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Seasonal changes in mood and behavior in relation to work conditions among the general population

by Pia Pajunen, MD,¹ Jouko Lönnqvist, MD,^{1,2,3} Timo Partonen, MD¹

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Objectives This study explored seasonal changes in mood and behavior in relation to work conditions.

Methods For the 4850 participants, who were 30–64 years of age, had a current profession, and participated in a nationwide population-based study in Finland, data on both the work conditions and seasonal changes in mood and behavior were valid and available for 3623 persons. The participants were divided into groups of indoor and outdoor workers and those working office hours and those not working office hours.

Results There was no difference in the seasonal changes in mood and behavior between the indoor and outdoor workers, except with respect to social activity among the women. The women working indoors reported more extensive seasonal changes in social activity than those working outdoors ($P=0.008$). There was no difference between the daytime workers and those working nonstandard hours, except that the men working evening and night shifts had more extensive seasonal changes in general ($P=0.0001$).

Conclusions Working indoors has a limited effect on seasonal changes in mood and behavior, whereas working evening and night shifts is associated with extensive seasonal changes among men in particular.

Key terms indoor work; office hours; outdoor work; seasonal pattern; shift work.

The endogenous circadian clock or pacemaker system of the human body controls cycles of sleep and wakefulness, as well as the rhythms of many other physiological functions (1, 2). The natural environmental light–dark cycle affects the endogenous circadian clock most likely through exposure to light, especially in the morning. When people truncate their sleep by waking early, their circadian clocks phase advance, and, when people wake late, their circadian clocks phase delay (3). Currently, most people work indoors and are not exposed to the natural light–dark cycle (ie, sunlight during the day and darkness at night). A person working indoors in a brightly lit room is exposed to 500–600 lux of light only, whereas a person working outdoors may be exposed to 100 000 lux or more of light on a bright day.

In the modern “24/7 society”, the need for ceaseless round-the-clock services has led to a situation in which most of the working population has workhours other than standard office hours (daytime). Indeed, recent data from 15 European Union countries reveal that only 24% of workers have daytime work defined

as workhours between 0730 and 1800 during weekdays (4). Different forms of shift work are very common, and 7% of employees work permanent night shifts only. Shift work is known to affect the circadian clock and disrupt endogenous rhythms. This circumstance can lead to subsequent problems with sleeping, chronic fatigue, and reduced work performance (5–7).

To our knowledge (PubMed search: 30 March 2007), seasonal changes in mood and behavior in relation to workhours and indoor versus outdoor work have not been studied earlier. Circadian clocks not only generate the circadian rhythms of the body, but also influence the sleep–wake and seasonal cycles and regulate the metabolic and cell division cycles. Regular light–dark transitions in the habitat are needed for the daily reset of the principal circadian pacemaker. Because shift work compromises circadian clockwork, it is likely that there are also abnormalities in the seasonal cycles or changes in mood and behavior among shift workers. We hypothesized that the self-report of seasonal changes in mood and behavior would be less extensive among employees

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engaged in regular office work (daytime) than among those working “nonstandard” hours, including different schedules of shift work, and that outdoor work during which employees are exposed to sunlight in the morning hours in particular would be protective against these seasonal changes.

Study population and methods

Study population

The Health 2000 Study is a multidisciplinary nationally representative epidemiologic health survey that was conducted between August 2000 and March 2001 in Finland. Data were collected with the aid of several health questionnaires and home and telephone interviews followed by clinical health examinations. Details of the study design have been published earlier (8) and are also available on the Internet (<http://www.ktl.fi/terveys2000/index.uk.html>).

As the participants were interviewed at home, they received a questionnaire including questions related to seasonal changes in mood and behavior, occupation, and work conditions. Of the study participants aged 30 to 64 years, 4850 were currently employed, and, of these persons, 3999 gave information on work conditions. Out of the 3999 persons, seasonal changes in mood and behavior were reported by 3623. These persons comprised the study sample.

Assessment of seasonal patterns

A modified version of the Seasonal Pattern Assessment Questionnaire (SPAQ) was applied in the assessment of the seasonal changes in mood and behavior (9). SPAQ includes six dimensions [sleep length, social activity, mood (overall feeling of well-being), weight, appetite, and energy level]. The sum of these items yields the global seasonality score (GSS).

Two modifications were made to the scoring. One modification to the original score was that each item was scored from 0 to 3 (no, slight, moderate or marked change), not from 0 to 4 (no, slight, moderate, marked or extremely marked change). In addition, the SPAQ has the following question: “If you experience changes with the seasons, do you feel that they are a problem for you?” The other modification was that this item was scored from 0 to 4 (no, mild, moderate, marked or severe problem), not from 0 to 5 (no, mild, moderate, marked, severe or disabling problem).

Measures of work

The health questionnaire was comprised of questions on profession and work schedules (ie, office hours)

in shifts and the like. The professions were coded according to the manual published by Statistics Finland (10). These data were collected from those who were currently working or who had worked during the past 12 months.

The question related to workhours was classified into the following eight categories: (i) regular daytime work defined as workhours between 0600 and 1800 (N=2548), (ii) regular evening work (N=29), (iii) regular nighttime work (N=27), (iv) two-shift work (N=275), (v) three-shift work (N=220), (vi) periodical work (N=60), (vii) work only on weekends (N=1), and (viii) other workhours (N=463). For the analysis, we recoded these groups into the following two categories: (i) regular daytime work and (ii) other work.

Since there are no established guidelines concerning the categorization of professions as work “indoors” or “outdoors”, two of us (PP and TP) did this classification by estimating how the representatives of different professions are exposed to the natural light–dark cycle during their workday. Of the 359 different professions, 280 were categorized as taking place indoors, and 79 were outdoor professions. As the leading idea in classifying the professions as work indoors or outdoors was to have exposure to sunlight as a dividing factor, we classified, for example, drivers and airplane pilots as outdoor workers because, even if they are placed inside their vehicles, they are exposed to sunlight through a window while working.

Statistical analyses

The difference in SPAQ scores between the groups working indoors and outdoors, as well as between the group working office hours and the remaining persons, was analyzed with the Mann-Whitney rank-sum test, and the t-test was used for the analysis of between-group differences in the GSS. Separate analyses were performed for the men and women. We also carried out two subgroup analyses in which the group with office-hour work was compared with the combined evening- and night-work group. We also performed two subgroup analyses in which the office-hour group was compared with the combined evening- and night-work group and the office-hour group was compared with three-shift group.

For the logistic regression models, the six items of the SPAQ were each recoded into the following two categories: (i) “no change” and (ii) “seasonal changes” ranging originally from slight to marked. The responses to the question estimating whether these seasonal changes were a problem were recoded into the following two categories: (i) “no problem” and (ii) “problems” ranging originally from mild to severe. In the logistic regression models, we used each categorized item of the SPAQ as the dependent variable; work conditions or work

indoors versus outdoors formed the independent variable; and gender, age, and the estimated mean number of weekly workhours were used as covariates. Linear regression models were used when the associations between the GSS and work conditions or work indoors versus outdoors were analyzed. The statistical analyses were performed using SPSS 13.0 software (SPSS Inc, Chicago IL, USA).

Results

The characteristics of the study groups are presented in tables 1 and 2 according to work type and workhours, respectively. There was no difference in the GSS between the indoor and outdoor workers among the men or women (table 3). However, the women working indoors reported more extensive seasonal changes in social activity than those working outdoors ($P=0.008$). The women working indoors scored higher on all of the SPAQ dimensions and experienced these changes as more problematic than the men did ($P=0.0001$ for each).

Among the daytime workers, the women reported more extensive seasonal changes at large than the men (table 4). Among the evening and nighttime workers, however, the men had a higher GSS ($P=0.045$) and scored higher on the mood dimension ($P=0.022$). Between the daytime and evening plus nighttime workers, there were significant differences with respect to all of the seasonal changes, except for those that occurred for weight and energy level, and in the extent to which these changes were a problem among the men but not the women (table 4).

In two separate linear regression models, using the GSS as the dependent variable and indoor–outdoor work (belonging either to the indoor or outdoor group) or office-hour work versus the remaining types of work, in addition to age, gender, and the mean weekly workhours as independent variables, the item “work conditions” was not associated with the GSS.

In six separate logistic regression models, using one categorized dimension of the SPAQ at a time (sleep length, social activity, mood, weight, appetite or energy level) as the dependent variable and indoor–outdoor work in addition to age, gender, and mean weekly workhours as independent variables, indoor–outdoor work

Table 1. Characteristics of the study population according to work type.

Characteristic	Indoor work								Outdoor work								Indoor versus outdoor work	
	Men (N=1135)		Women (N=1701)		P-value ^a	All (N=2836)		Men (N=575)		Women (N=212)		P-value ^a	All (N=787)		P-value ^b	P-value ^c		
	Mean	SD	Mean	SD		Mean	SD	Mean	SD	Mean	SD		Mean	SD				
Age ^d	44.43	8.71	44.35	8.42	0.804	44.38	8.54	44.42	8.75	45.96	9.10	0.031	44.83	8.87	0.979	0.010		
Weekly working hours ^{d, e}	41.04	8.06	36.70	7.52	0.0001	38.43	8.03	41.48	9.31	39.52	10.99	0.017	41.00	9.82	0.319	0.0001		

^a Men versus women.

^b Men versus men.

^c Women versus women.

^d t-Test.

^e Data available for 2771 persons in the indoor group and for 735 persons in the outdoor group.

Table 2. Characteristics of the study population according to workhours. (WW = weekly workhours, Other = daytime versus other workhours, Evening = daytime versus evening and night work)

Characteristic	Daytime work			Other workhours			Evening and nighttime work			Other		Evening	
	Men (N=1214)		All (N=2548)	Men (N=496)		All (N=1075)	Men (N=21)		All (N=56)	P-value ^a	P-value ^b	P-value ^a	P-value ^b
	Mean	SD		Mean	SD		Mean	SD					
Age ^c	44.31	8.61	44.41	44.73	8.99	44.66	42.14	43.97	43.29	0.365	0.800	0.253	0.719
WW ^{c,d}	40.74	7.04	38.85	42.38	11.45	39.26	41.00	30.23	34.27	0.0001	0.253	0.868	0.0001

^a Men versus men.

^b Women versus women.

^c t-Test.

^d Data available for 2522 persons in the daytime work group and for 984 persons in the other workhours group.

Table 3. Results of the GSS and SPAQ dimensions between the indoor and outdoor workers. (GSS = global seasonality score, SPAQ = Seasonal Pattern Assessment Questionnaire)

Characteristic	Indoor work								Outdoor work								Indoor versus outdoor work	
	Men (N=1135)		Women (N=1701)		P-value ^a	All (N=2836)			Men (N=575)		Women (N=212)		P-value ^a	All (N=787)			P-value ^b	P-value ^c
	Mean	SD	Mean	SD		Mean	SD		Mean	SD	Mean	SD		Mean	SD			
GSS ^d	4.61	2.77	5.70	3.05	0.0001	5.27	2.99		4.60	2.84	5.39	2.99	0.001	4.82	2.90		0.951	0.159
SPAQ dimensions ^a																		
Sleep length	0.91	0.69	1.02	0.68	0.0001	0.97	0.68		0.90	0.69	1.01	0.69	0.048	0.93	0.69		0.831	0.963
Social activity	0.91	0.71	1.12	0.73	0.0001	1.04	0.73		0.86	0.69	0.98	0.75	0.038	0.89	0.71		0.197	0.008
Mood	0.97	0.73	1.13	0.76	0.0001	1.07	0.75		0.97	0.71	1.06	0.67	0.105	0.99	0.70		0.804	0.156
Weight	0.48	0.61	0.68	0.67	0.0001	0.60	0.65		0.49	0.62	0.66	0.63	0.001	0.53	0.63		0.640	0.665
Appetite	0.40	0.58	0.61	0.67	0.0001	0.52	0.64		0.43	0.60	0.64	0.69	0.0001	0.49	0.64		0.192	0.532
Energy level	0.94	0.69	1.15	0.74	0.0001	1.07	0.73		0.94	0.73	1.05	0.75	0.083	0.97	0.74		0.984	0.065
Problem ^f	1.01	0.57	1.12	0.61	0.0001	1.08	0.59		1.01	0.63	1.05	0.61	0.404	1.02	0.63		0.928	0.095

^a Men versus women.^b Men versus men.^c Women versus women.^d t-Test.^e Mann-Whitney rank-sum test.^f Data available for 2830 persons in the indoor group and for 786 persons in the outdoor group.**Table 4.** Results of the GSS and SPAQ dimensions between the daytime work and other workhours groups and between the daytime and evening and nighttime groups. (Other = daytime versus other workhours, Evening = daytime versus evening and night work, GSS = global seasonality score, SPAQ = Seasonal Pattern Assessment Questionnaire)

Characteristic	Daytime work						Other work hours						Evening and nighttime work						Other		Evening	
	Men (N=1214)		Women (N=1334)		All (N=2548)		Men (N=496)		Women (N=579)		All (N=1075)		Men (N=21)		Women (N=35)		All (N=56)		P-value ^a	P-value ^b	P-value ^a	P-value ^b
	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD				
GSS ^c	4.57	2.75	5.72	3.02	5.17	2.95	4.70	2.89	5.57	3.11	5.16	3.04	6.81	2.87	5.06	3.23	5.71	3.19	0.405	0.308	0.0001	0.200
SPAQ dimensions ^d																						
Sleep length	0.90	0.68	1.01	0.68	0.96	0.69	0.94	0.71	1.02	0.67	0.99	0.69	1.24	0.44	0.97	0.71	1.07	0.63	0.191	0.791	0.022	0.720
Social activity	0.90	0.71	1.13	0.74	1.02	0.73	0.87	0.69	1.06	0.73	0.97	0.72	1.24	0.70	0.91	0.78	1.04	0.76	0.357	0.083	0.033	0.092
Mood	0.97	0.73	1.14	0.76	1.06	0.75	0.97	0.72	1.09	0.73	1.03	0.73	1.48	0.81	0.97	0.75	1.16	0.80	0.838	0.192	0.002	0.192
Weight	0.46	0.60	0.67	0.66	0.57	0.64	0.53	0.65	0.68	0.68	0.61	0.67	0.71	0.85	0.63	0.65	0.66	0.72	0.040	0.848	0.056	0.697
Appetite	0.40	0.57	0.61	0.67	0.51	0.63	0.44	0.63	0.61	0.70	0.53	0.67	0.90	0.94	0.54	0.66	0.68	0.79	0.195	0.978	0.0001	0.532
Energy level	0.94	0.70	1.15	0.74	1.05	0.73	0.95	0.73	1.09	0.76	1.03	0.75	1.24	0.63	1.03	0.75	1.11	0.71	0.772	0.113	0.052	0.322
Problem ^e	1.01	0.60	1.12	0.60	1.07	0.60	1.01	0.57	1.09	0.62	1.05	0.60	1.43	0.98	1.14	0.60	1.25	0.77	0.965	0.305	0.002	0.843

^a Men versus men.^b Women versus women.^c t-Test.^d Mann-Whitney rank-sum test.^e Data available for 2542 persons in the daytime group, for 1074 persons in the other workhour group, and for all persons in the evening and nighttime group.

did not predict any of the seasonal changes. In a logistic regression model using the categorized item of problem intensity as the dependent variable and age, gender, and mean weekly workhours as independent variables, indoor-outdoor work did not predict problem intensity.

In seven separate logistic regression models using one categorized dimension of the SPAQ at a time (sleep length, social activity, mood, weight, appetite, or energy

level) or the item “problem intensity” as the dependent variable and office-hour work versus the remaining types of work in addition to age, gender, and mean weekly workhours as independent variables, office-hour work versus the remaining types of work did not predict any of the SPAQ items. Female gender, as expected on the basis of earlier reports, but neither age nor mean weekly workhours was a significant predictor of the dependent

variable in all of the 16 aforementioned regression models.

Discussion

Our main finding was the lack of a difference in the seasonal changes in mood and behavior between indoor and outdoor workers, with the exception that the women working indoors had a more extensive seasonal change in social activity than the women working outdoors.

We expected that there would be less extensive seasonal changes among the outdoor employees due to stronger exposures to the light-dark transitions, but we found no support for this hypothesis. However, the women working indoors scored higher on all the dimensions and experienced the seasonal changes as more problematic than did the men working indoors. Interestingly, the findings were dissimilar among the outdoor workers. The women working outdoors had a higher global seasonality score, scored higher on the appetite, weight, social activity, and sleep length dimensions, but did not experience these changes as being more problematic than the men working outdoors.

There was no difference in seasonal changes between the daytime workers and the employees engaged in other than standard workhours. Nor did we find a difference between daytime work and three-shift work for any of the items measuring seasonal variation. Because the number per group differed, we decided to compare all other workhours against daytime work, and this procedure may have diminished the sensitivity of our results. Furthermore, the original question on the type of workhours was formulated so that daytime, evening, and nighttime work were considered to be "regular", whereas two-shift and three-shift work had no such definition. The group "other unspecified workhours" was large and may have included persons with irregular nighttime work.

When daytime work was compared with evening and night work combined, there were significant differences in the global score, sleep length, social activity, mood, appetite, energy level, and problem intensity among the men. This finding is not surprising since night work radically affects the endogenous generation of circadian rhythms. But it is surprising that the seasonal changes were more severe among the men, as, in previous studies of the general population, it has been the women who scored higher (11, 12). However, our results are in line with those of an earlier study in which men felt more sleepiness than women during consecutive night shifts, although no physiological differences were observed (13). It needs to be taken into account that the number of workers per group was not equal in our analysis, as

daytime work included 1214 persons, whereas there were only 56 persons in the combined evening- and night-work group.

One strength of our study was the relatively big total sample size of the general population representing Finns aged 30 years and over. To our knowledge, this is the first nationally representative population study investigating the relationship between seasonality and work conditions. A limitation was the fact that the data on seasonal changes were assessed with a self-report instrument requesting a retrospective evaluation.

In conclusion, in this study investigating seasonal changes in mood and behavior in relation to work conditions, the women reported more seasonal changes in mood and behavior than the men. This result agrees with findings from previous epidemiologic surveys in a range of samples and populations and thereby supports the validity of our report. Working indoors had a limited effect on seasonal changes in mood and behavior. In contrast, working evenings and nights was associated with extensive seasonal changes among the men in particular.

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