

Nature contact and organizational support during office working hours: Benefits relating to stress reduction, subjective health complaints, and sick leave

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Abstract.

BACKGROUND: Improving social support, and providing nature contact at work are potential health promoting workplace interventions.

OBJECTIVE: The objective was to investigate whether nature contact at work is associated with employee's health and participation, and to study whether the possible associations between nature contact and health can be explained by perceived organizational support.

METHOD: Data were collected through a web-based, cross-sectional survey of employees in seven public and private office workplaces in Norway ($n = 707$, 40% response rate). Multiple linear and logistic regression analysis were performed on 565 participants fulfilling inclusion criteria.

RESULTS: A greater amount of indoor nature contact at work was significantly associated with less job stress ($B = -0.18$, $CI = -0.318$ to -0.042), fewer subjective health complaints ($B = -0.278$, $CI = -0.445$ to -0.112) and less sickness absence ($B = -0.061$, $CI = -0.009$ to -0.002). Perceived organizational support mediated the associations between indoor nature contact and job stress and sickness absence, and partly mediated the association with subjective health complaints. Outdoor nature contact showed no reliable association with the outcomes in this study.

CONCLUSIONS: Extending nature contact in the physical work environment in offices, can add to the variety of possible health-promoting workplace interventions, primarily since it influences the social climate on the workplace.

Keywords: Workplace interventions, worksite health promotion, occupational health research, indoor plants, window view

1. Introduction

Paid employment accounts for a substantial part of the daily lives of the adult population. Employment promotes employee health, but it can also have negative effects, for example perception of stress [1], that

again is found to correlate with subjective health complaints [2]. Subjective health complaints, without objective signs or symptoms, are the most common diagnoses in connection with sick leave in Norway today, and they account for more than half of the days lost to sickness absence [3–5].

Stress, a non-specific response of the body to any demand placed upon it [6], arises when there is an imbalance between demands in life, such as those related to work, and the coping resources available to

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an individual [7]. The Demand-Control-Support Model [8, 9] attributes psychological job strain to the combination of high work demands, low decision control over the execution of tasks and low social support from supervisors and co-workers [8, 9]. Research on the model [9] indicates that high job strain may release a stress response and over time challenge for example the employee's physical health.

To counteract possible work-related impact of stress, many employers today strongly emphasize workplace health promotion. Health-promoting principles, such as improving the social climate, have recently become increasingly prevalent in more and more workplaces [10]. Another strategy involves environmental modification, i.e. physically changing the workplace environment [11], such as adding nature elements like indoor plants, or providing windows with natural daylight [11, 12].

The Human Environment Interaction Model [13] describes the interaction between people and the environment. According to the model, stress can be defined as a generalized response to different environmental factors. Such factors include the physical environment, for example at the workplace, the social environment, and the activities that individuals engage in. Both work tasks and the physical and social environment at work will therefore contribute to physiological activation, or the stress level. According to Küller [13], employees with high levels of stress might suffer from elevated levels of activation that, in the long run, can lead to adverse psychological, social and even medical consequences.

The Stress Recovery Theory [14–16] states that a nature environment has a particular aesthetic appeal, and, as such, gives rise to positive affect in people. According to the theory, positive emotions can block negative affect, and hence have a restorative effect in stressful situations. Adding nature elements to office workplaces can thus have a positive impact on the stress level, health and well-being of the employees [17]. Enhancing the social climate is another possible way of promoting the work environment according to the Human Environment Interaction Model [13] and the Demand-Control-Support Model [8, 9]. Social support at work refers to overall levels of helpful social interaction at work with both co-workers and supervisors [9]. Social relations at work can affect employees' well-being through various buffering mechanisms between psychological stressors at work and adverse health outcomes related to stress [9]. Perceived organizational support refers to the extent to which employees

perceive that their organization cares about their well-being and appreciates their contribution [18]. Research shows that employees' commitment to the workplace is strongly influenced by their perception of the workplace's commitment to them [e.g. 18, 19]. Higher perceived organizational support leads to more satisfied employees and less absenteeism [10, 18, 19].

Previous studies indicate that different types of nature contact at work are related to less stress and fewer health complaints. Findings from a cross-sectional study among office workers in Northern Florida by Largo-Wight and colleagues [11] indicate that, as nature contact during working hours increases, perceived stress and general health complaints decreases. Outdoor nature contact, for example taking breaks from work outdoors, was significantly associated with a reduction in both stress and general health complaints. Indoor nature contact, for example access to a window with an outdoor view, was only significantly associated with a reduction in general health complaints. Findings from a study by Kaplan [20] indicate that employees with an office window providing views of nature elements, for example trees, flowers, and water, felt less frustrated and reported better overall health compared to employees with window view of built elements, such as buildings and roads, even with no obstruction of natural light. In a cross-sectional questionnaire survey conducted in workplaces in Norway [21], individuals in windowless offices were found to compensate for the lack of a view of nature from their workplace by decorating their offices with indoor plants and pictures of natural landscapes. In the same study, no significant association was found between the presence of plants in the office and perceived stress among the employees, although the participants reported only moderate levels of stress [22].

Field studies have reported a reduction in health complaints among office workers after the introduction of foliage plants, or of both foliage plants and lighting that simulates daylight, in their indoor working environments [23, 24]. The biggest reduction in symptoms was obtained for fatigue, feeling heavy-headed, dizziness, and concentration problems [23]. Experimental studies in laboratories in which biological responses to different workplace environments were measured (e.g. brain waves, finger skin temperature) have revealed that the combination of a nature view and plants engendered the lowest mean level of stress as measured by the level of alpha activity [25]. A study conducted by Hartig [26] found that persons with higher levels of stress showed

the most positive effect on blood-pressure recording and self-reported emotions, of looking at nature settings dominated by vegetation, rather than a built environment without nature elements.

The association between nature contact at work and sick leave has rarely been studied. In a cross-sectional questionnaire survey [22] it was found that the number of indoor plants proximal to a worker's desk had a small but statistically significant association with sick leave. To our knowledge, the associations between nature contact at work and the social climate and social support in the workplace, have not yet been examined. However, adopting a qualitative, explorative approach to study people-plant relationships in office workplaces, Thomsen and colleagues [27] found that plants influence the social climate and interaction between employees. However, poorly tended plants generally gave rise to negative comments and were lacking in positive impact on perceived well-being [27].

1.1. Aim of the study

Previous studies in the field, make use of different measures for nature contact [28], and they also utilize stress measures that are not specific to work related circumstances [11, 22]. The purpose of this study was therefore to use a comprehensive measure of the experience of nature in workplace settings and a work-specific stress measure to study the following research questions: Is nature contact during working hours related to less job stress, fewer subjective health complaints, and fewer sick leave days among office workers? In addition, the study aimed to explore whether possible associations between nature contact and health outcomes can be explained by the social climate at work expressed as perceived organizational support.

2. Materials and methods

2.1. Design

A cross-sectional questionnaire survey was conducted in seven office workplaces in Southern Norway.

2.2. Companies and participants

Recruiting participants relied on companies being willing to distribute the survey via their employee e-mail lists and to allow their employees to complete the survey during working hours. Seven out of the ten

companies that were contacted agreed to participate in the study. The workplaces varied in size from 31 to 980 employees, and all employees received an invitation to fill in the questionnaire. An e-mail with a link to an anonymous questionnaire was sent to 1769 office employees. Employees in five different workplaces ($N=627$) received the link to the questionnaire in April 2012. Two companies received the questionnaire ($N=1140$) in September 2012. The workplaces were located in different areas of Southern Norway, including urban areas, small semi-urban areas and rural villages. Weather statistics from the Norwegian meteorological institute [29] show that mean temperatures in the period prior to distribution of the survey were similar, and rather low, for all locations for both April and September (mean temperature in April 6°C, September 11°C, both periods predominantly rainy days). In order to ensure the presence of plants, two of the workplaces ($N=1026$) were chosen because they have a professional firm that installs and maintains the plants. The workplaces represent different occupations in both the private and public sector, including engineering, computer science, human resources and management, municipal administration, economics and others.

The questionnaire was filled in by 707 persons, resulting in an overall response rate of 40% (Fig. 1).

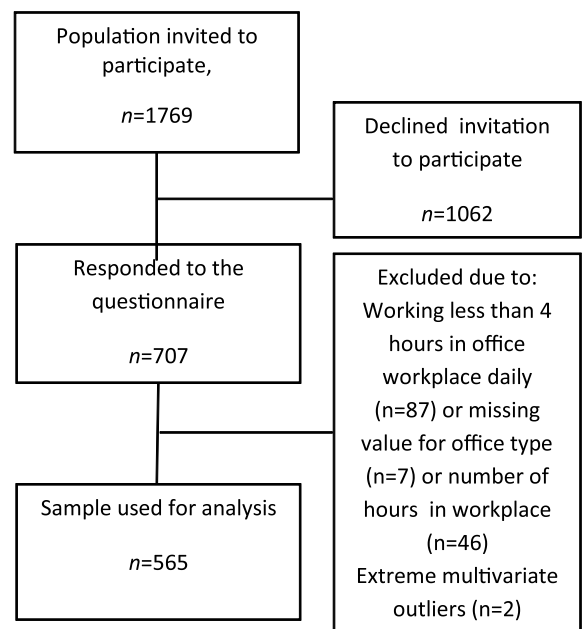


Fig. 1. Flow diagram describing the study design and sample available for analysis of the health outcomes.

Table 1
Presentation of the study sample

	Workplace							Total
	1	2	3	4	5	6	7	
County	Hedmark	Oppland	Oppland	Hedmark	Hedmark	Rogaland	Oslo	
Professional firm maintaining indoor plants	no	yes	no	no	no	no	yes	
Number of employees receiving invitation	260	46	240	50	31	160	980	1769
Number of employees used in final sample	82	28	69	26	16	61	283	565 (31.9%)
Gender								
Number of males	32	23	18	9	8	25	183	298 (52.7%)
Number of females	50	5	51	17	8	36	102	267 (47.3%)
Mean age	47.7	40.1	47.3	50.0	50.1	49.1	49.3	48.5 (17–69)
Years of employment	7.3	4.5	6.2	7.6	6.5	9.6	6.8	7.0 (<0–41)
Office type								
Number of single offices	62	0	51	16	14	59	157	359 (63.5%)
Number of shared offices	20	28	18	10	2	2	126	206 (36.5%)
Daily hours of work	7.7	8.3	7.7	7.6	7.8	7.6	7.8	7.8 (4.0–10.0)
Daily hours in the workplace	6.1	6.5	6.4	6.4	6.5	6.4	5.9	6.1 (4.0–9.0)

Workplaces 1–5 answered the questionnaire in April and workplaces 6 and 7 in September. The column for Totals states the mean years (range) for Age and Years of employment and mean hours (range) for Daily hours of work and Daily hours in the workplace.

2.3. Measures

The demographic variables included in the questionnaire are presented in Table 1.

Nature contact during working hours was measured by the Nature Contact Questionnaire (NCQ) [30], which was translated into Norwegian for the purpose of the study. The NCQ consists of 16 questions, comprising three subscales: *outdoor nature contact* (4 items), defined as contact with natural elements outdoors during working hours, *indoor nature contact* (6 items), defined as contact with natural elements inside a building such as live plants, natural light and windows with a view of the outside, and *indirect indoor nature contact* (6 items). Largo-Wight and colleagues [30] recommend excluding items with more than 95% of responses in the zero response option. The resulting questionnaire consisted of three items for outdoor nature contact and four items for indoor nature contact. Indirect indoor nature contact had a mean sum score close to zero and was therefore excluded completely from further analysis. *Outdoor nature contact* consisted of the sum score of three questions; Last week (Monday–Friday), how many times did you 1. Spend a morning or afternoon break outside? 2. Eat your lunch outside? 3. Go outside for a work-related task such as a delivery or errands? Responses were given on a six-point scale (1 = 0 times, and 6 = 5 or more times). The Cronbach's α of the original scale was 0.47 [30], and 0.39 in this study, indicating low internal consistency [33]. The test-retest reliability of the original scale was satisfactory ($r = 0.75$) [30, 31]. *Indoor nature contact* consisted of the sum score of

the four questions: Last week (Monday–Friday), how many did you have in your primary work space? 1. Live plants or flower arrangements, 2. Windows (including in doors) that lead directly to the outdoors? In your primary work space last week (Monday–Friday), what percentage of the time did you, 3. Have sunlight lighting your space? 4. Have an unobstructed view outside (blinds open and not drawn)? Responses to question 1 and 2, were given on a six-point scale (1 = zero times, and 6 = five or more times). The responses to questions 3 and 4 were given on a six-point scale (1 = 0%, 2 = 1–20%, 6 = 81–100%). A fifth question was added about the extent to which the view from the office window(s) featured natural or built elements; On a scale from 1–6, if you look through the window(s) in your primary work space, do you mainly see built areas such as buildings, roads and walls, or mainly natural elements such as trees, flowers and water (1 = 0% natural elements, 6 = 100% natural elements)? The reliability (Cronbach's α) of the original scale was 0.73 [30], while it was 0.44 for this study, indicating moderate or low internal consistency, respectively [33]. The test-retest reliability of the original scale was satisfactory ($r = 0.9$) [30, 31].

Perceived organizational support was measured by a sub-scale from the QPS-Nordic [32] that consists of questions within the same area as Eisenberg and colleagues' [18] more extensive survey of perceived organizational support. It was chosen to avoid the questionnaire containing too many items. The QPS subscale consists of the mean of the response to the three questions: 1. In your organization, are you rewarded (money,

encouragement) for a job well-done? 2. Are workers well taken care of in your organization? 3. To what extent is the management of your organization interested in the health and well-being of the personnel? Responses were given on a five-point scale (1 = very seldom or never, 5 = very often or always). The internal consistency (Cronbach's α) of the scale was 0.78, whereas the Cronbach's α of the original scale was 0.83 [34], indicating high internal consistency [32]. The test-retest reliability was 0.8 [32], indicating high test-retest reliability [31].

Job stress was measured by the Norwegian version of the Job Stress Survey (JSS-N) [33, 34], developed to assess sources of work-related stress in particular, assessing 30 job-related stressor events. Responses are given on a nine-point scale that assesses the perceived severity of the stressor (1 = little, 5 = moderate, 9 = severe). In addition, respondents indicate on a ten-point scale how often each stressor event has occurred during the last six months (0 days = 0, 9 + days = 9). The Job Stress Index assesses the overall level of stress based on the combined severity and frequency rating of all 30 stressor events. The scale has high internal consistency (Cronbach's $\alpha = 0.95$) [31]. Perceived organizational support consists of elements of social support relating to support from supervisors. Consequently, both perceived organizational support as a predictor variable and the job stress index as an outcome variable contained elements of social support relating to supervisors. To be able to rule out expected associations, the five items in the job stress index related to both the severity and frequency of lack of social support from supervisors were excluded from the job stress measure before performing the statistical analysis. Items related to lack of social support from co-workers were included.

Subjective health complaints were measured by the Subjective Health Complaint inventory (SHC) [35], consisting of 29 items about subjective somatic and psychological complaints experienced during the last 30 days. The severity of each complaint was rated on a four-point scale (0 = none, 3 = severe). A total sum score of all 29 items was calculated, as well as subscales for *musculoskeletal pain*, *allergy*, *gastrointestinal problems*, and *pseudo neurology* (e.g. sleep problems, anxiety). The internal consistency (Cronbach's α) for these items was as follows: total $\alpha = 0.87$, musculoskeletal pain $\alpha = 0.8$, allergy $\alpha = 0.56$, gastrointestinal problems $\alpha = 0.71$, and pseudo neurology $\alpha = 0.77$, indicating moderate to high internal consistency [31]. The test-retest reliability of the subscales was high for

gastrointestinal problems ($r = 0.68$), pseudo neurology ($r = 0.78$), and allergy ($r = 0.85$), and medium high for musculoskeletal pain ($r = 0.55$) [36]. The data on all the subscales were skewed, with mean scores close to zero. As a result, the answers on the subscales were dichotomized as not having complaints (coded 0), and having complaints (coded 1).

Sick leave was measured by two questions: 1. In the last year, have you been absent from work due to sickness certified by a doctor? (0 = no, 1 = yes), and 2. How many days during the last year have you been absent from work because you yourself were ill? There were ten response categories (0, 1, ... 9 and more days).

2.4. Data collection

The participants received an information letter by e-mail explaining the purpose of the survey. Participants were also informed that their responses to the survey would be fully anonymous. The questionnaire was executed using the electronic survey program Questback (questback.com), and the participants consented to participate by responding to the questionnaire. One reminder was sent after three weeks.

2.5. Statistical analyses

Data were analyzed using Statistical Package for the Social Sciences (SPSS version 21).

Since the aim of the study was to investigate possible beneficial links between nature contact in offices and employees' health, respondents who spent less than four hours a day in their primary workplace were excluded from further analysis. Similarly, respondents who did not report average hours in the work place, and office type were excluded from further analysis. The final sample for statistical analysis consisted of 565 respondents (Fig. 1).

The relationship between the variables was investigated using Pearson's correlation (r) for continuous variables, and Spearman's Rank Order Correlations (ρ) for non-parametric variables. Multicollinearity was used to identify whether the independent variables showed some relationship with the dependent variables, and to ensure that the correlation between the independent variables was not too high [31]. To investigate the association between nature contact and the health outcome measures, multiple regression was used on the continuous dependent variables, and logistic regression on the dichotomized variables (model I). R^2 was used on the continuous variables, and Cox and Snell R^2 and

Nagelkerke R² on the dichotomized variables to determine the extent to which the variance in the outcomes was explained by the model as a whole. To check possible mediating effects through perceived organizational support, the regressions were repeated while controlling for perceived organizational support (Model II). Sobels test was utilized to test whether the indirect effect of nature contact on the health outcomes via the mediator perceived organizational support was significantly different from zero [37]. Extreme multivariate outliers were identified with reference to Mahalanobis distance [38], and this led to the exclusion of two participants. The Omnibus Tests of Model Coefficients and the Hosmer and Lemeshow Test were used to indicate how well the models performed in logistic regressions. All analyses were adjusted for gender, age and office type. In addition, participants were excluded from the analysis if the data required for a particular analysis were missing [31].

2.6. Ethics

The Regional Committees for Medical and Health Research Ethics concluded that the study did not require approval pursuant to the Norwegian Act on Medical and Health Research, since the survey was completely anonymous.

3. Results

The study sample is presented in Table 1. The participant’s age ranged from 17–69. The sample consisted of slightly more men than women, and the mean year of work at the workplace was 7.0 years, ranging from two weeks to 41 years. The physical work environment varied between single- (63.5%) and shared offices (36.5%). Time spent daily at the office desk ranged from 4.0–9.0 hours (mean 6.1) and daily hours at work ranged from 4.0– 10.0 hours (mean 7.8).

The descriptive statistics for the measured variables and their interrelations are presented in Table 2. As indicated by the mean values for the descriptive statistics presented in Table 2, the sample was fairly healthy and satisfied with their job situation. They reported low levels of job stress (mean 11.22 range 0–48.3), moderate levels of subjective health complaints (mean 10.9, range 0–52), few days of sick leave (mean 3.36, range 0–9 days), and relatively high levels of perceived organizational support (mean 3.38, range 1–5). The amount of outdoor nature contact at work was quite low in this population (mean 5.26, range 3–13), while the amount of indoor nature contact was moderate (mean 17.71, range 5–30).

The Outdoor Nature Contact variable was correlated with fewer days of sick leave ($r=-0.09$). The

Table 2

Zero order correlations, means, range and standard deviations for the variables included in the regression analysis of the association between Nature Contact at work (NCQ outdoor, NCQ indoor) and Job Stress (JSS), Subjective Health Complaints (SHC), self-reported sick leave and perceived organizational support (POS) including the control variables: gender, age and office type

	1	2	3	4	5	6	7	8	9	10	11	12	13	14
1. Gender														
2. Age	-0.13**													
3. Office type	0.09*	0.18**												
4. Job stress	0.01	-0.06	0.02											
5. SHC total	0.17**	0.05	0.08	0.40**										
6. SHC muscle	0.13**	-0.06	0.08	0.15**	0.38**									
7. SHC pseudo	0.15**	0.04	0.15**	0.29**	0.42**	0.31**								
8. SHC gastro	0.09**	0.05	0.08	0.15**	0.57**	0.20**	0.30**							
9. SHC allergy	0.05	0.10*	0.03	0.17**	0.50**	0.17**	0.19**	0.29**						
10. Sick leave	0.05	0.14**	0.05	0.14**	0.31**	0.10*	0.24**	0.20**	0.11**					
11. Sick leave, days	0.14**	0.02	0.02	0.18**	0.36**	0.16**	0.26**	0.22**	0.17**	0.66**				
12. POS	-0.02	-0.5	-0.04	-0.27**	-0.27**	-0.11**	-0.17**	-0.15**	-0.19**	-0.15**	-0.18**			
13. NCQ outdoor	-0.27**	0.08	-0.03	0.02	-0.05	0.02	-0.01	-0.03	0.01	-0.01	-0.09*	0.05		
14. NCQ indoor	-0.01	0.02	-0.10*	-0.12**	-0.15**	-0.08	-0.14**	-0.09	-0.03	-0.03	-0.09*	0.20**	0.05	
Mean	-	48.41	-	11.22	10.9	4.47	2.98	1.69	0.9	-	3.36	3.38	5.26	17.71
Range	-	17–69	-	0–48.3	0–52	0–21	0–16	0–15	0–10	-	0–9	1–5	3–13	5–30
Standard deviation	-	9.86	-	9.06	9.37	4.32	3.09	2.33	1.61	-	3.27	0.86	2.46	4.88

*Significant at $P < 0.05$, **Significant at $P < 0.01$.

Table 3
Regression analysis examining the association between job stress, subjective health complaints (SHC) with four subscales, self-reported sick leave, or perceived organizational support (POS) and outdoor and indoor nature contact at work

	Gender	Age	Office type	NCQ outdoor	NCQ indoor	POS (mediation analysis)
Job Stress	B (CI) 0.086 (-1.322-1.494)	-0.05 (-0.119-0.02)	0.4 (-1.030-1.83)	0.09 (-0.193-0.373)	-0.18* (-0.318- -0.042)	-
- model I						
- model II	B (CI) 0.045 (-1.316-1.407)	-0.061 (-0.129-0.006)	0.37 (-1.009-1.757)	0.122 (-0.152-0.396)	-0.098 (-0.234-0.039)	-2.310*** (-3.078- -1.543)
SHC total	B (CI) 3.247*** (1.550-4.945)	0.070 (-0.15-0.154)	0.642 (-1.082-2.367)	-0.005 (-0.347-0.336)	-0.278*** (-0.445- -0.112)	-
- model I						
- model II	B (CI) 3.2*** (1.555-4.846)	0.056 (-0.026-0.138)	0.612 (-1.060-2.284)	0.32 (-0.3-0.363)	-0.182* (-0.347- -0.017)	-2.691*** (-3.619- -1.764)
SHC muscle	OR (CI) 2.060** (1.246-3.406)	0.984 (0.961-1.008)	1.503 (0.922-2.449)	1.057 (0.956-1.167)	0.963 (0.918-1.010)	-
SHC pseudo	OR (CI) 2.302*** (1.425-3.719)	1.016 (0.993-1.039)	1.719* (1.085-2.724)	1.056 (0.959-1.162)	0.935** (0.893-0.979)	-
- model I						
- model II	OR (CI) 2.330*** (1.431-3.795)	1.014 (0.992-1.038)	1.694* (1.059-2.710)	1.071 (0.970-1.182)	0.951* (0.907-0.997)	0.596*** (0.445-0.799)
SHC gastro	OR (CI) 1.505* (1.033-2.191)	1.011 (0.993-1.030)	1.243 (0.848-1.820)	0.987 (0.916-1.064)	0.968 (0.932-1.004)	-
SHC allergy	OR (CI) 1.247 (0.850-1.830)	1.026** (1.007-1.046)	1.076 (0.727-1.594)	1.009 (0.935-1.089)	0.991 (0.954-1.029)	-
Sick leave	OR (CI) 1.343 (0.892-2.023)	1.034** (1.013-1.056)	0.939 (0.617-1.427)	1.008 (0.929-1.093)	0.985 (0.946-1.025)	-
Sick leave days	B (CI) 0.841** (0.241-1.441)	0.014 (-0.016-0.044)	-0.101 (-0.711-0.508)	-0.073 (-0.194-0.048)	-0.061* (-0.009- -0.002)	-
- model I						
- model II	B (CI) 0.083** (0.238-1.423)	0.010 (-0.019-0.040)	-0.108 (-0.710-0.494)	-0.065 (-0.184-0.055)	-0.038 (-0.098-0.021)	-0.621*** (-0.955- -0.287)
POS	B (CI) -0.018 (-0.175-0.140)	-0.005 (-0.013-0.003)	-0.011 (-0.171-0.149)	0.014 (-0.018-0.045)	0.036*** (0.020-0.051)	-

Model I include gender, age, office type (control variables) and reported indoor (NCQ indoor)- and outdoor (NCQ outdoor) nature contact. In Model II, perceived organizational support (POS) is added for mediation analysis. *Significant at $P < 0.05$, ** Significant at $P < 0.01$, *** Significant at $P < 0.001$.

Indoor Nature Contact variable was correlated with job stress ($r=-0.12$), total subjective health complaints ($r=-0.15$), the subscale for pseudo-neurology ($r=-0.14$), and days of sick leave ($r=-0.9$), as well as perceived organizational support ($r=0.20$). (See Table 2 for further details.)

The association between nature contact and the stress and health outcomes, and the mediation analysis controlling for perceived organizational support, are presented in Table 3 (Models I and II). No significant association was found between outdoor nature contact and job stress. The indoor nature contact variable had a significant negative association with job stress ($B=-0.18$). Gender, age and office type were not associated with job stress. Overall, Model 1, with the variables gender, age, office type and indoor nature contact explained 1.8% of the variance in job stress. The outdoor nature contact variable showed no reliable association with either of the subjective health complaints scales. The indoor nature contact variable showed a reliable negative association with total subjective health complaints ($B=-0.278$). More indoor nature contact at work was significantly attended by a reduced odds ratio ($OR=0.935$) for reporting complaints within the pseudo neurology subscale of subjective health complaints. Being a woman had a reliable positive association with total subjective health complaints and the subscales for musculoskeletal pain, pseudo neurology and gastrointestinal problems. Age had a small but significant positive association with allergy. Employees with a private office had a significantly greater odds ratio for reporting problems within the subscale of pseudo neurology than employees who shared an office. Overall, Model 1, with the variables gender, age, office type and indoor nature contact explained 5.7% of the variance in subjective health complaints total and between 6.2% and 9.7% of the variance in the subscale for pseudo neurology. The outdoor nature contact variable had no reliable association with sick leave. The indoor nature contact variable had a small, but significant negative association with days of sick leave ($B=-0.061$), indicating that the more indoor nature contact at work, the fewer days of sick leave taken. Indoor nature contact was not associated with sick leave certified by a doctor. Age had a positive, reliable association with sick leave certified by a doctor, while being female was associated with more days of sick leave. Overall, Model 1, with the variables gender, age, office type and indoor nature contact explained 3.1% of the variance in days of sick leave. No significant association was found between outdoor nature contact and

perceived organizational support. Indoor nature contact at work had a significant, positive association with perceived organizational support ($B=0.036$), indicating that the more indoor nature contact at work, the more perceived organizational support. Gender, age and office type were not associated with perceived organizational support. Overall, Model 1, with the variables gender, age, office type and indoor nature contact explained 4.6% of the variance in perceived organizational support.

After repeating the regression analysis while controlling for perceived organizational support (Model II), the associations between indoor nature contact and job stress (Sobel's test=3.58 $p<0.001$), and indoor nature contact and days of sick leave (Sobel's test=2.86, $p=0.004$) disappeared. The connection between nature contact and job stress and sick leave was thus not direct, but mediated through elevated perceived organizational support. The reliable associations between indoor nature contact and the subjective health complaints total (Sobel's test=3.53 $p=0.004$) and the subscale of pseudo-neurology (Sobel's test=2.71 $p=0.007$) decreased, but remained significant. After introducing perceived organizational support in Model II, the variance in the outcomes explained by gender, age, office type, indoor nature contact and perceived organizational control, increased to 8.4% for job stress, 5.7% for days of sick leave, 11.6% for total subjective health complaints, and between 8.6% and 13.4% of the variance in the subscale of pseudo-neurology.

4. Discussion

The present cross-sectional questionnaire survey conducted in office workplaces showed that nature contact at work, particularly indoor nature contact, is significantly associated with less job stress, fewer subjective health complaints and fewer days of sick leave. The study included both outdoor and indoor nature contact, and operationalized indoor nature contact as a combination of various plant and window items. Previous studies indicated that it is relevant to combine plants and windows as a measure of indoor nature exposure. Firstly, the combination of both a nature view and live plants in offices engendered the lowest mean level of stress [25]. Secondly, employees in windowless offices may compensate by adding plants and pictures of natural landscapes to their offices [21], and, finally, windows with a view of built elements only, even with no

obstruction of natural light, did not produce psychological benefits [20].

In the present study, employees reporting high exposure to indoor nature contact at work also reported a significantly lower prevalence of job stress, fewer subjective health complaints, and fewer days of sick leave than those with low exposure. Furthermore, the introduction of indoor plants and windows with a view of nature enhanced perceived organizational support. Mediation analysis showed that the associations between indoor nature contact and job stress, as well as days of sick leave, were not direct, but mediated through elevated perceived organizational support. Both a mediated association, through elevated perceived organizational support, and a direct association were found between indoor nature contact and subjective health complaints and the subscale of pseudo-neurology. It thus seems that the social climate, expressed as elevated perceived organizational support, can be a key concept when trying to explain some of the underlying mechanisms or processes induced by including nature contact in the physical environment at work.

According to the Human Environment Interaction Model, the social climate and the physical environment are connected [14]. The findings from the present study indicate that purposeful use of nature contact at work may help to create a pleasant physical and social environment, and may facilitate the well-being and health of employees. The rationale behind this can be derived from the demand-control-support model [4, 5]. According to this model, social support from the management can buffer the experience of high psychological job strain [5]. Findings from this study indicate that indoor nature contact induces higher levels of perceived organizational support. The items used for reporting social support are not related to the organization of the physical environment but of more general terms. Providing possibilities for more nature contact could be associated with an increase in the experience of social support from supervisors in general, and reflected in how the employees perceive that their organization cares about their well-being. The Demand-Control-Support model can thus provide a possible explanation for how nature contact affects employees' well-being: elevated perceived social support leads to improved buffering mechanisms when faced with high psychological job strain, and thereby possibly improve health outcomes related to stress [5]. More perceived organizational support has been found to correlate with less absenteeism in earlier studies [11, 19, 20], as well as in the present study.

A combination of the perspectives in the Stress Recovery Theory [15–17] and the Human Environment Interaction Model [14] indicate that exposure to natural elements reduces stress through lower levels of activation. In the present study, the employees reporting high exposure to indoor nature contact at work also reported significantly lower prevalence of job stress. Previous studies have shown conflicting results as regards this connection, but the majority of them indicate the same positive relation between nature contact and stress reduction [11, 25, 27].

In the study by Largo-Wight and colleagues [11], as opposed to ours, only outdoor nature contact showed a reliable association with stress reduction. In the present study, the mean of each item and the subscales indicate lower levels of exposure to outdoor nature contact, and higher levels of indoor nature contact. There may be cultural variations that explain these differences, for instance in habits relating to nature contact and whether the management supports, or even allows, outdoor breaks and decorating the office with natural elements. Lunch breaks are traditionally shorter in Norway than in the US and going out for lunch is not so common in Norway. In addition, weather reports from the weeks prior to data collection in the present study showed low temperatures, with mostly rainy days [29], which further restricted outdoor lunch breaks. In contrast, the study by Largo-Wight and colleagues was conducted in Northern Florida that often allows for more outdoor breaks during work hours. On the other hand, indoor plants and a window view may be more common in work-places in Norway.

Further, in the present study, the indoor nature contact measure was extended by an additional question about what comprised the view from the office windows. Since the content of the view has to consist of natural elements to foster psychological benefits [20], this addition is an advantage of the current study. In addition, the fact that the NCQ allows for the inclusion of different items in the subscales makes it possible to capture nature contact in different cultural settings, but, on the other hand, it makes it difficult to compare the different studies directly.

Bringslimark and colleagues [22] found no significant association between the presence of plants in the office and general perceived stress in a population of moderately stressed office workers. However, their measure of stress was not specific to work related circumstances. This, together with plants as the sole nature exposure, could explain why the results conflict with the findings in the present study. It has previously been

suggested that individuals with higher levels of stress experience the greatest effect of green environments [26]. Interestingly, this study found significant associations between job stress and indoor nature contact in a group of fairly low stressed employees. One can only speculate that the association would be stronger among employees suffering from higher levels of job stress. No reliable gender differences were found in experienced job stress in this study, while Kim & Mattson [39] found that flowering plants only promoted stress recovery amongst highly stressed women.

Like previous studies [11, 20, 23, 24], the present study suggested that more indoor nature contact was significantly associated with fewer subjective health complaints. The study by Largo-Wight and colleagues [11] found a stronger association between reductions in general health complaints and outdoor nature contact than in relation to indoor nature contact, while the present study found no reliable association between outdoor nature contact and health complaints. As discussed above for the relation between nature contact and stress, this could be due to cultural differences.

In the present study, the subscale for pseudo-neurology was the only subscale of subjective health complaints that independently demonstrated a negative association with indoor nature contact. This is in line with an intervention study by Fjeld [23] who found that complaints within the pseudo-neurology subscale had the strongest beneficial association with indoor nature contact. Fjeld [23] introduced quite a large amount of plants; altogether 18 plants in single offices. In the present study, the amount of indoor nature contact was of a more moderate magnitude, but, interestingly, a significant association still was found.

The negative relation between indoor nature contact at work and days of sick leave in the present study is congruent with previous research conducted in Norway [22] finding that the number of indoor plants proximal to a worker's desk had a small but statistically reliable association with sick leave.

In the present study, employees with more indoor nature contact at work reported higher perceived organizational support. This association has not previously been explored in quantitative designs. However, qualitative research by Thomsen and colleagues [27] suggested that plants influenced the social climate and interaction among employees. Perceived organizational support consists of elements of social support, and these findings thereby point in the same direction. Unfortunately, little is known about the shape, size and condition of the plants in the workplaces under study,

except in the workplaces where a professional firm installs and maintains the plants. The study by Thomsen and colleagues [27] found that plants in poor condition did not have a positive impact on the social climate and interaction among employees. If the current study also included plants in poor condition, the positive impact of plants could potentially have been weakened.

4.1. Methodological limitations

One reason for the low response rate (40%) in this study was that the management of the bigger workplaces did not know the type of job of all employees. Consequently, they could not exclude from the mailing list employees who did not perform typical office work, such as school teachers and janitors, those temporarily absent from work, or employees on short-term contracts and not actually employed at the time of the study. The Cronbach's α values of both the NCQ subscales were below the recommended level, $\alpha > 0.7$ [40]. However, internal consistency may not be a relevant indicator of reliability for the NCQ [31]. Internal consistency reliability (α) is a measure of the similarity of an instrument's items to each other as measured by average correlations, and it is not an appropriate measure for questionnaires that seek to obtain information about the occurrence of unrelated events or behavior [41]. The NCQ measures objective counts of different nature contacts, and internal consistency may not be a relevant measure. When internal consistency is inappropriate, test-retest is the best reliability indicator [41].

Employee-environment relations are complex. Like most research on occupational health, the present study therefore does not claim to have controlled for all factors that might influence the outcomes under study. However, a certain standard of physical work environment is ensured through the Norwegian working environment regulations that apply to all employees and workplaces. In addition, the directions of effects cannot be inferred when using a cross-sectional design. Caution should therefore be exercised when drawing direct causal inferences about the effect of nature contact in the working environment based on such designs.

5. Conclusions and implications for practice and further research

The findings of the current study support the hypothesis that nature contact at work is beneficial in relation to the outcomes under study. Although small effect sizes,

more indoor nature contact at work was significantly attended by less job stress, fewer health complaints and fewer days of sick leave. Thus, the validity of theory and previous research in the field is strengthened. The present study also suggests that the social climate, expressed as elevated perceived organizational support, may be important when trying to explain possible benefits of nature contact in the physical work environment.

The small associations between nature contact and job stress, subjective health complaints and perceived organizational support should not discourage further studies and the development of more precise recommendations for practice. Most people spend a large portion of their lives at work, so even small associations could have great practical significance when aggregated over a large number of employees over a life-time of employment.

Enhancing nature contact at work can be achieved by adding plants to the workplace environment and opening window blinds to utilize view of nature elements and natural daylight. These are easy and cost-effective strategies that can add to the variety of possible health promoting initiatives in office work-places. Future research should preferably utilize prospective designs that enable causal conclusions to be drawn, and they should continue to use a comprehensive measure related to the experience of nature in the workplace setting and work-specific stress measures, which were advantages of the present study. The connection between indoor nature contact and perceived organizational support is an original contribution of this study. Exploring this, as well as other aspects of social support and the social climate in relation to nature contact at work, should therefore be given priority in future research in the field.

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