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Prediction of long-term absence due to sickness in employees: development and validation of a multifactorial risk score in two cohort studies <sup>1</sup>

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## Supplementary File 1.

Predictors entered in the full model are shown in Table A including the 14 items included in the parsimonious model for prediction of sickness absence lasting  $\geq$ 90 days. In Table B, the formulation of these items in the validation cohort is described. Differences in the wording of these items between the two cohorts were as follows. First, in the validation cohort, socioeconomic position was assessed by highest achieved educational level (1=university degree, 7=no vocational degree), opposed to current professional position (1=manager, 7=other) in the development cohort. For validation purposes, we treated highest achieved degree as equal to current professional position. Second, Jenkins sleep scale was not measured in the validation cohort. Instead we used the question "How well do you sleep?" as a proxy for the scale." Furthermore, answers were given on a 4-point scale in the validation cohort, and 6-points scale in the development cohort.

**Table A.** Variables, and items that those variables consist of, that were included in the full prediction model (Development cohort)

Variables	Items	
Sex		
Age		
BMI		
	Height in cm	
	Weight in kg	

Socioeconomic position	Status in employment
Smoking	
	Do you smoke or have you smoked regularly (every day or almost every day)?
	Do you still smoke regularly?
Alcohol consumption	
	Have you ever had at least a glass of an alcoholic beverage?
	How many times a week you consume beer?
	wine?
	spirits?
	How many times have you passed out from drinking during the past year?
Inactivity	
	During the past year, how many hours in a week have you walked?
	walked briskly?
	jogged?
	ran?
GHQ	
	In past weeks have you been able to concentrate?
	loss of sleep over worry
	playing a useful part
	capable of making decisions
	felt constantly under strain

	couldn't overcome difficulties
	able to enjoy day-to-day activities
	able to face problems
	feeling unhappy and depressed
	losing confidence
	thinking of self as worthless
	feeling reasonably happy
Chronic illness	
	Bronchial asthma
	Myocardial infarction
	Angina pectoris
	Cerebrovascular diseases
	Migraine
	Depression
	Diabetes
Self-rated health	
Jenkins sleep scale	
	How many times in the past 4 weeks have you hadtrouble falling a sleep
	frequent awakenings during the night
	trouble remaining asleep
	feelings of fatigue and sleepiness despite receiving a typical night's rest
No. of sickness absences in previous year	
Job strain	Job control
	My work requires creativity

My work requires me to learn new things My work involves a lot of repetitive tasks I have a say in the tasks included in my work My work requires highly developed skills I have very little freedom to decide how I do my work

#### Job demand

My work requires a lot of effort I am expected to do unreasonable amount of work I have sufficient time to get my work done

#### Relational justice

	Your supervisor considers your viewpoint
	Your supervisor is able to suppress personal biases
	Your supervisor provides you with timely feedback about the decision and its implications
	Your supervisor treats you with kindness and consideration
	Your supervisor shows concern for your rights as an employee
	Your supervisor takes steps to deal with you in a truthful manner
Procedural justice	
	Procedures designed to collect accurate information necessary for making decisions.
	provide opportunities to appeal or challenge the decision
	have all sides affected by the decision represented.
	generate standards so that decision could be made with consistency.
	hear the concerns of all those affected by the decision.
	provide useful feedback regarding the decision and its implementation
	allow for requests for clarification or additional information about the decision.

### Participatory safety

	People keep each other informed about work-related issues in the team
	There are real attempts to share information throughout the team
	We have a "we are in it together" attitude
	People feel understood and accepted by each other
Support for innovation	
	People in this team are always searching for fresh, new ways of looking at problems
	In this team we take the time needed to develop new ideas
	People in the team co-operate in order to help develop and apply new ideas
Vision	
	To what extent do you think your team's objectives are clearly understood by other members of the team?
	How far are you in agreement with these objectives?
	To what extent do you think your team's objectives can actually be achieved?
	How worthwhile do you think these objectives are?
Task orientation	
	Are team members prepared to question the basis of what the team is doing?
	Does the team critically appraise potential weaknesses in what it is doing in order to achieve the best possible outcome?
	Do members of the team build on each other's ideas in order to achieve the best possible outcome?
Social capital at work	
place	Do members of the team build on each other's ideas in order to achieve the best possible outcome?
	People keep each other informed about work-related issues in the team
	We have a "we are in it together" attitude
	People feel understood and accepted by each other
	People in the team co-operate in order to help develop and apply new ideas

	Do mem	Do members of the team build on each other's ideas in order to achieve the best possible outcome?											
	Your sup	Your supervisor treats you with kindness and consideration											
	Your sup employed	Cour supervisor shows concern for your rights as an employee											
	Your sup manner	Cour supervisor takes steps to deal with you in a truthful nanner											
Effort-Reward imbalance													
	Effort												
		How much of your skills and resources you invest in your work?											
	Reward												
		Do you feel that you get value for money for your work?											
		Do you feel that you get recognition and respect for your work?											
		Do you feel that you get personal satisfaction of your work?											
Shift work													
Working night shift													

Sex	
Age	
BMI	Height in cm
	Weight in kg
Socioeconomic position	Highest achieved degree
No. of sickness absences in during year	
Self-rated health	
No. of chronic diseases	
	Bronchial asthma
	Myocardial infarction
	Angina pectoris
	Cerebrovascular diseases
	Migraine
	Depression
	Diabetes
BMI	
Smoking	Do you smoke?
Sleep	How well you usually sleep?
Shift work	
Working night shift	

# Supplementary File 2.

### Table C. Descriptive statistics of the cohorts

		FPS(2000) n=47,525		FPS(2004) n=18,250			FPS(2000+2004) n=65,775			Hessup (1998) n=13,527			
Variable		Mean (SD)	No.	%	Mean (SD)	No.	%	Mean (SD)	No.	%	Mean (SD)	No.	%
Female				81			78			80			57
Age		44.57 (9.42)			41.41 (10.1)			43.7 (9.71)			2.77 (1.66)		
	<35		8024	17		5117	28		13141	20		5496	41
	35-39		6161	13		2856	16		9017	14		0	0
	40-44		7948	17		2995	16		10943	17		4072	30
	45-49		8517	18		2758	15		11275	17		0	0
	50-54		9227	19		2327	13		11554	18		3959	29
	55+		7648	16		2197	12		9845	15		0	0
Socioeconomic													
position		3.77 (1.7)			3.7 (1.67)			3.75 (1.69)			3.72 (1.84)		
	1		1288	3		324	2		1621	2		2212	16
	2		12440	26		5060	28		17558	27		327	2
	3		12388	26		5391	30		17860	27		4480	33
	4		3453	7		1152	6		4628	7		3157	23
	5		10349	22		3499	19		13928	21		292	2
	6		2125	4		925	5		3074	5		1233	9
	7		5164	11		1889	10		7106	11		1767	13
Sickness absence du	ring follow-												
up (>9 days)	-		32275	68		10972	60		43247	66		7499	55

Sickness absence during up (≥90 days)	follow-		9293	20		2565	14		11858	18		2045	15
Follow-up (years) for sic absence (>9 days)	ckness	5.11 (3.96)			4.18 (2.8)			4.85 (3.7)			6.39 (3.7)	-	-
Follow-up (years) for sic absence ( $\geq$ 90 days)	ckness	8.67 (3.25)			6.48 (1.81)			8.06 (3.08)			9.02 (2.22)	-	-
No. of sickness absence a during the previous year	spells	0.2 (0.48)			0.19 (0.48)			0.2 (0.48)			0.12 (0.38)	-	-
	0		39659	83		15349	84		55008	84		-	-
	1		6477	14		2360	13		8837	13		-	-
	2		1188	2		456	2		1644	2		-	-
	3		201	0		85	0		286	0		-	-
Self-rated health		1.93 (0.89)			1.83 (0.86)			1.9 (0.88)			1.76 (0.8)	-	-
Number of chronic illnes	sses	0.42 (0.66)			0.43 (0.66)			0.49 (0.74)			0.37 (0.61)	-	-
	0		14080	30		10954	60		23576	36		-	-
	1		12413	26		4734	26		19731	30		-	-
	2		7428	16		988	5		11552	18		-	-
	3		6922	15		188	1		10916	17		-	-
BMI		25.02 (4.04)			25.11 (4.2)			25.04 (4.09)			2.5 (0.69)		
<	<18.5		571	1		251	1		845	1		206	2
18.	.5-24.99		25989	55		9690	53		36523	56		7603	56
25	5-29.99		14613	31		5628	31		20777	32		4351	32
	30+		5249	11		2169	12		7630	12		1306	10
Smoking			8036	18		3485	19		12060	18		3343	25
Alcohol consumption		4.9 (5.72)			4.92 (5.77)			4.9 (5.74)				-	-
Inactivity			9236	20		3454	19		12997	20		-	-

Waking up during the night	2.85 (1.61)			2.77 (1.59)			2.83 (1.61)		2.45 (1.20)	-	-
GHQ	2.02 (0.45)			1.99 (0.44)			2.01 (0.45)			-	-
Relational justice	3.63 (0.95)			3.72 (0.95)			3.65 (0.95)			-	-
Procedural justice	3.02 (0.86)			3.06 (0.85)			3.03 (0.86)			-	-
Participatory safety	3.59 (0.88)			3.59 (0.88)			3.59 (0.88)			-	-
Support for innovation	3.14 (0.93)			3.13 (0.92)			3.14 (0.93)			-	-
Vision	3.83 (0.66)			3.82 (0.66)			3.83 (0.66)			-	-
Task orientation	3.33 (0.75)			3.34 (0.75)			3.33 (0.75)			-	-
Social capital at work place	3.58 (0.76)			3.61 (0.76)			3.59 (0.76)			-	-
Job strain		7623	16		2746	15		10501	16	-	-
Effort-Reward imbalance		35132	90		15999	89		59283	90	-	-
Shift work without night shifts		15528	34		6393	36		22644	34	2812	21
Night shift		8393	18		3629	21		12452	19	1442	11



**Figure A.** Bivariate association between predictor items and sickness absences lasting >9 days. Items are grouped as described in the method section. Most strongly associated items from each group are labeled, as well as other items that stand out.



**Figure B.** Bivariate association between predictor items and sickness absences lasting  $\geq$ 90 days. Items are grouped as described in the method section. Most strongly associated items from each group are labeled, as well as other items that stand out.

## Supplementary File 3.

_	Main mode regress	el (Cox ion)	Traditional model (Parametric survival mode distribution)	el with Weibu	11
Predictors	b	S.E.	Predictors	b	S.E.
	-	-	(Intercept)	6.5921	0.0816
Self-rated health	0.0959	0.0427	-	-	-
Depression	0.1368	0.0304	-	-	-
Sex	0.0015	0.0235	Sex	-0.1228	0.0223
Age	0.0005	0.0098	-	-	-
SES	0.1236	0.0055	SES	-0.3154	0.0280
Previous sickness absences	0.4429	0.0145	Previous sickness absences	-0.4073	0.0131
Nr. of chronic diseases	0.1414	0.0142	Nr. of chronic diseases	-0.2237	0.0136
Smoking	0.1034	0.0226	Smoking	-0.2010	0.0200
Shift work	0.0845	0.0248	Shift work	-0.1454	0.0177
Working night shift	0.0152	0.0312	-	-	-
Self-rated health <sup>2</sup>	0.0435	0.0085	Self-rated health <sup>2</sup>	-0.0551	0.0021
BMI^2	0.0002	0.0000	BMI^2	-0.0003	0.0000
Age^2	0.0004	0.0001	Age^2	-0.0005	0.0000
Jenkins sleep scale <sup>2</sup>	0.0038	0.0008	Jenkins sleep scale^2	-0.0061	0.0008
-	-	-	SES^2	0.0216	0.0031
-	-	-	Migraine	0.1168	0.0255
-	-	-	Log (scale)	-0.0989	0.0084

**Table D**. Comparison between main model, restricted model, and traditional model for sickness absence lasting ≥90 days

C-index for main model: 0.735 (95% CI: 0.731-0.740); C-index for traditional model: 0.737 (95% CI: 0.732-0.741)

# Supplementary File 4.

		Developm	Validation cohort						
Absolute risk cut- point %	True Positive Rate	False Positive Rate	Sensitivity	Specificity	Absolute risk cut-point %	True Positive Rate	False Positive Rate	Sensitivity	Specificity
10	0.94	0.77	0.94	0.23	10	0.86	0.61	0.86	0.39
20	0.66	0.34	0.66	0.66	20	0.50	0.19	0.50	0.81
30	0.43	0.16	0.43	0.84	30	0.27	0.06	0.27	0.94
40	0.28	0.08	0.28	0.92	40	0.14	0.02	0.14	0.98
50	0.18	0.04	0.18	0.96	50	0.07	0.01	0.07	0.99
60	0.12	0.02	0.12	0.98	60	0.05	0.00	0.05	1.00
70	0.07	0.01	0.07	0.99	70	0.02	0.00	0.02	1.00
80	0.04	0.00	0.04	1.00	80	0.01	0.00	0.01	1.00
90	0.02	0.00	0.02	1.00	90	0.00	0.00	0.00	1.00

Table E. Sensitivity and specificity of the model in both cohorts

## Supplementary File 5.



**Figure C.** Nomogram for the final risk prediction model for sickness absences lasting  $\geq$ 90 days.