

Criteria for
determining
the work-
relatedness of

**Nonspecific
low-back
pain**

Criteria for determining the work- relatedness of nonspecific low-back pain

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Introduction

Background

Nonspecific low-back pain occurs widely in workers, especially in physically demanding jobs. In order to ensure adequate working conditions for such workers, it is important to know what work-related factors play a role in the occurrence of such complaints. A number of work-related factors have been found to be clearly associated with nonspecific low-back pain. However, in practice it is difficult to determine to what extent these factors play a role in the occurrence of these complaints in individual workers. Various guidelines for acceptable physical loads at work have been drawn up on the basis of information from epidemiological studies combined with data derived from experimental investigations. Such guidelines are used as a basis for advice on necessary improvements in working conditions. Although these guidelines are partly based on epidemiological data, it is often not known whether physical loads exceeding the limits set in the guidelines actually increase the probability of developing nonspecific low-back pain. Moreover, these guidelines cannot be used to determine the relative contribution of various work-related risk factors to the occurrence of low back problems in an individual worker.

Objectives

The criteria presented in this document have been developed to provide a reliable basis for uniform determination of the role of work-related risk factors in the occurrence of nonspecific low-back pain. A 3-step plan provides a simple means of calculating the probability of work-relatedness of nonspecific low-back pain on the basis of data on exposure to established risk factors in the work situation. The calculated probability of work-relatedness provides information that can be used to support your professional assessment of the work situation and proposals for improving it in the interests of workers with nonspecific low-back pain. The criteria are intended to supplement existing guidelines for diagnosis and curative interventions of patients with nonspecific low-back pain.^{3, 14} The criteria described in this document are meant in the first instance to be useful instruments for occupational physicians, though they can also be used by other disciplines and will prove useful for the exchange of information between various disciplines.

Summary of objectives

The criteria support professionals in the field of occupational medicine in the assessment of the contribution of work-related risk factors to the occurrence of nonspecific low-back pain in individual workers.

Place of the criteria in the management process

1 → Problem assessment

+ criteria in present document

2 → Formulation of management plan

Development

A project group consisting of representatives of the Netherlands Expert Centre for Work-related Musculoskeletal Disorders (Dutch abbreviation Kenniscentrum AKB), the Department of Public Health, Erasmus MC, University Medical Centre Rotterdam, the Coronel Institute of Occupational Health, Academic Medical Center Amsterdam and the Netherlands Center for Occupational Diseases (Dutch abbreviation NCvB) (Academic Medical Center Amsterdam) was set up to develop the criteria. The project started at the end of 2001.

First of all, the scientific knowledge in this field was collected in a systematic way and used as the basis for development of a decision model. This decision model makes it possible to estimate the relative contribution of the most relevant work-related risk factors to the occurrence of nonspecific low-back pain.

In order to develop an effective instrument for use in practice on the basis of this decision model, two consensus meetings were organized for Dutch experts in the fields of epidemiology, back pain and occupational health. During the first of these meetings, in the autumn of 2002, a working group of scientific experts discussed the model. This led to modifications of the model. The second meeting was held in the spring of 2003; here, a working group of experts with practical experience on the field of occupational health discussed the utility

and practical implications of the model and came to conclusions about the instrument's content, form and possible applications. The next step was a two-day international workshop financed by SALTSA (Joint Programme for Working Life Research in Europe) which was held in November 2003. This workshop provided a platform for discussion of the model and the criteria by experts from eight European countries (UK, Italy, France, Sweden, Greece, Finland, Norway, The Netherlands) and the USA, which led to refinement of various aspects of the criteria.

The criteria presented in this document are the result of the procedure sketched above. Finally, a study was set up to allow a group of occupational physicians to evaluate the applicability in practice.

Summary of development process

- 1 → Systematic literature survey**
- 2 → Development of decision model on basis of scientific data**
- 3 → Consensus meetings on decision model and criteria to be derived from it**
- 4 → Evaluation of applicability of the criteria by occupational physicians**

Scientific basis

The basis of the criteria presented here is a decision model incorporating scientific data on the strength of the relationship between work-related risk factors and the occurrence of nonspecific low-back pain. Using methods from clinical decision theory, this decision model was constructed to estimate the relative contribution of exposure to work-related risk factors to the occurrence of nonspecific low-back pain in an individual worker. A brief description of the decision model is given below; for further details, see the relevant literature.¹³

Structure of decision model

The model assumes an *a priori* probability for the occurrence of nonspecific low-back pain in the absence of exposure to work-related risk factors. Exposure to such risk factors leads to an increase in the probability that nonspecific low-back pain will occur. The magnitude of the increase depends on the number of risk factors involved, and the intensity and duration of exposure during the working day.

The input for the model consists of an estimate of the *a priori* probability of nonspecific low-back pain on the one hand and risk estimates for the main work-related risk factors on the other. This input is obtained by combining data from published studies by means of a meta-analysis.

1

The *a priori* probability of nonspecific low-back pain was calculated in the meta-analysis from epidemiological data on the prevalence of nonspecific low-back pain in a population without any relevant occupational exposure. Since the *a priori* probability is known to be age-related, it was calculated for three age-groups (< 35 yr, 35–45 yr, > 45 yr.^{2,4,16}). The values found were 22%, 30%, and 34% respectively in these three groups.

2

For each risk factor a pooled odds ratio was calculated in the meta-analysis based on epidemiological data on the relationship between the main work-related risk factors and the occurrence of nonspecific low-back pain. This pooled odds ratio is adjusted for the presence of other risk factors. Only the risk factors for which the literature provided consistent evidence that they are related to the occurrence of nonspecific low-back pain¹² were included in the meta-analysis. These were the physical risk factors 'manual materials handling', 'frequent bending or twisting of the trunk', 'high physical workload' and 'whole-body vibration', and the psychosocial risk factors 'monotonous work' and 'job dissatisfaction'. In order to enable combination of data from different studies, cut-off points for high-risk exposure were determined for all risk factors prior to the meta-analysis, with the aid of internationally accepted guidelines for physical workload and the definitions of exposure used in the epidemiological studies. For example, lifting 25 kg is a risk factor but so is frequent (> 2x per minute for > 2 hours per day) handling of loads of 5 kg or more (see table on page 12).

3

Finally, only the physical risk factors with a pooled odds ratio found to be statistically significant in the meta-analysis ($p < 0.05$) were included in the model. These were 'manual materials handling' (odds ratio=1.51), 'frequent bending or twisting of the trunk' (odds ratio=1.68) and 'whole-body vibration' (odds ratio=1.30). The pooled odds ratio of the psychosocial risk factor 'job dissatisfaction' was also significant (odds ratio=1.30). However, it was decided on the basis of international consensus not to include this factor in the model because it is difficult to separate the individual component of 'job dissatisfaction' from the work-related component.

Calculation of probability of work-relatedness

The model is presented as a score table from which the probability of work-relatedness can be read off for a given exposure (page 12). This probability corresponds to the attributive fraction (AF) in epidemiological studies, i.e. in the proportion of cases of nonspecific low-back pain in a given professional group due to exposure to a specific risk factor. The AF is a mean proportion for the group as a whole, but in the probability model this mean AF is assigned as the AF at individual level, and is interpreted as the probability of work-relatedness for an individual worker. In order to calculate this probability, the pooled odds ratio for each risk factor is transformed to a score. This score, or the sum of the scores if the individual in question is exposed to several risk factors, corresponds to the probability that the individual's nonspecific low-back pain is due to work-related risk factors. The table on page 13 shows that this probability can vary between 0% and 66%, and decreases with age as a result of the fact that the *a priori* probability of nonspecific low-back pain increases with age.

Summary of scientific basis: the decision model

Probability of work-relatedness

The extent to which the probability of nonspecific low-back pain is raised due to exposure to *work-related risk factors*

A priori probability

Probability of suffering from nonspecific low-back pain without being exposed to work-related risk factors

Work-related risk factors

Manual materials handling
Frequent bending or twisting of the trunk
Whole-body vibration

The increased probability of nonspecific low-back pain due to exposure to these risk factors is based on the strength of the relationship between the work-related risk factors and nonspecific low-back pain.

Methods

The decision model is converted into a practical tool. This tool enables collection and interpretation of relevant data in an unambiguous way. Firstly, you calculate the probability of work-relatedness of nonspecific low-backpain in a 3-step plan. Then, this information is used to judge the work-relatedness of the low-back pain in the worker in question.

Calculating the probability of work-relatedness

Step 1 → Diagnosis

In view of the primary aim of the criteria (to assist in the determination of the degree to which working conditions cause low-back pain in a worker presenting himself with this complaint), the process of data collection and interpretation starts the first time the worker in question consults his (occupational) physician. As the doctor, you make use of the case definition (see page 11) to determine whether the diagnosis nonspecific low-back pain is applicable.

Step 2 → Inventory of risk factors

In step 2, you assess the exposure to the relevant risk factors in the working environment. It is important to collect objective, quantitative exposure data. This means that it is not enough to take information from the case history: you should also use data from worksite studies and/or risk inventories and evaluations, possibly supplemented by exposure data compiled for the branch of industry in question or the results of scientific studies of exposure in the relevant professional group. Use of the checklist on page 12 allows you to determine in a systematic way which of the relevant risk factors are in fact applicable to the worker in his working environment.

Step 3 → Probability of work-relatedness

By adding up the scores for the individual risk factors, you obtain a total score. The conversion table on page 13 allows you to simply read off the probability of work-relatedness corresponding to the total score found for the worker in question.

Interpretation of the calculated probability of work-relatedness

The calculated probability of work-relatedness should be used to support your professional judgement in the management of workers with nonspecific low-back pain and in determining whether the complaints observed can be regarded as an occupational disease.

Work-relatedness

The calculated probability of work-relatedness gives an indication of the extent to which the nonspecific low-back pain is due to working conditions. Nonspecific low-back pain is multifactorial: apart from work-related risk factors, person-related risk factors and factors associated with the home situation may also contribute to the pathogenesis. However, insufficient scientific data on the non-work-related factors is available to allow their effect to be included in the criteria. In the decision model used to calculate the probability of work-relatedness, the possible effect of these non-work-related factors is partially reflected in the *a priori* probability of the occurrence of nonspecific low-back pain.

Case management

The magnitude of the probability of work-relatedness found can provide guidance when determining the case management plan. If this probability is high, efforts should be mainly concentrated on reducing or otherwise modifying the workload, while more attention should be paid to person-related factors if the probability is low. If the probability of work-relatedness is greater than 50%, the exposure to the risk factors must be reduced. If the probability is less than or equal to 50% but one or more risk factors are known to be present, you should also consider lowering the exposure. It follows that it is always important to take the exposure to the separate risk factors covered by the inventory into account. In addition, you should also make use of relevant supplementary person-related information when drawing up your management plan. For example, proof exists that job dissatisfaction is a risk factor for nonspecific low-back pain. This has not been included in the criteria used to calculate the probability of work-relatedness, because it is difficult to separate the individual component from the work-related component (see 'Scientific basis', pp. 6 and 7). It may be appropriate, however, to take this psychosocial risk factor into account when drawing up the management plan for a worker with nonspecific low-back pain.

Occupational disease

The calculated probability of work-relatedness can also be used as a basis for deciding whether a given case of nonspecific low-back pain should be regarded as an occupational disease. According to the Dutch law, an occupational disease is "a disease or complaint largely due to risk factors occurring at work or in a work environment". In the Netherlands it was decided that you should report the nonspecific low-back pain as an occupational disease if the probability of work-relatedness calculated as described in this document is greater than 50%. If the probability is less than or equal to 50%, that does not necessarily mean that the back pain is not an occupational disease. It may be the case that the exposure to one particular risk factor substantially exceeds the cut-off points

for exposure in the decision model. In that case it is conceivable that the back pain is mainly caused by exposure to this factor at work, even though the probability of work-relatedness calculated as described in this document does not exceed 50%. You should therefore consider the exposure to the separate risk factors when deciding whether nonspecific low-back pain should be regarded as an occupational disease if the calculated probability of work-relatedness is less than or equal to 50%. The following existing guidelines are used for the purposes of this assessment:

→ In order to determine whether exposure to whole-body vibration alone is sufficient justification for reporting the complaint as an occupational disease, see the relevant EU directive, where it is stated that daily exposure to vibration exceeding 1.15 m/s^2 in intensity during an eight-hour reference period represents a health risk.⁵

→ The NIOSH-lifting formula (the National Institute for Occupational Safety and Health in the USA)¹⁷ can be used to decide whether exposure to the risk factor 'lifting' alone is enough to justify reporting the back pain as an occupational disease. If you find a Lifting Index of greater than 2, the back pain can be regarded as an occupational disease.

Summary of the methods

Calculating the probability of work-relatedness

Step 1 → Diagnosis

Diagnose nonspecific low-back pain with reference to the case definition

Step 2 → Inventory of risk factors

Assess exposure to risk factors at work by filling in the checklist on page 12

Step 3 → Probability of work-relatedness

Read off probability of work-relatedness corresponding to worker's exposure score from the conversion table on page 13

Interpretation of the calculated probability of work-relatedness

- Assess work-relatedness (calculated probability plus other relevant information about worker)
- Determine consequences for case management plan
- Decide whether the condition should be regarded as an occupational disease

Determining the probability of work-relatedness

Step 1 → Diagnosis of nonspecific low-back pain

Diagnose nonspecific low-back pain with reference to following case-definition

Case definition of 'nonspecific low-back pain'

Pain in the lower back region lasting at least 24 hours without any demonstrable physical cause.

Red flags

If one or more of the signs listed below are observed, further investigation should be carried out to exclude specific causes such as radicular syndrome due to a slipped disc at segment L4-L5 or L5-S1, or less common complaints such as malignancy, osteoporotic vertebral fracture, stenosis, spondylitis ankylopoetica (Bechterew's disease) and severe forms of spondylolisthesis:

- First signs of back pain appearing in workers less than 20 or more than 55 years old;
- Constant progressive back pain;
- Trauma;
- History of malignancy;
- Prolonged use of corticosteroids;
- Drugs use, immunosuppression, HIV;
- (Regular) general malaise;
- Unexplained weight loss;
- Neurological dysfunction (motor dysfunction, sensory abnormalities and/or miction disturbances);
- Lumbar kyphosis and/or past history of lumbar lordosis;
- Infectious complaints.

Step 2 → Inventory of risk factors

Assess exposure to work-related risk factors

- collect objective information about exposure to the following risk factors at work
- answer the questions in the following table, and fill in the individual scores
- determine the total score

Risk factor	Score
<p>A Manual materials handling Lifting, holding or moving object by hand without the help of mechanical aids</p>	
<p>A1 Does worker handle objects > 15 kg during > 10% of working day? No, go to A2 / Yes, score 7 and go to B →</p> <p style="text-align: center;">↓</p>	
<p>A2 Does worker handle objects > 5kg > 2x per minute for total of > 2 hours per working day, or objects > 25kg > 1x per day? No, score 0 and go to B / Yes, score 4 and go to B →</p>	
<p>B Bending or twisting of trunk Bending trunk forwards or sideways and/or twisting trunk (NB. The times given refer to the total time during which worker works in this position during a working day)</p>	
<p>B1 Does worker work with trunk bent and/or twisted > 40° for > ½ hour per working day? No, go to B2 / Yes, score 7 and go to C →</p> <p style="text-align: center;">↓</p>	
<p>B2 Does worker work with trunk bent and/or twisted > 20° for > 2 hours per working day? No, score 0 and go to C / Yes, score 5 and go to C →</p>	
<p>C Whole-body vibration The vibration levels given below are time-weighted averages over an 8-hour period; if the actual exposure time per working day is shorter, the time-weighted average can be calculated with the aid of the formula $a_8 = a_{exp} \cdot \sqrt{T_e/8}$ (where a_8 = time-weighted average over 8 hours, a_{exp} = vibration level (measured or estimated), T_e = daily exposure time)</p>	
<p>C1 Has worker been exposed to average vibration levels >1 m/s² per working day for ≥ 5 years? No, go to C2 / Yes, score 5 and calculate total score →</p> <p style="text-align: center;">↓</p>	
<p>C2 Is worker exposed to average vibration levels > 0.5 m/s² per working day? No, score 0 and calculate total score / Yes, score 3 and calculate total score →</p>	
<p>Total score (0-19) →</p>	

Step 3 → Probability of work-relatedness

The relationship between the exposure to risk factors at work and the probability of work-relatedness depends on the age of the worker concerned. Read off the probability corresponding to the total exposure score calculated from the checklist on page 12 from the appropriate column in the table below. The horizontal line in each column indicates the 50% work-relatedness probability limit.

	Age < 35 years	Age 35 – 45 years	Age > 45 years
Total exposure score	Probability of work-relatedness (%)		
0	0	0	0
1	7	7	6
2	14	13	12
3	20	18	17
4	26	23	22
5	31	28	26
6	35	32	30
7	39	35	33
8	43	39	36
9	46	42	39
10	49	44	42
11	52	47	44
12	55	49	46
13	57	51	48
14	59	53	50
15	61	54	51
16	62	56	53
17	64	57	54
18	65	58	55
19	66	60	56

Interpretation

The calculated probability of work-relatedness of nonspecific low-back pain should be used to support your professional judgement in the management of workers with nonspecific low-back pain and in determining whether the complaints observed can be regarded as an occupational disease.

- Assess work-relatedness (calculated probability plus other relevant information about worker)
- Determine consequences for case management plan
- Decide whether the condition should be regarded as an occupational disease

Probability of work-relatedness

≤ 50%

Interpretation

The nonspecific low-back pain may be due to risk factors at work.

Case management plan

Intervention depends on exposure to the individual risk factors; if a risk factor is present, it is worth while considering lowering the exposure.

Occupational disease?

Yes, if:

- Whole-body vibration level > 1.15 m/s² average over 8-hour working day
- NIOSH Lifting Index > 2

> 50%

Interpretation

The nonspecific low-back pain is largely due to risk factors at work.

Case management plan

Intervention is needed to lower the exposure to the work-related risk factors covered by the inventory.

Occupational disease?

Yes

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Appendix 1

Scientific evidence for existence of other risk factors

The criteria only include work-related risk factors that can be objectively assessed and where the epidemiological literature provides consistent evidence that there is a statistically significant relationship between exposure to the risk factor and occurrence of nonspecific low-back pain. There are many other possible risk factors for which no evidence or insufficient evidence is available. The survey given below gives an impression of the strength of the evidence for or against the relevance of other factors whose relationship with nonspecific low-back pain has been investigated. This information is based on the results of recent systematic reviews of the relationship between various work- and person-related factors and the occurrence of nonspecific low-back pain.^{1, 2, 6-12} Only the factors mentioned in these reviews are included in this table. If factors are not listed, this means that it is not known whether they should be considered as risk factors for nonspecific low-back pain.

The following three categories of evidence may be distinguished:

Evidence of risk

most of the studies in the literature show a statistically significant relationship between these factors and nonspecific back pain. The factors are regarded as risk factors for nonspecific low-back pain.

Contradictory evidence

Some studies in the literature show a significant relationship with nonspecific low-back pain and some do not. As a result, it is uncertain whether these factors should be considered as risk factors for nonspecific low-back pain or not.

Evidence against risk

Most of the studies in the literature show no relationship with nonspecific low-back pain.

Work-related physical factors

Evidence of risk

Manual materials handling
Whole-body vibration
Bending or twisting of the trunk
High physical workload

Contradictory evidence

Static working posture
Repetitive movements

Evidence against risk

Standing
Sitting
Walking

Work-related psychosocial factors

Evidence of risk

Work dissatisfaction
Monotonous work or lack of career prospects

Contradictory evidence

Mental stress
High work tempo/ time pressure
Lack of social support
Little independence in work
Emotional effort

Evidence against risk

Leisure activities

Evidence of risk

Contradictory evidence

Evidence against risk

Sport
Other physical activities

Individual factors

Evidence of risk

Age

Contradictory evidence

Sex
Educational level
Smoking
Previous injuries
Relative force exerted
Absolute force exerted
Maximal oxygen uptake

Evidence against risk

Weight
Height
Marital status
Alcohol consumption

Appendix 2

Score sheet work-relatedness of nonspecific low-back pain

Name of employee	Age	Trade
------------------	-----	-------

1 Diagnosis 'Nonspecific low-back pain'

Yes, go to 2 / No → Criteria not applicable



2 Inventory of risk factors

Score

A Manual materials handling

A1 Does worker handle objects > 15 kg during > 10% of working day?

No, go to A2 / Yes, score 7 and go to B



A2 Does worker handle objects > 5kg > 2x per minute for total of > 2 hours per working day, or objects > 25kg > 1x per day?

No, score 0 and go to B / Yes, score 4 and go to B



B Bending or twisting of trunk

B1 Does worker work with trunk bent and/or twisted > 40° for > ½ hour per working day?

No, go to B2 / Yes, score 7 and go to C



B2 Does worker work with trunk bent and/or twisted > 20° for > 2 hours per working day?

No, score 0 and go to C / Yes, score 5 and go to C



C Whole-body vibration

C1 Has worker been exposed to average vibration levels >1 m/s² per working day for ≥ 5 years?

No, go to C2 / Yes, score 5 and calculate total score



C2 Is worker exposed to average vibration levels > 0.5 m/s² per working day?

No, score 0 and calculate total score / Yes, score 3 and calculate total score



Total score (0-19)



3

Age < 35 years

Age 35 – 45 years

Age > 45 years

Total score	Probability of work-relatedness (%)		
0	0	0	0
1	7	7	6
2	14	13	12
3	20	18	17
4	26	23	22
5	31	28	26
6	35	32	30
7	39	35	33
8	43	39	36
9	46	42	39
10	49	44	42
11	52	47	44
12	55	49	46
13	57	51	48
14	59	53	50
15	61	54	51
16	62	56	53
17	64	57	54
18	65	58	55
19	66	60	56

Probability of work-relatedness of nonspecific low-back pain



%

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