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Is sitting-while-at-work associated with low back pain? A systematic, critical literature review

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Objectives: To present a critical review and evaluate recent reports investigating sitting-while-at-work as a risk factor for low back pain (LBP). *Methods*: The Medline, Embase and OSH-ROM databases were searched for articles dealing with sitting at work in relation to low back pain for the years 1985–97. The studies were divided into those dealing with sitting-while-working and those dealing with sedentary occupations. Each article was systematically abstracted for core items. The quality of each article was determined based on the representativeness of the study sample, the definition of LBP, and the statistical analysis. *Results*: Thirty-five reports were identified, 14 dealing with sitting-while-working and 21 with sedentary occupations. Eight studies were found to have a representative sample, a clear definition of LBP and a clear statistical analysis. Regardless of quality, all but one of the studies failed to find a positive association between sitting-while-working and LBP. High quality studies found a marginally negative association for sitting compared to diverse workplace exposures, e.g. standing, driving, lifting bending, and compared to diverse occupations. One low quality study associated sitting in a poor posture with LBP. *Conclusions*: The extensive recent epidemiological literature does not support the popular opinion that sitting-while-at-work is associated with LBP.

Key words: epidemiology, low back pain, literature review, occupation, risk factors, sedentary, work.

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INTRODUCTION

Low back pain (LBP) is one of the most common diseases with lifetime prevalence rates estimated to be around 70% (1). Standard medical textbooks (2, 3) and early studies (4) state that sitting-while-at-work is associated with LBP. One author, in a selective review, concludes that sitting-while-at-work is considered a risk determinant for LBP (5), while another author states that the evidence is not consistent (6). In a recent article, aiming at identifying factors that contribute to occupational back injury, the author goes as far as stating that: “The sitting position, one of the best studied occupational postures, is considered to be a strong risk factor for low back pain” (7).

Indeed many studies have dealt with the sitting position in relation to LBP. However, to our knowledge no formal meta-analysis or systematic literature reviews evaluating recent studies have been published, hence the present picture is unclear. This is unfortunate, because the workplace exposure to the sitting position is very common; for example, in 1995 close on one-third of Danish workers aged 18 to 59 spent at least 75% of their work time in the sitting position (8). Furthermore, office environments and office furniture may be different at present compared to even 20 years ago.

We therefore decided to critically evaluate reports published between 1985 and 1997 dealing with sitting-while-at-work in association with LBP, in order to determine whether this popular belief is supported by recent studies. This review will potentially enable healthcare professionals, and others, to offer better advice to workers regarding the potential risk to the lower back arising from sedentary work positions.

METHODS

Identification of studies

Journal articles for review were identified in the Medline, Embase and OSH-ROM databases for the years 1985–97 (inclusive) using all possible combinations of the index terms “low back pain”, “work”,

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"occupation", and "epidemiology", and the text words "sitting", and "sedentary" either in the title, the key words or the abstract. Reference lists of studies retrieved, in particular review articles, were carefully screened in order to locate additional papers. Only articles written in English were included in this review.

Abstraction

Each article was abstracted independently by two or three of the authors (JH, CY, SL) for items listed in Table I. Any discordance was resolved by discussion, except in a few instances where the fourth author (EC) arbitrated.

To facilitate comparison, cross-product odds ratios (OR) with corresponding 95% confidence intervals for sitting occupations were calculated for each study – if this was possible from the data provided and if it had not already been done. For calculations, we used Epi Info 6, version 6.04b.

Quality

The quality of each study was evaluated on the basis of on the representativeness of the sample, the definition of LBP, and the statistical analysis.

1. *Representativeness*: Entire large populations were considered representative, e.g. all workers at a factory or all workers in a department, as were subsamples if these were probability or systematic samples, and if the response rate was $> 80\%$. Study samples were considered non-representative when no attempt was made towards random sampling (i.e. convenience samples, volunteers, or no sampling description), when the response rate was $< 80\%$, when the response rate was not reported, or when it was expressively stated that the study sample was not representative. Furthermore, cases and controls had to be matched for at least age and gender (where applicable).
2. *Definition of LBP*: LBP was considered to be adequately defined if the definition was presented in an explicit manner to the study subject, and if readers were likely to be able to replicate the questions in relation to LBP in later studies.
3. *Statistical analysis*: The statistical analysis was considered appropriate if descriptive statistics concerning disease occurrence were provided for each exposure group, e.g. means, and if the groups were compared using an explicit appropriate method, e.g. "odds ratios derived from Mantel-Haenszel stratified analysis", or "logistic regression adjusted for age and sex".

Review

Studies were scrutinized to address whether sitting-while-at-work or sedentary occupations were associated with LBP in the following manner:

1. All articles were evaluated with respect to this question.
2. Studies considered to be of better quality (i.e. a representative sample with a high response rate, a clear definition of LBP, and an appropriate statistical analysis) were considered separately.
3. Studies also investigating the dose/response issue were considered with respect to this issue.

RESULTS

Description of studies

Thirty-five reports were identified. Of these, 14 dealt with sitting-while-working and 21 with sedentary occupations. Abstracted items from this review are summarized in Tables II and III. Thirty-one studies

Table I. *Information abstracted from each article*

1. Country where the study was conducted
2. Year of publication
3. Name of authors
4. Title of article
5. Source
6. Study design (cross-sectional, case-control, or prospective)
7. Sampling method and sample size
8. Data collection method (questionnaire, personal interview, medical records, etc.)
9. Occupational groups or type of work under study
10. Exposure information (hours spent sitting per day, years employed, any other measure of exposure)
11. Description of low back pain given to study subjects and in reports (definition, severity, duration, frequency, recall period, consequences)
12. Clarity and appropriateness of the selected statistical analysis (Was a hypothesis clearly presented and tested with an appropriate method? Were summary statistics, e.g. means and/or odds ratios presented?)
13. The summary statistics and probability values including 95% confidence intervals
14. The authors conclusions regarding sitting-while-at-work and low back pain

were cross-sectional and 4 were prospective. The studies were set in 17 different countries, most frequently in Scandinavia (40%).

Quality of studies

1. The reviewed studies used a wide variety of sampling methods ranging from random population samples (9–11) to no description of the sampling method (12, 13).
2. LBP was defined in different ways: Eight studies used a questionnaire with previously demonstrated reproducibility, such as the Standardized Nordic Questionnaire (9, 14–20); 1 study used a questionnaire previously used without validation (13); 9 studies used own questionnaires or drawings with the LBP definition explicitly described in the text (11–12, 21–27); 8 studies used own questionnaires or drawings without any description of LBP in the text (10, 28–34); 5 studies used injury claims or medical records including ICD8 or 9 codes with no description in the text (35–39); and 4 studies provided no description at all of LBP (40–43).
3. A variety of statistical measures were used ranging from well-described, standard, epidemiological methods used to calculate odds ratios (11) to merely reporting the percentage of workers with LBP in a single group (41).

We found 8 out of 33 studies to have a representative sample, a clear definition of LBP, and a clear statistical analysis (Tables II and III) (9, 11, 14, 15, 23, 25, 34, 36).

Is sitting-while-working associated with LBP?

None of the 14 studies summarized in Table II showed that sitting-while-working *per se* was statistically significantly, positively associated with LBP, including one prospective and 13 cross-sectional studies. One low-quality study found prolonged sitting in a "poor sitting posture" to be statistically significantly associated with the one-year period prevalence of LBP (13). LBP odds ratios for these studies ranged from 0.72 to 2.13. The only two high-quality studies dealing with sitting-while-working both demonstrated a weak statistically significant, negative association for sitting: OR = 0.72 (0.53–0.97) compared to standing (9) and OR = 0.84 (0.74–0.96) compared to standing, twisting or bending, physically hard work, or whole-body vibration (11).

Is having a sedentary occupation associated with LBP?

None of the 21 studies summarized in Table III showed that having a sedentary occupation was statistically significantly positively associated with LBP, including 18 cross-sectional and 3 prospective studies. Fourteen had ORs reported or calculated by the present authors based on the data provided ranging from 0.38 to 1.73: of these, 12 studies had ORs of less than or equal to the reference value of one, indicating the possibility of a protective or neutral effect.

The 5 high-quality studies of this type all showed a statistically significant, negative association for sedentary occupations: OR = 0.46 (0.24–0.89) when white-collar workers were compared with blue collar-workers (36), OR = 0.57 (0.32–1.00) when office-workers were compared with crane operators and straddle-carrier drivers (15), OR = 0.55 (0.40–0.78) when office-workers were compared with machine operators and carpenters (25), OR = 0.62 (0.54–0.71) when managerial, administrative, and clerical work was compared with healthcare and social work, commercial work, technical, scientific work, agriculture and fishing, transport and communication, manufacturing work, and service work (34), and OR = 0.69 (0.54–0.89) when white-collar workers were compared with plumbers, carpenters, painters, plasterers, bricklayers, or unskilled workers (23). Two studies had ORs > 1, indicating the possibility of an increased "risk" (20, 40). In both instances, however, the 95% CI straddles the value of 1, making it statistically non-significant.

Other summary measures were used in 7 studies: Days of absence from work owing to back pain (38), questionnaire score (pain, disability) (10, 18, 22), percentage with LBP (41), workers' compensation claims or number of accidents (37, 39). None of these studies showed an association between LBP and sitting *per se*. In fact, white-collar workers had the least days absent from work compared to nurses, manual workers, drivers, miners, and lumberjacks (38) and sedentary occupations had a lower than average risk of progressing to chronic LBP in a comparison between 18 occupational groups (39).

Is there a positive dose-response relationship between sitting and LBP?

Dose-response information was collected in three studies (9, 11, 20), two of which were high-quality studies (9, 11). Thus, Svensson and Andersson found that sitting for more than 4 h daily was significantly less often associated with LBP than sitting for 2–4 h daily and also for less than 2 h daily (9). Unfortunately, Xu et al. did not have confidence in the precise numbers of hours each subject spent sitting per day (personal communication) and therefore did not report their dose response results (11). Skov et al. investigated the proportion of time spent sitting, comparing persons sitting for 25%, 50%, 75%, and 100% of working time with those who worked continuously standing. Odds ratios ranged from 1.6 to 2.4 with wide confidence intervals, suggesting that the proportion of time sitting was not a major "risk" factor for LBP (20). Furthermore, it is unclear whether subjects driving cars were included in the sedentary group.

DISCUSSION

Only one of the 35 studies published from 1985 to 1997 that we succeeded in collecting showed that sitting-while-working was associated with LBP. In other words, we found no conclusive evidence for an association between sitting-while-at-work and LBP.

However, out of the 35 studies only 8 fulfilled the very basic criteria of obtaining a good response rate from a representative sample, a clear definition of LBP, and a clear and understandable statistical analysis. These criteria can, in our opinion, be considered the minimum standard when evaluating epidemiologic literature in relation to LBP. It is nevertheless interesting that both high-quality and low-quality studies are consistently in agreement with respect to this matter, leaving little room for doubt about the lack of positive association between sitting at work and LBP.

The only exception was the study by Lee and Chiou, who found that "poor sitting habits" were statistically significantly associated with LBP within the past year (13). However, the authors did not specifically explain the difference between "good" and "poor" sitting habits and since "good sitting habits" appeared not to be associated with LBP, we conclude that the increased one-year prevalence of LBP could not be caused by sitting *per se*.

In the case of sitting, a clear and understandable description of exposure creates some particular difficulties: Sitting-while-working starts as early as at school and there is often considerable spill-over from leisure time, i.e. watching TV, or playing computer games. Thus, it is extremely difficult to obtain a reliable measure of exposure over a period of time let alone obtain a reliable measure of lifetime exposure. This is different from of other workplace exposures, such as chemicals or vibrating machinery, which are for the most part limited to adults and to specific workplaces.

It is also possible that the occurrence of LBP is dependent on the specific task performed while sitting rather than by sitting itself, such as suggested by Rotgoltz et al. (25). This could also explain the "poor posture" findings of Lee and Chiou (13). In musculoskeletal disorders of the upper extremity, for instance, it is widely accepted that repetition of inappropriate, or even normally harmless, tasks may contribute to the onset of painful conditions (44, 45). However, none of the present studies deal specifically with this issue.

Strictly speaking, in order to obtain a reliable risk estimate, exposure should precede the outcome. This requires an initially disease-free study group and prospective investigations. In the case of work-related LBP, it is difficult to obtain such a study group, since the lifetime prevalence of LBP is already very high at the age of 20 (1). However, it would still be possible to study existing LBP, for example with respect to development of chronicity, treatment needed, and job changes in relation to sitting.

The lack of a positive association between sedentary jobs and LBP is even more remarkable considering that all but three studies were cross-sectional and therefore probably subject to the so-called "healthy worker effect". In other words, office workers incapable of sitting for long hours might move on to other types of jobs and not be in these studies. However, we believe it is more likely that already-diseased persons in heavy jobs end up with a sedentary job, thereby potentially inflating the prevalence of LBP among office workers.

All in all, we consider the idea that sitting-while-at-work causes LBP a myth. Apparently, this concept, at least partly, arises from two widely cited sources:

- First, Alf Nachemson in the 1960s published extensively on pressure conditions in the human intervertebral disc (46–51). Using *in vivo* measurements, he showed that the total load on the disc increases by about 38% in the seated as compared with the standing position in young adults (50). His measurements were, however, performed only on the L3, and to a lesser extent, the L4 discs in individuals with normal discograms and with no abnormal radiological findings. Furthermore, these measurements were not correlated with pain findings and Nachemson did not himself propose that sitting was a risk factor for *low back pain per se*.
- Second, in 1972 Magora concluded that sitting at work increases the risk for LBP in one of the first major epidemiological studies concerning work and LBP (5). A closer look at this often-cited study reveals, however, that his conclusion was not justified on the basis of the data provided in the article. We calculated the odds ratio for his "sitting often" group compared to his "sitting rarely or never" group and found that the "sitting often" group, in fact, had significantly *less* LBP (odds ratio 0.41 (0.33–0.51). When comparing "sitting often" to "sitting sometimes" the OR was 9.25 (5.31–

Table II. *Selected items abstracted from articles investigating sitting-while working*

Reference #	First author, country and year of publication	Type of study	Sample size and response/participation rate	Sampling method	Occ. groups/physical demands compared	Exposure description	Description of LBP	Odds Ratio for sitting group with (95% CI)	Authors' conclusion	Repr. sample LBP definition Stat. analysis yes = +, no = –
9	Svensson, Sweden, 1989	Cross-sectional	1,760 80–81.5%	General population sample from census register	Sitting, standing, bending, lifting	Three categories of sitting	Nachemson & Andersson	0.72 (0.53–0.97) $p<0.02^{1}$ (sitting > 4 h/day vs sitting < 2 h/day)	"...Other studies did not find sitting to be a risk factor for LBP, which is in agreement with the results of our study."	+ + +
10	Walsh, England, 1989	Cross-sectional	545 75–88%	General population sample aged 20–70 recruited through general practitioner	Sitting, standing, walking, lifting, driving car, driving truck, vibration	Sitting more than 2 h/day	Own drawing	1.3 (0.9–1.9) in men 1.2 (0.8–1.8) in women for risk of *lbp* if sitting > 2 h/day more than half of worklife	Non-significant trend to more LBP in persons sitting more than 2 h on the job	+ – +
19	Linton, Sweden, 1990	Cross-sectional	22,180 participation rate not reported	Swedish employees undergoing routine screening examination at occupational health care service	Sitting, monotonous work, uncomfortable posture, vibration, heavy lifting	Questionnaire by Hane et al.	Questionnaire by Hane et al.	Between 0.92 and 0.97 (0.73–1.11) for four age categories	"Sitting did not increase the risk for either back- or neck pain."	– + +
17	Jacobsson, Sweden, 1991	Cross-sectional	900 48%	900 persons (50–70 yrs) randomly sampled from population records	Repetitive/static, standing/walking, heavy lifting, awkward working posture	Self-rated heaviness of work	Nachemson & Andersson	1.6 (0.52–5.04) $p=0.36^{1}$	LBP not related to sitting *per se*	– + –
35	Fuortes, USA, 1994	Cross-sectional	297 44–53%	Cases: All nurses awarded workers compensation claim for back injury controls: Randomly selected nurses w. out back pain	Sitting, standing, pushing, pulling	Mean hrs of sitting/day	Not provided	0.98 (0.96–1.01) $p=0.86$	Sitting decreases risk for low back injury at work	– – +
12	Krapac, Croatia, 1994	Cross-sectional	95 response rate not reported	Workers at Institute for Financial Control, selection method not described	Office workers using video display terminals more than 5 hrs/day, office workers with relatively free rhythm	Sitting all day vs. free work rhythm	Own drawing	1.88 (0.70–5.08) $p=0.1661$ for video display terminal users	More frequent LBP in video display terminal users but non-significant	– + –
21	Masset, Belgium, 1994	Cross-sectional	2,023 30.5%	Male blue collar workers at two steel industries	Nine occupational groups not described	Not provided	Own questionnaire	1.46 (CI not provided) $p=0.09$	Seated posture showed non-significant tendency to association with LBP	– + +
13	Lee, Taiwan, 1994	Cross-sectional	3193 99.4%	Nursing personnel working in one of four branches of major hospital	Sleeping, sitting, standing, walking, working	Self-rated habits of posture	Not provided	2.13 (1.46–3.11)	Poor sitting habits significantly associated with 1 yr. Prevalence of LBP, good sitting habits not	+ – +

28	Hultman, Sweden, 1995	Cross-sectional	168 86–100%	All men aged 45–55 working at large cable manufacturing company. All men aged 45–55 referred to outpatient clinic for chronic non-specific LBP	Sitting, upright, standing, walking, whole body vibration, driving, lifting, pulling, pushing	Percieved physical exertion	Not provided	Cannot be calculated from data provided	"No statistically significant differences between any of the groups"	+ – –
32	Toroptsova, Russia, 1995	Cross-sectional	800 87.6%	800 persons ramdonly selected from a list of employees at a machine-building factory	Sitting, standing, walking, vibration, static postures, repetitive work, lifting, others	Not provided	Own questionnaire	Cannot be calculated form data provided	"No association between other factors (incl. sitting) was established."	+ – –
20	Skov, Denmark, 1996	Cross-sectional	1978 66%	Random sample of members of occupational association	Sedentary work, driving, self-rated work demands, self-rated work Variation	Time spent doing sedentary work	Standardized Nordic Ouestionnaire	1.42 (0.89–2.26) $p=0.04$	"The risk for neck and back symptoms were high for those ......who had much sedentary work."	– + +
31	Macfarlane, England, 1997	Prospective, cohort	7,699 59%	All respondents who were 18–75, employed and free from back pain recruited from all registered patients at general practitioner	Sitting, standing/walking, driving car, driving truck, lifting/moving, digging	Sitting more than 2 h/day	Own questionnaire	0.79 (0.59–1.07) $p<0.11^1$	Non-significant difference between sitting and not sitting on the job	– – +
11	Xu, Denmark, 1997	Cross-sectional	9,700 89.3%	Random sample of Danish population aged 18–59 employed in specific occupations drawn from census register	Sitting, standing, frequent twisting and bending, physically hard work, whole-body vibration	4 categories: 25, 50, 75 and 100% of time	Own questionnaire	0.84 (0.74–0.96) $p<0.02$	Sitting on the job appears to have protective effect	+ + +

[1] = own calculation from data provided.

Table III. *Selected items abstracted form articles investigating sedentary occupations*

Reference #	First author, country and year of publication	Type of study	Sample size and response/ participation rate	Sampling method	Occ. groups/ physical demands compared	Exposure description	Description of LBP	Odds Ratio for sitting group with (95% CI)	Authors' conclusions	Repr. sample LBP definition Stat. analysis yes = +, no = −
42	Reisbord, USA, 1985	Cross-sectional	2,792 respondents rate not reported	Proportionate random sampling scheme producing a sample similar to to that found in published census data	No job, sedentary, light, moderate, heavy	No	"Frequent back pain during 12 months prior to interview"	0.61 (052 – 0.83) $p = 0.001^1$	"...Sedentary workers still had about 25% lower prevalence than the remaining demand categories ..."	− − +
30	Lloyd, Scotland, 1986	Cross-sectional	576, 62 – 71%	20% of colliery workers randomly sampled, all office workers at National Coal Board invited to participate	Colliery workers, office workers	No	No	OR for LPB in previous three months: 0.64 (0.42 – 0.97) $p = 0.03^1$	LBP common in both groups, no statistically significant difference.	− − +
36	Heliövaara, Finland, 1987	Case-control	2732, 100%	Cases: persons with diagnosed lumbar disc herniation or sciatica discharged from hospital controls: matched for age, sex, residence	10 occupational groups according to Nordic Standard Classification of Occupations	Self-rated strenuousness of work	Diagnostic codes (ICD 8th revision)	Relative risk: white-collar workers: 0.46 (0.24 – 0.89) $p = 0.02^1$	White-collar workers have the lowest risk of all for being hospitalized for lumbar disc herniation or sciatica	+ + +
24	Riihimäki, Finland, 1988	Cross-sectional	2222, 67 – 71%	Members of three different trade unions recruited according to age and geographical criteria	Longshoremen, carpenters, office workers	No	Lumbago, sciatica, other	0.38 (0.31 – 0.46) $p < 0.0001^1$	"Our results do not support the hypothesis that sedentary work would be associated with an increase in the risk of low-back disorders"	− + −
29	Leigh, USA, 1989	Cross-sectional	1496 response rate not reported	Probability sample of United States workers	10 occupational groups	No	No	0.52 (0.39 – 0.69) for white-collar workers, $p = 0.0001$ (professionals, managers, clerks)[1]	White-collar workers suffer significantly less LBP than blue collar workers	+ − +
14	Kamwendo, Sweden, 1991	Cross-sectional	438 96%	Female medical secretaries working at medical centre in Sweden	No comparison groups	Daily number of hours spent sitting	Standardized Nordic Questionnaire	0.92 (0.58 – 1.44)	"...odds ratios...(for LBP) were neither elevated nor significant"	+ + +
27	Tömer, Sweden, 1991	Cross-sectional	112, 69 – 84%	All welders and 39% of office clerks (selection method not described) at an energy systems plant	Office clerks, welders	Years in present occupation	Pain between T12 and buttocks	0.62 (0.20 – 1.92) $p = 0.36^1$	"Welders had a significantly higher frequency of subjective symptoms from...and back than office clerks."	− + −
38	Rossignol, Canada, 1992	Prospective, cohort	Not reported	Random sample of workers compensated in 1981 for a back problem.	White-collar workers, nurse, manual worker, driver, miner/lumberjack, other	No	No	Cannot be calculated from data provided	White collar workers have least absence from work compared to other groups	− − −
26	Rotgoltz, Israel, 1992	Cross-sectional	208 respondents, rate not reported	Employees at pharmaceutical company, sampling method not described	6 departments at Pharmaceutical company	No	No	1.73 (0.91 – 3.31) $p = 0.07^1$	"Both prolonged sitting and type of job independently associated with LBP."	+ − +
33	Westgaard, Norway, 1992	Cross-sectional	245 participants, rate not reported	Sample of production workers at Norwegian clothing company (method not described) and all non-production workers	Production workers (mainly sewing), office workers	Work task, work time	No	Cannot be calculated from data provided	Same LBP symptom score for production and office workers	+ + −
15	Burdof, Holland, 1993	Cross-sectional	300, 86 – 95%	Three groups of workers at large transport company in Rotterdam port sampled through company records according to age and duration of employment	Crane operators, straddle carrier drivers, office workers	Sitting more or less than 6 h/day	Standardized Nordic Questionnaire	0.57 (0.32 – 1.00) $p = 0.04$ for office workers[1]	Sustained sedentary work in non-neutral trunk posture is a risk factor for LBP	+ + +
41	Ignatius, Japan, 1993	Cross-sectional	330, 51.5%	Typists working in government department volunteering information	Typists	<4 h, 5 – 6 h, >6 h typing per day	No	Cannot be calculated from data provided	53% of typists have had LBP within past two years	− − −

18	Johansson, Sweden, 1994	Cross-sectional	500, 90%	Entire divisions or random samples of employees of eight different companies	White-collar & blue-collar workers	No	Standardized Nordic Questionnaire	Cannot be calculated form data provided	Monotonous working postures increase risk of LBP also for sedentary work	+ + −
25	Riihimäki, Finland, 1994	Prospective, cohort	2222, 79–89%	All participants in study from 1988 (24)	Machine operators, carpenters, office workers	No	Lumbago, sciatica, other	Rate ratio office workers: 0.55% (0.40–0.78) $p<0.0001$[1]	"LBP causes more more trouble for people in physically strenuous work than for those in sedentary work..."	+ + +
16	Hildebrandt, Holland, 1995	Cross-sectional	8748, not reported	Random sample of Dutch workers from Central Statistics Office	Sedentary, non-sedentary professions	No	"Do you have trouble from your back quite often?"	0.75 (0.68–0.82)[1]	"...in non-sedentary work, both men and women have higher prevalence rates of back pain than in sedentary work."	− + +
22	Jefferson, McGrath, USA, 1996	Cross-sectional	322, 95%	All employees at aircraft engine factory	Three departments: Systems, Cutter grind & tooling, Materials & shipping	No	Pain between 12th rib and gluteal fold-defined from own drawing	Cannot be calculated from data provided	"Systems dept. (predominantly sedentary) reports high levels of spinal discomfort"	+ + −
39	Rudd, New Zealand, 1996	Cross-sectional	1482, 100%	All work-related back injury claims made over a six-month period	18 occupational groups	No	No	Cannot be calculated from data provided	Sedentary occupations lower than average risk of progressing to chronic LBP	− − −
34	Xu, Denmark, 1996	Cross-sectional	9,700, 89.3%	Random pop. Sample, method not described	8 occupational groups as defined by ISCO (ref)	No	No	0.62 (0.54–0.71) for managerial, administrative and clerical work	Sedentary occ. groups all have less LBP than rest	+ + +
40	Hurwitz, USA, 1997	Cross-sectional	84,572, 94.9%	52 weekly replicated samples of general US non-institutionalized population performed by NHIS (method not described)	13 occupational groups (own classification)	No	No	Clerical jobs: 1.01 (0.89, 1.14) for non-disabling back pain Administrative jobs: 1.00 (0.88, 1.13) for non-disabling back conditon	Workers in sedentary occupations are less likely to have a disabling back condition than others	+ − −
37	Kuwashima, Japan, 1997	Cross-sectional	13,166, 100%	All cases of accidental LBP in 1986 and 1988 reported to the Labor Standards Inspection Offices	Various manufacturing occupations and various non-manufacturing occupations	No	No	Cannot be calculated from data provided	Static work posture (including sitting) not associated with low back injuries	− − −
23	Matsui, Japan, 1997	Cross-sectional	3,622, 84%	All employees of large manufacturing company	Sedentary, light, moderate, heavy	Sitting all day	Own questionnaire	0.69 (0.54–0.89) $p<0.01$ for men 0.46 (0.27–0.81) $p<0.01$ for women[1]	The heavier the work the more LBP	+ + +
43	Rothenbacher, Germany, 1997	Prospective, cohort	4,958, 86–95%	All male employees aged 40–64 examined at one of six occupational health centres	White-collar, plumbers, carpenters, painters, plasteres, bricklayers, unskilled	No	"Any type of LBP or sciatica"	0.93 (0.70–1.25) for white-collar workers $p=0.63$[1]	Inconclusive regarding sitting work	+ − −

[1] = own calculation from data provided.

16.41) making the conclusions of this study equivocal at best.

The creation of a scientific myth probably requires several premises. The first is confusion or a lack of precise knowledge combined with an interest in providing answers within a short time frame. The second is a reasonable degree of logical arguments, in this case provided by the already-mentioned papers (5, 50). The third is the lack of opposing arguments over time or, as we suspect in this case, systematic citation bias.

To challenge a scientific myth and to propose a different view is difficult. Meta-analysis or systematic literature reviews are helpful in clarifying the picture in areas with a considerable amount of diffuse information.

CONCLUSION

This literature review did not support the widespread opinion that sitting-while-working is a risk factor for LBP. Studies in a variety of settings applying different definitions of LBP consistently failed to demonstrate a statistically significant, positive association between these two factors. It is important that physicians are aware of this information when advising patients.

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