In men, lifting loads of the highest exposure category doubled the risk of HOA/THR (RR 2.09 [1.4; 3.1]). The second highest exposure category was associated with a 1.3-fold increase in risk (RR 1.35 [0.9; 1.9]). All studies found an increase in the risk of HOA/THR with increasing exposure. Based on a mean lifetime prevalence of HOA of 1.9% (19 per 1000), the risk in the highest exposure category rose to 40 per 1000 (95% CI: [27; 59]) (*Table 1*). In the second highest exposure category the risk of HOA/THR went up to 26 per 1000 [18; 36]. Therefore, a positive dose-response relationship was demonstrated both at the level of the seven studies included and at the level of the pooled estimators (*Table 2*).

In women, lifting loads increased the risk of HOA/THR in the two highest exposure categories by about 40% compared with the lowest exposure category (RR 1.41; [1.0; 1.9] and RR 1.40 [0.9; 2.2] respectively). The risk of developing HOA thus increased from 21 per 1000 [21; 40] to ca. 30 per 1000 [19; 46] (*Table 3*).

The five studies that did not evaluate men and women separately (e7, e8, e11–e13) also confirm that higher exposures are associated with an increased risk of HOA (*eTable 5*). The lifting and carrying of heavy loads also increases the risk of developing hip pain (RR 1.47 [1.1; 1.9]) (e11, e15). The moderate to high heterogeneity displayed by all risk estimators can be attributed to differences in study design and the variation in the weight of the loads concerned. Sensitivity analyses based on high-quality studies (scoring at least 12 of 15 points for quality) confirm the increase in the risk of developing HOA with increased exposure (e1, e4, e6–e8).

In men, physically demanding work increased the risk of HOA/THR 2.5-fold in the highest strain category (RR 2.46 [1.3; 4.8]) and twofold in the second highest strain category (RR 1.97 [1.3; 3.1]) (*eTable 6*). The increase in risk was somewhat lower for women: 38% in the highest (RR 1.38 [0.9; 2.2]) and 30% in the second highest strain category (RR 1.30 [0.9; 2.0]) (*eTable 7*). Studies that evaluated men and women together confirm these findings (*eTable 7*). The two cohort studies (e14, e21) that investigated hip pain found that activities involving physical strain increased the risk of pain (RR 1.77 [1.3; 2.4]).

Owing to the widely varying definitions of “physically demanding work,” the heterogeneity of the exposure effects for this form of exposure was greater than in studies of the effects of lifting loads. The study with a low-threshold definition of physically demanding

TABLE 1

Risk of developing osteoarthritis of the hip^{*1} owing to the lifting of heavy loads in men: comparison of highest and lowest exposure category

TABLE 2

Risk of developing osteoarthritis of the hip^{*1} owing to the lifting of heavy loads in men: comparison of second highest and lowest exposure category

TABLE 3

Risk of developing osteoarthritis of the hip^{*1} owing to the lifting of heavy loads in women: comparison of highest and second highest exposure categories with lowest exposure category

Study	No. of cases/ controls Age (years)	Comparison	QS	Effect estimator [95% CI]
Highest versus lowest exposure category				
Coggon 1998 (e8) (CCS)	13/11 45–91	Loads ≥ 50 kg more than 10 × per week for at least 10 years vs. <10 years	12	OR: 1.10 [0.49; 2.46]
Elsner 1995 (e10) (CCS)	18/11 adults ^{*2}	Loads >20 kg, always/often vs. seldom/practically never	5	OR: 1.90 [0.80; 4.80]
Kaila-Kangas 2011 (e1) (CCS)	16/3 446 30–97	Loads >20 kg, > 10 × per working day, for more than 24 years vs. 0 years	13	OR: 1.20 [0.7; 2.1]
Lau 2000 (e9) (CCS)	21/29 k. A.	Loads ≥ 50 kg at least 10 × per week vs. 0 × per week	7	OR: 2.90 [1.50; 5.60]
Rubak 2014 (e7) (CCS)	25/23 41–69	>20 TY vs. 0 TY	14	OR: 1.0 [0.7; 1.4]
Vingård 1997 (e6) (CCS)	82/n.d. 50–70	>44 089 lifting events (weight unspecified) up to age 50 years vs. 0–20 328 lifting events	13	OR: 1.50 [0.90; 2.50]
Heterogeneity I ² = 46%		Increase in risk from 21 per 1000 to 44 per 1000 ; 95% CI: [21; 40]	RR _{pooled} : 1.41 [1.02; 1.94]	
Second highest versus lowest exposure category				
Coggon 1998 (e8) (CCS)	20/21 45–91	Loads 25–49 kg more than 10 × per week for at least 10 years vs. <10 years	12	OR: 0.90 [0.49; 1.66]
Elsner 1995 (e10) (CCS)	37/27 adults ^{*2}	Loads 5–20 kg, always/often vs. seldom/practically never	5	OR: 2.00 [1.00; 4.10]
Kaila-Kangas 2011 (e1) (CCS)	8/3 446 30–97	Loads >20 kg, 10 × per working day, for 13–24 years vs. 0 years	13	OR: 3.8 [1.7; 8.1]
Lau 2000 (e9) (CCS)	10/18 n.d.	Loads ≥ 50 kg, 1–10 × per week vs. 0 × per week	7	OR: 2.00 [0.89; 4.60]
Rubak 2014 (e7) (CCS)	33/40 41–69	>10 to 20 TY vs. 0 TY	14	OR: 0.81 [0.61; 1.1]
Vingård 1997 (e6) (CCS)	n.d./n.d. 50–70	20 329–44 089 lifting events (weight unspecified) up to age 50 years vs. 0–20 328 lifting events	13	OR: 1.10 [0.71; 1.71]
Heterogeneity I ² = 74%		Increase in risk from 21 per 1000 to 29 per 1000 ; 95% CI: [19; 46]	RR _{pooled} : 1.40 [0.9; 2.2]	

CCS, Case-control study; CI, confidence interval; n.d., no data; OR, odds ratio;

QS, quality score; RR, relative risk; RR_{pooled}, pooled relative risk; TY, ton year

^{*1} Total hip replacement or clinically/radiologically diagnosed osteoarthritis of the hip; ^{*2} age range not specified

work (e16) showed no increase in effects with increasing exposure, whereas very pronounced exposure effects were found in some of the studies with higher thresholds (e3). For this form of exposure too, analysis of only high-quality studies confirms that the risk increases with the level of exposure.

Discussion

The studies included in our analyses show that both the lifting of heavy loads and physically demanding work in general increase the risk of HOA. This finding is in agreement with previously published reviews (14, 15, 20) reporting a moderate to high increase in the risk of the development of HOA for “heavy lifting and carrying” and “physically demanding work,” whereby these earlier publications described the exposure effects

purely in narrative form. Our study involved additional meta-analytic pooling of the effects observed in comparable studies.

All analyses show that men are at greater risk of developing HOA. In all categories considered, the increase in risk is lower for women than for men. This is probably due to methodological inadequacies of the studies concerned. Most of the studies did not cover occupations where women predominate (e.g., nursing). Frequently the high exposure categories included only small numbers of women.

The frequency of lifting was usually not reported in absolute terms; rather, a minimum number of lifting events (e.g., 10 per working day) was defined. It can be assumed that men lift heavy loads more often per working day than women and thus have greater

exposure. A sufficiently reliable statement on the effects for women cannot be derived from the data of the studies we analyzed. Studies with hip pain as the sole diagnostic criterion (e11, e14, e15, e21) also show an increase in risk with increasing exposure.

Dose–response relationship

Examination of the effect estimators for the highest and second highest exposure categories shows that the risk of HOA increases with the weight of loads that are lifted and carried. A precise dose–response relationship could not be calculated because of the pronounced heterogeneity of data acquisition.

Four studies (e1, e7–e9) permit estimation of the minimum dose for loads. In men, the risk of developing HOA is increased after ca. 20 years' regular lifting of loads weighing around 20 kg. For loads of 50 kg, the risk increases after only 10 years. In cumulative terms, lifting of at least 3000 to 5000 t is necessary to raise the risk of HOA to any significant extent. The weight thresholds seem to be lower for women. However, the studies do not permit specification of relevant cumulative loads for women. Men in occupations involving physically demanding work have an increased risk of HOA after ca. 15 to 20 years (e2, e4).

Limitations

The precision of the effect estimators is reduced by the heterogeneity of the exposure. Not all studies reported the duration of exposure. Investigations into memory distortion (recall bias) with regard to occupational exposure have shown that patients tend to overestimate their past exposure, particularly in respect of lighter loads (<5 kg), shorter work tasks (<2.5 min), and recent exposure. In the studies we analyzed, the duration of exposure was usually over 10 years and the loads mostly exceeded 20 kg, or exposure was derived indirectly from the type of occupation. In general the risk of HOA tended to be overestimated by recall bias. However, we believe that recall bias probably had only a slight impact owing to the nature of the studies included. The data on the effects in women are insufficient.

Total hip replacement is often used as a study endpoint. However, the relative frequency of this operation differs widely among countries owing to variation in healthcare structures (21). Therefore, studies of THR patients do not reflect the total incidence of HOA. Despite these limitations, the consistently comparable results of the cohort and case–control studies indicate that our findings are robust.

Summary

For men, our data demonstrate a positive association between long-term lifting and carrying of heavy loads, or physically demanding work in general, and the risk of developing osteoarthritis of the hip. For women, we take the view that more research is needed.

On the basis of our findings, recommendations for preventive measures can be proposed. Loads of 20 kg or more should not be lifted without mechanical assis-

KEY MESSAGES

- Both the lifting of heavy loads and physically demanding work increase the risk of osteoarthritis of the hip (HOA).
- In all the studies evaluated, the effect increased with increasing exposure. Precise delineation of a dose–response relationship was precluded by the heterogeneity of data acquisition.
- In all analyses the effects were lower for women than for men. There are methodological reasons for this. Women were clearly underrepresented in the studies evaluated. Occupations that involve physical strain and are typically carried out by women (e.g., nursing) were not included. Further research is required.
- Only four studies permit dose estimation with regard to loads. For men, the risk of developing HOA is increased after ca. 20 years' regular lifting of loads weighing around 20 kg. For loads of 50 kg, the risk increases after only 10 years.

tance. With the goal of detecting signs of HOA as early as possible, preventive occupational medicine should include examination of the hip after no more than 15 to 20 years in a relevant occupation. Since the limited available data do not show any meaningful effect of training and exercise on the progression of HOA in the occupational context (22), any measures taken should aim at reducing the amount of strain. Workers who need to change their job should take advantage of the occupational rehabilitation programs offered by health insurance providers and pension insurance funds. Osteoarthritis of the knee is legally defined in Germany as an occupational disease (code no. 2112) with a cause–effect relationship comparable to that which is demonstrable for HOA. Thus, together with compensation in individual cases, section 3 of the Ordinance on Occupational Diseases (*Berufskrankheiten-Verordnung*, BKK) provides for technical aids and occupational reorientation.

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Conflict of interest statement

The authors declare that no conflict of interest exists.

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Supplementary material

For eReferences please refer to:
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Supplementary material to:

Occupational Strain as a Risk for Hip Osteoarthritis

A Systematic Review of Risk Assessment

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eTABLE 1

Quality criteria for cohort studies

I. Selection (max. 5 stars)	Assessment
1. Representativeness of the cohorts	
Representative of the occupational group concerned or of the general population, whichever is applicable	*
Selected group	
No or inadequate description of cohort derivation	
2. Selection of members of the groups with no or low exposure	
Drawn from the same population segment as the exposed group; one star awarded for representativeness of cohort	*
Drawn from the same population segment as the exposed group, but no star awarded for representativeness of cohort	
Drawn from another source	
No or inadequate description of derivation of nonexposed cohort	
3. Participation rate at baseline	
Response rate >80% or participation rate 50%; nonresponder analysis shows comparability of responders and nonresponders	**
Response rate ≥ 50% to 80% without nonresponder analysis	*
Response rate < 50%	
Not reported	
4. Baseline: probands with hip osteoarthritis or hip pain	
Not included in study or excluded from analysis	*
Data not acquired or not considered in analysis	
II. Exposure (max. 4 stars)	
1. Validity and reproducibility of data acquisition (methods)	
Reliable, reproducible data acquisition (e.g., measurement at workplace, valid documentation)	**
Structured interview/questionnaire or registry data	*
Written self-report	
No or inadequate description of data acquisition	
2. Same method of data acquisition for exposed and nonexposed subjects	
Yes	*
No	
3. Accuracy of exposure data	
Quantitative data on exposure (frequency and/or duration, e.g., weight of load, hours driving a tractor)	*
Only occupation or activity specified, without information on concrete tasks such as those mentioned in the line above	
III. Comparability of exposure groups, analysis (max. 4 stars)	
1. Comparability of cohorts on basis of designs or analysis (adjustment, subgroup analysis, or other suitable methods, e.g., stratification or matching)	
Analysis after adjustment, matching, or stratification for age, sex, and body mass index or other important confounders (with a coherent concept, i.e., the second star for adjustment for other important confounders was awarded only if the adjustment is sufficiently justified, e.g., by description as confounders or change in estimate)	**
Analysis after adjustment, matching, or stratification for age and sex (if relevant)	*
No adjustment, no matching, no stratification	
2. Have all the planned comparative hypotheses mentioned in the methods section been reported with quantifiable data?	
Yes	*
No (e.g., only significant differences are reported, or only p-values are given)	
3. Have effect estimators been calculated separately for men and women?	
Yes, or only one sex was investigated	*
No	

IV. Endpoint (max. 6 stars)	
1. Validity and reproducibility of the diagnosis hip osteoarthritis	
If one of the following conditions is met, two stars are awarded: diagnosis by statement of hip pain + clinical examination with measurement of mobility/function + radiological imaging with clearly defined criteria as stipulated in guidelines (7, 8; measurement of joint space width), or implantation of a hip prosthesis (total hip replacement, THR), or on waiting list for THR	**
If one of the following conditions is met, one star is awarded: diagnosis from registry data or measurement of mobility/function by means of a complex scale with subscales for pain assessment, mobility, and function—e.g., Western Ontario and McMaster Universities Osteoarthritis Index (WOMAC), Harris Hip Score (HHS), Hip Disability and Osteoarthritis Outcome Score (HOOS)—or statement of hip pain or impaired mobility + criteria of hip osteoarthritis according to guidelines on clinical examination without radiological imaging, or statement of hip pain or impaired mobility + radiological finding without clinical examination, or diagnosis of hip osteoarthritis by an orthopedist or rheumatologist without documentation of the radiological or clinical findings, or solely radiologically confirmed diagnosis of hip osteoarthritis	*
Simple form of self-reported hip pain and mobility impairment (e.g., visual analog scale [VAS], inquiry about hip pain and dysfunction on most days of previous month) or patients' self-report of diagnosis by an orthopedist/surgeon or medical diagnosis (not by an orthopedist or rheumatologist) without documented criteria	
2. Diagnosis of hip osteoarthritis with blinding to exposure	
Yes, or influence of exposure on documentation of outcome can be practically excluded (substantiation required)	*
No	
Not reported	
3. Was the follow-up long enough for the endpoint to occur?	
Yes (duration ≥ 10 years)	*
No	
4. Adequate follow-up	
Information as to outcome is available for at least 95% of all probands in the cohort	**
It is improbable that the rate of study drop-outs suffices to produce bias: follow-up rate ≥ 80% or nonresponder analysis shows comparability of responders and nonresponders	*
Follow-up rate <80% and no nonresponder analysis, or nonresponder analysis shows that responders and nonresponders are not comparable	
No description, or differences in follow-up rates >15% between exposed and nonexposed groups	

eTABLE 2

Quality criteria for case-control studies and cross-sectional studies

I. Selection (max. 6 stars)	Assessment
1. Are the cases adequately defined?	
If one of the following conditions is met, two stars are awarded: diagnosis by statement of hip pain + clinical examination with measurement of mobility/function + radiological imaging with clearly defined criteria as stipulated in guidelines (7, 8; measurement of joint space width), or implantation of a hip prosthesis (total hip replacement, THR), or on waiting list for THR	**
If one of the following conditions is met, one star is awarded: diagnosis from registry data or measurement of mobility/function by means of a complex scale with subscales for pain assessment, mobility, and function—e.g., Western Ontario and McMaster Universities Osteoarthritis Index (WOMAC), Harris Hip Score (HHS), Hip Disability and Osteoarthritis Outcome Score (HOOS)—or statement of hip pain or impaired mobility + criteria of hip osteoarthritis according to guidelines on clinical examination without radiological imaging, or statement of hip pain or impaired mobility + radiological finding without clinical examination, or diagnosis of hip osteoarthritis by an orthopedist or rheumatologist without documentation of the radiological or clinical findings, or solely radiologically confirmed diagnosis of hip osteoarthritis	*
Simple form of self-reported hip pain and mobility impairment (e.g., visual analog scale [VAS], inquiry about hip pain and dysfunction on most days of previous month) or patients' self-report of diagnosis by an orthopedist/surgeon or medical diagnosis (not by an orthopedist or rheumatologist) without documented criteria	

2. Representativeness of the cases	
Continuous or randomly selected and obviously representative case series from defined study basis	*
Possibility of selection bias or inadequate description of case identification	
3. Selection of controls	
General population or same population as cases, if a star was awarded for representativeness of cases	*
Same population as cases, but no star awarded for representativeness of cases	
Hospitalized controls	
No adequate selection or selection not described	
4. Nonresponse rate	
Response rate >80%, or participation rate 50% + nonresponder analysis shows comparability of responders and nonresponders	**
Response rate ≥ 50%, and difference in response rate between case and control groups does not exceed 25%	*
Nonresponder analysis shows comparability of responders and nonresponders	
Not described or conditions not stated	
II. Confounding, comparability of exposure groups, analysis (max. 4 stars)	
1. Comparability of cases and controls on basis of design or analysis (adjustment, subgroup analyses, or other suitable methods: stratification, matching)	
Analysis after adjustment, matching, or stratification for age, sex, and body mass index or other important confounders (with a coherent concept, i.e., the second star for adjustment for other important confounders should be awarded only if the adjustment is sufficiently justified, e.g., by description as confounders or change in estimate)	**
Analysis after adjustment, matching, or stratification for age and sex (if relevant)	*
No adjustment, no matching, no stratification	
2. Have all the planned comparative hypotheses mentioned in the methods section been reported with quantifiable data?	
Yes	*
No (e.g., only significant differences are reported, or only p-values are given)	
3. Have effect estimators been calculated separately for men and women?	
Yes, or only one sex was investigated	*
No	
III. Exposure (max. 5 stars)	
1. Validity and reproducibility of data acquisition (methods)	
Reliable, reproducible data acquisition (e.g., measurement at workplace, valid documentation)	**
Structured interview/questionnaire or registry data	*
Written self-report	
No or inadequate description of data acquisition	
2. Accuracy of exposure data	
Quantitative data on exposure (frequency and/or duration, e.g., weight of load, hours driving a tractor)	*
Only occupation or activity specified, without previously mentioned information on concrete tasks	
3. Documentation of exposure with blinding as to outcome	
Yes	*
Influence of outcome on documentation of exposure can be practically excluded (substantiation required)	*
No	
Not reported	
4. Same method of data acquisition for cases and controls	
Yes	*
No	

eTABLE 5

Risk of developing osteoarthritis of the hip* owing to the lifting of heavy loads: joint evaluation of men and women, comparison of highest and second highest exposure categories with lowest exposure category

Study	No. of cases/ controls Age (years)	Comparison	QS	Effect estimator [95% CI]
Highest vs. lowest exposure category				
Allen 2010 (e12) (CCS)	38/183 63.6 ± 10.5	Loads ≥ 50 kg, >10 x per week vs. <10 kg	7	OR 1.88 [1.21; 2.92]
Coggon 1998 (e8) (CCS)	73/47 45–91	Loads ≥ 50 kg more than 10 x per week for at least 10 years vs. <10 kg	12	OR 1.80 [1.1; 2.9]
Rubak 2014 (e7) (according to Rubak 2010 [e24]) (CCS)	126/85 41–69	>50 TY vs. 0 TY	14	OR 1.37 [1.06; 1.77]
Sobti 1997 (e11) (CCS)	23/984 70–75	>20 years with mean load weight >25 kg vs. 0 years	10	OR 1.14 [0.65; 2.00]
Yoshimura 2000 (e13) (CCS)	13/4 >45, 63.8 ± 10.9	Loads >50 kg vs. <10 kg	9	OR 4.1 [1.1; 15.2]
Heterogeneity I ² = 26%		Increase in risk from 20 per 1000 to 31 per 1000 [24; 40]	RR _{pooled} : 1.55 [1.2; 2.0]	
Second highest vs. lowest exposure category				
Allen 2010 (e12) (CCS)	75/501	Loads 20–59 kg, >10 x per week vs. <10 kg	7	OR 1.63 [1.15; 2.30]
Coggon 1998 (e8) (CCS)	57/52 45–91	Loads >20 kg, 10 x per working day for 13–24 years vs. <10 kg	12	OR 1.10 [0.67; 1.8]
Rubak 2014 (e7) (according to Rubak 2010 [e24]) (CCS)	605/979 41–69	10–50 TY vs. 0 TY	14	OR 1.36 [1.09; 1.68]
Sobti 1997 (e11) (CCS)	26/748 70–75	1–20 years with mean load weight >25 kg vs. 0 years	10	OR 1.65 [0.97; 2.80]
Yoshimura 2000 (e13) (CCS)	28/19 >45, 63.8 ± 10.9	Loads 25–50 kg vs. <10 kg	9	OR 1.5 [0.7; 3.0]
Heterogeneity I ² = 0%		Increase in risk from 20 per 1000 to 28 per 1000 , 95% CI: [24; 34]	RR _{pooled} : 1.41 [1.2; 1.7]	

CCS, Case-control study; CI, confidence interval; OR, odds ratio;

QS, quality score; RR, relative risk; RR_{pooled}, pooled relative risk; TY, ton year (1 TY = lifting of 1 t in the course of 1 year)

* Total hip replacement or clinically/radiologically diagnosed osteoarthritis of the hip

eTABLE 6

Risk of developing osteoarthritis of the hip* owing to physically demanding work in men: comparison of highest and second highest exposure categories with lowest exposure category

Study	Participants Age (years)	Comparison	QS	Effect estimator [95% CI]
Highest vs. lowest exposure category				
Case-control studies				
Cvijetić 1999 (e16)	50/50 62.5 ± 10.3	High physical demands (>80% walking, standing, loads >5 kg) for >30 years vs. <20 years	11	OR: 1.22 [0.98; 2.46]
Roach 1994 (e2)	54/97 68.2 ± 6.4/ 67.7 ± 7.1	Hard work while standing, kneeling/walking for at least 15 years vs. light work (sitting/standing)	8	OR: 2.4 [1.3; 4.3]
Vingård 1992 (e3)	50/23 46–65	High personal exposure to strain (calculated from years in occupation and four load categories from slight to high) in past 20 working years vs. low exposure	10	OR: 12.4 [6.7; 23.0]
Case-control studies: Heterogeneity I ² = 92%			RR _{pooled} : 3.74 [2.6; 5.5]	
Cohort studies				
Flugsrud 2002 (e19)	6202/6420 34–59	Physically demanding work (e.g., forestry, farming; n.d. on duration of exposure) vs. sedentary work	14	RR: 2.1 [1.5; 3.0]
Rubak 2013 (e18)	88 131/21 407 49.1 ± 10.5	35–86 PY vs. 0 PY	15	OR: 1.33 [1.17; 1.53]
Cohort studies: Heterogeneity I ² = 82%			RR _{pooled} : 1.63 [1.1; 2.5]	
Second highest vs. lowest exposure category				
Case-control studies				
Cvijetić 1999 (e16)	92/92 62.5 ± 10.3	High physical demands (>80% walking, standing, loads >5 kg) for 20–29 years vs. <20 years	11	OR: 2.46 [0.51; 4.54]
Roach 1994 (e2)	27/60 68.2 ± 6.4/ 67.7 ± 7.1	Moderately hard work (not sitting, no hard work) for at least 15 years vs. light work (sitting/standing)	8	OR: 1.9 [1.0; 3.8]
Vingård 1992 (e3)	70/128 46–65	Moderate personal exposure to strain (calculated from years in occupation and four load categories from slight to high) in past 20 working years vs. low exposure	10	OR: 4.1 [2.4; 7.1]
Case-control studies: Heterogeneity I ² = 92%			RR _{pooled} : 2.95 [2.0; 4.4]	
Cohort studies				
Flugsrud 2002 (e19)	5972/6420 34–59	Intermediate manual labor (e.g., postman, construction worker) vs. sedentary work	14	RR: 1.7 [1.1; 2.4]
Rubak 2013 (e18)	171 795/21 407 49.1 ± 10.5	25–34 PY vs. 0 PY	15	OR: 1.27 [1.11; 1.48]
Cohort studies: Heterogeneity I ² = 33%			RR _{pooled} : 1.36 [1.1; 1.7]	
Total: Heterogeneity I ² = 79%		Increase in risk from 19 per 1000 to 26 per 1000 [21; 32]		RR _{pooled} : 1.97 [1.3; 3.1]

CI, Confidence interval; n.d., no data; OR, odds ratio; PY, point years (years of employment × strain score from industry exposure matrix);

QS, quality score; RR, relative risk; RR_{pooled}, pooled relative risk

* Total hip replacement or clinically/radiologically diagnosed osteoarthritis of the hip

eTABLE 7

Risk of developing osteoarthritis of the hip* owing to physically demanding work in women: comparison of highest and second highest exposure categories with lowest exposure category

Study	Participants Age (years)	Comparison	QS	Effect estimator [95% CI]
Highest vs. lowest exposure category				
Cvijetić 1999 (e16) (CCS)	49/49 63.5 ± 11.0	High physical demands (>80% walking, standing, loads >5 kg) for >30 years vs. <20 years	11	OR: 1.41 [0.78; 1.97]
Flugsrud 2002 (e19) (C)	1 368/3 423 34–59	Physically demanding work (e.g., forestry, farming) vs. sedentary work	14	RR: 2.1 [1.3–3.3]
Rubak 2013 (e18) (C)	13 850/35 635 48.2 ± 9.9	35–86 PY vs. 0 PY	15	OR: 1.01 [0.88; 1.16]
Heterogeneity I ² = 80%		Increase in risk from 19 per 1000 to 31 per 1000 [21; 48]	RR _{pooled} : 1.38 [0.9; 2.2]	
Second highest vs. lowest exposure category				
Cvijetić 1999 (e16) (CCS)	115/115 63.5 ± 11.0	High physical demands (>80% walking, standing, loads >5 kg) for 20–29 years vs. <20 years	11	OR: 2.34 [0.66; 2.93]
Flugsrud 2002 (e19) (C)	5 112/3 423 34–59	Intermediate: work with frequent walking and load lifting/carrying (e.g., postman, construction worker) vs. sedentary work	14	RR: 1.4 [0.9; 2.0]
Rubak 2013 (e18) (C)	46 674/21 407 48.2 ± 9.9	25–34 PY vs. 0 PY	15	OR: 0.99 [0.88; 1.10]
Heterogeneity I ² = 72%		Increase in risk from 21 per 1000 to 23 per 1000 [17; 32]	RR _{pooled} : 1.30 [0.9; 2.0]	

C, Cohort study; CCS, case–control study; CI, confidence interval; OR, odds ratio; PY, point years (years of employment × strain score from industry exposure matrix); QS, quality score; RR, relative risk; RR_{pooled}, pooled relative risk

* Total hip replacement or clinically/radiologically diagnosed osteoarthritis of the hip

eTABLE 8

Risk of developing osteoarthritis of the hip* owing to physically demanding work in men and women: comparison of highest and second highest exposure categories with lowest exposure category

Study	Participants Age (years)	Comparison	QS	Effect estimator [95% CI]
Highest vs. lowest exposure category				
Allen 2010 (e12) (CCS)	65/405 63.6 ± 10.5	Heavy labor (standing for >50% of working time) vs. <50% of working time	10	OR: 1.39 [1.01; 1.91]
Juhakoski 2009 (e20) (C)	11/178 63 ± 8, 50–94	Physically demanding work vs. light sedentary work	12	OR: 6.7 [2.3; 19.5]
Heliövaara 1993 (e22) (CCS)	27/421 n.d.	Sum index of manual labor strain 4–5 vs. sum index 0	9	OR 2.7 [1.7; 4.4]
Heterogeneity I ² = 82%		Increase in risk from 20 per 1000 to 37 per 1000 [28; 48]	RR _{pooled} : 1.85 [1.4; 2.4]	
Second highest vs. lowest exposure category				
Allen 2010 (e12) (CCS)	63/560 63.6 ± 10.5	Light work (standing for >50% of working time) vs. <50% of working time	10	OR: 0.74 [0.54; 1.01]
Juhakoski 2009 (e20) (C)	13/178 63 ± 8, 50–94	Intermediate manual labor vs. light sedentary work	12	OR: 3.1 [1.2; 8]
Heliövaara 1993 (e22) (CCS)	62/825 n.d.	Sum index of manual labor strain 3 vs. sum index 0	9	OR 2.7 [1.8; 3.9]
Heterogeneity I ² = 93%		Increase in risk from 20 per 1000 to 26 per 1000 [20; 34]	RR _{pooled} : 1.31 [1.0; 1.7]	

C, Cohort study; CCS, case–control study; CI, confidence interval; n.d., no data; OR, odds ratio; QS, quality score; RR_{pooled}, pooled relative risk

* Total hip replacement or clinically/radiologically diagnosed osteoarthritis of the hip

eTabelle 3: Kohortenstudien, die für die Expositionsbewertung Angaben zur körperlichen Tätigkeiten und Lasten verwendet haben

Studie* (Literatur) Herkunftsland Follow Up	Studienpopulation Baseline: Teilnehmerzahl, Response, Rekrutierungsperiode Alter Geschlecht	Expositionserfassung Zeitraum der Exposition Tätigkeiten	Endpunkterfassung Diagnosesicherung der Koxarthrose, Zeitpunkt der Diagnose Lost to Follow-up Ausschluss von Probanden mit Hüft- CA/-Schmerz in Baseline	Vergleiche/ Adjustierung / Confounder	Qualitätskriterien Auswahl (5) Exposition (4) Vergleichbarkeit (4) Endpunkt (6) Gesamt (19) Interessenkonflikt bzw. Förderung
Flugsrud 2002 (e19) Norwegen Follow-Up: 0,1- 9,5 Jahre (Durchschnittlich 9,0 Jahre)	<ul style="list-style-type: none"> Teilnehmer des „National Health Screening Service“ (zu kardiovaskulären Erkrankungen) in 3 norwegischen Bezirken Baseline 1977-1983 Zusammenführen von Daten aus kardiovaskulärem Screening Register und norwegischem Arthroplastieregister 56.818, Männer und Frauen (Responderate Baseline 91%, 24,997 Männer und 25,037 Frauen 34-59 Jahre (mittleres Alter 46,6 J.) 	<p>Fragebogen zur körperlichen beruflichen Aktivität (im letzten Jahr), Selbsteinstufung in Sitzend-(z.B. Büroarbeit), mäßig/ moderate (z.B. leichte Industriearbeit), mittlere (z.B. Bau), schwere (z.B. Landwirtschaft)</p>	<p>Erster Hüftgelenkersatz Follow Up 1989-1998</p> <p>Ausschluss von Probanden mit H-TEP beim Start des Follow-up oder sekundäre CA</p>	<p>RR für sitzende vs. mäßige, mittlere, schwere körperliche Aktivität</p> <p>Adjustierung: Alter, Geschlecht, BMI, körperliche Freizeitaktivität Rauchen</p>	<p>4/ 2/ 4/ 4/ 14</p> <p>Interessenkonflikt: k. A.</p> <p>Förderung: OrtoMedic Chamley Fellowship</p>
Juhakoski 2009 (e20)	<ul style="list-style-type: none"> 8.000 Männer und Frauen (repräsentative 	Fragebogen + Interview zu Körperlicher Arbeitsbelastung	Diagnose CA über klinische	OR für leichte sitzende Tätigkeit vs.	5/2/3/2/12

Studie* (Literatur) Herkunftsland Follow Up	Studienpopulation Baseline: Teilnehmerzahl, Response, Rekrutierungsperiode Alter Geschlecht	Expositionserfassung Zeitraum der Exposition Tätigkeiten	Endpunkterfassung Diagnosesicherung der Koxarthrose, Zeitpunkt der Diagnose Lost to Follow-up Ausschluss von Probanden mit Hüft- CA/-Schmerz in Baseline	Vergleiche/ Adjustierung / Confounder	Qualitätskriterien Auswahl (5) Exposition (4) Vergleichbarkeit (4) Endpunkt (6) Gesamt (19) Interessenkonflikt bzw. Förderung
Finland Follow-Up: 20-23 Jahre	<p>Stichprobe der finnischen Bevölkerung; „Mini-Finland Health Examination Survey),</p> <ul style="list-style-type: none"> 30 -70 Jahre (mittleres Alter 42 J) Response BL: 90% 1978-1980 	<p>(Bezugsgröße zur Expositionsdauer nicht angegeben), 6 Gruppen: Leichte sitzende Tätigkeit Andere sitzende Tätigkeiten Körperlich leichte stehende Tätigkeit Einigemaßen leichte oder mittelschwere Tätigkeit Schwere handwerkliche Tätigkeit Sehr schwere manuelle Tätigkeit</p>	<p>Untersuchung nach Protokoll + Symptome oder nur Symptome Follow up 2000-2001 im Rahmen des „Health 2000 Survey“: 1286 ehemalige Teilnehmer wurden zum Follow-Up eingeladen, 909 (70%) nahmen an FU teil</p> <p>Ausschluss von Probanden mit CA in BL</p>	<p>die anderen Gruppen</p> <p>Adjustierung: Alter, Geschlecht, BMI, Rauchen</p>	<p>Interessenkonflikt: keiner</p> <p>Förderung: Mikkel Central Hospital</p>
Ratzlaff 2011* (e21) Kanada Follow-Up: 2 Jahre	<p>127.424 Mitglieder der „Canadian Association of Retired“, Männer und Frauen (angeschrieben per Mail und Newsletter)</p> <p>4.258 Teilnehmer</p> <p>Response rate 3,3 %</p> <p>Alter 45-85 J. (mittleres Alter 61,6)</p> <p>2005</p>	<p>Fragebogen zur lebenslangen Berufstätigkeit, Berechnung von “Cumulative peak force index (CPFI)” Produkt aus lebenslangen spezifischen Aktivitäten (Stunden) x Körpergewicht (kg) x typische Spitzen der Hüftgelenksbeanspruchung (in kg Stunden/Jahr), “peak joint force” aus Literaturreview</p>	<p>Selbstberichtete CA (Fragebogen mit spezifischem Items und Schmerzskala – Verifizierung mittels einer Validitätsstudie an 100 Probanden, Kappa 0,65) Erfassung des Outcomes in BL und Follow Up, Ausschluss von</p>	<p>HR für lebenslange Exposition über CPFI Quintile 2-5 vs. Quintil 1</p> <p>Adjustierung: Alter, Geschlecht, Unfälle</p>	<p>2/ 4/ 3/ 1/ 10</p> <p>Interessenkonflikt: keiner</p> <p>Förderung: Canadian Institute of Health Research, Anreiz zur Teilnahme an der Studie – Lotterrie</p>

Studie* (Literatur) Herkunftsland Follow Up	Studienpopulation Baseline: Teilnehmerzahl, Response, Rekrutierungsperiode Alter Geschlecht	Expositionserfassung Zeitraum der Exposition Tätigkeiten	Endpunkterfassung Diagnosesicherung der Koxarthrose, Zeitpunkt der Diagnose Lost to Follow-up Ausschluss von Probanden mit Hüft- CA/-Schmerz in Baseline	Vergleiche/ Adjustierung / Confounder	Qualitätskriterien Auswahl (5) Exposition (4) Vergleichbarkeit (4) Endpunkt (6) Gesamt (19) Interessenkonflikt bzw. Förderung
			Probanden mit CA in BL Follow-Up: 2006 und 2007: 2918 Follow-up Teilnehmer (68% Response)		mit Preisen in Höhe von 1.500\$
Rubak* 2013 (e18) Dänemark Follow Up: ≥ 10 Jahre	Alle Personen, die in Dänemark zwischen 1925 und 1964 geboren wurden („Danish Civil Registration- System“) 2.522.349 Männer und Frauen Mittleres Alter zum Start follow up Frauen: 48.2 J (SD 9,9), Männer 49.1 (SD 10,5) Registerstudie 2007	Mindestens 10 jährige Vollzeittätigkeit Daten aus „Supplementary Pension Fund Register“ Einteilung der Tätigkeiten entsprechend einer „industry exposure matrix“ (IEM) 0=minimale Last 1=moderate Last 2= hohe Last, Berechnung von „point-years“ aus Anzahl der Beschäftigungsjahre, dem Score der IEM aufsummiert über alle Arbeitsverhältnisse (in Anlehnung an Packungsjahre)	Erste Hüft-TEP aufgrund primärer CA, Daten aus „National Patient Register“ aus „Classification of Surgical Procedures“ Follow-Up: 1996-2006 Probanden mit CA aus BL ausgeschlossen	OR für kumulative körperliche Arbeitsbelastung (point-years) 0-5, 5- 15, 15-25, 25-35, 35- 86 vs. Personen, die niemals in der Industrie mit mittlerer oder hoher Belastung gearbeitet haben Adjustierung: Alter, Geschlecht, SES	5/2/3/5/15 Interessenkonflikt: k. A. Förderung: Danish Ministry of Health and Prevention
Tüchsen 2003 (e14)	Randomisierte Stichprobe aus Central Population	Fragebogenerhebung zu Körperlich anstrengender	Frage nach Hüftschmerz (in den	Logistische Regression, OR	5/3/3/1/12

Studie* (Literatur) Herkunftsland Follow Up	Studienpopulation Baseline: Teilnehmerzahl, Response, Rekrutierungsperiode Alter Geschlecht	Expositionserfassung Zeitraum der Exposition Tätigkeiten	Endpunkterfassung Diagnosesicherung der Koxarthrose, Zeitpunkt der Diagnose Lost to Follow-up Ausschluss von Probanden mit Hüft- CA/-Schmerz in Baseline	Vergleiche/ Adjustierung / Confounder	Qualitätskriterien Auswahl (5) Exposition (4) Vergleichbarkeit (4) Endpunkt (6) Gesamt (19) Interessenkonflikt bzw. Förderung
Dänemark Follow-Up: 5 Jahre	Register BL 1990 mit 9.653 Teilnehmern, Alter 18-59 J. Response 90%	Arbeit, Schweres Tragen (>20 kg), Sitzende Arbeit Kategorien jeweils „Selten oder nie“ und „≥ 25% der Arbeitszeit“, Bezugsdauer nicht angegeben	letzten 12 Monaten) Interview Follow-Up: 1995, nur Teilnehmer, die 1990 erwerbstätig waren n= 5.001 (84% Response) Ausschluss von Probanden mit Hüftschmerz in BL Insgesamt 223 inzidente Fälle beobachtet	für schweres Heben und körperlich schwere Arbeit ≥ 25% der Arbeitszeit vs. selten oder nie Adjustierung: Alter, Geschlecht, BMI, Rauchen, und die jeweiligen Kategorien gegeneinander	Interessenkonflikt: k. A. Förderung: k. A

*mehrere Veröffentlichungen, hier Zusammenfassung aller Publikationen zu der Studie

BL: Baseline, CA: Coxarthrose, CPEI: Cumulative peak force index, FU: Follow-Up, H-TEP: Hüftendoprothese, HR Hazard-Ratio, OR Odds-Ratio, RR: relatives Risiko, SES: Sozio-ökonomischer Status, SD: Standardabweichung

eTabelle 4: Fall-Kontrollstudien, die für die Expositionsbewertung Angaben zu körperlichen Tätigkeiten und Lasten verwendet haben

Studie (Literatur) Herkunftsland Studientyp	Studienpopulation Gesamtzahl der Teilnehmer Response Fälle/Kontrollen Geschlecht Alter Einschluss bzw. Ausschlusskriterien	Beschreibung der Fälle und Kontrollen Diagnosekriterien Koxarthrose Rekrutierungsperiode	Expositionserfassung Instrument Erfasster Expositionszeitraum Tätigkeiten / Berufsgruppen Kategorien	Vergleiche/ Adjustierung/ Confounder	Qualitätskriterien Auswahl (6) Vergleichbarkeit (4) Exposition (5) Gesamt (15) Interessenkonflikt bzw. Förderung
Allen 2010 (e12)** USA* QS mit Auswertung nach FK- Status	<ul style="list-style-type: none"> Stichproben (n=5138) aus dem ersten und zweiten Follow-up einer Kohortenstudie (JoCo OA), Erwachsene > 45 Jahre aus 6 Gemeinden in Johnston County. 933 Männer, 1796 Frauen Fälle radiolog. OA: 847, Kontrollen 1683 Fälle: radiolog. OA+Symptome: 294, Kontrollen 2212 Response 60% Ausschluss: Berufstätigkeit < 1J. 	<p>Fälle: radiologische OA (Kellgren ab Grad 2 und/oder Symptome an derselben Hüfte (Schmerz, Steifheit an den meisten Tagen))</p> <p>Kontrollen: Röntgen Hüfte Kellgren Grad 0 oder 1 und/oder keine Symptome an den Hüften</p> <p>1999-2004 und 2003-2004</p>	<p>Interview-unterstützter Fragebogen</p> <p>Erfassung von 10 Tätigkeiten im am längsten aufgeführten Beruf (Laufen, Tragen > 10 Pfund Sitzen u.a., lebenslange Exposition gegenüber 8 Tätigkeiten (Schwere Arbeit im Stehen > 50% der Arbeit, leichte Arbeit im Stehen > 50% der Arbeit, Heben 10/20/50 kg ≥ 10x/Woche etc.)</p>	<p>Multivariate log. Regression</p> <p>Exponierte vs. Nichtexponierte</p> <p>Adjustierung: Alter, Geschlecht, Rauchen, BMI, Unfälle, Rasse, ältere Knieverletzungen, Haushaltsaufgaben</p>	<p>2/ 3/2/ 7</p> <p>Interessenkonflikt: k. A.</p> <p>Förderung: Center for Disease Control und Prevention/Association of Schools of Public Health.</p>
Coggon 1998 (e8)	<ul style="list-style-type: none"> Patienten aus zwei Gesundheitsbezirken 	<p>Fälle: alle Patienten > 45 J. auf Anmelde liste für Hüft-TEP</p>	Interviewgestützter Fragebogen	mindestens 10 Jahre Lastenhandhabung:	5/4/3/12

Studie (Literatur) Herkunftsland Studientyp	Studienpopulation Gesamtzahl der Teilnehmer Response Fälle/Kontrollen Geschlecht Alter Einschluss bzw. Ausschlusskriterien	Beschreibung der Fälle und Kontrollen Diagnosekriterien Koxarthrose Rekrutierungsperiode	Expositionserfassung Instrument Erfasster Expositionszeitraum Tätigkeiten / Berufsgruppen Kategorien	Vergleiche/ Adjustierung/ Confounder	Qualitätskriterien Auswahl (6) Vergleichbarkeit (4) Exposition (5) Gesamt (15) Interessenkonflikt bzw. Förderung
England FK	<ul style="list-style-type: none"> 210 Männer (mittl. Alter 68 J), 401 Frauen (mittl. Alter 71 J) Response: Fälle 84%, Kontrollen 58% Ausschluss: Hüftfraktur, M. Perthes, Hüftdysplasie, andere sekundäre CA 	Kontrollen: Patienten, die den gleichen Hausarzt haben (Ausschluss: frühere Eingriffe an der Hüfte) 1993-1995	Alle Jobs > 1 Jahr, Lasten mit Häufigkeit und Gewicht erfasst, auch Sitzen, Knie u.a.	< 10 kg vs. 10-24 kg, 25-49 kg, > 50 kg (>10x /Woche) Matching für Alter und Geschlecht	Interessenkonflikt: k. A. Förderung: Arthritis and Rheumatism Council of Great Britain
Croft 1992 (e5) England FK **	<ul style="list-style-type: none"> Alle ambulanten Patienten der urologischen Departments North Staffordshire, die ein i.v. Urogramm erhielten 787 (353 Fälle, 434 Kontrollen) Response 69% Fälle, 68% Kontrollen Alter 60-75 J. Ausschluss: verstorben, zu krank für Interview, 	Fälle: Hüft-TEP oder Gelenkspalt < 2,5 mm, schwere Fälle < 1,5 mm Kontrollen: Gelenkspalt > 3,5 mm in beiden Hüften 1982-1987	PC-Interview zur lebenslangen Berufsgeschichte, Angabe zu Tätigkeiten (z.B. Heben von Lasten>25 kg, ohne Angabe Häufigkeit)	OR für Exposition vs. Nichtexposition z.B. Lastenhandhabung > 25 kg 1-19 Jahre und >20 Jahre vs. < 1 Jahr Adjustierung: Alter, Krankenhaus	2/3/4/9 Interessen-konflikt: k. A. Förderungen: k. A.

Studie (Literatur) Herkunftsland Studientyp	Studienpopulation Gesamtzahl der Teilnehmer Response Fälle/Kontrollen Geschlecht Alter Einschluss bzw. Ausschlusskriterien	Beschreibung der Fälle und Kontrollen Diagnosekriterien Koxarthrose Rekrutierungsperiode	Expositionserfassung Instrument Erfasster Expositionszeitraum Tätigkeiten / Berufsgruppen Kategorien	Vergleiche/ Adjustierung/ Confounder	Qualitätskriterien Auswahl (6) Vergleichbarkeit (4) Exposition (5) Gesamt (15) Interessenkonflikt bzw. Förderung
	Röntgenbild nicht auswertbar				
Cvijetic 1999 (e16) Kroatien QS mit Auswertung im FK-Status	<ul style="list-style-type: none"> • Randomisierte Stichprobe der Bevölkerung von Zagreb (Gesamtzahl nicht berichtet) 678 Teilnehmer • Responderaten nicht angegeben • Keine Angaben zu Anzahl F/K • 298 Männer, 292 Frauen • Alter > 45 Jahre • Ausschluss: Rheumathoid Arthritis, Gicht 	Fälle: CA ab Kellgren Grad 2 Kontrollen: alle anderen Probanden der Stichprobe 1981-1982	Interview + Fragebogen zur Berufsgeschichte 4 Kategorien: 1) überwiegend sitzende Tätigkeit 2) >80% der Zeit stehende Tätigkeit 3) > 80% nicht sitzende Tätigkeit (Laufen, leichte physische Beanspruchung, Heben von Lasten bis 5 kg) 4) Tätigkeiten hoher physischer Beanspruchung (häufiges Laufen, Heben von Lasten über 5 kg)	Vergleich für jede Kategorie: Arbeitsjahre 20-29 und > 30 vs. Arbeitsjahre < 20 Adjustierung: Alter, Geschlecht, BMI	4/4/3/11 Interessenkonflikt: k. A. Förderungen: k. A.
Elsner 1995 (e10) Deutschland FK	<ul style="list-style-type: none"> • Patienten einer orthopädischen Praxis 134 Männer, 86 Frauen • Response Fälle: 61% • Response Kontrollen: keine Angabe • Alter: keine Angabe 	Fälle: Patienten mit Hüftbeschwerden und jedweden, auch diskreten radiologischen Zeichen einer CA (nicht näher definiert) Kontrollen: beschwerdefreie Patienten einer Allgemein- und	Fragebogen , Fragen zu Tätigkeiten (in Jahren) z.B. Heben und Tragen 5-20 und > 20 kg „in ihrem Leben“	Tätigkeiten „immer+häufig“ vs. selten+praktisch nie“ Adjustierung für Alter	1/2/2/5 Interessenkonflikt: k. A. Förderung: Hans-Böckler-Stiftung

Studie (Literatur) Herkunftsland Studientyp	Studienpopulation Gesamtzahl der Teilnehmer Response Fälle/Kontrollen Geschlecht Alter Einschluss bzw. Ausschlusskriterien	Beschreibung der Fälle und Kontrollen Diagnosekriterien Koxarthrose Rekrutierungsperiode	Expositionserfassung Instrument Erfasster Expositionszeitraum Tätigkeiten / Berufsgruppen Kategorien	Vergleiche/ Adjustierung/ Confounder	Qualitätskriterien Auswahl (6) Vergleichbarkeit (4) Exposition (5) Gesamt (15) Interessenkonflikt bzw. Förderung
	<ul style="list-style-type: none"> Ausschluss: Hüftdysplasie, entzündliche Erkr., Adipositas, Trauma 	Augenarztpraxis (keine Röntgenbilder) 1989-1993			
Heliovaara 1993 (e22) Finnland QS mit Auswertung im FK-Status	<ul style="list-style-type: none"> Repräsentative Stichprobe (n=8.000) der finnischen Bevölkerung aus Melderegistern Response: 7.217 (90%), für F/K nicht angegeben Männer (3.637) und Frauen (4.363) >30 Jahre 369 Fälle 	Fälle: CA diagnostiziert durch Studienarzt auf der Grundlage von Krankengeschichte, Symptomen und klinischen Befunden (Empfindlichkeit und Beweglichkeit der Hüfte, keine genaueren Angaben) Kontrollen: alle anderen Probanden der Stichprobe 1977-1980	Fragebogen zur Berufsgeschichte Bildung eines Summen-Index „of physical stress at work“ (max. 5 Punkte), Je 1 Punkt für Heben und Tragen schwerer Lasten, Ungünstige Körperhaltung, Repetitive Bewegungen u.a. jeweils im am längsten ausgeübten Beruf (keine Angaben zur Dauer)	Summenindex “physical stress at work” 0 Punkte vs. 1/2/3/4- 5 Punkte Adjustierung: Alter, Geschlecht, BMI, Unfälle	4/3/2/9 Interessenkonflikt: k. A. Förderungen: k. A.
Jacobsen 2004* (e23) Dänemark QS mit Auswertung im FK-Status	<ul style="list-style-type: none"> Probanden aus 3. Follow up Copenhagen City Heart Study (randomisierte Stichprobe) 1397 Männer (23-93J), 2289 Frauen (22-92 J) 2949 Fälle, 1202 Kontrollen 	Fälle: >3 positive Antworten im Fragebogen muskuloskeletale Beschwerden und Gelenkspaltweite < 2mm Kontrollen: <4 positive Antworten im Fragebogen zu muskuloskeletalen Beschwerden 1991-1994	Fragebogen der CCHS: Tätigkeit (z.B. sitzen, Heben und Tragen >20 kg), Dauer der Tätigkeit, Häufigkeit und Schwere der Last erfasst, Einzel- Ergebnisse nicht publiziert.	OR range 0,7-1,0 für Art und Dauer der Tätigkeit unter Einbeziehung täglichen Heben, keine Einzelangaben Adjustierung: keine	3/1/3/7 Interessenkonflikt: k. A. Förderung: Research Board National University Hospital of

Studie (Literatur) Herkunftsland Studientyp	Studienpopulation Gesamtzahl der Teilnehmer Response Fälle/Kontrollen Geschlecht Alter Einschluss bzw. Ausschlusskriterien	Beschreibung der Fälle und Kontrollen Diagnosekriterien Koxarthrose Rekrutierungsperiode	Expositionserfassung Instrument Erfasster Expositionszeitraum Tätigkeiten / Berufsgruppen Kategorien	Vergleiche/ Adjustierung/ Confounder	Qualitätskriterien Auswahl (6) Vergleichbarkeit (4) Exposition (5) Gesamt (15) Interessenkonflikt bzw. Förderung
	<ul style="list-style-type: none"> Ausschluss: Chirurgie oder Frakturen der Hüfte, angeborene Hüftschäden, Rheumatoide Arthritis 				Rigshospitalet, danish Rheumatism Association u.a.
Keila-Kangas 2011 (e1) Finnland QS mit Auswertung im FK-Status	<ul style="list-style-type: none"> Stichprobe aus Health survey 2000 3110 Männer (mittl. Alter 51 J), 6446 Frauen (mittl. Alter 53 J) Response 82% Ausschluss: keine Angabe 	<p>Fälle: TEP, frühere Diagnose anhand überzeugender Befunde oder Bewegungseinschränkungen bei klinischer Untersuchung (z.B. Innenrotation) und typische Symptome einer CA.</p> <p>Kontrollen: alle Teilnehmer</p> <p>2000-2001</p>	<p>Interview, 5 am längsten ausgeübte Berufe, kumulative Jahre für Tätigkeiten mit Lasten >20 kg mehr als 10x pro Arbeitstag</p>	<p>Prävalenzberechnungen CA für Jahre mit Lastenhandhabung,</p> <p>OR Nichtexponierte vs. 1-12 Jahre, 13-24 J und > 24J</p> <p>Exposition mit Lasten > 20 kg</p> <p>Adjustierung: Alter, BMI, Rauchen, Trauma</p>	<p>5/4/4/13</p> <p>Interessenkonflikt: keiner</p> <p>Förderung: Finnish Work Environment Fond und Farmers Social Insurance Insitution</p>
Lau 2000 (e9) Hong Kong FK	<ul style="list-style-type: none"> Patienten aus 7 von 8 Krankenhäusern in Hong Kong, 138 Fälle, 414 Kontrollen Fälle: 30 Männer, 108 Frauen 	<p>Fälle: hospitalisierte Patienten, mit CA Kellgren> Grad 3 oder innerhalb der letzten 3 Jahre Hüft-TEP</p> <p>Kontrollen: aus Hausarztpraxen derselben Region</p>	<p>Interview gestützt</p> <p>Fragebogen</p> <p>Angaben zum am längsten ausgeübten Beruf: Heben, Laufen, Knien u.a. mit Häufigkeit bzw. Dauer und Gewicht</p>	<p>Heben von Lasten >10 kg nie vs. 1-10/Woche, > 10x Woche vs.</p> <p>Matching für Alter und Geschlecht,</p>	<p>1/3/3/7</p> <p>Interessenkonflikt: k. A.</p> <p>Förderung: Health Services Research</p>

Studie (Literatur) Herkunftsland Studientyp	Studienpopulation Gesamtzahl der Teilnehmer Response Fälle/Kontrollen Geschlecht Alter Einschluss bzw. Ausschlusskriterien	Beschreibung der Fälle und Kontrollen Diagnosekriterien Koxarthrose Rekrutierungsperiode	Expositionserfassung Instrument Erfasster Expositionszeitraum Tätigkeiten / Berufsgruppen Kategorien	Vergleiche/ Adjustierung/ Confounder	Qualitätskriterien Auswahl (6) Vergleichbarkeit (4) Exposition (5) Gesamt (15) Interessenkonflikt bzw. Förderung
	Kontrollen: 90 Männer, 324 Frauen <ul style="list-style-type: none">• Alter nicht angegeben• Keine Angaben zu Response• Ausschluss: Fraktur, Rheumatoide Arthritis, Dysplasie, andere sekundäre CA	01/1998-12/1998		Adjustierung BMI und Hüftunfälle	Committee of Hong Kong
Pope 2003 (e15) England FK	<ul style="list-style-type: none">• Stichprobe von Patienten aus zwei Hausarztpraxen• Fälle: 128 Männer, 224 Frauen• Kontrollen: 1518 Männer, 1484 Frauen• Response 61%• Ausschluss: nicht berichtet	Fälle: Angabe von Schmerzen in der Hüfte in den letzten Monaten für wenigstens 24 h und positive Antworten zu Hüftschmerz im Fragebogen Kontrollen: alle anderen Rekrutierungsperiode nicht berichtet	Fragebogen für alle Berufstätigkeiten > 1 Jahr Angaben zu Stehen, Sitzen, Laufen, Heben von Lasten > 23 kg (ohne Angabe zu Häufigkeit der Hebevorgänge)	Multivariate Analyse Nichtexponierte vs. Lasten > 23 kg 1-12 Jahre, > 13 Jahre Adjustiert für Alter und Geschlecht	2/2/3/7 Interessen-konflikt: k. A. Förderung: k. A.
Riyazi 2008 (e17) Niederlande FK	<ul style="list-style-type: none">• Probanden aus der GARP-Studie (Genetics, Arthrosis and Progression) – Patienten mit CA aus rheumatologischen	Fälle: Diagnose durch einen Arzt, nach ACR-Kriterien + femorale oder acetabuläre Osteophyten oder Gelenkspaltverschmälerung oder HTEP Kontrollen: Stichprobe der	Fragebogen: Berufsbezeichnungen erfasst, anschließend klassifizierten Fachleute die Berufe in körperlich oder geistig beanspruchende Tätigkeiten (	Physical demanding work vs. ?? (hierzu k. A., nur Ergebnis berichtet) Altersmatching (±5	2/ 3/ 3/ 8 Interessenkonflikt: keiner Förderung:

Studie (Literatur) Herkunftsland Studientyp	Studienpopulation Gesamtzahl der Teilnehmer Response Fälle/Kontrollen Geschlecht Alter Einschluss bzw. Ausschlusskriterien	Beschreibung der Fälle und Kontrollen Diagnosekriterien Koxarthrose Rekrutierungsperiode	Expositionserfassung Instrument Erfasster Expositionszeitraum Tätigkeiten / Berufsgruppen Kategorien	Vergleiche/ Adjustierung/ Confounder	Qualitätskriterien Auswahl (6) Vergleichbarkeit (4) Exposition (5) Gesamt (15) Interessenkonflikt bzw. Förderung
	<p>orthopädischen Praxen und allgemeinmedizinische Praxen in 5 großen Städten.</p> <ul style="list-style-type: none"> 1.874 Probanden angeschrieben, nicht bekannt, wie viele davon Fälle insgesamt, rekrutierte Fälle 382, davon 312 Frauen und 70 Männer Response rate für Fälle nicht angegeben , 345 Kontrollen, Response 71% Alter 40 – 70 Jahre Ausschluss: keine Angabe 	Population der selben Region (Zufallsstichprobe der Bevölkerung – Telefonliste, keine Überprüfung, ob Kontrollen CA hatten)	nach Klassifikationsschema von Schellart) Berufe mit Körperlich anstrengenden Tätigkeiten (Tragen schwerer Gegenstände, Bedienen schwerer Werkzeuge im Stehen) waren z.B. Landwirtschaft, Bau und Industrie (keine Angabe zur Dauer)	Jahre)	„Netherlands Organization for Scientific Research“
Roach 1994 (e2) USA FK	<ul style="list-style-type: none"> Mitglieder der US-Armee aus Großraum Chicago die ambulant in einem Department of Veteran`s Affairs Hospital behandelt 	<p>Fälle: Röntgenbild der Hüfte wegen Beschwerden (Beurteilung nach ARA-Kriterien, Kellgren Grad 3+4) oder Hüft-TEP(aus radiologischer Datenbank),</p> <p>Kontrollen: ambulante Patienten</p>	Fragebogen Anzahl der Berufsjahre die in folgenden 5 Kategorien: (1) leichte Tätigkeit im Stehen, (2) sitzende Tätigkeit, (3) schwere Tätigkeit im Stehen,	schwere Arbeit und mittelschwere Arbeit vs. leichte Arbeit Für schwere Arbeit vs. leichte Arbeit (15-24 Jahre, 25-34	2/ 4/2/ 8 Interessenkonflikt: k. A. Förderung: k. A.

Studie (Literatur) Herkunftsland Studientyp	Studienpopulation Gesamtzahl der Teilnehmer Response Fälle/Kontrollen Geschlecht Alter Einschluss bzw. Ausschlusskriterien	Beschreibung der Fälle und Kontrollen Diagnosekriterien Koxarthrose Rekrutierungsperiode	Expositionserfassung Instrument Erfasster Expositionszeitraum Tätigkeiten / Berufsgruppen Kategorien	Vergleiche/ Adjustierung/ Confounder	Qualitätskriterien Auswahl (6) Vergleichbarkeit (4) Exposition (5) Gesamt (15) Interessenkonflikt bzw. Förderung
	<p>wurden</p> <ul style="list-style-type: none"> Keine Angaben zur Response 99 Fälle, 233 Kontrollen Nur Männer mittleres Alter - Fälle: 69,3; Kontrollen: 67,6 Ausschluss: dienstbedingte Verletzungen, Polyarthropathie, Frakturen der unteren Extremität, minimaler Gelenkspalt < 1,5 mm 	mit i-v- Pyelogramm 01/1989-06/1990	<p>(4)Tätigkeit im Knien oder Hocken, (5) Tätigkeit im Laufen</p> <p><i>Schwere Arbeit = Tätigkeiten (3), (4) und (5) mit mindestens 15 Jahren Exposition</i></p> <p><i>Leichte Arbeit = (1) und (2) mit mindestens 15 Jahren Exposition</i></p> <p><i>mittlere Arbeit = alle anderen Probanden die nicht in die Kategorien eingeordnet werden konnten</i></p>	<p>Jahre, >34 Jahre)</p> <p>Adjustierung: Alter, BMI, sportliche Aktivität</p>	
<p>Rubak 2014* (e7) Dänemark FK</p>	<ul style="list-style-type: none"> Registerstudie (Einwohnermeldeamt und Patientenregister) Alle dänischen Männer und Frauen geboren zwischen 1925 und 1964, die in den letzten 10 Jahren erwerbstätig waren 861 Fall-Kontroll-sets 	<p>Fälle: erstmalige Hüft-TEP durch primäre CA</p> <p>Kontrollen: Personen ohne Hüft-TEP 2005-2006</p>	<p>Fragebogen zu den ausgeführten Berufen, über JEM wurden die kumulative Last pro Tag und die Häufigkeit von Heben von Lasten > 20 kg geschätzt. Berechnung von Tonnen-Jahren (= 1 t gehoben pro Tag oder tägliches Heben von Lasten > 20 kg/10x Tag über</p>	<p>Heben und Tragen: Nichtexponierte vs. Tonnen-Jahren vs. <10, 10-20, 20-115 Tonnenjahre</p> <p>Matching für Alter und Geschlecht</p>	<p>5 / 4 / 5/14</p> <p>Interessenkonflikt: k. A.</p> <p>Förderung durch Danish Ministry of Health and Prevention</p>

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	<ul style="list-style-type: none"> für Frauen und 915 sets für Männer Mittleres Alter Männer 64,3 J, Frauen: 64,7 Jahre Response 71% Ausschluss: keine Angabe 		ein Jahr) Ganzkörpervibration, Stehen		
Sobti 1997 (e11) England QS mit Auswertung im FK-Status	<ul style="list-style-type: none"> Pensionierte Postmitarbeiter geboren 1919-1923 Alter 70-75 J 2389 Männer, 1531 Frauen 1736 Kontrollen, 1503 Fälle Response rate 78% Ausschluss: Fragebogen nicht vollständig ausgefüllt 	Fälle: 2 Kategorien (1) Hüft-TEP Und (2) Hüftschmerz und Steifheit in den letzten Monaten Kontrollen: keine Angabe Rekrutierungszeitraum nicht berichtet	Fragebogen; Angaben zu allen Berufstätigkeiten > 1 Jahr: für durchschnittlichen Arbeitstag: Heben von Lasten > 25 kg, Treppensteigen u.a.	Regressionsmodell; Vergleich u.a. für Jahre, in denen Lasten > 25 kg an einem durchschnittlichen Arbeitstag gehoben wurden Keine Exposition vs. 1-20 Jahre, > 20 Jahre, Adjustierung: Geschlecht	5/2/3/10 Interessenkonflikt: k. A. Förderung: k. A.
Vingard 1991* (e4)	<ul style="list-style-type: none"> Alle Männer im Einzugsbereich von 4 großen 	Fälle: erste Hüft-TEP wegen idiopathischer OA (Kliniken kontaktiert)	Telefoninterview und Fragebogen zur lebenslangen Berufsgeschichte	Mittlere und hohe Expositionen wurden mit niedrigen	5/ 4/4/ 13 Interessenkonflikt:

Studie (Literatur) Herkunftsland Studientyp	Studienpopulation Gesamtzahl der Teilnehmer Response Fälle/Kontrollen Geschlecht Alter Einschluss bzw. Ausschlusskriterien	Beschreibung der Fälle und Kontrollen Diagnosekriterien Koxarthrose Rekrutierungsperiode	Expositionserfassung Instrument Erfasster Expositionszeitraum Tätigkeiten / Berufsgruppen Kategorien	Vergleiche/ Adjustierung/ Confounder	Qualitätskriterien Auswahl (6) Vergleichbarkeit (4) Exposition (5) Gesamt (15) Interessenkonflikt bzw. Förderung
Schweden FK	Krankenhäusern in Stockholm <ul style="list-style-type: none"> 253 Fälle, 392 Kontrollen Response Fälle (96%); Kontrollen (77%) Alter: 50-70 Jahre Ausschlusskriterien: Fehlbildungen, Folgen von Poliomyelitis, Rachitis, Verletzungen am Rumpf oder untere Extremität 	Kontrollen: randomisierte Stichprobe der Studienpopulation 1984-1986	Befragung nach Körperhaltungen, Fahren von Fahrzeugen, (jeweils in Anzahl der Stunden pro Woche) und wie viele kg pro Woche gehoben wurden. Kumulativer Wert vom Beginn der Berufstätigkeit bis zur Diagnose in Jahren Für jede Exposition Bildung von 3 Kategorien <i>niedrig</i> (Nicht-Exponierte + unter 5%) <i>mittlere</i> und <i>hoch</i> (jeweils 50% vom Rest)	Expositionen verglichen z.B. Hebevorgänge > 40 kg Adjustierung: Alter, BMI, sport activities	keiner Förderung: The National Institute of Occupational Health and The Swedish Work Environment Fund
Vingard 1992 (e3) Schweden FK **	<ul style="list-style-type: none"> Männer, die eine Invalidenrente erhalten aus dem Bezirk Stockholm (Register) Alter: 46-65 Jahre 140 Fälle/298 Kontrollen Keine Responderaten angegeben 	Fälle: Invalidenrente wegen CA Kontrollen: zufällige Stichprobe aus der Bevölkerung 1979,1980,1981,1984	Interviews zur beruflichen Laufbahn, anschließend Klassifizierung nach „Nordic occupational classification“. Über einen Score wurde die Exposition in niedrig, mittel und hoch eingeteilt	Berechnung des RR für Erhalt einer Invalidenrente wegen CA, mittlere und hohe Exposition vs. niedrige Exposition Adjustierung: Geschlecht, Alter	4/2/4/ 10 Interessenkonflikt: k. A. Förderung: „Swedish National Social Insurance Board“ und „Swedish Work

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	<ul style="list-style-type: none"> Ausschluss: psych. Störungen, Trauma, rheum. Erkrankungen, angeborene Fehlbildungen 				Environment Fund"
Vingard 1997 (e6) Schweden FK	<ul style="list-style-type: none"> Alle Frauen 50-70 Jahre aus 5 Bezirken in Schweden Initial 255 Fälle/334 Kontrollen Response: 230 Fälle (90%)/273 Kontrollen (82%) Ausschluss: jede andere Form der Arthritis und Trauma der unteren Extremität, Kontrollen mit bekannter Hüfterkrankung 	<p>Fälle: Hüft-TEP wegen primärer OA der Hüfte (aus „National Register of Total hip Replacement“), Diagnose basiert auf definiertem Protokoll mit Röntgenbild und klinischer Untersuchung.</p> <p>Kontrollen: gematcht nach Alter aus Einwohnermeldeämtern der Studienregionen</p> <p>1991-1994</p>	<p>Interview und Fragebogen zur Berufsgeschichte, Kumulative Exposition in Stunden zwischen dem 16. und 50. Lj., Für jede Exposition Bildung von 3 Kategorien: <i>niedrige</i> (untere 25%), <i>mittlere</i> (25-50%) <i>hohe</i> (obere 25%)</p>	<p>Vergleich von hoher und mittlerer Exposition vs. niedrige Exposition für körperlich anstrengende Tätigkeiten, Schweres Tragen u.a.</p> <p>Adjustierung: Alter, BMI, sport activities</p>	<p>6/ 4/ 3/ 13</p> <p>Interessenkonflikt: k. A.</p> <p>Förderung: "Swedish Council For Work Life Research"</p>
Yoshimura 2000 (e13) Japan FK	<ul style="list-style-type: none"> Patienten aus dem Register von 5 Krankenhäusern aus zwei Städten Fälle/Kontrollen je 103 	<p>Fälle: > 45 J auf der Warteliste für Hüft-TEP</p> <p>Kontrollen: aus Einwohnermeldeamt (Ausschluss bei Hüft-TEP)</p>	<p>Fragebogen zum Hauptberuf Lastenhandhabung > 10 kg während einer durchschnittlichen Arbeitswoche</p>	<p>Hauptberuf (mittlere Dauer 23 J.)</p> <p>Nichtexponierte vs. 10 kg, 25 kg, 50 kg</p>	<p>5/2/2/9</p> <p>Interessenkonflikt: k. A.</p>

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	Frauen und 11 Männer <ul style="list-style-type: none"> • Response Fälle 90%, Kontrollen 88% • Ausschluss: Rheumatoide Arthritis, angeborene Hüfterkrankungen, M-Bechterew 	Rekrutierungsperiode ein Jahr	Auch Knien, Laufen u.a.	Matching für Alter, Geschlecht und Region <i>Zusätzlich</i> Adjustierung für Knieschmerzen und Alter bei Schulengang	Förderung: k. A.

* mehrere Veröffentlichungen, hier Zusammenfassung aller Publikationen zu der Studie

** Studie enthält Auswertung sowohl zu Berufen als auch zu Tätigkeiten (siehe jeweils beide Tabellen)

Abkürzungen: CA - Coxarthrose, HTEP – Hüftendoprothese, k.A. - keine Angaben, OA - Osteoarthrose, OR - Odds Ratio.