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## Different domains of health functioning as predictors of sickness absence – a prospective cohort study

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**Objectives** The aim of this study was to examine different domains of health functioning as predictors of sickness absence.

**Methods** The Short Form 36 (SF-36) is one of the best known instruments measuring various domains of physical and mental health functioning. A questionnaire including the SF-36 was mailed to 40–60-year-old employees of the City of Helsinki in 2000–2002. For the subsequent three years, sickness absence episodes >2 weeks were derived from the employer's register. The predictive ability of the eight subscales and two component summaries of the SF-36 were compared using regression methods and receiver operating characteristic (ROC) curve analysis.

**Results** All eight SF-36 subscales and the two component summaries predicted the occurrence of sickness absence over the follow-up period. Among women, bodily pain was the strongest predictor, with 1 standard deviation increase in bodily pain increasing the occurrence of sickness absence by 77% [95% confidence interval (95% CI) 68–86%]. Role limitations due to emotional problems were the weakest predictor of sickness absence (29%, 95% CI 23–36%). Among men, the results were similar to those of women. In both genders, the area under the ROC curve was largest for bodily pain, general health, and physical functioning and lowest for mental health and role limitation due to emotional problems.

**Conclusions** The subscales measuring physical domains of functioning were more strongly associated with sickness absence than the mental subscales. In particular, ability to perform daily activities, pain, and general health were important predictors of sickness absence >2 weeks.

**Key terms** gender; occupational social class; short form 36; SF-36.

Sickness absence has been increasingly used as an outcome in research on work and health. However, there is some debate about the nature and validity of sickness absence as a health measure. It has been argued that motivational factors and employee satisfaction play a decisive role in sickness absence behavior (1, 2), which is also affected by contextual factors at work (3, 4) and outside of work (5, 6). Previous studies examining associations between sickness absence and other health measures have shown that medically confirmed sickness absence predicts future disability retirement (7, 8) and mortality (9–11). In a UK study, medically confirmed sickness absence predicted mortality even better than well-established indicators of general health such as poor self-rated health or having a longstanding illness (12). The association with mortality has been observed

for various causes of death (11, 13), and diagnostic information about the reason of sickness absence improves the prediction for mortality (13, 14). Thus, these studies indicate that sickness absence is connected to health in one way or another, but little is known about the different domains of health as predictors of sickness absence.

By definition, sickness absence is absence from work due to sickness, and in most countries at least long sickness absence episodes require a certificate from a physician. Sickness absence denotes a temporary inability to carry out one's work-related tasks, thus measuring functional health in occupational settings. It has been suggested that sickness absence may serve as an integrated measure of health-related functioning that reflects a mixture of physical, psychological, and social defects in functioning (12).

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We examined health-related functioning as a predictor of sickness absence using prospective register data from middle-aged employees of the City of Helsinki. Functioning was measured by the Short-Form 36 questionnaire (SF-36), a non-specific profile measure capturing different domains of physical and mental health functioning. Our particular aim was to find out which domains of health-related functioning are the strongest predictors of sickness absence.

## Methods

### Study population

The data were collected among the employees of the City of Helsinki, the largest employer in Finland (15). In 2000, the personnel register of the City of Helsinki was used to identify all employees who during that year reached the ages of 40, 45, 50, 55 or 60 years, and a self-administered questionnaire was mailed to them. A similar procedure was repeated in 2001 and 2002. Altogether these three independent cross-sectional baseline surveys included 13 346 employees of whom 8960 (67%) responded. According to non-response analysis the data are generally representative of the target population although men, younger people, and manual workers were slightly underrepresented among the respondents (16).

### Measurement of health functioning

Health-related functioning was measured by the SF-36 health questionnaire. The questionnaire includes 36 items assessing health status on eight empirically distinct domains that "represent the most frequently measured concepts in widely-used health surveys and those most affected by disease and treatment" (17). The eight domains are selected from 40 concepts and several hundreds of individual questions included in the Medical Outcomes Study (MOS) and other health surveys. The eight domains are (i) physical functioning, (ii) role limitations due to physical problems, (iii) bodily pain, (iv) general health perceptions, (v) mental health, (vi) role limitations due to emotional problems, (vii) social functioning, and (viii) vitality. Additionally, factor analysis has been used to compress these eight subscales into two component summaries indicating physical and mental health, where each subscale positively or negatively contributes to both component summaries (18). Of the eight subscales, the four first mentioned are often referred to as physical subscales and the latter four as mental subscales, although vitality, and to a lesser degree social functioning and general health, also have noteworthy correlations with the other component

summary. The SF-36 has been shown to have good construct validity, high internal consistency, and high test-retest reliability (17, 18).

### Measurement of sickness absence

Data on sickness absence were derived from the employer's sickness absence records. For the 6934 respondents who had provided a written consent for the linkage upon returning the questionnaire, data on all sickness absence spells were retrieved for three subsequent years after the day of returning the questionnaire or until the work contract terminated. All consecutive and overlapping sickness absence spells were combined. The overall number of person-years in the analyses was 18 795 with a mean follow-up time of 2.7 years. The main reason for the reduced follow-up time was a terminated work contract, but also interruptions due to reasons other than the worker's own illness, such as parental leave, were subtracted from the follow-up time. The sickness absence register is used for salary payments and social security purposes and is therefore likely to be reliable. Non-response analysis showed that those respondents who declined the register linkage did not markedly differ from those who consented by age, occupational class, income, type of employment contract, and employment sector. Furthermore, there were no differences in the associations of these characteristics with sickness absence by responding and consenting (16). Further details about sickness absence rates in this study population can be found elsewhere (19).

### Statistical methods

Applying the SF-36 subscales in this kind of comparison is complicated by the differing distributions of the subscales. While all subscales range from 0–100, with higher scores indicating better health-related functioning, some of the subscales can have few possible numerical values. Furthermore, the distributions of some subscales are skewed and some have clear ceiling or floor effects. Special attention was paid to selecting methods that are not sensitive to these kinds of problems, although it is not possible to avoid them entirely.

Poisson regression analysis was first used to examine associations of the SF-36 subscales and component summaries with the number of sickness absence spells >2 weeks during the follow-up period. To increase comparability, all subscales were standardized by setting the mean to 0 and the standard deviation (SD) to 1. Differences in the individual follow-up times were taken into account using the logarithm of the time until censoring as the offset. Overdispersion was corrected by scaling (20). The results are presented as rate ratios (RR) with 95% confidence intervals (95% CI) representing

the increase in the risk of sickness absence per 1 SD decrease in functioning. We first present crude RR and then adjust these for age and a four-category variable of socioeconomic status (SES).

Following this analysis, we calculated the area under the receiver operating characteristic (ROC) curve for each of the subscales and the component summaries (21). For this analysis, we dichotomized the respondents who, during the follow-up period, had at least one sickness absence spell >2 weeks (32%) from those who did not (68%). Median values for the subscales and the component summaries are presented in the two groups and the P-value from the Mann-Whitney U-test is given. The area under the ROC curve (AUC) presents how well the SF-36 subscales discriminate these two groups. The AUC receives numerical values between 0–1. The larger the value, the better the predictive ability of the SF-36 subscale. The analyses were conducted separately for women and men using STATA, version 9.2 (StataCorp, Chicago, IL, College Station, TX, USA).

## Results

All SF-36 subscales predicted sickness absence during the follow-up period. Among women (table 1a), the occurrence of sickness absence was 1.77 (95% CI 1.68–1.86) times higher for each increase of 1 SD in bodily pain. Additionally, general health perceptions were strongly associated with sickness absence (RR 1.73, 95% CI 1.64–1.82) while mental health and role limitations due to emotional problems showed the weakest associations. Among men (table 1b), the largest rate ratios were observed for bodily pain and physical functioning followed by general health. Adjusting for age and SES slightly attenuated the associations of the physical subscales and sickness absence but had no effect on the associations of the mental subscales and sickness absence.

For each of the subscales, the median SF-36 score was higher among those who did not have sickness absence during the follow-up period than among those who did, indicating better health-related functioning in this group. Results from the ROC analysis were largely similar to those from the Poisson regression. Among both women and men, the largest AUC were found for bodily pain, general health and physical functioning and the lowest for mental health and role limitations due to emotional problems. All subscales were statistically significantly >0.5 suggesting that they distinguish the group with sickness absence from that with no sickness absence better than by chance.

Overall, among men and women, the four physical subscales were better predictors of sickness absence

than the four mental subscales. This is also reflected in the component summaries: the physical component summary was strongly associated with sickness absence whereas the association between the mental component summary and sickness absence was weak.

## Discussion

We studied various dimensions of health-related functioning as predictors of sickness absence among the employees of the City of Helsinki. While all dimensions of the SF-36 were associated with sickness absence, the associations were stronger for the physical subscales. The findings were very similar for women and men.

Data on sickness absence and early retirement have shown that during the last few decades, problems of mental health have become increasingly important grounds for work disability in European countries (22). In Finland, sickness absence levels have been on the increase since the early 1990s and this increase has been mainly due to mental and behavioral disorders. Current statistics based on sickness absence episodes >2 weeks show that absence due to mental and behavioral disorders now cover approximately one quarter of absence days (23). In line with this, in a previous study among the employees of the City of Helsinki, 21% of all sickness absence episodes >2 weeks were due to mental and behavioral disorders (24). Despite the increasing importance of mental problems as reasons for work disability, somatic diagnoses still cover the overwhelming majority of sickness absence spells. Therefore, it is plausible that in these data collected in the early 2000s, the measures of physical functioning showed stronger associations with overall sickness absence than those of mental functioning.

The physical component summary of the SF-36 showed as strong as or even stronger an association with sickness absence than the four subscales usually considered to reflect physical functioning. In contrast, the mental component summary was more weakly associated with sickness absence than any of the mental subscales. The explanation for this finding, which may at first seem peculiar, is that the component summaries were derived using the standard scoring algorithm (18) that provides uncorrelated (orthogonal) factors. The mental component summary score, therefore, expresses the level of mental functioning that is independent of physical functioning, and vice versa. The finding implies that the effect of pure mental functioning on sickness absence is weaker than that mixed with physical influences (ie, the mental subscales partly reflect somatic co-morbidity). However, it could also be argued that for this very reason it is unjustified to force the component

**Table 1a.** Short-Form 36 (SF-36) subscales and component summaries as predictors of sickness absence >2 weeks over the subsequent 3-year period among *female* employees of the City of Helsinki (N=5470). Rate ratios (RR) with 95% confidence intervals (95% CI) unadjusted and adjusted for age and socioeconomic status for 1 standard deviation (SD) change in functioning, median SF-36 scores in the groups with and without sickness absence during the follow-up period, and area under the receiver operating characteristic curve (AUC) for each of the subscales and the component summaries.

	RR per 1 SD change in functioning				Median			AUC	
	Unadjusted		Adjusted for age and socioeconomic status		No sickness absence (N=3681)	Sickness absence (N=1789)	P-value <sup>a</sup>	Value	95% CI
	RR	95% CI	RR	95% CI					
Bodily pain	1.77	1.68–1.86	1.68	1.59–1.77	74	62	<0.001	0.64	0.63–0.66
General health	1.73	1.64–1.82	1.66	1.58–1.74	77	67	<0.001	0.64	0.61–0.65
Physical functioning	1.53	1.48–1.59	1.48	1.42–1.53	95	90	<0.001	0.64	0.62–0.65
Role physical	1.49	1.43–1.56	1.44	1.38–1.51	100	100	<0.001	0.59	0.57–0.60
Social functioning	1.41	1.34–1.47	1.39	1.33–1.45	100	87.5	<0.001	0.59	0.57–0.60
Vitality	1.36	1.28–1.43	1.37	1.31–1.45	65	60	<0.001	0.58	0.56–0.59
Mental health	1.30	1.24–1.37	1.31	1.24–1.37	84	80	<0.001	0.56	0.55–0.58
Role emotional	1.29	1.23–1.36	1.29	1.23–1.36	100	100	<0.001	0.55	0.53–0.56
Physical component summary	1.69	1.62–1.76	1.61	1.54–1.68	52.2	48.1	<0.001	0.65	0.63–0.67
Mental component summary	1.21	1.14–1.28	1.24	1.18–1.31	55.0	54.0	<0.001	0.53	0.51–0.55

<sup>a</sup> Mann-Whitney U-test; Due to ceiling effects it sometimes happens that the medians in the two groups are the same even if the P-value indicates a difference between the groups' distributions

**Table 1b.** Short-Form 36 (SF-36) subscales and component summaries as predictors of sickness absence >2 weeks over the subsequent 3-year period among *male* employees of the City of Helsinki (N=1464). Rate ratios (RR) with 95% confidence intervals (95% CI) unadjusted and adjusted for age and socioeconomic status for 1 standard deviation (SD) change in functioning, median SF-36 scores in the groups with and without sickness absence during the follow-up period, and area under the receiver operating characteristic curve (AUC) for each of the subscales and the component summaries.

	RR per 1 SD change in functioning				Median			AUC	
	Unadjusted		Adjusted for age and socioeconomic status		No sickness absence (N=1051)	Sickness absence (N=413)	P-value <sup>a</sup>	Value	95% CI
	RR	95% CI	RR	95% CI					
Bodily pain	1.65	1.45–1.89	1.58	1.39–1.79	84	72	<0.001	0.62	0.59–0.65
General health	1.64	1.44–1.86	1.57	1.38–1.77	72	62	<0.001	0.63	0.60–0.66
Physical functioning	1.66	1.50–1.84	1.61	1.45–1.79	95	95	<0.001	0.63	0.60–0.66
Role physical	1.47	1.30–1.67	1.45	1.29–1.63	100	100	<0.001	0.58	0.55–0.61
Social functioning	1.41	1.25–1.60	1.43	1.28–1.60	100	87.5	<0.001	0.59	0.56–0.62
Vitality	1.37	1.19–1.57	1.40	1.24–1.57	70	60	<0.001	0.60	0.56–0.63
Mental health	1.29	1.14–1.46	1.31	1.17–1.46	84	80	<0.001	0.58	0.55–0.61
Role emotional	1.29	1.13–1.46	1.32	1.17–1.48	100	100	<0.001	0.55	0.53–0.58
Physical component summary	1.77	1.57–2.00	1.68	1.49–1.89	53.3	50.4	<0.001	0.63	0.59–0.66
Mental component summary	1.24	1.08–1.42	1.29	1.14–1.45	55.1	53.8	0.005	0.55	0.52–0.58

<sup>a</sup> Mann-Whitney U-test; Due to ceiling effects it sometimes happens that the medians in the two groups are the same even if the P-value indicates a difference between the groups' distributions

summaries to be uncorrelated, and thus the subscales give a more adequate expression of the associations (25). Nevertheless, examining the component summaries along with the subscales provides the most complete account of the associations of mental and physical functioning and sickness absence.

#### Methodological considerations

The strengths of this study include its large sample, register-based data on medically confirmed sickness

absence, and prospective study design. A limitation is that the study population consisted of municipal employees only and it is, therefore, numerically dominated by women. Since the study lacks industrial occupations, there are few blue-collar employees compared to the general employee population. The physical and mental working conditions of the people working in the 215 occupations included in the analyses may, therefore, differ from those of the overall workforce.

The SF-36 is a generic health measure that assesses functioning in everyday contexts. In the subscales

measuring pain, role limitations due to physical problems, and role limitations due to emotional problems there are some items that directly relate to work ability. For example, one of the questions on pain asks: "During the past 4 weeks, how much did pain interfere with your normal work, including both work outside the home and housework?" In this way, some of the questions might have some conceptual overlap with sickness absence. However, while these questions deal with the respondent's own experience of health problems, sickness absence is limited functioning and ability that, in agreement with the physician's certificate, leads to non-attendance at work.

Medically-confirmed sickness absence episodes >2 weeks were chosen as the outcome measure in this study. Because two-thirds of the respondents had at least one medically-confirmed sickness absence episode of any length (≥4 days) during the three-year follow-up period, this was considered to be too common an outcome for the AUC analysis. In these data, approximately one quarter of all medically confirmed sickness absence episodes lasted >2 weeks. The cut-off point of two weeks has also been used in previous studies (3, 5). Supplementary analyses made with medically confirmed sickness absence episodes of any length showed somewhat weaker associations than those with the cut-off point of two weeks, but the ranking on the SF-36 subscales remained the same.

### Concluding remarks

This study, based on questionnaire surveys with prospective three-year linkages to the employer's sickness absence records showed that sickness absence reflects various domains of health-related functioning. In particular, the ability to perform daily activities, pain, and general health were important predictors of sickness absence >2 weeks. Overall, the subscales measuring physical domains of functioning were more strongly associated with sickness absence than the mental subscales.

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