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Self-reported physical exposure association with medial and lateral epicondylitis incidence in a large longitudinal study

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Abstract

Introduction—Although previous studies have related occupational exposure and epicondylitis, the evidence is moderate, and mostly based on cross-sectional studies. Suspected physical exposures were tested over a three year period in a large longitudinal cohort study of workers in the United States.

Method—In a population-based study including a variety of industries, 1107 newly employed workers were examined; only workers without elbow symptoms at baseline were included. Baseline questionnaires collected information on personal characteristics and self-reported physical work exposures and psychosocial measures for the current or most recent job at 6 months. Epicondylitis (lateral and medial) was the main outcome, assessed at 36 months based on symptoms and physical examination (palpation or provocation test). Logistic models included the most relevant associated variables.

Results—Of 699 workers tested after 36 months who did not have elbow symptoms at baseline, 48 suffered from medial or lateral epicondylitis (6.9%), with 34 cases of lateral epicondylitis (4.9%), 30 cases of medial epicondylitis (4.3%), and 16 workers who had both. After adjusting for

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age, lack of social support, and obesity, consistent associations were observed between self-reported wrist bending/twisting and forearm twisting/rotating/screwing motion and future cases of medial or lateral epicondylitis (odds ratios 2.8 [1.2;6.2] and 3.6 [1.2;11.0] respectively in men and women).

Conclusion—Self-reported physical exposures that implicate repetitive and extensive/prolonged wrist bend/twisting and forearm movements were associated with incident cases of lateral and medial epicondylitis in a large longitudinal study, although other studies are needed to better specify the exposures involved.

Keywords

epicondylitis; observational study; occupational; risk factor; epidemiology

INTRODUCTION

Epicondylitis (medial and lateral) is one of the most common musculoskeletal disorders of the upper extremity.[1-2] While several cross-sectional studies have shown associations between epicondylitis and work activities,[3–7] a systematic review of work-related elbow disorders found only one longitudinal cohort study of epicondylitis.[3, 8] This study and others concluded that additional longitudinal studies are needed to confirm the findings from current studies, which show moderate evidence of association between epicondilytis and occupational exposures of force and combined exposures.[9-10] The aim of this study was to examine the association of physical occupational risk factors in a three year longitudinal study in a cohort of workers in various jobs in the United States.

METHODS

Population

We enrolled a cohort of 1107 newly employed workers in St. Louis, USA, between July 2004 and October 2006.[11] Subjects were 18 years or older, working at least 30 hours per week, and were recruited from eight employers and three trade unions representing manufacturing, construction, biotechnology, and healthcare. Subjects with a history of carpal tunnel syndrome were excluded from the study.

Variables

Baseline questionnaires collected information on personal characteristics, age, gender, body mass index (obese, ≥30kg/m^2), educational level, and prior history of arthritis. Questions also included elbow and forearm symptoms occurring more than 3 times or lasting more than one week in the past year. Prior history of elbow pain or other musculoskeletal disorders was not collected.

Self-reported workplace psychosocial measures and the duration of eight physical exposures were collected for the current or most recent job at several time points. Exposures relevant to epicondylitis included “bending” (On average, how long altogether each day did you frequently bend or twist your hands or wrists?) “rotating” (On average, how long altogether each day did you do tasks where there was a rotating, twisting or screwing motion of the forearm?), and “gripping” (On average, how long altogether each day did you use your hand in a forceful grip?). We categorized responses into four categories (none or less than 1 hour/day, 1-2 hours/day, 2-4 hours/day, ≥4hours/day). Based on results of univariate analyses, we chose the most relevant cut points for dichotomizing exposures. A social support scale measurement less than or equal to 22 was chosen as threshold, representing the lowest quartile of social support. At the baseline examination, most workers had just started their new jobs. We thus used the physical and psychosocial measures reported after six months at work, thinking that these reports would better represent typical job conditions.

Outcome

Medial and lateral epicondylitis were assessed with a questionnaire and physical examination 3-5 years after baseline exam. Our case definition of epicondylitis required symptoms of recurrent or persistent elbow pain in the past year and positive physical examination in the same arm. Subjects who reported elbow or forearm pain at baseline were excluded from further analysis. The physical examination was considered positive if the subject reported pain or discomfort when the examiner palpated the medial or lateral epicondyles, muscle insertions, or surrounding musculature, or if the subject reported pain or discomfort at the elbow on resisted extension or flexion of the wrist (the examiner applied resistance against the hand with the elbow in 30° of flexion). We evaluated both arms of each subject and reported cases at the level of the person.

Analysis

We performed logistic regression to test the association of demographic and work-related factors with lateral and medial epicondylitis, considered separately and as a composite outcome. We combined men and women in initial models, and also evaluated them separately. We performed sensitivity analysis with a model containing only those subjects who did not change jobs during the study period.

Statistical Analysis Software (SAS v9.3, SAS institute Inc, Cary, NC, USA) was used for all analyses. Associations were expressed as odds ratios and 95% confidence intervals.

RESULTS

Of the 1107 subjects recruited, 76 reported elbow or forearm pain at baseline; after excluding these subjects, 699 (67.8%) completed follow-up testing with physical examination and questionnaire. The median follow-up time was 34 months from baseline (range 26 to 71 months). Loss to follow-up was more common among workers with a high school diploma or less education at baseline, compared to those with some education beyond high school (n=194, 58.4% of those lost to follow-up vs. n=336, 48.7% in the group who were followed up, $P<0.05$). No other differences in variables of interest were found between those who completed follow-up and those lost to follow-up. At follow-up, 34 subjects had lateral epicondylitis (4.9%), 30 subjects had medial epicondylitis (4.3%), 48 had either medial or lateral epicondylitis (6.9%) and 16 had both.

Univariate analysis of the composite variable of incident epicondylitis found associations with bending, rotating, and forceful gripping, with risk increasing at higher reported durations of these exposures (Table 1). There were some differences in personal factors (including obesity) associated with lateral and medial epicondylitis; grip was not strongly associated with lateral epicondylitis. Due to the number of subjects exposed, the associations observed, and the high correlation between bending and twisting (P<0.0001), work exposure variables were re-coded into one variable that required bending of over 4hours/day and rotating over 2hours/day. In multivariable analyses we found consistent association between this combined bending and rotating exposure and medial epicondylitis, lateral epicondylitis, and the composite outcome of epicondylitis (odds ratios 2.8 [1.2;6.2] and 3.6 [1.2;11.0] respectively in men and women). The addition of time spent in forceful grip added little to the combination of the other two variables. The three variable exposure gave a crude OR of 2.0 [0.9-4.4] for lateral epicondylitis, and 2.5 [1.1-5.5] for medial (vs. 2.5 [1.1-5.3] and 3.6 [1.7-7.7] for the two variable combination of bending/rotating). Despite relatively few cases, we observed similar associations after gender stratification. The most common jobs (five or more subjects in each job) where subjects reported performing both these actions were framing carpenter, construction carpenter, flooring installer, housekeeper, sheet metal worker, and drywall hanger among men, and housekeeper among women.

When we focused on only subjects who had not changed jobs in the three-year period for sensitivity analyses (n=467, 66.8%), we found a similar magnitude of association between bending/rotating and epicondylitis (odds ratio 3.4, 95% c.i. 0.9-12.3).

DISCUSSION

We found that self-reported physical exposures of wrist bending and forearm rotation were associated with incident medial and lateral epicondylitis after three years of follow-up in a longitudinal cohort study of workers in a variety of jobs.

Our study had several limitations. Subjects did not receive serial physical examinations during the study, but only a single follow-up examination. While the frequency of epicondylitis (6.9%) in our study was comparable to that in other studies of working populations,[1-2, 12] we may have underrepresented the true incidence of epicondylitis during the study period due to its episodic nature. Our study relied on self-reported exposures, which may be subject to information bias. Our study may have had other exposure misclassification since work exposures reported at 6 months were used to represent the entire study period, although some workers subsequently changed job duties. However, results were similar among workers who did not report at change of job during the study period.

Strengths of the study include its prospective nature, a large and varied cohort, and a case definition requiring both symptoms and physical signs. Physical exposures were self-reported more than two years before the assessment of case definition, limiting opportunities for biased reporting of exposures due to symptoms. Despite their modest to low agreement with observed exposures,[13] worker self-reports of exposure were associated with future case finding in this prospective study. Particularly in highly variable jobs, it is possible that worker self-reports better capture typical exposures over time than do short periods of work observation.

Wrist bending/twisting and forearm rotating, twisting, or screwing motion were associated with incident cases of both lateral and medial epicondylitis in our study. Previous cross-sectional studies have found associations between epicondylitis and work exposures, including hard perceived physical exertion combined with elbow flexion/extension (>2 hr/day) and wrist bending (>2 hr/day),[10] and forearm supination at > 45 degrees for > 5% of the time combined with high lifting force (OR = 2.98, 95% CI 1.18-7.55).[5] In 2009, van Rijn et al. found in their systematic review that main physical factors, found mostly in cross-sectional studies, were handling tools or load, and repetitive movements.[8] In a previous cohort of workers highly exposed to repetitive work, “turn and screw “ was found to be associated with lateral epicondylitis (odds ratio 2.1 [1.2;3.7]) which is similar to the effects of physical exposure found in the current study.[3]

In conclusion, self-reported physical exposures involving repetitive and extensive movements of the wrist and forearm were associated with future cases of medial and lateral epicondylitis in a three-year prospective longitudinal study. Although additional studies are needed to better define the specific work exposures (including gripping) and personal factors (such as obesity) related to medial and lateral epicondylitis, self-reported work exposures predicted future risk in our study, and may be useful in workplace preventive efforts for this relatively common disorder.

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What this paper adds

What is already known on this subject

- Many cross sectional studies have established that medial and lateral epicondylitis are associated with physically forceful occupational activities, especially high force combined with high repetition or awkward posture

What this study adds

- At three-year follow-up among workers without elbow symptoms at baseline, 48 suffered from medial or lateral epicondylitis (6.9%)

- Self-reported physical exposures were associated with subsequent incident cases of lateral and medial epicondylitis in this large longitudinal study

Table 1

Univariate and multivariate associations between personal and work-related risk factors and epicondylitis

		Lateral epiconylitis n=34				Medial epiconylitis n=30				Lateral or Medial epicondylitis n=48				Lateral or Medial epicondylitis n=31, MEN	Lateral or Medial epicondylitis n=17, WOMEN
	N (total)	n	%	Odds ratio (univariate analyses)	Odds ratio (multivariate analyses)	n	%	Odds ratio (univariate analyses)	Odds ratio (multivariate analyses)	n	%	Odds ratio (univariate analyses)	Odds ratio (multivariate analyses)	Odds ratio (multivariate analyses)	Odds ratio (multivariate analyses)
Age (years, continuous)				**1.1 [1.0;1.1]**	**1.0 [1.0;1.1]**			1.0 [1.0;1.1]	1.0 [1.0;1.1]			1.0 [1.0;1.1]	1.0 [1.0;1.1]	1.0 [1.0;1.1]	1.1 [1.0;1.1]
Gender															
Men	449	20	4.5	1	1	18	4.0	1	1	31	6.9	1	1		
Women	250	14	5.6	1.3 [0.6;2.6]	1.1 [0.5;2.4]			1.2 [0.6;2.5]	1.3 [0.6;3.0]	17	6.8	1.0 [0.5;1.8]	0.9 [0.5;1.8]		
Low educational level															
> high school	363	13	3.6	1	1	7	1.9	1	1	17	4.7	1	1		
≤High school education	336	21	6.3	1.8 [0.9;3.6]	1.87 [0.9;4.1]	23	6.9	**3.8 [1.6;8.9]**	**3.5 [1.3;8.6]**	31	9.3	**2.1 [1.1;3.8]**	**2.1 [1.1;4.0]**	1.9 [0.8; 4.4]	2.5 [0.8;7.7]
Lack of social support															
No	512	23	4.5	1	1	22	4.3	1	1	35	6.8	1	1	1	1
Yes	122	7	5.7	1.3 [0.5;3.1]	1.0 [0.4;2.6]	7	5.7	1.4 [0.6;3.2]	1.1 [0.4;2.8]	9	7.4	1.1 [0.5;2.3]	0.9 [0.4;2.1]	0.5 [0.1; 1.7]	2.3 [0.7;7.9]
Medical Disorders *															
No	666	30	4.5	1	1	26	3.9	1	1	44	6.6	1	1	1	1
Yes	33	4	12.1	2.9 [1.0;8.9]	2.0 [0.6;7.0]	4	12.1	**3.4 [1.1;10.3]**	3.3 [0.9;11.9]	4	12.1	2.0 [0.7;5.8]	1.7 [0.5;5.7]	0.9 [0.1;7.7]	2.9 [0.6;15.7]
Body Mass Index															
<30 kg/m^2	468	16	3.4	1	1	18	3.9	1	1	27	5.8	1	1	1	1
≥30 kg/m^2	231	18	7.8	**2.4 [1.2;4.8]**	1.8 [0.8;3.9]	12	5.3	1.4 [0.7;2.9]	1.0 [0.4;2.2]	21	9.1	1.6 [0.9;3.0]	1.3 [0.7;2.5]	1.5 [0.6;3.4]	0.9 [0.3;2.9]
Bending															
No or <1 hour/day	227	4	1.8	1		0	0.00	1 **		4	1.8	1			
1-2 hours/day	70	1	1.4	0.8 [0.1;7.4]		3	4.3	1 **		3	4.3	2.5 [0.6;11.4]			

		Lateral epiconylitis n=34				Medial epiconylitis n=30				Lateral **or** Medial epicondylitis n=48				Lateral or Medial epicondylitis n=31, MEN	Lateral or Medial epicondylitis n=17, WOMEN
	N (total)	**n**	**%**	**Odds ratio (univariate analyses)**	**Odds ratio (multivariate analyses)**	**n**	**%**	**Odds ratio (univariate analyses)**	**Odds ratio (multivariate analyses)**	**n**	**%**	**Odds ratio (univariate analyses)**	**Odds ratio (multivariate analyses)**	**Odds ratio (multivariate analyses)**	**Odds ratio (multivariate analyses)**
2-4 hours/day	106	5	4.7	2.8 [0.7;10.5]		5	4.7	**4.9 [1.1;20.7]**		7	6.6	**3.9 [1.1;13.8]**			
≥ 4hours/day	272	20	7.4	**4.4 [1.5;13.1]**		1	7.8	**8.2 [2.4;27.9]**		30	11.0	**6.9 [2.4;19.9]**			
Rotating															
No or <1 hour/day	371	11	3	1		11	3.0	1		16	4.3	1			
1-2 hours/day	68	2	2.9	1.0 [0.2;4.6]		1	1.5	0.5 [0.1;3.9]		3	4.4	1.0 [0.3;3.6]			
2-4 hours/day	77	5	6.5	2.3 [0.8;6.7]		6	7.8	2.8 [1.0;7.7]		8	10.4	2.6 [1.1;6.3]			
≥ 4hours/day	159	12	7.6	**2.7 [1.2;6.2]**		11	7.0	**2.5 [1.0;5.8]**		17	10.7	**2.7 [1.3;5.4]**			
Gripping															
No or <1 hour/day	312	11	3.5	1		7	2.2	1		13	4.2	1			
1-2 hours/day	89	4	4.5	1,3 [0,4; 4,2]		4	4.5	2.1 [0.6;7.2]		6	6.7	1.7 [0.6;4.5]			
2-4 hours/day	99	5	5.1	1.5 [0.5;4.3]		4	4.1	1.9 [0.5;6.5]		6	6.1	1.5 [0.6;4.0]			
≥ 4hours/day	175	10	5.7	1.7 [0.7;4.0]		14	8.0	**3.8 [1.5;9.6]**		19	10.9	**2.8. [1.4;5.8]**			
Bending>=4h/day AND Rotating ≥2hours/day															
No	512	16	3.1	1	1	14	2.7	1	1	22	4.3	1	1	1	1
Yes	163	14	8.6	**3.0 [1.4;6.1]**	**2.5 [1.1;5.3]**	15	9.3	**3.6 [1.7; 7.7]**	**3.1 [1.4;6.8]**	22	13.5	**3.5 [1.9;6.5]**	**3.0 [1.6;5.8]**	**2.8 [1.2;6.2]**	**3.6 [1.2;11.0]**

* Medical Disorders = diabetes, rheumatic arthritis or osteoarthrosis;

** because no worker with medial epicondlytis reported less than 1 hour of bending, reference included also 1-2 hours/day; **bold : P<0.05**