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Psychosocial Risk Factors for Neck Pain: A Systematic Review

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Background *Neck pain, which is assumed to be a multifactorial disease, is a major problem in modern society.*
Methods *To identify the most important psychosocial risk factors for neck pain, a systematic review of the literature was carried out. The methodological quality of all studies in the review was assessed. Four levels of evidence were defined to assess the strength of evidence for potential risk factors for neck pain (strong, moderate, some or inconclusive evidence).*
Results *Some evidence was found for a positive relationship between neck pain and high quantitative job demands, low social (coworker) support, low job control, high and low skill discretion and low job satisfaction. Inconclusive evidence was found for high job strain, low supervisor support, conflicts at work, low job security, and limited rest break opportunities.*
Conclusion *The procedure of the assessment of the methodological quality and the rating system applied to distinguish between high- and low-score studies, had a considerable influence on the level of evidence, indicating that changes in this procedure may have a major impact on the overall conclusions of this review.* Am. J. Ind. Med. 39:180–193, 2001. *© 2001 Wiley-Liss, Inc.*

KEY WORDS: neck pain; systematic review; psychosocial; risk factors; observational studies

INTRODUCTION

Musculoskeletal problems are a major problem in modern society. In the Netherlands, the costs of work-related sick leave and medical consumption are very high (US$ 4.8 billion a year). Around 40% of these total costs is due to musculoskeletal disorders [Koningsveld and Mossink, 1997]. Neck pain may not be the biggest musculoskeletal problem, but it still is substantial. Recent prevalence data showed that in a general population the 1-year prevalence of neck pain was 15% and 17% for males and females, respectively [Lau et al., 1996]. Prevalence data in occupational settings are even more impressive. Skov et al. [1996] reported 1-year prevalences of neck pain in a population of sales people (n = 1304) of 54% in males and 76% in females.

Neck pain is assumed to be a multifactorial disease, implying that there are a number of risk factors contributing to its development. Risk factors can be work-related, as well as non-work-related. Furthermore, risk factors can be divided roughly in three groups, i.e., physical, psychosocial, and individual-related risk factors. Many studies have been conducted to identify the most important risk factors for neck pain. Most studies focus on only one or a few risk factors, or on one particular category of risk factors. While most attention has always been given to physical risk factors for neck pain, psychosocial risk factors also seem to play a major role in the development of neck pain.

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To identify the most important psychosocial risk factors for neck pain, a systematic review of the literature was carried out. This review deals with psychosocial risk factors at work and in leisure time, such as demands and control over work, work organization factors, work satisfaction, and social support at work and in leisure time. Individual-related psychological factors such as coping behavior are not within the scope of this review. A complementary systematic review concerning physical risk factors for neck pain has been published elsewhere [Ariëns et al., 2000].

MATERIALS AND METHODS

On-line searches in Medline, Embase, Psychlit, Sportdiscus, HSELINE, CISDOC, and NIOSHTIC were carried out to identify all relevant studies. The search concerned the time period January 1966 to November 1997, using the following keywords (MeSH and text words): neck, neck pain, risk factors, determinants, causality, work, exercise, overuse, physical load, workload, psychosocial factors. Abstracts of all studies identified were read. If no abstract was available, or if, based on the abstract, it was unclear whether a study should enter this systematic review, the whole article was retrieved and read. In order to be included, a study had to meet the following criteria:

1. The study population must be a working population or a community-based population. Studies of patient populations were excluded.
2. The study design must either be case–control, cross-sectional, or cohort.
3. The assessment of exposure should at least concern one psychosocial factor at work or during leisure time.
4. The assessment of exposure may not be based just on job titles.
5. The outcome can include one or more syndromes, signs or symptoms of the neck. The outcome can be a self-reported variable, as well as a clinical diagnosis. The outcome must be reported for the neck region separately.
6. The study must be a full, peer-reviewed report published in the English, Dutch or German language.

Reference lists of included studies were checked for additional references. To check the selection procedure, a random sample of 30 studies was judged by a second reviewer to determine whether or not a study should be included in the review.

The methodological quality of all studies that entered the review was assessed by means of a methodological quality assessment list. After critically reviewing existing quality lists [Stock, 1991; van Tulder et al., 1997; Borghouts et al., 1998], a criteria list was developed to assess the methodological quality of observational studies. The criteria list contained various items on information and validity and/or precision in five categories: study purpose, study design, exposure measurements, outcome measurements, and analysis and data presentation. Separate quality assessment lists were constructed for cross-sectional, case–control, and cohort studies. In Table I the items of the methodological quality assessment lists are presented. The first two items of the quality assessment list (items A and B) provide descriptive information only, while all other items of the list concern the validity and/or precision of the study (see also Appendix A).

For every item in the quality list, two independent reviewers (GA and WvM) rated each study either ''positive'' (+), ''negative'' (−), or ''unclear'' (?) if a study did or did not meet an item, or if no clear information was stated regarding that item, respectively. Results of these two independent reviewers were compared and, if differing, in a meeting consensus upon each item was reached. For each study, a total quality score was calculated by counting the number of validity/precision items that were rated positively. Based on this total score, a study was either categorized as high or low-score study. A high-score was arbitrarily defined as a study that scored positively on at least 50% of the validity/precision items of the methodological quality list concerned. Low-score studies scored positively on less than 50% of the validity/precision items.

The strength of evidence for potential risk factors was assessed by defining four levels of evidence as follows:

1. Strong evidence: consistent findings in multiple high-score cohort and/or case–control studies.
2. Moderate evidence: consistent findings in multiple cohort and/or case–control studies, of which only one study is a high-score study.
3. Some evidence: findings of one cohort or case–control study, or consistent findings in multiple cross-sectional studies of which at least one study is a high-score study.
4. Inconclusive evidence concerns all other cases, i.e., consistent findings in multiple low-score cross-sectional studies, or inconsistent findings in multiple studies. Moreover, the evidence is considered to be inconclusive if only one cross-sectional study is available, irrespective of the quality of this study.

Cross-sectional studies that were rated lowest for quality according to the methodological quality list (score of 3 or less) were excluded from the analysis for the determination of the strength of evidence. A positive, a negative or no effect of a risk factor can be found in the publications reviewed. A positive effect is defined as an increased risk for the occurrence of neck pain due to the presence of a risk factor. In contrast, a decreased risk for the occurrence of neck pain due to the presence of a risk factor was defined as

TABLE I. Description of the Items in the Quality Assessment Lists

	Item Definition		Design[a]
Study purpose	A.	Positive if a specific, clearly stated purpose is described.	Cr Ca Pr
Study design	B.	Positive if the main features (description of sampling frame, distribution by age and sex) of the study population are stated.	Cr Ca Pr
	C.	Positive if the participation rate at baseline is at least 80%.	Cr Ca Pr
	D.	Positive if cases and controls were drawn from the same population and a clear definition of cases and controls was stated. Persons with neck pain in the last 90 days must be excluded from the control group.	Ca
	E.	Positive if the response after 1 year of follow-up is at least 80%, or if the non-response is not selective.	Pr
Exposure measurements	F.	Positive if data on physical load at work are collected and used in the analysis.	Cr Ca Pr
	G.	Positive if data on physical load at work are collected using standardized methods of acceptable quality.[b]	Cr Ca Pr
	H.	Positive if data on psychosocial factors at work are collected and used in the analysis.	Cr Ca Pr
	I.	Positive if data on psychosocial factors at work are collected using standardized methods of acceptable quality.[b]	Cr Ca Pr
	J.	Positive if data on physical and/or psychosocial factors during leisure time are collected and used in the analysis.	Cr Ca Pr
	K.	Positive if data on historical exposure at work are collected and used in the analysis.	Cr Ca Pr
	L.	Positive if data on history of neck disorders, sex and age are collected and used in the analysis.	Cr Ca Pr
	M.	Positive if the exposure assessment is blinded with respect to disease status.	Cr Ca
	N.	Positive if exposure is measured in an identical way in cases and controls.	Ca
	O.	Positive if the exposure was assessed at a time prior to the occurrence of the outcome.	Ca
Outcome measurements	P.	Positive if data on outcome are collected using standardized methods of acceptable quality.[c]	Cr Ca Pr
	Q.	Positive if incident cases are used (prospective enrolment).	Ca
	R.	Positive if data on outcome are collected for at least 1 year.	Pr
	S.	Positive if data on outcome are collected at least every 3 months.	Pr
Analysis and data presentation	T.	Positive if the statistical model used is appropriate for the outcome studied and the measures of association estimated with this model are presented (including confidence intervals).	Cr Ca Pr
	U.	Positive if the study controls for confounding.	Cr Ca Pr
	V.	Positive if the number of cases in the multivariate analysis is at least 10 times the number of independent variables in the analysis.	Cr Ca Pr

[a]This column indicates whether the item is used in the quality assessment list for cross-sectional (Cr), case–control (Ca) and/or prospective cohort studies (Pr).
[b]This item is scored positive if one of the following criteria is met: (1) for direct measurements: intraclass correlation coefficient > 0.60 or $\kappa > 0.40$; (2) for observational methods: intraclass correlation coefficient > 0.60 or $\kappa > 0.40$ for the inter- or intraobserver reliability; and (3) for self-reported data: intraclass correlation coefficient > 0.60 or $\kappa > 0.40$ for the inter- or intraobserver reliability.
[c]This item is scored positive if one of the following criteria is met: (1) for self-reported data: intraclass correlation coefficient > 0.60 or $\kappa > 0.40$; (2) for registered data: data must show that registration system is valid and reliable; and (3) for physical examination: intraclass correlation coefficient > 0.60 or $\kappa > 0.40$ for the inter- or intraobserver reliability.

a negative effect. No effect implied that the presence of a risk factor was neither associated with an increased nor with a decreased risk for the occurrence of neck pain.

The focus of this review was on the size and direction of the risk estimate, irrespective of the level of significance. A study that reported a nonsignificant association between a risk factor and neck pain, with no mention of the risk estimate was eliminated from the determination of the level of evidence. This ignorance of statistical significance and exclusion of nonsignificant study results (without the mention of a risk estimate), was based on the fact that in most studies no sufficient information is presented on the possible reason for finding nonsignificant results: either there was no association or there was a lack of statistical power due to, for example, a small study population [Lang et al., 1998]. Reporting a significant association without stating the risk estimate was considered as a finding and thus contributed to the level of evidence.

Consistent findings implied that the results of at least 75% of the studies investigating the effect of a certain risk

factor pointed in the same direction. The risk estimates and *P*-values reported by these studies should lead to the same conclusion, i.e., that a positive, negative or no effect was found in relation to neck pain. The same methods have been used in our systematic review on physical risk factors for neck pain [Ariëns et al., 2000].

RESULTS

Identification of Studies and Quality Assessment

Out of 1,026 studies identified, 29 studies were included in this review. All studies included but one, a prospective cohort study of Viikari-Juntura et al. [1994], had a cross-sectional design. The most important reason for exclusion from this review was the use of a combined outcome measure [e.g. Bjelle et al., 1987; Veiersted and Westgaard, 1993; Westgaard et al., 1993; Engels et al., 1994; Bergqvist, 1995; Hasvold et al., 1996; Hägg and Aström, 1997]; these studies did not report their results separately for the neck region, but combined the neck region with another body region (most often the shoulder region). The two independent reviewers agreed on inclusion or exclusion for 90% of the studies in the random sample. After discussion with a third person, consensus was reached on inclusion or exclusion of all studies.

In Appendix A the results of the assessment of the methodological quality of all studies included in this review are presented. The percentage of agreement between the two independent reviewers on the methodological quality assessment was 86.3%. All disagreements between the two reviewers were discussed and resolved in a consensus meeting, and for each study, a final score was given on every item. Twenty-eight studies collected and analyzed data concerning psychosocial factors at work. One additional study did not collect data on psychosocial factors at work. However, in this study, data on psychosocial factors during leisure time were collected [Westgaard and Jansen, 1992]. The items in the quality list that were most often scored negative, were those concerning the use of standardized exposure measurements of acceptable quality (items G and I) and Item L, the item that was scored positive if data on a history of neck disorders, sex, and age were collected and used in the analysis. Only once, these items were scored positive. The items on blinding of the exposure assessment and on the use of standardized methods for the outcome measures (items M and P) were scored positive only twice. Confounding was controlled for by 23 out of 29 studies (Item U) and 22 studies had also collected data on physical exposure at work. Nine cross-sectional studies scored 3 or less points on the quality list [Chang et al., 1987; Ursin et al., 1988; Flodmark and Aase, 1992; Rosecrance et al., 1992; Westgaard and Jansen, 1992; Johansson et al., 1993; Johansson, 1994; Pocekay et al., 1995; Ingelgård et al., 1996]. They were excluded from the determination of the level of evidence. The final number of studies to be used for the level of evidence synthesis is therefore 20. Of these 20 studies, five scored positive on more than 50% of the validity/precision items of the methodological quality list, and were defined as being high-score studies. Table II gives a brief description of the studies that have been used for the determination of the level of evidence.

Levels of Evidence

As can be seen in Table II, various psychosocial factors were examined. All these factors were grouped into nine categories of psychosocial factors. The results concerning the determination of the level of evidence for these nine categories are described below and summarized in Table III.

Quantitative job demands

A total of 13 cross-sectional studies investigated the effect of high quantitative job demands in relation to neck pain [Kilbom et al., 1986; Musson, 1989; Linton, 1990; Kamwendo et al., 1991; Bernard et al., 1994; Hales et al., 1994; Johansson and Rubenowitz, 1994; Johansson, 1995; Ahlberg-Hultén et al., 1995; Lagerström et al., 1995; Skov et al., 1996; Bru et al., 1996; Toomingas et al., 1997]. Three of these studies were rated as high-score studies [Kamwendo et al., 1991; Bernard et al., 1994; Hales et al., 1994]. Three studies have not been taken into account for the determination of the level of evidence because they reported a non-significant relationship between psychosocial workload and neck pain without mentioning a risk estimate [Kilbom et al., 1986; Musson, 1989; Skov et al., 1996]. In their high-score study, Hales et al. [1994] reported an odds ratio of 2.4 for the relationship between increasing work pressure and self-reported neck pain. The high-score study of Bernard et al. [1994] reported an odds ratio of 1.7 for the relationship between neck pain and an increased number of hours spent working under a deadline. Kamwendo et al. [1991] showed a *P*-value of 0.01 for the relationship between neck pain and the following statement: "I have too much to do." Several low-score cross-sectional studies, investigating the relationship between high quantitative job demands and neck pain, confirm the results found in the high-score studies [Linton, 1990; Johansson and Rubenowitz, 1994; Lagerström et al., 1995; Johansson, 1995; Bru et al., 1996; Toomingas et al., 1997]. One low-score study [Ahlberg-Hultén et al., 1995] could not detect a relationship between high quantitative job demands and neck pain. Based on the results described above, it is concluded that some evidence is found for a positive relationship between high quantitative job demands and neck pain.

TABLE II. Descriptive Information of All Studies Included in this Review That Had a Total Quality Score of 4 or More

Reference	Design	MQS[a]	Study population	Outcome measure(s)	Psychosocial risk factor(s) and strength of association
Kilbom et al., 1986	Cr[b]	5	Female assembly line workers of two electronic manufacturing companies Response at baseline 77% (n = 106)	Severity of self-reported neck symptoms	*Work-related factors* Overtime work (ns);[c] Perceived psychological stress at work (ns); Work satisfaction (ns); Number of breaks and rest pauses at work (ns)
Dartigues et al., 1988	Cr	5	A working population (n = 990)	Self-reported recurrent cervical pain syndrome	*Work-related risk factors* Conflict related to work (OR = 3.1, 2.0–4.8);[d] *Non-work-related risk factors* Conflict related to family (OR = 1.8, 1.1–3.0);
Musson, 1989	Cr	4	Workers using various types of impact tools (n = 445) Response at baseline 38% (n = 169)	Self-reported regularly pain or stiffness in the neck	*Work-related factors* Time pressure (ns)
Linton, 1990	Cr	6	Full-time employees daytime working (n = 22,180)	Self-reported neck pain	*Work-related risk factors* Monotonous work (OR = 2.25–2.95);[e] Overall psychosocial score (OR = 1.89–2.57); Poor work content (OR = 1.94–2.47); Low social support (OR = 1.38–2.57); High psychosocial work load (OR = 1.24–1.49)
Kamwendo et al., 1991	Cr	7	Female medical secretaries and office personnel Response at baseline 96% (n = 420)	Self-reported neck pain	*Work-related risk factors* Poorly experienced psychosocial work environment ($P = 0.004$);[f] Interesting and stimulating work (ns); Work variation (ns); Friendly spirit of cooperation with fellow workers ($P = 0.013$); Help and support if you run into difficulties in your work (ns); Ability to influence working conditions ($P = 0.001$); Too much to do ($P = 0.010$); Good contact and cooperation with superiors (ns); Demands of your work too great (ns); Anxiety feelings about possible reorganization or new techniques in your work (ns)
Mäkelä et al., 1991	Cr	9	Finnish adults drawn from the population register, representing the Finnish adult population of 30 years and older Response at baseline 90% (n = 7,217)	Chronic neck syndrome	Work-related factors (age 30–64 years) Mental stress at work (OR = 1.20, 1.12–1.28) Work-related risk factors (age > 64 years) Mental stress at work (OR = 1.27, 1.11–1.46)
Ignatius et al., 1993	Cr	6	Female typists working in the Government Housing Department Response at baseline 52% (n = 170)	Self-reported neck pain	*Work-related factors* No rest other than lunch breaks (ns)
Bernard et al., 1994	Cr	9	Newspaper employees using video display terminals Response at baseline 93% (n = 973)	Self-reported neck symptoms	*Work-related risk factors* Number of hours spent under a deadline per week (OR = 1.7, 1.4–3.0); Work variance (OR = 1.7, 1.2–2.5); Number of breaks (ns); Job control (ns); Job security (ns); Interaction with coworkers or customers (ns); Group conflict (ns) *Non-work-related risk factors* Lack of social support from spouses and friends (ns)
Hales et al., 1994	Cr	7	Telecommunication employees using video display terminals for at least 6 h per day Response at baseline 96% (n = 512)	Self-reported neck disorders	*Work-related risk factors* Routine work lacking decision making opportunities (OR = 4.2, 2.1–8.6), Lack of productivity standard (OR = 3.5, 1.5–8.3); Fear of being replaced by computers (OR = 3.0, 1.5–6.1); High information processing demands (OR = 3.0, 1.4–6.2); Job requires a variety of tasks (OR = 2.9, 1.5–5.8); Increasing work pressure (OR = 2.4, 1.1–5.5)

TABLE II. (*Continued*)

Reference	Design	MQS[a]	Study population	Outcome measure(s)	Psychosocial risk factor(s) and strength of association
Johansson and Rubenowitz, 1994	Cr	5	Blue and white collar workers from 8 large metal industry companies Response at baseline 90% (n = 450)	Self-reported neck symptoms	*Work-related factors (blue collar workers)* Low influence on and control over work (ns); Poor supervisor climate ($P < 0.05$); Low stimulus from the work (ns); Poor relations with fellow workers (ns); High psychological work load ($P < 0.001$) *Work-related factors (white collar workers)* Low influence on and control over work (ns); Poor supervisor climate (ns); Low stimulus from the work (ns); Poor relations with fellow workers (ns); High psychological work load (ns)
				Self-reported neck symptoms, symptoms must be work-related	*Work-related risk factors (blue collar workers)* Low influence on and control over work (ns); Poor supervisor climate ($P < 0.05$); Low stimulus from the work ($P < 0.05$); Poor relations with fellow workers (ns); High psychological work load ($P < 0.001$); *Work-related risk factors (white collar workers)* Low influence on and control over work ($P < 0.05$); Poor supervisor climate (ns); Low stimulus from the work (ns); Poor relations with fellow workers (ns); High psychological work load ($P < 0.01$)
Viikari-Juntura et al., 1994	Pr[g]	9	Male machine operators, carpenters and office workers Response at baseline 69% (n = 2,222) Response at follow-up 82%) (n = 1,832)	Self-reported neck pain, change from 1984 to 1987: ● none to moderate ● none to severe ● persistent severe	*Work-related factors* Job satisfaction (ns) *Work-related factors* Job satisfaction (OR = 1.7, 1.1 – 2.6) *Work-related factors* Job satisfaction (ns)
Ahlberg-Hultén et al., 1995	Cr	5	Female nurses and nurse's aides Participation rate 79% (n = 90)	Self-reported pain in the neck	*Work-related factors* Feeling of isolation (0.01, $P = 0.92$);[h] Poor relations with superiors (−0.14, $P = 0.40$); Conflicts (0.11, $P = 0.52$); Stress (0.08, $P = 0.72$); Intensity of authority over decisions (0.05, $P = 0.71$); High psychological demands (0.00, $P = 0.97$); Lowskill utilization (−0.03, $P = 0.73$); High job strain (−0.43, $P = 0.67$; 0.59, $P = 0.62$)[i]
Bergqvist et al., 1995	Cr	6	Office workers (n = 353) Response Q[j] 92% Response PE[k] 91% Response WA[l] 82%	Tension neck syndrome	*Work-related factors* Limited rest break opportunities (OR = 7.4, 3.1 – 17.4)
Johansson, 1995	Cr	6	Home care workers (n = 305)	Self-reported neck symptoms	*Work-related factors* Low influence and control over work (RR = 1.27, 1.00 – 1.62);[m] Poor supervisor climate (RR = 1.23, 0.99 – 1.53); Low stimulus from the work itself (RR = 1.33, 1.05 – 1.67); Poor relationships with fellow workers (RR = 1.19, 0.94 – 1.50); High psychological work load (RR = 1.52, 1.20 – 1.94; $P < 0.001$)
				Self-reported work related neck symptoms	*Work-related factors* Low influence and control over work (RR = 1.30, 0.93 – 1.81); Poor supervisor climate (RR = 1.29, 0.93 – 1.79); Low stimulus from the work itself (RR = 1.52, 1.10 – 2.11); Poor relationships with fellow workers (RR = 1.20; 0.87–1.65); High psychological work load (RR = 1.83, 1.28 – 2.61; $P < 0.001$)

TABLE II. (*Continued*)

Reference	Design	MQS[a]	Study population	Outcome measure(s)	Psychosocial risk factor(s) and strength of association
Lagerström et al., 1995	Cr	5	Female nursing personnel of a hospital Response at baseline 84% (n = 688)	Self-reported ongoing neck symptoms	*Work-related risk factors* Low work commitment (OR = 1.67, 1.10–2.60; OR = 1.65, 1.07–2.54); Low support from superiors (OR = 2.08, 1.32–3.26; OR = 2.03, 1.28–3.16); High work demand (ns); Lack of stimulation (ns); Low work control (ns)
				Self-reported severe ongoing neck symptoms	*Work-related risk factors* Low work commitment (ns); Low support from superiors (ns); High work demand (OR = 1.82, 1.14–2.92; OR = 1.82, 1.14–2.92); Lack of stimulation (ns); Low work control (ns)
Tharr, 1995	Cr	6	Teleservice representatives drawn from 2 teleservice centers Response at baseline 95% (n = 108)	Self-reported neck symptoms	*Work-related factors* High workload variability (OR = 1.2, 1.0–1.4)
Bru et al., 1996	Cr	5	Female hospital staff Response at baseline 85% (n = 586)	Neck pain index (based on self-reported data)	*Work-related factors* Work overload ($P = 0.004$); Poor social relations ($P = 0.005$); Poor work content ($P = 0.03$)
Skov et al., 1996	Cr	6	Random 8% sample of the members of the association of Danish Active Salespeople Response at baseline 66% (n = 1,306)	Self-reported neck symptoms	*Work-related factors* High demands in the work (ns); Variation in the work (highest quartile is reference value), next to highest quartile (OR = 1.78, 1.16–2.73), next to lowest quartile (ns), lowest quartile (OR = 1.82, 1.23–2.69); Control over time, low compared to high control (OR = 1.44, 1.07–1.93), medium compared to high control (ns); Perceived competition, high compared to low competition (OR = 1.44, 1.08–1.91), medium compared to low perceived competition (ns)
Toomingas et al., 1997	Cr	4	Male furniture movers, female medical secretaries and males and females of the working population Response at baseline 71% (n = 358)	Self-reported neck symptoms in past 12 months	*Work-related factors* High psychological demands (PR = 1.5, 1.1–2.0);[n] High decision latitude (ns); High social support (PR = 1.6, 1.1–2.3); High job strain (PR = 1.6, 1.1–2.2)
				Neck sign: neck tenderness	*Work-related factors* High psychological demands (PR = 2.0, 1.1–3.7); High decision latitude (ns); High social support (ns); High job strain (PR = 2.1, 1.2–3.7)
				Neck sign: neck movement restriction	*Work-related factors* High decision latitude (ns); High job strain (ns)
				Neck Syndrome: neck tension syndrome	*Work-related factors* High psychological demands (ns); High decision latitude (ns); High social support (PR = 2.7, 1.1–6.7); High job strain (ns)
Zettenberg et al., 1997	Cr	6	Car assembly workers (n = 564)	Self-reported neck complaints	*Work-related factors* Good relation with workmates/foreman ($P < 0.01$; $P < 0.01$), Low work satisfaction ($P < 0.04$), Stress at work ($P < 0.001$)
				Neck myalgia	*Work-related factors* Good relation with workmates/foreman (ns), Work satisfaction (ns), Stress at work ($P < 0.005$)

[a]Methodological quality score; [b]Cross-sectional study; [c]Not significant; [d]Odds ratio and 95% confidence interval; [e]Several odds ratios are presented within this range for different age groups; [f]*P*-value; [g]Prospective cohort study; [h]Coefficient and corresponding *P*-value; [i]If two analyses are carried out, results of both analyses are presented; [j]Questionnaire; [k]Physical examination; [l]Work place assessment; [m]Rate ratio and 95% confidence interval; [n]Prevalence ratio and 95% confidence interval.

TABLE III. Summary of the Results Concerning the Level of Evidence Synthesis

Risk factor	Direction of the association	Number of high and low-score studies[a]	Number of studies with positive effect[b]	Level of evidence
Quantitative job demands	High	High: 3	High: 3	Some
		Low: 7	Low: 6	
Social support at work	Low	High: 1	High: 1	Some
		Low: 8	Low:7	
Supervisor support	Low	High: 0	High: 0	Inconclusive
		Low: 4	Low: 3	
Coworker support	Low	High: 1	High: 1	Some
		Low: 1	Low: 1	
Conflicts at work	Yes	High: 0	High: 0	Inconclusive
		Low: 2	Low: 1	
Conflicts in leisure time	Yes	High: 0	High: 0	Inconclusive
		Low: 1	Low: 1	
Job control	Low	High: 2	High: 2	Some
		Low: 4	Low: 3	
Skill discretion	Low	High: 1	High: 1	Some
		Low: 6	Low: 5	
	High	High: 1	High: 1	Some
		Low: 1	Low: 1	
Job strain	High	High: 0	High: 0	Inconclusive
		Low: 3	Low: 2	
Job satisfaction	Low	High: 1	High: 1	Some
		Low: 3	Low: 3	
Job security	Low	High: 1	High: 1	Inconclusive
		Low: 0	Low: 0	
Rest break opportunities	Limited	High: 0	High: 0	Inconclusive
		Low: 1	Low: 1	

[a]Number of high-score (high) and low-score (low) studies that are used for the determination of the level of evidence.
[b]Number of high-score (high) and low-score (low) studies that reported a positive effect of a risk factor, i.e., an increased risk for the occurrence of neck pain.

Social support

Ten cross-sectional studies investigated the relationship between work-related social support and neck pain [Linton, 1990; Kamwendo et al., 1991; Bernard et al., 1994; Johansson and Rubenowitz, 1994; Johansson, 1995; Lagerström et al., 1995; Ahlberg-Hultén et al., 1995; Bru et al., 1996; Toomingas et al., 1997; Zettenberg et al., 1997]. Two of these studies were classified as being high-score studies [Kamwendo et al., 1991; Bernard et al., 1994]. One of these high-score studies was not taken into account for the determination of the level of evidence, since this study only reported that the relationship between low social support and neck pain was not significant, without mentioning a risk estimate [Bernard et al., 1994]. Kamwendo et al. [1991] reported a *P*-value of 0.013 for the relationship between neck pain and ''a poor spirit and cooperation with fellow workers'' in their high-score study. Seven of eight low-score cross-sectional studies [Linton, 1990; Johansson and Rubenowitz, 1994; Johansson, 1995; Lagerström et al., 1995; Bru et al., 1996; Toomingas et al., 1997; Zettenberg et al., 1997] confirm the results of Kamwendo et al. [1991], leading to the conclusion that there is some evidence of a positive relationship between poor social support at work and neck pain.

With respect to work-related social support, supervisor support and coworker support can be distinguished. The relationship between supervisor support and neck pain was investigated by five cross-sectional studies [Kamwendo et al., 1991; Johansson and Rubenowitz, 1994; Ahlberg-Hultén et al., 1995; Johansson, 1995; Lagerström et al., 1995], one of which was a high-score study [Kamwendo et al., 1991]. Despite the high score of Kamwendo et al. [1991], a non-significant relationship was reported, without the mention of a risk estimate. Three of the remaining four low-score cross-sectional studies suggested a positive relationship between poor supervisor support and neck pain. However, due to the low-score of these cross-sectional

studies, it is concluded that there is inconclusive evidence for the relationship between low supervisor support and neck pain.

Results regarding the relationship between coworker support and neck pain are reported by three cross-sectional studies [Kamwendo et al., 1991; Johansson and Rubenowitz, 1994; Johansson, 1995]. One study was not included in the determination of the level of evidence, since only a non-significant relationship without a risk estimate was mentioned [Johansson and Rubenowitz, 1994]. In their high-score study, Kamwendo et al. [1991] reported a *P*-value of 0.013 for the relationship between poor coworker support and neck pain. In the low-score study of Johansson [1995] this result was confirmed, leading to the conclusion that there is some evidence for a positive relationship between poor coworker support and neck pain.

Finally, as the only study in this review, the high score study of Bernard et al. [1994] studied the relationship between neck pain and the lack of social support by friends and family. However, they reported a non-significant association and no risk estimate was mentioned. This leads to the conclusion that there is inconclusive evidence for such a relationship.

Conflicts

Three cross-sectional studies investigated the relationship between conflicts at work and neck pain [Dartiques et al., 1988; Bernard et al., 1994; Ahlberg-Hultén et al., 1995]. The study of Bernard et al. [1994], a high-score study, however, reported that the relationship between neck pain and conflicts at work was not significant, without reporting a risk estimate. The other two studies [Ahlberg-Hultén et al., 1995; Dartiques et al., 1988] were low-score cross-sectional studies. Due to the low score of these two studies, it is concluded that there is inconclusive evidence for a relationship between conflicts at work and neck pain.

One study also investigated the effect of non-work-related conflicts on the occurrence of neck pain [Dartiques et al., 1988]. An odds ratio of 1.8 was reported for this relationship. Due to the fact that no other studies in this review investigated this relationship, inconclusive evidence was found for the relationship between non-work-related conflicts and neck pain.

Job control

Nine cross-sectional studies studied the risk factor job control in relation to neck pain [Kamwendo et al., 1991; Bernard et al., 1994; Hales et al., 1994; Johansson and Rubenowitz, 1994; Lagerström et al., 1995; Johansson, 1995; Ahlberg-Hultén et al., 1995; Skov et al., 1996; Toomingas et al., 1997]. Three of these studies were not taken into account because they stated that the relationship between job control and neck pain was not significant without the report of a risk estimate [Bernard et al., 1994; Lagerström et al., 1995; Toomingas et al., 1997]. Of the remaining six studies, two were qualified as high-score studies [Kamwendo et al., 1991; Hales et al., 1994]. Both these studies reported results suggesting a positive relationship between low job control and neck pain. First, Hales et al. [1994] reported an odds ratio of 4.2 for the relationship between neck pain and routine work lacking decision making opportunities. Second, Kamwendo et al. [1994] showed a *P*-value of 0.001 for the relationship between low ability to influence working conditions and neck pain. Three low-score cross-sectional studies confirmed the results of the high-score studies [Johansson and Rubenowitz, 1994; Johansson, 1995; Skov et al., 1996]. One low-score cross-sectional study could not identify a relationship between job control and neck pain [Ahlberg-Hultén et al., 1995]. Based on the results of six cross-sectional studies, of which two were of high-score studies, it is concluded that there is some evidence for a positive relationship between low job control and neck pain.

Skill discretion

Nine cross-sectional studies reported results on the relationship between low skill discretion and neck pain. Two studies were high-score studies [Kamwendo et al., 1991; Bernard et al., 1994], seven studies were classified as low-score studies [Linton, 1990; Johansson and Rubenowitz, 1994; Ahlberg-Hultén et al., 1995; Johansson, 1995; Lagerström et al., 1995; Skov et al., 1996; Bru et al., 1996]. One low-score and one high-score study reported that the relationship between skill discretion and neck pain was not significant without reporting a risk estimate [Kamwendo et al., 1991; Lagerström et al., 1995]. In their high-score study, Bernard et al. [1994] reported an odds ratio of 1.7 for the relationship between neck pain and low work variance. Five low-score cross-sectional studies confirmed the results of Bernard et al. [1994], all suggesting a positive relationship between low skill discretion and neck pain [Linton, 1990; Johansson and Rubenowitz, 1994; Johansson, 1995; Bru et al., 1996; Skov et al., 1996]. One low-score cross-sectional study could not identify a relationship between skill discretion and neck pain [Ahlberg-Hultén et al., 1995]. Based on the results of the six studies that were used for the determination of the level of evidence, it is concluded that there is some evidence for a positive relationship between low skill discretion and neck pain.

On the contrary, two studies investigated the effect of high skill discretion on neck pain [Hales et al., 1994; Tharr, 1995]. In their high-score study, Hales et al. [1994] reported an odds ratio of 2.9 for the relationship between neck pain and a variety of job tasks. Tharr [1995] reported an odds ratio of 1.2 for high work load variability in relation to neck

pain. Based on the findings of these two cross-sectional studies, of which one is a high-score study, it is concluded that there is some evidence for a positive effect of high skill discretion in relation to neck pain.

Job strain

A total of four cross-sectional studies investigated the relationship between high job strain and neck pain [Kilbom et al., 1986; Ahlberg-Hultén et al., 1995; Toomingas et al., 1997; Zettenberg et al., 1997]. One of these studies reported a non-significant relationship between perceived psychological stress at work and neck pain, but did not mention a risk estimate [Kilbom et al., 1986]. Three studies remained for the determination of the level of evidence. Due to the low score of these studies, and irrespective of their results, it is concluded that there is inconclusive evidence for a relationship between high job strain and neck pain.

Job satisfaction

Three low-score cross-sectional studies [Kilbom et al., 1986; Bru et al., 1996; Zettenberg et al., 1997] and one high-score prospective study [Viikari-Juntura et al., 1994] investigated the relationship between job satisfaction and neck pain. Viikari-Juntura et al. [1994] reported an odds ratio of 1.7 for the relationship between low job satisfaction and change in neck pain from no neck pain at baseline till severe neck pain at follow-up. This result suggested a positive relationship between low job satisfaction and the development of neck pain. Zettenberg et al. [1997] and Bru et al. [1996] reported *P*-values of 0.04 and 0.03, respectively, for the relationship between low job satisfaction and neck pain. Kilbom et al. [1986] reported that this relationship was not significant, without mentioning a risk estimate. Based on the results of one high-score prospective study of Viikari-Juntura et al. [1994] and two low-score cross-sectional studies of Zettenberg et al. [1997] and Bru et al. [1996], it is concluded that there is some evidence for a positive relationship between low job satisfaction and neck pain. One additional study investigated the relationship between neck pain and low work commitment [Lagerström et al., 1995]. If ''low work commitment'' is considered to represent low job satisfaction, the study of Lagerström et al. [1995] should also be taken into account for the determination of the level of evidence. The conclusion, that there is some evidence for a positive relationship between low job satisfaction and neck pain, will not change if this additional study is added.

Job security

A total of three cross-sectional studies, all defined as high-score studies, reported results concerning the relationship between low job security and neck pain [Kamwendo et al., 1991; Bernard et al., 1994; Hales et al., 1994]. Two of these studies reported a non-significant relationship between job security and neck pain, without mentioning a risk estimate. Hales et al. [1994] reported an odds ratio of 3.0 for the relationship between ''the fear of being replaced by a computer'' and neck pain in their high-score study. Since only one study reported results to determine the level of evidence, it is concluded that there is inconclusive evidence for the relationship between low job security and neck pain.

Rest break opportunities

Of the four cross-sectional studies that reported results on the relationship between neck pain and rest break opportunities, three studies stated that this relationship was not significant. No risk estimate was presented [Kilbom et al., 1986; Bernard et al., 1994; Bergqvist et al., 1995]. Bergqvist et al. [1995] reported an odds ratio of 7.4 for the relationship between ''limited rest break opportunities'' and neck pain. Based on only one low-score cross-sectional study, it is concluded that there is inconclusive evidence for the relationship between rest break opportunities and neck pain.

DISCUSSION

In order to identify psychosocial risk factors for neck pain, a systematic review of the literature was carried out. The results showed some evidence for a positive relationship between neck pain and high quantitative job demands, poor social (coworker) support, low job control, low skill discretion, and low job satisfaction. Inconclusive evidence was found for the relationship between neck pain and poor supervisor support, conflicts at work, low job security, high job strain, and limited rest break opportunities (Table III). Other factors, such as feelings of isolation and lack of productivity standards were taken into consideration by some of the studies in this review, although these factors were not used in the determination of the level of evidence. The reason for this was that it was difficult to place these factors within any of the nine categories of risk factors identified in this review. Furthermore, in three studies very general measures for psychosocial exposure at work were used, such as ''mental stress at work'' or ''overall psychosocial score'' [Linton, 1990; Kamwendo et al., 1991; Mäkelä et al., 1991]. Since the focus of this review was on specific aspects of the psychosocial exposure, these general measures were not discussed.

The risk factor ''skill discretion'' was studied in different ways. Eight studies investigated the effect of low skill discretion on the occurrence of neck pain, while two studies looked at the effect of high skill discretion in relation to neck pain. For both high and low skill discretion it was

concluded that there is some evidence of a relationship with neck pain, suggesting a U-shaped relationship between skill discretion and neck pain.

Several investigators suggest three mechanisms that account for possible associations between psychosocial factors and musculoskeletal disorders [Bongers et al., 1993; Hales and Bernard, 1996; Sauter and Swanson, 1996]. Firstly, they suggest that psychosocial demands can exceed an individual's coping capabilities, resulting in a stress response, which, in turn, can produce muscle tension or static loading of the muscles or generate other physiological responses that may result in neck pain. As a second mechanism, they suggest that psychosocial demands may affect the awareness and reporting of musculoskeletal disorders, or increase its attribution to the work environment. As a third possible mechanism, it is stated that, in a certain situation, psychosocial demands may be highly correlated with physical demands. This suggests that any association between a psychosocial risk factor and musculoskeletal disorders may actually reflect a relationship between a physical risk factor and musculoskeletal disorders.

As stated above it is hypothesized that psychosocial and physical demands may be highly correlated. Studies on psychosocial risk factors for neck pain should therefore also take the physical workload into account in their analyses. In this review, several studies did not assess the physical workload [Ursin et al., 1988; Flodmark and Aase, 1992; Westgaard and Jansen, 1992; Ahlberg-Hultén et al., 1995; Lagerström et al., 1995; Toomingas et al., 1997; Zettenberg et al., 1997]. In order to test the effect of these studies on the level of evidence of the psychosocial factors, a sensitivity analysis was carried out. In this analysis, studies that did not assess or control for work-related physical exposure (studies that scored negative or unknown on Item F of the quality list) were eliminated. Without these studies, the level of evidence for the different psychosocial variables in this review was determined again. Exclusion of these studies had no effect on the results regarding the level of evidence for the different psychosocial factors in this review.

Three other literature reviews were found focusing on psychosocial risk factors for neck pain. Bongers et al. [1993] discussed the literature for psychosocial risk factors at work for musculoskeletal disorders. They concluded that a relationship between psychosocial variables, such as monotonous work, time pressure, poor work content, and high workload, and symptoms of the neck or shoulders seemed likely. For the risk factor social support, they found contradictory results, whereas in our review some evidence was found for coworker support and inconclusive evidence was found for supervisor support. However, a comparison between the results of the review of Bongers et al. [1993] and this review is difficult, since Bongers et al. [1993] also included studies that combined neck symptoms with shoulder symptoms. Hales and Bernard [1996] have critically examined the literature to describe psychosocial risk factors that are associated with neck disorders. Hales and Bernard stated that high work load, perceived time pressure, work pressure, high work load variability, poor work content, and monotonous work are associated with musculoskeletal complaints of the upper extremities. However, they stated that most of the studies based the case definition of musculoskeletal disorders on self-reports of neck and shoulder symptoms. In the present review, studies using a combined outcome measure (e.g., the combination of the neck region and shoulder region) were not included, therefore making it hard to compare the results of this review with the results found by Hales and Bernard [1996].

In the NIOSH review of Bernard [1997] neck disorders were combined with shoulder, elbow, hand, and wrist disorders. Bernard [1997] concluded that intensified workload, monotonous work, and low levels of support have a positive association with these upper extremity disorders. Moreover, lack of control over the job and low job satisfaction were also positively associated with these disorders, although not as strongly. Bernard [1997] also stated that the evidence of the relationships between these factors and upper extremity disorders was stronger for disorders related to the neck/shoulder region in comparison to the hand/wrist region. Again, the comparison of the results of the review of Bernard with this review is difficult, since no results for the neck as a separate region were reported by Bernard.

For this review several databases were systematically searched to identify all relevant studies. It is crucial to find all possible studies, involving the subject of this review. Many risk factor studies do not consider one outcome measure, but investigate several outcome measures, neck pain being one of them. If, in these studies, the main focus is not on neck pain but, for example, on low back pain, these studies might have used keywords relating only to low back pain instead of also to neck pain. Consequently, it is possible that these studies were missed during the literature search. The number of studies that was found in the literature for several psychosocial factors in this review was small. One additional study could have changed the conclusion regarding the level of evidence. Consequently, missing a study, even if this was not selective with regard to the study results, may have influenced the conclusion regarding the level of evidence for these psychosocial factors.

The most important reason for exclusion of a study from this review was the fact that results of a study were not reported for the neck region separately. A lot of studies do not use neck pain as an outcome measure, but used a combination of neck and/or shoulders pain as the outcome measure [e.g., Bjelle et al., 1987; Veiersted and Westgaard, 1993; Westgaard et al., 1993; Engels et al, 1994; Bergqvist, 1995; Hasvold et al., 1996; Hagg and Astrom, 1997]. Since the objective of this review was to identify risk factors for neck pain, these studies were excluded. In the excluded

studies, it is often unclear what was meant by neck and/or shoulder pain. Pain in the proximal part of the upper arm may also have been included in these studies. Other risk factors may be of influence to determine whether pain in this region will exist, and therefore these studies were excluded. However, on the other hand this may have led to the exclusion of studies that did actually investigate the neck region.

Most of the studies identified were cross-sectional studies. No case–control study and only one prospective cohort study entered this review [Viikari-Juntura et al., 1994]. In cross-sectional research both risk factors and outcome are measured at the same time. Therefore, in cross-sectional research, cause and effect cannot be distinguished and a causal relationship can hardly be established. The reason to include cross-sectional studies in this review, despite of this disadvantage, was that most research on risk factors for neck pain is actually carried out with the use of a cross-sectional design. Although perhaps desirable from a purely methodological standpoint, it would not be acceptable to neglect this large amount of information obtained from cross-sectional research. The maximum level of evidence that consequently could be reached was ''some evidence'', due to the fact that there was only one (high score) prospective study included in this review.

A quality list was constructed to assess the methodological quality of the studies in this review. This list consists of several items in different categories concerning information, validity, and precision. A total quality score was calculated by counting the number of validity and precision items in the criteria list that were scored positively. Based on this obtained total quality score, studies were labeled as either being a high-score study or a low-score study. Four levels of evidence were defined to establish the strength of evidence of a relationship between a risk factor and neck pain. Obviously, this procedure and our rating system had a considerable influence on the assessment of the level of evidence, meaning that changes in this procedure may have had an impact on the results. The methodology of rating of the methodological quality of studies is widely used in systematic reviews of the effectiveness of certain clinical treatments, but is new and still in an experimental stage for systematic reviews of observational studies. No established guidelines for rating procedures for such studies are available yet. In the quality list developed for this review some items, especially the items on the use of standardized methods for the collection of exposure and outcome (items G,I and P), in retrospect did not really discriminate between high- and low-score studies, since almost all studies scored negative on these items. If these three items were not taken into account the number of high-quality studies would increase from 5 to 12 [Linton, 1990; Kamwendo et al., 1991; Mäkelä et al.,1991; Ignatius et al., 1993; Bernard et al., 1994; Hales et al., 1994; Viikari-Juntura et al., 1994; Bergqvist et al., 1995; Johansson, 1995; Tharr, 1995; Skov et al., 1996; Zettenberg et al., 1997]. This sensitivity analysis would lead to the conclusion that, in addition to the previously mentioned factors, some evidence is also found for low supervisor support (data not shown).

Many studies in this review just reported that the relationship between a risk factor and neck pain was not significant, without mentioning the risk estimate. Since the direction of such a result is unclear, it was decided not to take these studies into account for the determination of the level of evidence. If the report of a non-significant relationship were interpreted as no relationship, and these results were taken into account for the determination of the levels of evidence, some evidence would be found for a positive relationship between neck pain and low social support, low job satisfaction, and high skill discretion. In addition some evidence would be found of no relationship between limited rest break opportunities and neck pain. Inconclusive evidence would be found for all other risk factors discussed in this review.

In conclusion, this systematic review shows some evidence of a positive relationship between neck pain and the following psychosocial risk factors: high quantitative job demands, low social (coworker) support, low job control, high as well as low skill discretion, and low job satisfaction. Furthermore, it should be concluded that, due to the study design, study population, and data analysis of observational studies, it appeared to be difficult to construct a valid and reliable quality assessment list that could be used to determine the quality of observational studies. Although major pitfalls still have to be accounted for, we still feel that there is much to gain from a systematic and transparent method for the review of observational studies.

APPENDIX A: METHODOLOGICAL QUALITY SCORES

The scores on the items of quality assessment list for all studies in the review. The letters on the first row correspond with the letters in front of the item definitions in Table I.

Reference	A	B	C	E	F	G	H	I	J	K	L	M	P	R	S	T	U	V	Total[a]
Kilbom et al., 1986	+	+	–	[b]	+	?	+	?	+	+	–	–	?			–	+	?	5
Chang et al., 1987	+	+	–		+	?	+	?	–	+	–	–	?			–	–	–	3

Reference	A	B	C	E	F	G	H	I	J	K	L	M	P	R	S	T	U	V	Total[a]
Dartiques et al., 1988	+	+	?		+	?	+	?	+	−	?	−	?			+	+	?	5
Ursin et al., 1988	+	−	+		−	−	+	?	−	−	−	−	?			−	+	?	3
Musson, 1989	+	−	−		+	?	+	?	−	−	−	−	?			+	+	−	4
Linton, 1990	+	+	?		+	?	+	?	+	−	−	−	?			+	+	+	6
Kamwendo et al., 1991	+	+	+		+	?	+	?	−	+	−	−	?			+	+	+	7*
Mäkelä et al., 1991	+	+	+		+	+	+	+	−	−	?	−	+			+	+	+	9*
Flodmark and Aase, 1992	+	?	+		−	−	+	?	−	−	−	−	?			−	−	−	2
Rosecrance et al., 1992	+	+	−		+	?	+	?	−	−	−	−	?			−	−	−	2
Westgaard and Jansen, 1992	+	−	?		−	−	−	−	+	−	+	−	?			−	+	?	3
Ignatius et al., 1993	+	+	−		+	?	+	?	−	+	−	−	?			+	+	+	6
Johansson et al., 1993	+	+	?		+	?	+	?	−	+	−	−	?			−	−	−	3
Bernard et al., 1994	+	+	+		+	?	+	?	−	+	−	+	?			+	+	?	7*
Hales et al., 1994	+	+	+		+	?	+	?	+	+	−	−	?			+	+	−	7*
Johansson and Rubenowitz, 1994	+	−	+		+	?	+	?	−	−	−	−	?			−	+	+	5
Johansson, 1994	+	+	?		+	?	+	?	−	+	−	−	?			−	−	−	3
Viikari-Juntura et al., 1994	+	+	−	+	+	?	+	?	+	+	?		?	+	−	+	+	+	9*
Ahlberg-Hult³n et al., 1995	+	+	−		−	−	+	?	−	−	−	−	?			+	+	+	5
Bergqvist et al., 1995	+	?	+		+	?	+	?	−	−	−	−	?			+	+	+	6
Johansson, 1995	+	+	−		+	?	+	?	−	+	−	−	?			+	+	+	6
Lagerström et al., 1995	+	+	+		?	?	+	?	−	−	−	−	?			+	+	+	5
Pockacy et al., 1995	+	+	−		+	?	+	?	−	−	−	−	?			−	+	?	3
Tharr, 1995	+	+	+		+	?	+	?	−	+	−	−	?			+	+	?	6
Bru et al., 1996	+	+	+		+	?	+	?	−	−	−	−	+			−	+	?	5
Ingelgård et al., 1996	+	+	−		+	?	+	?	−	−	−	−	?			−	−	−	2
Skov et al., 1996	+	+	−		+	?	+	?	+	−	−	−	?			+	+	+	6
Toomingas et al., 1997	+	+	−		?	?	+	?	−	−	−	−	?			+	+	+	4
Zettenberg et al., 1997	+	+	+		−	−	+	?	−	+	−	+	?			−	+	+	6

[a] Total score calculated by counting the number of positive validity/precision items. Studies marked with an asterisk (*) are high-score studies.
[b] An empty cell in the table implies that the item was not in the methodological quality list for the study design of the study at issue.

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