

## Research Paper

# Workplace greenery and perceived level of stress: Benefits of access to a green outdoor environment at the workplace

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## HIGHLIGHTS

- ▶ The study addresses employees' access to workplace greenery (WG) during their work day.
- ▶ Significant relationship between access to WG, and workplace attitude (males and females).
- ▶ Significant relationship between access to WG and level of stress (only males).
- ▶ Significant relationship between workplace attitude and level of stress (only females).

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## ABSTRACT

Dealing with stress and stress-related diseases is an increasing problem in both developed and developing countries and has an enormous cost for individuals, companies, and societies. A positive relationship between access to a green outdoor environment at work, and decreased stress has been found in previous studies, and this relationship is in line with a vast body of research in other contexts. The aim of this study is to investigate whether access to a green outdoor environment at work is related to employees' perceived level of stress and attitude toward the workplace. The study is based on data from a questionnaire answered by 439 randomly selected individuals in Sweden. The questionnaire addressed the respondents' level of stress and workplace attitude, and the characteristics and accessibility of the outdoor environment at the respondents' workplace. The results showed significant relationships between physical and visual access to workplace greenery, and a positive workplace attitude and decreased level of stress for male respondents. For female respondents, a significant relationship between physical and visual access to workplace greenery and a positive workplace attitude was found, but not between access to workplace greenery and level of stress. Furthermore, a positive workplace attitude was related to decreased levels of stress for female respondents, but not for male respondents. These findings support existing research which suggests that the workplace outdoor environment is an asset for employees' wellbeing and level of stress, and they indicate that gender plays a central role in realizing the benefits of such environments.

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## 1. Introduction

Worldwide, work-related stress is considered a major challenge to workers' health and the health of their organizations (World Health Organization, 2011). The European Agency for Safety and Health at Work (2011a) reports that work-related stress is one of the most significant European health and safety problems, and it affects nearly one in four workers. Work-related stress can impair

an individual's psychological and physical health, as well as an organization's effectiveness (World Health Organization, 2011), and studies suggest that between 50% and 60% of all lost working days are related to stress (European Agency for Safety and Health at Work, 2011a). This represents a major cost in terms of human distress and impaired economic performance (ibid.). Work-related stress was previously considered as being primarily a problem in the developed countries, but it is now also an issue of growing concern in developing countries due to processes of globalization and the changing nature of work (World Health Organization, 2007). A review on qualitative research, which addressed work-related stress, found that stressors at work were reported more frequently than stressors associated with other role areas, and concluded that research on occupational stress is especially relevant to

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efforts aimed at reducing overall stress levels (Mazzola, Schonfeld, & Spector, 2011).

Against this background, it is hardly surprising that individuals, companies and communities are very concerned about the topic (European Agency for Safety and Health at Work, 2011b) and that a lot of resources are invested in stress management programs (Goetzl & Ozminkowski, 2008; World Health Organization, 2004). Contemporary stress management programs at workplaces typically focus on psychosocial factors, and do not address the growing body of research on the environmental psychology of workspace (for a meta-analysis see Van der Klink, Blonk, Schene, & Van Dijk, 2001). However, studies show that the physical working environment is significantly related to employees' stress-level (for reviews see Rashid & Zimring, 2008; Vischer, 2007). The effect of the workplace outdoor environment for employees' level of stress has mainly been ignored, even though the relationship between access to green outdoor environments and human stress in other contexts is supported by a vast body of empirical evidence (e.g. Nielsen & Hansen, 2007; Stigsdotter et al., 2010; van den Berg, Maas, Verheij, & Groenewegen, 2010). Theoretical explanations for this relationship are based on cognitive or evolutionary perspectives. The Attention Restoration Theory (Kaplan, 1995; Kaplan & Kaplan, 1989) focuses on two different types of attention, which are based on different brain functions. The 'directed attention' is used for dealing with disturbing environmental factors or demanding tasks, and if this type of attention is used without the possibility for restoration, it may lead to mental fatigue. The other type of attention is an 'involuntary attention', which operates on a wide scale between 'hard fascination' (e.g. when a person is watching engaging television news or exciting football matches) and 'soft fascination' (when a person is in a gentle interesting environment with e.g. glittering water, birds, flowers, etc.). This last type of fascination is found to provide possibilities for mental restoration (ibid.). The 'Aesthetic Affective Theory' (Ulrich, 1993, 1983) focuses on people's most primitive emotions, called affects, and argues that people today, just like our ancient ancestors, unconsciously read the information in green outdoor environments that tells them whether their surroundings are safe or not. In perceived safe environments, people automatically relax and restore from stress (ibid.).

### 1.1. Workplace outdoor environments as restorative environments

Few studies have addressed the potential benefits of access to a green outdoor environment at work for employees, companies and societies. However, the few that have indicate that access, either visual or physical, to such environments during the working day is related to increased health (Kaplan, 1993), wellbeing (Hernandez, 2007; Kaplan, 1993; Leather, Pyrgas, Beale, & Lawrence, 1998), job satisfaction (Kaplan, Bardwell, Ford, & Kaplan, 1996; Kaplan, 1993; Leather et al., 1998; Shin, 2007) and work performance (Kaplan et al., 1996; Pati, Harvey, & Barach, 2008), and to decreased perceived levels of stress (Pati et al., 2008; Shin, 2007). Recent studies show that, despite the potential benefits, the majority of office workers do not go outdoors during the working day, mainly due to a perception of being too busy and a working culture that does not include outdoor behavior (Hitchings, 2010; Lottrup, Stigsdotter, Meilby, & Corazon, 2012).

The above-mentioned studies show that access to a green outdoor environment at the workplace is beneficial on a personal and organizational level, and this study intends to address the relationship between access to workplace outdoor environments and employees' level of stress as well as their overall attitude toward their workplace. The point of departure for this study is the hypothesis that green outdoor environments are health-promoting assets at workplaces, and that increased access to such environments

for the employees can lead to decreased levels of stress. Furthermore, green outdoor environments at workplaces are expected to be related to a positive overall attitude toward the workplace.

## 2. Methods

A questionnaire was conducted with pre-coded questions, often with multiple-choice options, and an opportunity for respondents to add their own remarks. The questionnaire consisted of three parts which addressed the respondent's: 1, background data; home environment and access to garden at home and at work; 2, use of urban green spaces; 3, health status. Only data from parts 1 and 3 are presented in this article. For analyses of other data from this study see Stigsdotter and Grahn (2011), Grahn and Stigsdotter (2010), and Grahn and Stigsdotter (2003). Part 1 of the questionnaire focused on the respondents' personal data, such as age, gender, and socioeconomic status. The socioeconomic status (SES) was categorized into a three level index with low socioeconomic index representing manual workers (SES-codes 10 & 20); Intermediate socioeconomic index representing non-manual employees, lower level (SES-code 30); and high socioeconomic index representing non-manual employees, professionals and higher level (SES-codes 40, 50, 60) (Statistics Sweden, 1995). Furthermore, the respondents were asked about their access to the outdoor environment during their working day through the questions, 'do you have the possibility of viewing a green outdoor environment through the window while you are working?' with the response categories being 'yes' or 'no', and, 'do you have the possibility of taking a break in a garden, park or other natural environments during your working day?' with the response categories being 'no', 'yes, but I never use it', 'yes, and I use it sometimes', 'yes, and I use it often'. The respondents were also asked about the characteristics of the outdoor environment at their workplace with the following possible responses, 'it is an environment that lack greenness', 'it is an environment with some vegetation and greenness', 'it is an environment with a lot of vegetation and greenness', and 'it is an environment dominated by vegetation and greenness'. Finally, part 1 asked whether the respondents considered their workplace to be pleasant or not, with the response categories ranging from 1 ('I think my workplace is very unpleasant') to 5 ('I think my workplace is very pleasant'). Part 3 of the questionnaire asked the respondents to rate their health status. In order to investigate the respondents' perceived stress levels, we used a set of self-assessment questions. Several different tests relating to stress-triggered reactions are based on knowledge of clear symptoms of stress-triggered illnesses (e.g. Maslach, 2001; Nyström & Nyström, 1995) all of which demand the individual's personal and subjective experience of health status. In Sweden, the SCI-93 test, developed by two physicians (Nyström & Nyström, 1995; Nyström & Nyström, 1996), is frequently applied to estimate a population's stress level. The test contains 35 questions concerning stress symptoms in terms of mental, muscular and autonomic complaints (problems with eating, sleeping, etc.). An earlier study (Grahn & Stigsdotter, 2003) has used the most prominent and clearest questions from the SCI-93 protocol to achieve a simplified, but relevant, subset of questions to examine perceived stress. The chosen questions concern headache, pain in the nape of the neck, common cold, irritation, fatigue, backache and stress. The association between these seven complaints was examined using factor analysis (Grahn & Stigsdotter, 2003). The three complaints irritation, fatigue and stress formed a strong factor, which is interpreted as the perceived level of stress (LS). This self-assessment LS-test includes questions to determine whether the respondents have considered themselves to be stressed, irritated or tired during the last year, with the response categories 'no', 'a few times', 'maximum once every quarter', 'maximum once every month',

**Table 1**  
Description of the construction of “Workplace Greenery Index”.  $n = 436$ ,  $n_{\text{miss}} = 3$ .

Workplace greenery index	Description of the access to workplace greenery covered by the indexes	$n$
WG-Index 1	No view of a green outdoor environment No physical access to any outdoor environment	168
WG-Index 2	View of a green outdoor environment No physical access to an outdoor environment dominated by greenery	177
WG-Index 3	Physical access to an outdoor environment dominated by greenery	91

‘maximum once every 14 days’, ‘maximum once every week’, ‘more than once a week’, and ‘almost every day’. In the analysis, these three questions which address the respondents stress, irritation and fatigue were grouped into one factor called ‘level of stress’ (LS). This instrument has been used in several studies which are similar to this (Adevi & Grahn, 2011; Annerstedt et al., 2010; Grahn & Stigsdotter, 2003; Grahn & Stigsdotter, 2010; Nordh, Grahn, & Wahrborg, 2009).

The questionnaire was sent by post to 2200 individuals in the following nine Swedish cities: Enköping, Halmstad, Kristianstad, Lund, Trelleborg, Trollhättan, Uppsala, Varberg and Västerås. The individuals were selected randomly, and the state-owned company DAFA, which keeps the Swedish personal register and address register, was responsible for the randomization. The number of 2027 questionnaires was successfully delivered, of which 953 completed or nearly completed questionnaires were returned. The response-rate was hence 47%. Of the 953 returned questionnaires, 439 were answered by working people. The rest of the answers were from children and adolescents (270), pensioners (73), students (81), parents at home with children (40) and unemployed (50). The distribution of socio-demographic data for the respondents, such as socio-economic grouping, age and gender, were not found to be different from the general situation in Sweden (Statistics Sweden, 2001).

### 2.1. Statistical analysis

T-tests and ANOVA type III analysis were used to analyze the data from the questionnaire. The data has been statistically processed using the statistical software SAS (SAS Statistics, version SAS 9.2), and a significance level of 0.05 was used.

### 2.2. Definitions

Some of the concepts addressed in this article are very broad, or they are used with different meanings in different contexts or research traditions. In the following, the definitions of the key concepts are described, and when the concepts are mentioned in this article, they refer to these definitions.

### 2.3. Workplace greenery

The term refers to the natural elements in the outdoor environment at the workplace, such as trees, shrubs, flowers and other vegetation. In order to use access to workplace greenery as one single variable, the respondents' answers to the questions, which addressed these issues, were classified into a workplace greenery index consisting of three levels: no view or physical access to a green outdoor environment at the workplace; view but no physical access to a green outdoor environment at the workplace; physical access to a green outdoor environment at the workplace. For a more detailed description of the workplace greenery index, see Table 1.

### 2.4. Level of stress (LS)

This stress-measurement is a factor which includes reports of perceived stress, irritation and fatigue (see Section 2). LS can take values from 0 to 1095, which represents the variance in this sample (mean: 122). LS were categorized into five groups of equal size, which were named the LS groups. The measurement has been validated by Annerstedt et al. (2010), who showed a close relationship between LS and EQ-VAS, which is a subscale of EuroQoL which measures perceived health state. EuroQoL is a validated instrument for measuring health outcome (Brooks & De Charro, 1996; Brooks, Rabin, & De Charro, 2003).

### 2.5. Workplace attitude

This concept is related to the question of whether the respondents found their workplace pleasant or not. In Sweden, this concept has been used to evaluate workplaces, and it often correlates with employees' health and wellbeing (Kaufmann & Kaufmann, 2005; Lowden & Åkerstedt, 2000). Workplace attitude is included as a key concept in this study in order to investigate whether the respondents' overall perception of the workplace is related to the characteristics of the outdoor environment. The workplace attitude variable has a range from 1 to 5 (mean: 3.5). The concept of workplace attitude may be close to the concepts of, e.g. job satisfaction and workplace wellbeing, and therefore the findings regarding workplace attitude are put into the context of findings regarding these other concepts in Section 4.

## 3. Results

### 3.1. Sample characteristic

Table 2 shows that significantly more female respondents than male respondents reported high LS, and that the respondents who reported high LS were, on average, almost five years younger than those who reported low/medium LS. Respondents with a high socioeconomic status reported significantly higher levels of stress than those with an intermediate or low socioeconomic status. With respect to workplace attitude, respondents who reported a positive workplace attitude were, on average, approximately two years older than those who reported a less positive attitude. There were no significant relationships between workplace attitude, and gender and socioeconomic status (see Table 2).

### 3.2. Is access to a green outdoor environment at work related to the employees' level of stress?

Table 3 shows that respondents who had physical access to workplace greenery reported the most positive workplace attitude, while respondents who had visual, but not physical, access reported a less positive workplace attitude, and respondents who had no visual or physical access to workplace greenery reported the most negative workplace attitude. For both genders, the positive attitude toward the workplace decreased less from physical access to visual access, than from visual access to no access. The ANOVA type III analysis showed a highly significant relationship ( $F = 8.81$ ,  $p < 0.0001$ ) where workplace greenery was strongest in the model ( $F = 24.65$ ,  $p < 0.0001$ ), followed by age ( $F = 8.33$ ,  $p < 0.05$ ), whereas gender and SES were not significant. Separate analyses of the genders showed similar patterns, but the results were stronger for females: model for males:  $F = 3.57$ ,  $p < 0.01$ , where workplace greenery:  $F = 7.00$ ,  $p < 0.01$ ; age:  $F = 4.47$ ,  $p < 0.05$ ; and SES: ns. Models for females:  $F = 6.14$ ,  $p < 0.001$ , where workplace greenery:  $F = 16.78$ ,  $p < 0.0001$ ; age:  $F = 3.98$ ,  $p < 0.05$  and SES: ns.

**Table 2**  
Relationships between respondents level of stress (LS) and workplace attitude (WA), and the background factors age, gender, and socioeconomic status. SAS T-test (gender) and ANOVA GLM Type III analyses (age and socioeconomic index).

		LS low/medium	LS high	Numbers of obser- vations and sign	WA low/medium	WA high	Numbers of observations and sign
Gender	Male	81.75%	18.05%	N = 427	52.00%	48.00%	N = 431
	Female	64.85%	35.15%	$p < 0.001$	43.72%	56.28%	ns
Age	Mean	42.3 years	37.6 years	N = 432	39.8 years	42.1 years	N = 436
				$p < 0.001$			$p < 0.05$
Socio-economic index	Low	77.68%	22.32%	N = 423	53.57%	46.43%	N = 427
	Intermediate	78.95%	21.05%	$p = 0.010$	47.40%	52.60%	ns
	High	64.15%	35.85%		44.10%	55.90%	

**Table 3**  
Relationships between workplace attitude (WA) and workplace greenery (WG) ANOVA SAS GLM Type III analyses. Model all respondents: dependent variable WA = WG-Index SES Age Gender (SES, Age and Gender confounders, not in table). Model for separate analyses, male and female respondents: dependent variable WA = WG-Index SES Age (SES and Age confounders, not in table).

	Workplace attitude	std	n	Missing
All respondents				
Model: $F = 8.81$ , $p < 0.0001$				
WG-Index 1	3.17	1.31	168	0
WG-Index 2	3.76	1.20	176	1
WG-Index 3	4.03	1.33	65	26
Male respondents				
Model: $F = 3.57$ , $p < 0.01$				
WG-Index 1	3.24	1.18	84	0
WG-Index 2	3.73	1.19	73	1
WG-Index 3	3.85	1.43	26	14
Female respondents				
Model: $F = 6.14$ , $p < 0.001$				
WG-Index 1	3.11	1.45	81	0
WG-Index 2	3.81	1.19	99	0
WG-Index 3	4.15	1.27	39	12

Furthermore, Table 4 shows that respondents who had physical access to workplace greenery reported the lowest levels of stress: ANOVA type III analysis, adjusted for age, gender and socioeconomic status, showed a highly significant relationship ( $F = 6.99$ ,  $p < 0.0001$ ), where age was strongest in the model ( $F = 13.26$ ,

**Table 4**  
Relationships between level of stress (LS) and workplace greenery (WG) ANOVA SAS GLM Type III analyses. Model all respondents: dependent variable LS = WG-Index SES Age Gender (SES, Age and Gender confounders, not in table). Model for separate analyses, male and female respondents: dependent variable LS = WG-Index SES Age (SES and Age confounders, not in table).

	LS	std	n	Missing
All respondents				
Model: $F = 6.99$ , $p < 0.0001$				
WG-Index 1	3.61	1.14	166	2
WG-Index 2	3.58	1.14	175	2
WG-Index 3	3.26	1.31	91	0
Male respondents				
Model: $F = 4.54$ , $p = 0.011$				
WG-Index 1	3.50	1.14	84	0
WG-Index 2	3.35	1.15	74	0
WG-Index 3	2.78	1.14	40	0
Female respondents				
Model: ns				
WG-Index 1	3.73	1.16	79	2
WG-Index 2	3.75	1.12	97	2
WG-Index 3	3.65	1.31	51	0

$p < 0.001$ ), followed by workplace greenery ( $F = 4.95$ ,  $p < 0.01$ ), while gender and SES were not significant. Separate analyses of the genders showed significant associations for males, while the result for females was not significant: model for males:  $F = 4.54$ ,  $p = 0.011$ , where workplace greenery:  $F = 7.46$ ,  $p < 0.01$ , while age and SES is not significant. Model for females: no significant associations. Male respondents with physical access to workplace greenery reported the lowest LS, compared to male respondents with visual access, who reported middle LS, and male respondents with no access to workplace greenery, who reported highest LS. Table 5 shows a significant relationship between a positive workplace attitude and low LS for female respondents, but not for male respondents. Finally, when both workplace attitude and the workplace greenery index were included in the models, the high access to workplace greenery index was related to lower LS for male respondents, but no relationship was found between a positive workplace attitude and lower LS. For female respondents, a significant relationship was identified between positive workplace attitude and lower LS, but not between high access to workplace greenery index and lower LS (see Table 6).

#### 4. Discussion

The results from this study show that more working women than men experience a high level of stress. This is in line with an existing study which reports significant gender differences with respect to stress (Stigsdotter et al., 2010, for an overview see Baum & Grunberg, 1991). Women report more stress than men (Stigsdotter et al., 2010), and have a higher prevalence rate to develop stress-related disorders such as acute stress disorder, post-traumatic stress disorder, and major depressive disorder (Carter-Snell & Hegadoren, 2003; Nolen-Hoeksema, 2001; Olf, Langeland, Draijer, & Gersons, 2007). Men and women engage in different types of health-promoting behavior (Soffer, 2010), and the fact that women refrain from certain "masculine" types of health-promoting behavior is partly due to their levels of general stress (ibid.). A recent study has found that the area of the brain which is activated in response to stress varies among men and women (Nauert, 2011). In contrast to men, women respond to stress by increasing activity in regions of the brain which process emotion (the limbic system), and this activity lasts longer than in men's brain activity, which is located in regions of the brain, which deal with the planning of complex cognitive behavior, personality expression, decision-making and the moderation of correct social behavior (prefrontal cortex and orbitofrontal cortex) (ibid.).

In this study, we found distinctly different relationships between workplace greenery, workplace attitude and LS for men and women (see Fig. 1). We found a significant relationship between both physical and visual access to workplace greenery and lower LS for men, with physical access being related to the lowest LS. This relationship was not found for women. Previous studies, which address the relationship between the outdoor environment at workplaces and employees' stress-level, focus on visual access, and show a positive relationship between a green window view

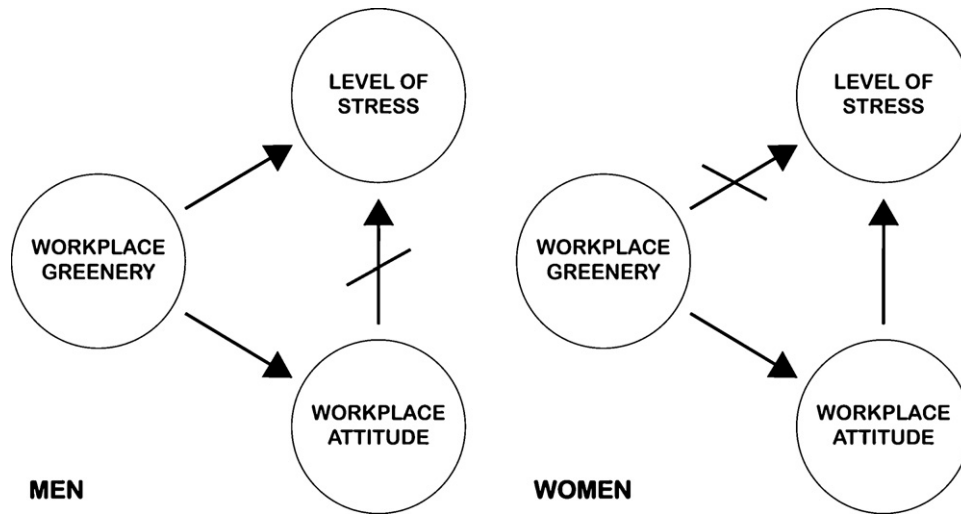


Fig. 1. The relationships between workplace greenery, workplace attitude, and level of stress for men and women.

and decreased levels of stress. However, these studies only include female respondents (Pati et al., 2008), or find no difference with respect to gender (Shin, 2007). A study, which addressed the use of workplace outdoor environments, found that more men than women went outdoors during the working day, and that women reported ‘being too busy’ as an impediment to going outdoors far more often than men (Lottrup et al., 2012). This indicates a gender difference in exposure to greenness during the working day, although the results need to be validated in future studies. A Danish national study addressing the relationship between green outdoor environments and stress did not find any gender differences regarding the type and the degree of beneficial effects derived from the environment (Stigsdotter et al., 2010). An explanation for the unexpected gender difference in this study can be found in the area of occupational stress research, where gender differences are found with respect to various aspects of stress. Women

and men are found to differ with respect to the type of perceived stressor related to the workplace (McDonald & Korabik, 1991; Nelson, Quick, & Hitt, 1989; Vivien & Thompson, 1996). Compared to men, women tend to report more interpersonal stressors (Jones & Fletcher, 1996; Narayanan, Menon, & Spector, 1999), and more stress due to multiple roles, lack of career progress, and discrimination and stereotyping (for review see Gyllensten & Palmer, 2005). The influence of moderators, such as social support, on the effect of occupational stressors, might be different between the genders (Bellman, Foster, Still, & Cooper, 2003; Etzion, 1984; Gadinger et al., 2010). Much research on the role of gender in perceived occupational stress shows that, in general, women experience more stress than men (for a review see Gyllensten & Palmer, 2005). However, other studies have not reported any difference between the genders (ibid.). In the light of this research, it is hardly surprising that the stress-related benefits, which are derived from access to green outdoor environments, experienced by men and women differ. However, the above-mentioned findings do not help to explain the specific types of relationship found in this study. A reason for the lack of a significant relationship between workplace greenery and LS for women might be that women’s LS, in contrast to men’s, depends, to a large extent, on their workplace attitude, as shown in this study. The close relationship between LS and workplace attitude amongst female respondents may be partly explained by men and women’s different perceptions of interpersonal stressors.

**Table 5**  
Relationship between level of stress (LS) and workplace attitude (WA). ANOVA SAS GLM Type III analyses. Model all respondents: dependent variable LS = WA SES Age Gender (SES, Age and Gender confounders, not in table). Model for separate analyses, male and female respondents: dependent variable LS = WA SES Age (SES and Age confounders, not in table).

	LS	std	n	Missing
All respondents				
Model: $F=7.49$ , $p < 0.0001$				
WA 1	3.94	1.13	32	0
WA 2	3.78	1.16	69	0
WA 3	3.61	1.00	80	0
WA 4	3.59	1.13	92	2
WA 5	3.29	1.24	132	2
Male respondents				
Model: ns				
WA 1	3.27	1.10	11	0
WA 2	3.38	1.16	32	0
WA 3	3.43	1.02	44	0
WA 4	3.60	1.20	43	0
WA 5	3.06	1.18	53	0
Female respondents				
Model: $F=7.64$ , $p < 0.0001$				
WA 1	4.25	1.02	20	0
WA 2	4.14	1.07	36	0
WA 3	3.82	0.98	33	0
WA 4	3.63	1.08	48	2
WA 5	3.46	1.27	78	2

**Table 6**  
Relationships between level of stress (LS), and workplace greenery (WG) and workplace attitude (WA) ANOVA SAS GLM Type III analyses. Model all respondents: dependent variable LS = WG-Index WA SES Age Gender (SES, Age and Gender confounders, not in table),  $n=439$ . Model for separate analyses, male and female respondents: dependent variable LS = WG-index WA SES Age (SES and Age confounders, not in table).

		F value	pr > F
All respondents	WG-Index	0.46 <sup>a</sup>	0.4990.007
Model: $F=5.63$ , $p < 0.0001$	WA	7.46 <sup>a</sup>	
Male respondents	WG-Index	4.06 <sup>b</sup> 0.04 <sup>b</sup>	0.0450.833
Model: $F=2.86$ , $p < 0.05$	WA		
Female respondents	WG-Index	0.63 <sup>b</sup> 13.48 <sup>b</sup>	0.427<0.001
Model: $F=6.23$ , $p < 0.0001$	WA		

<sup>a</sup> Adjusted for gender, age, and socioeconomic status.

<sup>b</sup> Adjusted for age, and socioeconomic status.

Mazzola et al. (2011) found that women reported more interpersonal conflicts than men, and given the fact that interpersonal conflicts appeared to be the most pervasive stressor across all occupations (ibid.) and that interpersonal conflicts at work can have negative long-term consequences for individual well-being (De Dreu, Van Dierendonck, & Dijkstra, 2004), this stressor may well play a role in the significant relationship between women's workplace attitude and LS found in this study. However, further research is needed to determine whether this explanation holds any truth.

Finally, this study found that physical and visual access to workplace greenery was related to an increased positive workplace attitude among both genders, with physical access being related to the most positive workplace attitude. This relationship is in line with existing studies which have addressed the connection between job satisfaction and workplace outdoor environments (Kaplan et al., 1996; Kaplan, 1993; Leather et al., 1998; Shin, 2007), in that a view to a forest and nature involvement at work has been shown to be related to increased job satisfaction. The results from this study also correspond with studies on employees' wellbeing. For example, a study by (Hernandez, 2007) concluded that a garden provided freedom for the employees and became a 'coping mechanism' to seek diversion during the working day, while a study by Leather et al. (1998) found that a view of a green outdoor environment from the workplace window was related to the employees' feeling less uptight than if they had a view of an urban scene. None of these studies report differences with respect to gender.

In this study, the results indicate that physical access to workplace greenery has greater benefits than merely visual access. To our knowledge, no previous peer-reviewed literature has compared the benefits of a green window view and physical access to a green outdoor environment.

#### 4.1. Implications for practice

Based on the findings of this study, companies should maximize their view of natural elements from workplace windows and physical access to green outdoor environments for employees in order to reduce stress levels amongst employees and to stimulate a positive attitude toward the workplace. The findings could be of value to practitioners, such as city planners, architects and landscape architects, in order to stress the importance of considering access to green outdoor environments in the design of future workplaces. Furthermore, the findings may also be of value to employees to encourage them to consider ways of increasing the use of the outdoor environment during the working day.

#### 4.2. Discussion of methodology and future perspectives

To our knowledge, this study is the first study to address the role of gender regarding beneficial impacts of green outdoor environments at workplaces. To explain or refute the types of relationship found in this study, further research on the topic is necessary. It could be interesting to investigate the relationships between different types of stressors, e.g. interpersonal conflicts, and access to workplace greenery and gender. In this study, we only distinguish between green and built outdoor environments. In future studies, it would be very valuable to provide a more nuanced picture of outdoor environments by distinguishing between, e.g. different amounts or types of vegetation, in order to provide useful information to corporate managers, architects, landscape architects, city planners, and others who make decisions about the physical environment at the workplace. The concept of workplace attitude is very broad, and it is recommended that future studies use several more specific attitude variables in order to gain knowledge on the different elements included in the concept of workplace attitude. Also, the measurement of stress, which is only based on self-rated

values in this study, could be strengthened in future studies by being combined with other types of measurements, such as saliva-cortisol or heart-rate variability. A limitation of this study is that it is cross-sectional, and it was therefore not possible to study any causal relationships between LS, workplace attitude and workplace greenery. A longitudinal study would be appropriate to investigate such relationships. An additional line of research, which would be of great value in order to explore the meaning and subjective effects of outdoor environments at workplaces, and the employees' reasons for using or not using them, would be a qualitative approach including, e.g. focus group interviews and 'walk and talks'. Finally, this study was conducted in Sweden, which is, together with Norway, at the top of the list of UN countries with the highest level of equality with respect to gender and socio-economic conditions (UNDP, 2002). Because of this, it will be important to continue this line of research in other countries.

## 5. Conclusion

This study adds to existing knowledge regarding the effect of green outdoor environments at workplaces by showing that access to workplace greenery is related to decreased levels of stress and increased positive attitudes toward the workplace. Furthermore, the results show that these relationships are distinctly different for men and women. To our knowledge, such a gender difference has not been previously found. Further research is necessary to establish whether gender plays a vital role in deriving benefits from green outdoor environments at work. The overall findings of this study indicate that the green workplace outdoor environment has the potential to support a more healthy and enjoyable working day.

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