

# Measurement quality and validity of the "need for recovery scale"

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The "need for recovery scale" is suggested as an operationalisation for the measurement of (early symptoms of) fatigue at work. Definition of and background on the concept of need for recovery are briefly discussed. Details about scale construction are summarised. Correlations with other relevant measurement scales on fatigue at work are presented to validate the operationalisation claim, as are early results on predictive validity.

A study is presented that further investigates the measurement quality and validity of the scale. The data used in this study were collected by Occupational Health Services for 68 775 workers during the period 1996–2000. Comparing the measurement quality of subgroups (Cronbach's alpha) differing in terms of age class, sex, and education level, the general applicability of the scale was shown. The validity of the scale was studied by analysing its association with psychosocial risk factors. Multiple regression analyses of need for recovery were performed on individual and department level data, using 10 psychosocial job characteristics as independent variables. The two most important factors in the explanation of variance at the individual level were also dominant at the department level: pace and amount of work, and emotional workload. The percentage of explained variance was higher at the department level than at the individual level, and increased with department size.

Results suggest that the need for recovery scale is an adequate scale, both for applications at the individual and at the group (department/organisation) level.

The concept of work stress is used in many different ways, which causes much confusion.<sup>1</sup> To avoid confusion about the concept of work stress, Meijman and Schaufeli<sup>2</sup> focused on the term fatigue at work instead. They described fatigue at work as the change in the psychophysiological control mechanism that regulates task behaviour, resulting from preceding mental and/or physical efforts which have become burdensome to such an extent that the individual is no longer able to adequately meet the demands that the job requires on his or her mental functioning; or that the individual is able to meet these demands only at the cost of increased mental effort and coping with increased task resistance.

Fatigue at work is the major symptom in a variety of psychological and psychiatric disorders, diagnosed in occupational health care as chronic job stress, burnout, and adjustment disorders. Because this category of disorders is one of the major causes of production loss, sickness absence, and work disability in the Dutch working population, research into fatigue at work is of strong social significance.<sup>3</sup> Similarly European research signals that work pressure, an important cause of fatigue at work, is a work related risk factor which is of particular importance for the Netherlands.<sup>4</sup>

Occupational health practice is confronted with the problem of fatigue at work, both at the individual and at the group (for example, department, location, job, organisation) level. Whereas attention in the field until now has been largely focused on the individual level, the call for a parallel focus on the organisational or department level is becoming stronger.<sup>5</sup> Contrary to the situation in most European countries, in the Netherlands a relatively strong tradition exists in occupational health practice to simultaneously study work related risks and early effects at the individual and at the group level in a health surveillance setting.<sup>6,7</sup> This tradition provided the conditions for instrument development in the area of psychosocial job conditions and job stress.<sup>8</sup>

During 1992–94, Van Veldhoven and Meijman developed a Dutch questionnaire for this purpose: the Questionnaire on the Experience and Evaluation of Work (Dutch abbreviation: VBBA).<sup>8,9</sup> The VBBA consists of 27 scales, constructed according to a scaling method called Mokken analysis.<sup>10,11</sup> This

method belongs to a category of psychometric analyses collectively referred to as the "latent trait" approach or "item response" theory.<sup>12</sup> The Mokken scaling method results in more unidimensional scales than the classic psychometric approach, and thus provides better measurement quality. Because, from the start, application of the instrument was intended in occupational health practice at both the group and individual level, additional measurement rigour was appropriate.

The reliability and unidimensionality of all 27 scales of the VBBA were considered satisfactory, both at the construction<sup>8</sup> and in a replication study on an independently gathered database.<sup>13</sup>

## Need for recovery: concept and scale construction

The concept of need for recovery was deduced from the effort-recuperation model by Meijman and his coworkers.<sup>14,15</sup> In this model work produces costs in terms of effort during the working day. Effort results in an array of emotional, cognitive, and behavioural symptoms, that are reversed when the effort stops. This is what constitutes short term fatigue at work.<sup>2</sup> The symptom reversal takes a certain time span, usually within the same working day and/or the following night. With enough time and possibilities to recuperate (within the work task and after work is finished) a worker will arrive at the next working day with no residual symptoms of previous effort.

Within this normal recuperation cycle the concept of need for recovery refers to the extent that the work task induces a need to recuperate from work induced effort. This need for recovery can be observed especially during the last hours of work and immediately after work. It is characterised by temporary feelings of overload, irritability, social withdrawal, lack of energy for new effort, and reduced performance.

As Jansen and colleagues<sup>16</sup> discussed, the concept is related to Glass and Singer's concept of "postwork irritability".<sup>17</sup> Mohr<sup>18</sup> formulated a similar construct under the name of "irritation". Sluiter and colleagues<sup>19</sup> tried to link the need for recovery concept to the personal psychophysiological homeostatic balance of the worker that is finishing or has just finished working, but did not find strong relations.

**Table 1** Items of the “need for recovery scale”

1.	I find it difficult to relax at the end of a working day.
2.	By the end of the working day, I feel really worn out.
3.	Because of my job, at the end of the working day I feel rather exhausted.
4.	After the evening meal, I generally feel in good shape.
5.	In general, I only start to feel relaxed on the second non-working day.
6.	I find it difficult to concentrate in my free time after work.
7.	I cannot really show any interest in other people when I have just come home myself.
8.	Generally, I need more than an hour before I feel completely recuperated after work.
9.	When I get home from work, I need to be left in peace for a while.
10.	Often, after a day's work I feel so tired that I cannot get involved in other activities.
11.	A feeling of tiredness prevents me from doing my work as well as I normally would during the last part of the working day.

The answer “yes” signals unfavourable situations, except for item 4, where “no” signals an unfavourable situation.

This translation of the original Dutch scale<sup>9</sup> into UK English (as for the other scales of the VBBA) was done by J Lisle and G Pender-Takke in collaboration with the first author. Please note that the translation presented here differs slightly from the version published by Sluiter *et al.*,<sup>22</sup> De Croon *et al.*,<sup>31</sup> and Jansen *et al.*,<sup>16</sup> although their version is also based on the same original.

When the normal possibilities for recuperation are not sufficient, the worker starts the next working day with a residual need for recovery. Starting from here, a cumulative process is postulated by Kompier,<sup>20</sup> which produces more serious stress and adverse health outcomes in the long run.<sup>21</sup> As part of this cumulative process the need for recovery increases, but gradually the concept loses its salience to more serious long term fatigue related syndromes such as burnout. Conceptually, need for recovery, as a measure of short term work related fatigue, bridges the stage between normal work related effort and serious long term work related fatigue syndromes, such as burnout.

In the VBBA questionnaire, need for recovery is measured by an 11 item scale. The items of this scale inquire about the severity and duration of symptoms which indicate that the respondent is not fully recovered from the effects of sustained effort during the working day, for instance lack of attention and concentration at the end of the working day, and reduced motivation for activities in the evening with family or friends. Table 1 contains the wording of the 11 items of the “need for recovery scale”.

The simplicity of dichotomous answering categories (yes or no) was preferred to a polychotomous scale, because of the intended application at the individual level in occupational health practice: the scale had to be as easy to fill in and score as possible. Scale length was determined by the minimum requirements formulated for reliability and unidimensionality in the VBBA project (0.40 for unidimensionality (Loevinger's H) and 0.80 for reliability (Cronbach's alpha)), thus not compromising measurement quality by choosing for dichotomous answering possibilities.

Judging by the wording of the items, the content of the “need for recovery scale” closely follows the definition of fatigue at work by Meijman and Schaufeli,<sup>2</sup> although the symptoms of fatigue measured are probably to be considered relatively light. We think the “need for recovery scale” is an early indicator of fatigue at work, or an indicator for the development of this type of fatigue. This interpretation concurs with Sluiter and colleagues<sup>22</sup> and Jansen and colleagues.<sup>16</sup> The possible role as an early indicator makes the scale important from a preventive point of view in a health surveillance tradition.

#### Available evidence for measurement quality and validity

The available research so far suggests that the psychometric qualities of the “need for recovery scale” are good: reliability, expressed as rho (comparable with Cronbach's alpha), was found to be 0.87 at the construction stage<sup>8</sup> and 0.86 in an independent replication study.<sup>13</sup> Unidimensionality of the scale, expressed as Loevinger's H, was also good in both studies: 0.48 and 0.46 respectively. In Mokken analysis, scales with a Loevinger's H above 0.40 are considered unidimensional.<sup>23</sup>

Comparisons of the scores on the “need for recovery scale” with scores of the same respondents on other measurement scales about fatigue (at work) and on stress related health complaints can support our claim that the “need for recovery scale” can be used to measure (early indications of) fatigue at work. These comparisons can be regarded as content validation of the “need for recovery scale” as a measure of fatigue at work.

The Dutch Checklist Individual Resilience, 20 item version (Dutch abbreviation CIS-20),<sup>24, 25</sup> is a questionnaire developed to measure fatigue in groups of patients in a clinical setting, independent of the working situation. The CIS-20 consists of four subscales, of which the scale “subjective fatigue” is the closest to need for recovery in terms of item content. In 1998, the VBBA and the CIS-20 were used together in two large scale research projects.<sup>26, 27</sup> The correlation coefficients between the two scales were 0.66 (n = 1637) and 0.71 (n = 3458) respectively. In view of the difference between the two scales in their relation to work, we consider this correlation to be high.

The Utrecht Burnout Scale (Dutch abbreviation UBOS),<sup>28</sup> especially the subscale “emotional exhaustion”, is another possibility for content validation of the “need for recovery scale”. Three versions of the UBOS were developed for different target groups: the first for teachers, the second for occupations involving intensive client contact, and the third for all occupations (general version). The “emotional exhaustion” scale of the second version showed a strong correlation with need for recovery in a study among 742 occupational physicians (correlation coefficient 0.84).<sup>28</sup> In a study among 559 policemen, the correlation between the “need for recovery scale” and the “emotional exhaustion scale” (third version) was 0.75.<sup>28</sup> According to these two studies, the “need for recovery scale” and the “emotional exhaustion scale” measure the same concept to a large extent. This is somewhat remarkable because we expected the “emotional exhaustion” scale to measure serious symptoms of fatigue at work and the “need for recovery scale” less serious symptoms. The transition from less serious and short term to serious and long term symptoms of fatigue at work may however be gradual.

In the Netherlands, the use of the questionnaire for perceived health complaints (Dutch abbreviation VOG),<sup>29</sup> for the measurement of stress related health complaints is common. In a large scale study in the financial sector, the “need for recovery scale” and the 13 item version of the VOG<sup>30</sup> correlated 0.63 (n = 3011) (unpublished research by the first author).

The correlation between need for recovery and stress related health complaints is lower than the correlation found between need for recovery and fatigue or exhaustion symptoms. This finding is in accordance with models which regard need for recovery as a phenomenon directly reflecting work effort, and that regard stress related health complaints as a long term

effect—that is, as a later stage in the stress process.<sup>15, 21</sup> In conclusion, we can state with good reason that the “need for recovery scale” has sufficient content validity.

Information on the predictive validity of the scale would add to its utility as an instrument in occupational health care. Van Veldhoven<sup>8</sup> showed the predictive validity of the “need for recovery scale” for sickness absence registered among 411 workers in a health care organisation during an interval of six months after completion of the questionnaire. The scale was predictive of both frequency and duration of absenteeism, and was among the three most important predictors (together with skill variety and unfairness in reward). Similarly, De Croon and colleagues<sup>31</sup> showed that the “need for recovery scale” was a predictor for self reported absenteeism in a two year follow up study in 526 truck drivers. The odds ratio of high baseline need for recovery with respect to the risk of sickness absence (>14 working days) was found to be 2.19, after adjustment for age, previous sickness absence, marital status, educational level, and company size. However, in this study need for recovery was not found to mediate the relation between stressful working conditions and sickness absence.

### Further research into measurement quality and validity

Since its publication in 1994 the scale has been widely used both in Dutch occupational health practice and in Dutch applied research (as part of the VBBA questionnaire), generating data on an organisation by organisation, project by project basis. These data have been collected in a central database following a standardised protocol. This has resulted in a large database, accessible for further analysis of measurement quality and validity.

A first direction for additional research concerns generalisability. Is the scale measuring the same latent construct reliable for different subpopulations? A positive answer would make the scale suitable for comparative analyses at the level of occupational subgroups in the working population: departments, organisations, or branches of industry.

A second direction for additional research relates to the application of the scale at both individual and group level. We think it is important to present results of analyses on an aggregated level, because many of the research and consultancy projects in occupational health practice are focused on this level. The content, size, and representativeness of most Dutch databases on fatigue at work do not allow analyses on an aggregated level, for example, analyses between departments of many organisations. Working with aggregated data has the advantage of reducing the influence of individual factors not related to work, whereas the influence of shared characteristics of the respondents of the department, for example, the nature of the work and the working conditions, are amplified. However, there are also methodological objections against working with aggregated data.<sup>32, 33</sup> One objection is that it is rarely possible to get a random sample of aggregated data (for example, departments) because these mostly originate from limited sets of units (for example, organisations). A second objection is that working with aggregated data often results in such a reduction of the number of observations that reliable multivariate analyses are impossible. Finally, results at the group level cannot be unambiguously translated to implications for individual workers.

In this paper results of group level analyses on departments will be compared with results of individual level analyses. Using the large VBBA database, we can try to replicate individual level research findings on the department level. For the “need for recovery scale” to be applicable on both levels, the same psychosocial job characteristics have to be associated with need for recovery at both the individual and the department level. This would make the scale suitable for contexts where both individual and group level interventions are required in parallel,<sup>5</sup> or where multilevel analyses are

viable.<sup>34, 35</sup> The scale would provide data on both levels of analysis that are not contradictory because of measurement problems in the dependent variable, need for recovery.

In this paper two research questions will be addressed:

- (1) Is scale quality (Cronbach's alpha) comparable for different subgroups of the working population?
- (2) Are psychosocial job factors associated with need for recovery comparable for the individual and department levels of analysis?

## METHODS

### Database

In the period 1996–2000, the VBBA has been used by occupational health care services for the measurement of psychosocial job characteristics and work stress in over a thousand research and consultancy projects in companies and institutions. The individual data of all these health surveillance projects were gathered in an extensive database of 123 708 individual records.

The non-response rate of the separate projects in occupational health practice that constitute the database, is often not determined and is not centrally registered. However, we know from more exact data collection during scale construction that response percentages in this type of research context in the Netherlands typically vary from 60% to 80%.<sup>8, 36</sup> This leads us to expect that the database provides valid information on the researched topics in the researched population. Because no exact data exist on non-response, it is however not possible to know what bias is to be expected as a result of self selection of respondents.

Apart from this possible source of bias at the individual level, selection bias is possible because of self selection of organisations and parts of organisations participating in this type of occupational health surveillance. It might be expected that only organisations participate where job stress is an issue. This might increase stress levels found in our results compared to stress levels in non-participating organisations. On the other hand it might be argued that only organisations participate that recognise the importance of preventive activities. As they are expected to be exponents of “good occupational health care practice”, one might expect stress levels in these organisations to be lower than in non-participating organisations. Both positive and negative effects might therefore be expected of self selection at the organisational level in this study. As the focus is on measurement quality and validity of relations with psychosocial risk factors, the representativity of the stress levels in the sample studied is less important than its size, heterogeneity, and nested data structure.

### Questionnaire

In many instances the number of items of the complete VBBA is too large for application in regular practice of occupational health care. For that purpose 14 of the 27 scales were selected to form a core version.<sup>37</sup> Ten scales are about psychosocial job characteristics: “pace and amount of work”; “emotional load”; “physical exertion”; “lack of variety in your work”; “lack of opportunities to learn”; “lack of independence in your work”; “lack of participation in decisions about your work”; “problems in the relationships with colleagues”; “problems in the relationship with your immediate boss”; and “uncertainty about the future”. The other four scales of the core version measure possible work stress reactions: “lack of pleasure in your work”; “lack of involvement in the organisation where you work”; “need for recovery”; and “worrying about your work”. In almost all projects, these 14 scales of the core version are used.

### Departments

For many respondents in the database, information is available about the department they work in. The classification and coding of departments is done by the occupational

**Table 2** Number of cases and Cronbach's alpha of the "need for recovery scale" by education level, gender, and age class

Age class	Primary education		Lower secondary education		Higher secondary education		Higher vocational education		University degree	
	F	M	F	M	F	M	F	M	F	M
Section A: Number of cases										
<25 y	*	*	248	311	800	388	280	155	*	*
25–34 y	154	269	1313	1397	3097	2299	1818	1801	881	798
35–44 y	263	533	1841	2409	2039	2894	1349	2440	630	1067
45–54 y	354	762	1418	2266	1054	2108	800	1923	370	863
>54 y	118	325	318	539	187	444	138	465	(2)	183
Section B: Cronbach's alpha										
<25 y	*	*	0.86	0.86	0.83	0.84	0.85	0.81	*	*
25–34 y	0.89	0.86	0.87	0.89	0.86	0.87	0.85	0.85	0.85	0.85
35–44 y	0.90	0.90	0.88	0.88	0.87	0.88	0.87	0.87	0.84	0.86
45–54 y	0.90	0.91	0.89	0.90	0.89	0.89	0.87	0.87	0.88	0.87
>54 y	0.85	0.92	0.88	0.89	0.92	0.90	0.88	0.88	†	0.89

F, female; M, male.

\* Small number of respondents, joined with the age class 25–34 of the same gender and education level.

† Small number of respondents, joined with the age class 45–54 of the same gender and education level.

health care service with the purpose of subdividing a company in more or less homogeneous groups with regard to the type of work and working conditions. Each group should be of sufficient size to justify department level analyses and statistical comparisons.

The word department in this study should be interpreted in a broad perspective, as it can refer to a hierarchical department, a functional occupational group, or a location.

Department homogeneity is important in this study as it determines the amount of contrast between individual level and department level data. Therefore a few additional criteria have been formulated to select more homogeneous departments for this study. Only departments have been included that were part of a larger project in their organisation. This eliminates projects where all workers have been investigated as one group. Department size has been limited to an arbitrary maximum of 100 respondents, eliminating larger groups, which are expected to be more heterogeneous in terms of constituting job types. Finally, a code had to be available for the department that identified it as "not a rest group".

### Respondents

For this study, only respondents are available who have complete data for the 10 psychosocial job factors and for the "need for recovery scale", and who belong to a department as specified. This results in a data selection of 68 775 workers (56% of total available workers).

Most of the questionnaires returned by these respondents contained information about personal characteristics. Age class of the respondent was known in 89% of selected cases. Five per cent of the sample was below 25 years of age, 30% was between 25 and 34, 33% was between 35 and 44, 26% was between 45 and 54, and 6% was older than 54 years. In comparison with national statistics on the Dutch workforce as reported by Statistics Netherlands,<sup>38</sup> the age group 25 and below was underrepresented, and the other age groups were each slightly overrepresented. Data on gender were available for 97% of selected cases, and showed that 59% were male and 41% were female, similar to the Dutch workforce.<sup>38</sup> Education level was available only in 75% of selected cases. Of these respondents, 6% had primary education only, 26% secondary school (lower level) or lower vocational education, 33% secondary school (higher level) or middle vocational education, 24% higher vocational education or equivalent, and 11% had a university degree or equivalent. Comparing these data to those reported by Statistics Netherlands,<sup>38</sup> we find that the distribution was representative, with the exception of workers

with secondary school (higher level) or middle vocational education, which were underrepresented in the current sample.

### Analyses

In order to investigate the generalisability of scale characteristics, Cronbach's alpha of the "need for recovery scale" will be calculated for subgroups in the data with regard to education level, gender, and age class. The combination of these three variables was present in 67% of the 68 775 cases. When crossing these three variables with each other, of the 50 possible subgroups with a specific combination of age class, gender, and education level, 45 had a size of 50 respondents or more. The five subgroups of less than 50 respondents were joined with a subgroup of an adjacent age class and of the same gender and education level to achieve reasonably large numbers.

The individual questionnaire scores on psychosocial job factors and need for recovery were aggregated to mean scores for each department in order to perform the analysis on this aggregated level. In order to assess the effect of minimum department size, different variations of this parameter were used. The first department level analysis imposes no restrictions as to minimum department size. Five analyses are then done on a restricted number of departments, increasing the minimum department size from 5 employees per department to 10, 15, 20, and 25 employees. Multiple regression analyses are performed on the relation between the 10 psychosocial job factors and need for recovery: one on the individual level, and six for the variations on the department level.

### RESULTS

#### Measurement quality in subgroups

Respondents were classified in subgroups according to the combination of education level, age class, and gender. Table 2 presents the number of respondents and Cronbach's alpha for the "need for recovery scale" of the 45 subgroups with at least 50 respondents.

Cronbach's alpha is of consistent, good quality for all subgroups, ranging from 0.81 to 0.92. For the total sample ( $n = 68.775$ ) in this study Cronbach's alpha is 0.88.

#### Validity of relations with psychosocial job factors: individuals and departments

The "need for recovery scale" counts 11 dichotomous items, which can thus result in 12 different scores on the individual level. Individual scores are transformed (as for all VBBA

**Table 3** Results of regression analyses for need for recovery on the individual and the department level

Independent variable	Individual level	Department level					
		All departments	Employees per department				
			n>5	n>10	n>15	n>20	n>25
Standardised betas							
Pace and amount of work	0.36**	0.43**	0.49**	0.48**	0.51**	0.53**	0.54**
Emotional load	0.14**	0.17**	0.23**	0.24**	0.24**	0.23**	0.24**
Physical exertion	0.08**	0.09**	0.11**	0.12**	0.11**	0.10**	0.04
Lack of variety in your work	0.03**	0.05*	0.04	0.04	0.05	0.04	-0.02
Lack of opportunities to learn	0.02**	-0.01	-0.00	-0.02	-0.01	0.01	0.04
Lack of independence in your work	0.02**	0.01	0.00	0.05	0.07*	0.09	0.09
Problems with colleagues	0.08**	0.06**	0.09**	0.12**	0.13**	0.15**	0.14**
Problems with immediate boss	0.01	0.00	-0.04	-0.01	0.00	-0.03	-0.06
Lack of participation in decisions	0.10**	0.12**	0.14**	0.11**	0.08	0.10	0.14**
Uncertainty about the future	0.02**	0.01	-0.02	-0.04	-0.05**	-0.08**	-0.04
R <sup>2</sup>	0.27	0.33	0.45	0.49	0.52	0.54	0.54
Number of individuals	68775	68775	63642	53817	42987	33344	25854
Number of departments	6020	6020	3833	2512	1614	1038	687
Average number of individuals per department	11.42	11.42	16.60	21.42	26.63	32.12	37.60
Mean score need for recovery	27.30	26.66	26.99	27.18	27.04	26.83	26.76
Standard deviation need for recovery	29.57	16.97	12.26	11.32	10.90	10.67	10.17

Means, standard deviations, and multiple regression analyses with 10 psychosocial job characteristics as independent variables and need for recovery as dependent variable.

For each analysis are reported: the number of individual respondents, the number of departments, the average number of individuals per department, the mean and standard deviation for the "need for recovery scale", standardised beta coefficients for the 10 psychosocial job factors, significance of the coefficients, and R<sup>2</sup> of the regression model.

\*p<0.01; \*\*p<0.001.

scales) to a range between 0 (minimum) and 100 (maximum). Table 3 presents means, standard deviations, and multiple regression analyses for need for recovery.

As can be seen from table 3 the mean score for the scale in the sample is around 27 for both individuals and all variations on the department level. The standard deviation decreases from a value just above the mean score on the individual level, to a value almost one third of this value for departments with a minimum size of 25 employees. The largest decrease in standard deviation takes place when shifting from the individual to the department level of analysis, and further when department size restrictions are introduced.

In table 3 the results of the multiple regression analyses are presented, one on the individual level and six on the department level. In both types of analysis need for recovery is used as a dependent variable, and 10 psychosocial job characteristics of the core version of the VBBA as independent variables. In the table standardised beta coefficients and their significance are reported, as is the R<sup>2</sup> for the entire equation.

There is a strong resemblance between all equations in the order of the two most important independent variables. In all equations the variable "pace and amount of work" has the highest standardised beta coefficient, followed by "emotional workload". In the analysis on the individual level, the next highest beta coefficients are found for the scales "lack of participation in decisions about your work", "problems in the relationships with colleagues", and "physical exertion". The impact of these three variables on the department level depends only slightly on the minimum department size chosen. For job insecurity a significant negative coefficient was found at minimum department sizes of 15 and 20, suggesting that more job insecurity is linked to lower need for recovery. In all equations the contribution of "lack of variety", "lack of opportunities to learn", and "problems with immediate boss" is trivial, coefficients even changing plus and minus signs for different levels of analysis or different minimum department sizes. For "lack of independence" the coefficient becomes stronger with the increase of minimum department size, but in general it fails to reach significance.

The 10 selected psychosocial job characteristics explain 27% of the variance in individual scores of need for recovery, and

33–54% of the variance in the department mean scores. The difference in proportion of variance explained between individual level and department level analyses is remarkable, as the standard deviation between department mean scores is smaller than the standard deviation between individual scores. The difference in variance explained between the individual and the department level is especially clear when a minimum department size is introduced, starting from departments with a minimum size of 5 or 10 employees.

## DISCUSSION

### Earlier studies

In research by both the scale constructors and other researchers the "need for recovery scale" showed good psychometric quality. Content validity was also sufficiently shown: correlations between the "need for recovery scale" and other scales measuring fatigue at work all are above 0.65. The correlation between the "need for recovery scale" and the "emotional exhaustion scale" from the Utrecht Burnout Scale is about 0.80, which can be regarded as an indication that the scales to a large extent measure the same concept. Also, there is a considerable correlation of about 0.60 between the "need for recovery scale" and stress related health complaints. Although there is a resemblance in the wording of some of the items in both of these questionnaires, this resemblance cannot totally explain the size of the correlation. There must also be a conceptual resemblance. Finally, some research results are available on predictive validity, showing that need for recovery is a good predictor of future sickness absence. In conclusion: earlier studies suggest that the "need for recovery scale" is a good operationalisation of (early symptoms of) fatigue at work, although further work needs to be done, especially regarding predictive validity.

### This study

The results presented in table 2 show that measurement quality of the "need for recovery scale" is good and consistent for subgroups of the Dutch workforce in terms of age class, gender, and education level. This is an encouraging result with respect to the possible use of the scale for health surveillance

purposes and for (epidemiological) studies on a national scale, within specific branches of industry and/or within large organisations.

The diminishing of variance of mean scores in need for recovery at the department level with increasing minimum department size, especially when compared with the variance of mean individual scores, can be interpreted as a gradual suppression of the influence of individual factors that are not work related with the increase of minimum department size. The large percentage of variance explained in the mean scores of need for recovery for departments compared to individual level data, is a finding of a different order. This finding reflects a rather strong relation between the mean pace and amount of work in a department (and to a lesser extent the degree of emotional workload) and the mean need for recovery. In other terms, there are substantial and meaningful differences between departments in independent variables, which can explain the variance in need for recovery. This result is a strong argument for analyses at the aggregated level in both occupational health research and practice. Department level mean need for recovery scores reflect the influence of shared work (situation) characteristics of the employees in a department. At least they reflect shared perceptions of work related fatigue by the employees in a department.<sup>32</sup>

The equations resulting from the regression analyses indicate that the most important factors in the explanation of variance in need for recovery on the individual level are also the most important on the department level. This concerns the scales "pace and amount of work" and "emotional workload". Other important correlates are "lack of participation", "problems with colleagues", and "physical exertion". Although in this study need for recovery appears to be mainly influenced by psychological job characteristics, this last factor indicates that the influence of physical workload is to some extent also reflected. This finding is in accordance with previous results in fatigue research,<sup>39</sup> and illustrates that it is difficult, maybe even impossible, to disentangle physical and psychological aspects of fatigue (at work).

It is interesting to note that in the analyses some independent variables that were expected to be at least of some importance, were found to be of trivial importance for need for recovery at the department level. This is especially true for variables concerning decision latitude<sup>40</sup> in the work task ("lack of variety", "lack of opportunities to learn", "lack of independence"). Also, the relationship with the immediate boss seems to be unimportant. For uncertainty about the future at least some evidence was found, but in a contra-intuitive direction, linking more uncertainty with less need for recovery.

Because of the relative consistency of relationships found at the individual and department levels, the "need for recovery scale" will provide reliable results in studies of a single or a multilevel nature, which is an encouraging result. An important side result of the study is the observation that at the department level psychosocial job factors explain more than half of the variance between departments in need for recovery, departing from a minimum department size of 15 employees, reflecting the gradual suppression of individual factors, both in independent and dependent variables. This is important in view of arguments in favour of prevention of psychosocial risk factors at the departmental or organisational level.<sup>5</sup>

The two most important psychosocial job factors correlated with need for recovery concern work demands. Physical exertion is a third workload aspect that makes a significant contribution to the regression equations at both individual and department levels. These three factors taken together imply an operationalisation of work demands in terms of both quantitative (work speed and work quantity) and qualitative (emotional demands and physical exertion) dimensions, both making a unique contribution to the variance explained in need for recovery at the individual and the department level.

It is important to note again that the data set presented in this study holds the possibility of selection bias. No detailed data exist on the amount and background of non-response at the individual level, which is a serious methodological drawback of this study. However, in a non-response analysis Weel and Broersen<sup>36</sup> showed that there is only a limited impact of non-response on data collected in the context of large occupational health surveillance programmes in the Netherlands. The data used in this study have been collected in self selected organisations, open to stress research and likely to invest in stress prevention and intervention activities. Generalisation of the study results should be limited primarily to this type of organisation. Recognising the possibility of selection bias by non-response and recognising the potential restrictions to generalisability, we still recommend the use of large cross sectional data sets collected in occupational health practice for the purpose of scientific studies. Not using this type of data could, in our view, possibly result in losing "ecological validity" in large scale scientific studies. One of the questions in this respect is whether workers participating in long term trials with multiple repeated measures over several years are representative of the modern, flexible workforce.<sup>4</sup>

The "need for recovery scale" is a short, simple, but adequate measure for early symptoms of fatigue at work, for use in both health surveillance and scientific research, at the individual, departmental, organisational, or national level. Future development of the scale could involve translations into other languages and validity studies in other language areas. Another element for the future research agenda is to establish a cut off point for the "need for recovery scale" (comparable to the development of a cut off point for the CIS-20 by Bültmann and colleagues<sup>41</sup>), in order to make it easier to use in the context of epidemiological studies. Furthermore, a cut off point can be used by occupational health practitioners for the surveillance and selection of employees at high risk for more serious long term work related fatigue syndromes, such as burnout.

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