



MONASH University
Business and Economics

Work environment stress: The impact of the physical work environment on psychological health.

A Snapshot Review

Authors:

Dr Tracey Shea, Ms Trisha Pettit and Professor Helen De Cieri
Australian Centre for Research in Employment and Work (ACREW)
Faculty of Business and Economics, Monash University

December 2011

**Australian Centre for Research in
Employment and Work (ACREW)**
People and knowledge working together

Table of Contents

Executive Summary	3
Background/Context	4
What is the physical work environment?	4
Defining psychological health	5
Review question.....	5
Method	6
Peer reviewed academic research literature	6
Grey literature	6
Search terms and procedure	7
Results	8
Links between the physical work environment and psychological health	9
Discussion	10
The relationship between physical work environment and psychological health	11
Confounding issues in the literature.....	11
Conclusion.....	12
References	13
Appendix one: Summary of studies investigating the impact of physical work environment on psychological health	16
Appendix two: Links between physical work environment and psychological health	26

Executive Summary

This Snapshot Review describes a brief investigation of the impact of the physical work environment on psychological health in employees. The physical work environment can be seen as all materials, objects and stimuli that employees are exposed to in their workplace (Elsbach & Pratt, 2007) while psychological health is generally operationalised in terms of deficits in psychological health (e.g. stress, anxiety and depression). Given that all elements of our environment can potentially interact with our state of health or wellbeing several researchers have sought to determine the impact of the physical work environment on the psychological health of employees.

The purpose of the review was to focus specifically on the negative impact of the physical work environment. The question addressed in this review is: What aspects of the physical work environment (e.g. space, lighting, noise, vibration, confined spaces, temperature) contribute to poor psychological health in workers? A search of academic and grey literature was conducted in order to gather information relevant to work environment stress measurement. Specific inclusion and exclusion criteria were employed in the selection of studies for this review.

The results of this review reveal that there is only limited evidence of a relationship between the physical work environment and psychological health of employees. In research where a relationship has been identified, most relationships were weak and generally found between composite measures of the physical work environment (e.g. temperature, noise, crowding) and psychological factors such as stress and anxiety. The physical work environment was generally not found to impact on psychological health, when psychological health has been measured in terms of depression, burnout or generalized measures of psychological distress (e.g. anxiety, depression and stress incorporated into one scale).

The findings within this literature are confounded by several methodological problems including use of scales that have not been validated to measure physical work environment and psychological health; conflating both physical and psychological variables into the measurement of physical work environment and psychological distress scales; and study designs that lead to indirect links rather than direct links between predictors and outcomes.

Presently, given the small number of studies located and the methodological problems in some of the studies reported in this review, we conclude that evidence of a negative relationship between the physical work environment and psychological health is limited. Further empirical research is required to investigate the direct and indirect links between the physical work environment on psychological health.

Background/Context

Psychological health at work is an important subject of investigation because employees with a greater sense of psychological wellbeing are more likely to be productive, creative, and satisfied in their jobs compared to employees suffering from symptoms of psychological distress such as stress, anxiety and depression. Furthermore, psychological distress in the workplace is associated with decreased job satisfaction and increased levels of absenteeism and presenteeism. While several factors (e.g. psychosocial elements such as workload or lack of support from one's supervisor) can impact negatively on the psychological health of employees, the focus of this review is on the physical work environment. Studies from the field of environmental psychology indicate that there is potential for the physical work environment to impact on the psychological health of employees. For example, community studies have indicated that issues such as noise and crowding result in symptoms of poor psychological health (Taylor and Repetti, 1997) and medical studies have shown that patient outcomes improve when they have windows with nature scenes (Ulrich, 1984) or exposure to natural light (Choi, Beltran & Kim, 2012).

What is the physical work environment?

The physical environment in the workplace has been described as all material objects and stimuli that employees interact with in their working lives (Elsbach & Pratt, 2007). Material objects can be observed at both the macro (e.g. buildings) and micro levels (e.g. furnishings and office arrangements). Stimuli include the conditions under which employees work such as the lighting and temperature. Salient factors within the physical work environment that may impact on employees can be divided into several broad areas: ambient properties, spatial arrangements and architectural design. Ambient properties refer to factors such as noise, temperature, air quality, and vibration; spatial arrangements refer to factors such as office layout, level of enclosure and proximity to office (Evans, Johansson & Carrere, 1994; McCoy, 2002). Architectural design refers to elements such as lighting or the presence of windows (Evans, Johansson & Carrere, 1994; McCoy, 2002).

The physical work environment may be influenced by a wide variety of elements or sources of material objects and stimuli. In the workplace ambient properties such as noise can arise from sources such as telephones, employee conversations or noises generated by industrial equipment (e.g. construction sites, factories) (Raffaello & Maass, 2002). Concerns with temperature may arise in office environments but also exist for workers employed in outdoor working environments who are exposed to extreme weather conditions (e.g. fishing or resources industry). Indoor air quality is a complex issue where problems may arise from pollutants or odours (biological, chemical or particle) or defects in building ventilation systems (EPA, 1998). However, employees who work in external

industrial sites may also face air quality issues from chemical and dust exposure. An example of spatial arrangements is office type (open vs enclosed) while architectural issues refer to the lighting (intensity of artificial lighting, access to daylight, sunlight penetration) and presence of a window or type of views from the workspace (nature scenes, other buildings).

Defining psychological health

Defining psychological health has been the subject of some debate and discussion. There is evidence to suggest that psychological health should be based upon the presence of positive symptoms such as well-being and the absence of negative symptoms (Boudrias et al., 2011; Masse et al., 1998). However, the more widely accepted term for concepts linked to psychological health (i.e. stress, anxiety, and depression) is mental health. The World Health Organization (WHO, 2010) defines mental health thus:

Mental health is a state of well-being in which an individual realizes his or her own abilities, can cope with the normal stresses of life, can work productively and is able to make a contribution to his or her community. In this positive sense, mental health is the foundation for individual well-being and the effective functioning of a community.

In academic studies deficits in psychological or mental health are generally operationalised in discrete ways such as depression (e.g. Beck Depression Inventory: Beck et al., 1974); anxiety (e.g. Zung Self-Rating Anxiety Scale: Zung, 1971) and stress (e.g. Perceived Stress Scale: Cohen et al., 1983). As the focus of this review is deficits in psychological health we have reviewed studies that address evidence of psychological distress through specific mental health problems such as depression, anxiety, stress, and burnout as well as general measures of psychological distress and mood problems such as anger and hostility.

Review question

The question addressed in this review is:

1. What aspects of a physical work environment (e.g. space, lighting, noise, vibration, confined spaces, temperature) contribute to poor psychological health in workers?

Specifically, this review focuses on risk factors in the physical work environment that may lead to deficits in psychological health.

Method

To locate studies that examined the impact of the physical work environment on psychological health we conducted searches of two academic databases and grey literature. Specific inclusion and exclusion criteria were applied and are discussed below.

Peer reviewed academic research literature

The databases searched for studies of work environment stress were Business Source Complete (EBSCO) and Ovid. Further searches through references from relevant articles were also conducted.

Studies were selected for inclusion in this review if they met the following criteria:

- 1) Were explicit in their focus on measuring psychological health in the workplace as an outcome variable (e.g. stress, depression, anxiety); and
- 2) Incorporated the physical work environment as a predictor of psychological health.

Studies were excluded from the review if they:

- 1) Did not include psychological health as a dependant variable e.g. they were excluded if study outcomes were job satisfaction, job strain, productivity or physical health;
- 2) Focused on improving well-being rather than the negative impact of the physical work environment.

Grey literature

The search of grey literature included several sources:

- PRIMA-EF (www.prima-ef.org/default.aspx) - PRIMA-EF aims at providing policy makers, employers, trade unions, experts and employees with a comprehensive best practice framework for psychosocial risk management at the workplace. PRIMA-EF is part of the [World Health Organization's Healthy Workplaces Framework](#).
- Canadian Institute of Work & Health (www.iwh.on.ca/) - The Institute for Work & Health (IWH) is an independent, not-for-profit research organization. The Institute is credited as being one of the top five occupational health and safety research centres in the world.
- APA: Psychologically Healthy Workplace Program (<http://www.apa.org/practice/programs/workplace/index.aspx>) - [The Psychologically Healthy Workplace Program \(PHWP\)](#) is a collaborative effort between the American Psychological Association and the APA Practice Organization designed to educate employers about the link between employee health and well-being and organizational performance.

- National Institute of Safety & Occupational Health (NIOSH), USA (<http://www.cdc.gov/niosh/>) - NIOSH is the USA federal agency responsible for conducting research and making recommendations for the prevention of work-related injury and illness.
- World Health Organisation (WHO) (<http://www.who.int/en/>) - WHO is the directing and coordinating authority for health within the United Nations system. WHO is responsible for providing leadership on global health matters, shaping the health research agenda, setting norms and standards, articulating evidence-based policy options, providing technical support to countries and monitoring and assessing health trends.

Search terms and procedure

A combination of search terms was used to locate articles that investigated the relationship between physical work environment and psychological health and only two constraints were applied to the search procedure. Articles were selected if they were: 1) peer reviewed; and 2) written in English. No other constraints were imposed and no constraints regarding the year of publication were applied due to the limited number of studies in this area.

Search terms:

- Physical work environment
- Physical workplace / Physical workspace
- Work(place) environment
- Work environment stress
- Built environment

A search of the Business Source Complete database for physical work environment resulted in 88 articles; many of these articles did not address a possible link between physical work environment and psychological health so other search term variations were conducted and are listed below. A search for 'built environment' returned 1936 articles; however, to search this set is beyond the scope of a snapshot review. Hence, a coupling of this search term with 'psychological health' as well as 'stress' for additional searches was conducted but did not return articles that were relevant to this review. The search in the Ovid database resulted in a similar pattern of returns.

Additional searches were conducted for 'physical work environment and anxiety', 'physical work environment and depression' and 'physical work environment and stress'. More specific searches were conducted for elements of the physical work environment and psychological health: lighting or illumination; temperature, thermal comfort or climate; noise, acoustics or sound; air quality; chemical hazards, vibration and office architecture (e.g. spatial and open-plan).

Results

The findings of this report are discussed below. First, we present a summary of the physical work environment and psychological health issues that have been investigated. Second, we report the links between the physical work environment and psychological health.

Measuring the physical work environment and psychological health

Academic studies investigating the link between the physical work environment and psychological health have either assessed the impact of discrete issues, for example, a direct relationship between noise and stress, or they have selected several issues and constructed an index of multiple items to reflect the overall quality of the physical environment. Twenty seven studies were found to have investigated the link between physical work environment and psychological health and they are summarised in Table one below. This table summarises the types of variables used to measure physical work environment in studies investigating its impact on psychological health. The predominant way of measuring the physical work environment has been to construct a composite index that reflects a range of issues (e.g. Goldenhar et al., 2001: temperature, noise, air quality, lighting) which conflates pertinent issues and results in an index reflecting the overall quality of the physical work environment. However, on some occasions psychosocial elements (e.g. workload) were incorporated into an index with measures of the physical work environment (e.g. Evans et al., in press) resulting in a composite psychosocial-physical work environment index. Interestingly, with the exception of onshore versus offshore workers in the resources industry no attention appears to be paid to the psychological impact of outdoor work.

Table 1. Summary of physical work environment issues investigated

Physical work environment properties	N	%
Air quality	4	14.8
Decoration (colour, art)	3	11.1
Ergonomics	2	7.4
Lighting	4	14.8
Noise	4	14.8
Office layout/ Crowding/privacy	3	11.1
Onshore vs offshore locations	2	7.4
Perceptual physical scale (e.g. temperature, noise, etc)	8	29.6
Physical/psychosocial scale (e.g. work demands, crowding, etc)	2	7.4
Windows/views	2	7.4

N=27 (Note: total is >27 due to multiple issues investigated in single studies)

Table two below summarises the main psychological health issues investigated in association with the physical work environment. The single issues that have received the most attention in the relationship between physical environment and psychological health were stress and anxiety followed by depression and burnout. However, one third of the studies have also constructed scales to measure psychological symptoms (e.g. Stellman et al., 1987: depression, anxiety, hopelessness, irritation).

Table 2. Summary of psychological health issues investigated

Psychological health	N	%
Aggression / Anger / Hostility / Irritation	4	14.8
Anxiety	6	22.2
Burnout – all MBI subscales	1	3.7
Burnout – emotional exhaustion	3	11.1
Depression	4	14.8
Neuroticism	1	3.7
Psychological health/distress scale (addressing multiple issues)	9	33.3
Social dysfunction	1	3.7
Somatic	2	7.4
Stress	11	40.7

N=27

Links between the physical work environment and psychological health

The evidence for a link between the physical work environment and psychological health is limited as very few studies revealed significant results. Table three below summarises the links between the physical work environment and psychological health, see Appendix two for a more detailed summary.

Where significant relationships were found the physical work environment was more likely to be measured by a perceptual scale that contains multiple indicators of physical environmental conditions (e.g. Goldenhar et al., 2001; Leung et al., 2008; 2009; 2010; Suteeraroj et al., 2008). These studies demonstrated a weak link between a general measure of physical work environment (e.g. temperature, noise, etc) and subjective measures of stress, anxiety and burnout. That is, the poorer the physical work environment, the greater the level of stress, anxiety or burnout. There was also some evidence that offshore working conditions might be implicated in greater levels of psychological distress (Parkes, 1992). Of the five studies that investigated a link between noise and psychological distress (stress, anxiety, depression) only two studies revealed a weak positive correlation between noise and stress (Applebaum et al., 2010) as well as general distress and

irritation (Klitzman & Stellman, 1989). Similarly, the two studies that directly investigated the impact of lighting and external views on psychological health revealed a weak relationship between light and stress (Klitzman et al., 1989; Leather et al., 1998). Higher levels of stress were associated with decreased sunlight penetration through windows.

The predominant outcome variables for significant associations with elements of the physical work environment were stress and anxiety. Other outcomes such as depression and general scales for psychological health were not significantly associated with elements of the physical work environment. Several results have been reported as inconclusive due to a conflation of psychosocial and psychological predictor variables (e.g. Srivastava, 2007). Other studies have reported group differences without establishing consistent and measurable differences in the physical work environment between participant groups (e.g. Stellman et al., 1987).

Table 3. Summary of links between physical work environment and psychological health

Physical work environment properties	Links to psychological health	
	N	%
Air quality	1	3.7
Decoration (colour, art)	0	0.0
Ergonomics	1	3.7
Lighting	2	7.4
Noise	2	7.4
Office layout/ Crowding/privacy	1	3.7
Onshore vs offshore locations	1	3.7
Windows/views	1	3.7
Physical index (e.g. temperature, noise)	5	18.5
Physical/psychosocial (work demands, crowding)	0	0.0

N=27

Discussion

Presently there is a paucity of research that demonstrates direct links between the physical work environment and the psychological health of employees. Studies of workplace stress tend to focus on psychosocial aspects of the work environment as antecedents of psychological health (Vischer, 2007). Furthermore, studies that have investigated the impact of the physical work environment on health have tended to focus on physical health, particularly concerns such as musculoskeletal problems. However, there is a small body of work that has focussed specifically or in part on the relationship between the physical work environment and the psychological health of employees.

Predominant psychological issues in this field have been stress, anxiety and burnout with less emphasis on depression and maladaptive coping mechanisms such as substance abuse.

The relationship between physical work environment and psychological health

Overall there is little evidence to support a strong link between the physical work environment and psychological health. Where links exist between the physical work environment and psychological health they appear to be weak and based on perceptual scales that conflate numerous physical elements of the environment into an overall score of environment quality. This lack of evidence is partly due to the small number of studies that focus directly on this relationship. Further, the main focus in academic studies appears to be the impact of the psychosocial work environment as a predictor and physical health as a dependant variable.

Greater theoretical attention needs to be paid to the question of why certain elements of the physical work environment might be expected to produce specific deficits in psychological health. For example, there are demonstrated links between exposure to natural light and depression so it could be expected that poor light quality, reduced exposure to natural light and the absence of windows within the work place may lead to an increased prevalence of depression. However, how does poor air quality (Burke, 1990) or limited light exposure (Alimoglu et al., 2005) in the physical environment lead to psychological problems such burnout? Could ergonomic (Stellman et al., 1987) or decorative elements of the physical work environment be expected to lead to deficits in general psychological health as measure by composite scales of depression, anxiety and stress? Therefore, the lack of strong evidence for a link between the physical work environment and deficits in psychological health may be associated with model misspecification. Confounding issues noted during the review are discussed below.

Confounding issues in the literature

Confounding issues were observed in this body of literature and make establishing a link between the physical work environment and psychological health difficult. One such issue is that the conflation of psychosocial and physical elements of the workplace into one score makes it difficult to reach conclusions regarding the impact of the physical work environment. For example, Evans, Becker, Zahan, Bilotta and Keesee (in press) have constructed a cumulative risk index that includes workload, job control, social support, noise, natural elements, maintenance. However, while they address elements of the physical work environment (e.g. noise) they report them as part of an index with psychosocial and job related issues. In this instance there can be no separate conclusions regarding the individual contribution of each physical work environment variable to psychological health.

Furthermore, while constructing an index or scale to measure physical work environment may be useful in determining the overall quality of the physical work environment it does not allow us to isolate elements of the environment that may be associated with risks to psychological health. This is further confounded by the fact that the studies reviewed in this report have not attempted to validate their scales and indices and there are no consistent approaches to measuring the physical work environment across the studies. This problem also applies to the measurement of psychological health. Some studies have used well-validated scales to measure psychological health (e.g. Nassiri et al., 2011) but others have employed a series of scales that are not well accepted or validated measures (Stellman et al., 1987).

Another confounding factor is that while studies may incorporate the physical work environment into the research design, links are sometimes implied and not directly tested (e.g. Chen, Wong, Yu, Lin & Cooper, 2003). In other studies only group differences have been tested with no specific associations reported between the physical work environment and psychological health leading to speculative rather than conclusive results (e.g. Klitzman and Stellman, 1989).

Conclusion

There is limited evidence for a link between the physical work environment and psychological health in employees. Further, the findings of the majority of studies reported in this review do not support this link. Deficits in measurement tools and study design confound the findings of this literature on the relationship between the physical work environment and psychological health. On the basis of this review, we conclude that further research needs to be conducted to improve our understanding of the direct impact of the physical work environment on psychological health. Additionally, further research is recommended to determine the importance of the physical work environment relative to the psychosocial work environment regarding its impact on the psychological health of employees.

References

1. Alimoglu MK and Donmez L (2005) Daylight exposure and other predictors of burnout among nurses in a university hospital. *International Journal of Nursing Studies* 42(5): 549-555.
2. Applebaum D, Fowler S, Fiedler N, Osinubi O and Robson M (2010) The impact of environmental factors on nursing stress, job satisfaction, and turnover intention. *Journal of Nursing Administration* 40 (7/8): 323-328.
3. Banks MH, Clegg CW, and Jackson PR (1980) The use of the General Health Questionnaire as an indicator of mental health occupational studies. *Journal of Occupational Psychology* 5: 187-194.
4. Beck AT, Rial WY and Rickels K (1974) Short form of depression inventory: Cross-validation. *Psychological Reports* 34(3): 1184-1186.
5. Berwick DM, Murphy JM, Goldman PA, Ware JE, Barsky AJ and Weinstein MC (1991) Performance of a five item mental health screening test. *Medical Care* 29: 169-176.
6. Bjerkan AM (2011) Work and health: A comparison between Norwegian onshore and offshore employees. *Work* 40: 125-142.
7. Boudrias J, Desrumaux P, Gaudreau P, Nelson K, Brunet L, and Savoie A (2011) Modeling the experience of psychological health at work: The role of personal resources, social-organizational resources, and Job Demands. *International Journal of Stress Management* 4: 372-395
8. Brauer C (2005) *The Sick Building Syndrome Revisited*, Copenhagen, University of Copenhagen.
9. Burke RJ (1990) Effects of physical environment and technological stressors among stock brokers: A preliminary investigation. *Psychological Reports* 66: 951-959
10. Buss AH and Perry MP (1992) The aggression questionnaire. *Journal of Personality and Social Psychology* 63: 452-459.
11. Chen W-Q, Wong T-W, Yu T-S, Lin Y-Z and Cooper CL (2003) Determinants of perceived occupational stress among Chinese offshore oil workers. *Work & Stress* 17(4): 287-305.
12. Choi J, Beltran L, and Kim H (2012) Impacts of indoor daylight environments on patient average length of stay (ALOS) in a healthcare facility. *Building and Environment* 50: 65-75.
13. Cohen S, Kamarck T, Mermelstein R (1983) A global measure of perceived stress. *Journal of Health & Social Behavior* 24: 385-396.
14. Cox T, Thirlaway M, M, Gotts G, and Cos S (1983) The nature and assessment of general well-being. *Journal of Psychosomatic Research* 27: 206-229.
15. Danielsson CB and Boden L (2008) Office type in relation to health, well-being, and job satisfaction among employees. *Environment and Behavior* 40(5): 636-668.
16. Derogatis LR, Rickels K and Rock AF (1996) The SCL-90 and the MMPI: A step in the validation of a new self-report scale. *British Journal of Psychiatry* 128: 280-189.
17. Elsbach KD and Pratt MG (2007) The physical environment in organizations. *The Academy of Management Annals* 1(1): 181-224.
18. Environmental Protection Agency (1998) *Building air quality: Action plan*. National Institute of Occupational Safety & Health: publication no. 98-123.
19. Eriksen HR, Ihlebaek C, and Ursin H (1999) A coring system for subjective health complaints (SHC). *Scandinavian Journal of Public Health* 27: 63-72.
20. Evans Gw, Becker FD, Zahn A, Bilotta E, and Keesee AM (In press) Capturing the ecology of workplace stress with cumulative risk. *Environment and Behaviour*.
21. Evans GW, Johansson G, and Carrer S (1994) Psychosocial factors and the physical environment: Inter-relations in the workplace. In CL Cooper and IT Robertson (Eds.) *International Review of Industrial and Organizational Psychology*. Chichester, UK: Wiley.
22. Eysenck HJ and Eysenck SBG (1975) *Manual of the Eysenck Personality Questionnaire*. Hodder & Stoughton: London.
23. Fairbrother K and Warn J (2003) Workplace dimensions, stress and job satisfaction. *Journal of Managerial Psychology* 18(1): 8-21.

Work Environment Stress: A Snapshot Review

24. Finnegan MC and Solomon LZ (1981) Work attitudes in windowed vs. windowless environments. *Journal of Social Psychology* 115: 291-292.
25. Firth L, Mellor DJ, Moore KA and Loquet C (2004) How can managers reduce employee intention to quit? *Journal of Managerial Psychology* 19(1/2): 170-187.
26. Gmelch WH (1982) *Beyond Stress to Effective Management*. New York: Wiley.
27. Goldberg D and Williams P (1988) *GHQ: A User's Guide to the General Health Questionnaire*. Windsor: NFER-Nelson.
28. Goldenhar LM, Gershon R, Mueller C and Karkasian C (2001) Psychosocial work stress in female funeral service practitioners. *Equal Opportunities International* 20(1/2): 17-38.
29. Goldenhar L, Williams L, Swanson N (2003) Modeling the relationship between job stressors and injury and near-miss outcomes for construction labourers. *Work & Stress* 17 (3): 218-240.
30. Jahncke H, Hygge S, Halin N, Green AM and Dimberg K (2011) Open-plan office noise: Cognitive performance and restoration. *Journal of Environmental Psychology* 31: 373-382.
31. Jermier JM, Gaines J and McIntosh NJ (1989) Reactions to physically dangerous work: A conceptual and empirical analysis. *Journal of Organizational Behavior* 10(1): 15-33.
32. King MG, Burrows GD and Stanley GV (1983) Measurement of stress and arousal: Validation of the stress/arousal adjective checklist. *British Journal of Psychology* 74: 473-479.
33. Klitzman, S and Stellman, JM (1989) The impact of the physical environment on the psychological well-being of office workers, *Social Science and Medicine* 29: 733-742.
34. Kristensen TS, Borg V and Hannerz H (2002) socioeconomic status and psychosocial work environment: Results from a Danish national study. *Scandinavian Journal of Public Health* 59: 41-48.
35. Kweon B-S, Ulrich RS, Walker VD, Tassinary LG (2008) Anger and stress: The role of landscape posters in an office setting. *Environment and Behaviour* 40(3): 355-381.
36. Lambert EG, Edwards C, Camp SD and Saylor WG (2005) Here today, gone tomorrow, back again the next day: Antecedents of correctional absenteeism. *Journal of Criminal Justice*, 33: 165-175.
37. Leather P, Pygras M, Beale D and Lawrence C (1998) Windows in the workplace: Sunlight, view and occupational stress. *Environment and Behavior* 30(6): 739-762.
38. Leather P, Beale D, and Sullivan L (2003) Noise, psychosocial stress and their interaction in the workplace. *Journal of Environmental Psychology* 23: 213-222.
39. Leung M-Y, Chan Y-S, Chong A and Sham JFC (2008) developing structural integrated stressor-stress models for clients' and contractors' cost engineers. *Journal of Construction Engineering and Management* 134(8): 635-643.
40. Leung, MY, Chan YS, and Yu JY (2009) Integrated model for the stressors and stresses of construction project managers in Hong Kong. *Journal of Construction Engineering and Management* 135(2): 126-134.
41. Leung M-Y, Chan, Y-S, Yuen K-W (2010) Impacts of stressors and stress on the injury incidents of construction workers in Hong Kong. *Journal of Construction Engineering and Management* 136(10): 1093-1103.
42. Leung M-Y, Sham JFC and Chan Y-S (2007) adjusting stressors – job-demand stress in preventing rustout/burnout in estimators. *Surveying and Built Environment* 18 1): 17-26.
43. Maslach C and Jackson SE (1981) The measurement of experienced burnout. *Journal of Occupational Behavior* 2: 99-113.
44. Masse R, Poulin C, Dassa C, Lambert J, Belair S, and Battaglini A (1998) The structure of mental health: Higher-order confirmatory factor analyses of psychological distress and well-being measures. *Social Indicators Research* 45: 475-504
45. McCoy JM (2002) Work environment. In RB Bechtel & A Churchman (Eds.) *Handbook of Environmental Psychology*. New York: John Wiley & Sons.
46. Mohapatra BK and Srivastava AK (2003) *A study of the relationship of perceived work environment with job attitude, performance and health*. Unpublished PhD. Dissertation, Department of Psychology, Banaras Hindu University.

Work Environment Stress: A Snapshot Review

47. Nassiri,P, Azkhosh M, Mahmoodi A, Alimohammadi I, Zeraati H, Shalkouhi PJ, and Bahrami P (2011) Assessment of Noise Induced Psychological Stresses on Printery workers. *International Journal of Environmental Science and Technology* 8(1): 169-176
48. Parkes KR (1992) Mental health in the oil industry: a comparative study of onshore and offshore employees. *Psychological Medicine* 22: 997-1009.
49. Raffaello M and Maass A (2002) Chronic exposure to noise in industry: the effects on satisfaction, stress symptoms and company attachment. *Environment and Behavior* 34 (5): 651-671.
50. Revicki DA, May HJ, and Whitley TW (1991) Reliability and validity of the Work-Related Strain Inventory among health professionals. *Behavioral Medicine* 17: 111-120.
51. Schell E, Theorell T and Saraste H (2011) Workplace aesthetics: Impact of environments upon employee health. *Work* 39: 203-213.
52. Spielberger CD (1996) *State-trait anger expression inventory: Professional manual*. Tampa, FL: Psychological Assessment Resources.
53. Srivastava AK (2007) Perceived work environment and employees health. *Psychological Studies* 52(4): 345-347.
54. Stellman JM, Klitzman S, Gordon GC and Snow BR (1987) Work environment and the well-being of clerical and VDT workers. *Journal of Occupational Behavior* 8: 95-114.
55. Stone NJ and English AJ (1998) Task type, posters and workspace colour on mood, satisfaction and performance. *Journal of Environmental Psychology* 18: 175 -185.
56. Suteeraroj M and Ussahawanitchakit P (2008) Stress, anxiety, and intention to leave: The empirical study of managers in Thai petroleum and chemical businesses. *Review of Business Research* 8(4): 163-173.
57. Sutherland VJ and Cooper CL (1996) Stress in the offshore oil and gas exploration and production industries: An organizational approach to stress control. *Stress Medicine* 12: 61-78.
58. Taylor SE, Repetti RL, and Seeman T (1997) Health psychology: What is an unhealthy environment and how does it get under the skin? *Annual Review of Psychology* 48: 411-447.
59. Ulrich RS (1984) View through a window may influence recovery from surgery. *Science* 224(4647): 420-421.
60. Vischer JC (2007) The effects of the physical environment on job performance: Towards a theoretical model of workspace stress. *Stress and Health* 23: 175-184.
61. WHO (2010) *Mental health: strenghtening our response*. World Health Organization. Retrieved 5 April 2011 from: www.who.int/mediacentre/factsheets.
62. Zuckerman M and Lubin B (1985) *The Multiple Affect Adjective Check List–Revised*. San Diego, CA: Educational and Industrial Testing Service.
63. Zung WWK (1971) A rating instrument for anxiety disorders. *Psychosomatics* 12(6): 371-379.

Appendix one: Summary of studies investigating the impact of physical work environment on psychological health

Authors	Year	Participants	Measures (abbreviated)*	Conclusions
Alimoglu & Donmez	2005	Nurses (n=141) <ul style="list-style-type: none"> • Experimental group (daylight < 3 hours/day, n=66) • Control group (daylight ≥ 3 hours/day, n=75) 	<p><i>Physical environment</i></p> <p>Level of exposure to natural light: two groups, less than three hours per day or greater/equal to three hours per day.</p> <p><i>Psychological health</i></p> <p>Burnout measured by the three MBI subscales: emotional exhaustion ($\alpha=.89$), depersonalisation ($\alpha=.71$) and personal accomplishment ($\alpha=.72$) (Maslach et al., 1996).</p>	No significant differences observed between groups on any of the MBI subscales: emotional exhaustion ($t=.41, p=.686$), depersonalisation ($t=.69, p=.491$) or personal accomplishment ($t=.20, p=.844$).
Applebaum, Fowler, Fiedler, Osinubi, & Robson	2010	Nurses working in acute-care settings (n=116)	<p><i>Physical environment</i></p> <p>University of Texas M. D. Anderson Survey. A subset of 15 survey items was used to measure physical environment: odour ($\alpha=.77$), noise ($\alpha=.70$) and light ($\alpha=.87$). (Item details not reported).</p> <p>Level of colour (details not reported).</p> <p><i>Psychological health</i></p> <p>Perceived Stress Scale (PSS-10: Cohen et al., 1983).</p>	<p>A significant but weak relationship between perceived stress and noise was observed ($r=-.18, p<.05$) - it is not clear how this relationship manifests.</p> <p>No significant relationships were observed between perceived stress and odour ($r=-.14, p=.14$), light ($r=-.11, p=.24$) or colour ($r=.08, p=.40$).</p>
Bjerkan	2011	Norwegian on/off shore workers (n=414) <ul style="list-style-type: none"> • Onshore n=290 • Offshore n=90 • Both n=25 	<p><i>Physical environment</i></p> <p>Objective work environment defined as onshore and offshore.</p> <p><i>Psychological health</i></p> <p>Subjective Health Complaints Inventory (SHCI: Eriksen et al., 1999). Incorporates psychological aspects of employee health in the pseudoneurology subscale: heartbeats; heat flushes, sleep problems, tiredness, dizziness, anxiety, sadness/depression ($\alpha=.73$).</p>	Results are inconclusive as there is no direct test of psychological health between groups.

Work Environment Stress: A Snapshot Review

Authors	Year	Participants	Measures (abbreviated)*	Conclusions
Burke	1990	Stockbrokers (n=73) Female=14%; Male=86%	<i>Physical environment</i> Office adequacy measured by five items (temperature, lighting, noise, space $\alpha=.50$); air quality (3 items: stagnant, smoke, draft $\alpha=.00$). <i>Psychological health</i> Emotional exhaustion subscale from the Maslach Burnout Inventory ($\alpha=.85$) (MBI: Maslach et al., 1996).	No significant relationship between office environment and emotional exhaustion ($r=.13$, $p>.05$). No significant relationship between air quality and emotional exhaustion ($r=.18$, $p>.05$).
Danielsson & Boden	2008	Officer workers (n=469) Female=53; Male=78	<i>Physical environment</i> Office space was differentiated into seven types of offices: cell, shared room, open plan (small, medium and large), flex and combi. <i>Psychological Health</i> How much of the time have you felt depressed and sad over the past 4 weeks?	No significant differences in ratings for employees across office types were observed for the item "How much of the time have you felt depressed and sad over the past 4 weeks?" (Most of the time).
Evans, Becker, Zahan, Bilotta & Keesee	In press	Clerical workers (n=135) Female=135	<i>Physical environment</i> Physical work characteristics measuring noise ($n=5$), maintenance ($n=7$), natural elements ($n=5$) <i>Psychological Health</i> Mental Health Inventory (MHI-5: Berwick et al., 1991) which measures anxiety, depression, positive affect and behavioural/emotional control ($\alpha=.82$).	No specific results for the impact of physical work characteristics on psychological health. However, authors developed a cumulative risk index (e.g. workload, job control, social support, noise, technological stress, crowding, role ambiguity) which was weakly associated with greater psychological distress ($r=.27$, $p<.01$).
Study 1				
Evans, Becker, Zahan, Bilotta & Keesee	In press	Nursing staff (n=191) Female=191	<i>Physical environment</i> Physical work characteristics measuring noise ($n=5$), crowding ($n=3$) <i>Psychological Health</i> Mental Health Inventory (MHI-5: Berwick et al., 1991) which measures anxiety, depression, positive affect and behavioural/emotional control ($\alpha=.82$).	No specific results for the impact of physical work characteristics on psychological health. However, the cumulative risk index (e.g. workload, job control, social support, noise, technological stress, crowding, role ambiguity) was weakly associated with greater psychological distress ($r=.13$, $p<.05$).
Study 2				

Work Environment Stress: A Snapshot Review

Authors	Year	Participants	Measures (abbreviated)*	Conclusions
Fairbrother & Warn	2003	Naval officer trainees (n=100) Female=35; Male=65	<i>Physical environment</i> Physical environment measured by a seven-item scale e.g. temperature and crowding ($\alpha = 0.77$). <i>Psychological Health</i> Stress measured by the GHQ-28 (Goldberg & Williams, 1988). Four sub-scales were summed to a single score (somatic symptoms; anxiety and insomnia; social dysfunction; and severe depression).	No significant relationship was observed between discomfort due to poor physical environment and stress.
Finnegan & Solomon	1981	Employees - jobs not reported (n=123) • Window n=81 • No window n=32 Female=110; Male=13	<i>Physical environment</i> Window or no window <i>Psychological health</i> Anxiety (full details not reported)	No significant differences in anxiety levels between employees with a window versus employees with no window ($p > .05$).
Goldenhar, Gershon, Mueller & Karkasian	2001	Funeral service practitioners (n=265) Female=265	<i>Physical environment</i> Measured by five items loud noise, poor air quality, poor lighting, bothersome odors and temperature extremes ($\alpha = 0.77$). <i>Psychological health</i> Stress measured by the Work Related Strain Inventory (WRSI: Revicki et al., 1991) ($\alpha = 0.82$). Anxiety and depression measured by the Symptom Checklist 90 (SCL-90: Derogatis, 1976). (Anxiety $\alpha = 0.81$; Depression $\alpha = 0.90$).	There was a weak relationship between perceived stress and a poorer physical work environment ($r = .161, p < .05$). There was a weak relationship between poor physical work environment and higher levels of anxiety ($r = .217, p < .05$). This relationship remained significant when mediated by perceived stress. There was a weak relationship between poor physical work environment and higher levels of depression ($r = .162, p < .01$). This relationship was no longer significant when mediated by perceived stress.

Work Environment Stress: A Snapshot Review

Authors	Year	Participants	Measures (abbreviated)*	Conclusions
Goldenhar, Williams & Swanson	2003	Construction workers n=591 Females=213; male=195	<i>Physical environment</i> How many hours per day are you exposed to each of the following hazardous or unpleasant conditions: noise, chemicals, asphalt, asbestos, and lead? <i>Psychological health</i> Sum of three questions: In the past year, how often have you felt 1) tense? 2) angry? sad?	A weak significant correlation was observed between hours of exposure to poor physical work environment and psychological health ($r=.13, p<.01$). This relationship was no longer significant when other factors such as job-task demands and psychosocial organisational stressors were taken into account in a regression analysis.
Jahncke, Hygge, Halin, Green, & Dimberg	2011	University students (n=47)	<i>Physical environment</i> Recordings of office noise. <i>Psychological health</i> Psychophysiological stress measured by urinary catecholamines & salivary cortisol	No significant relationship between level of office noise and levels of catecholamines.
Klitzman & Stellman	1989	Public sector office workers (non-managerial) (n=2074) • Clerical • Technical • Professional Male=496	<i>Physical environment</i> Air quality measured by five items ($\alpha=.78$) Privacy measured by six items ($\alpha=.66$) Ergonomic measured by five items ($\alpha=.83$) Lighting (too bright, too dark) Excessive noise <i>Psychological health</i> General distress measured by: sad/depressed, worried, low spirits, nervous, lonely, feel like crying, anxious ($\alpha=.86$). Irritation measured by: angry, aggravated, irritated, frustrated ($\alpha=.83$)	Significant correlations were observed between general distress and poor air quality ($r=.27, p<.001$), ergonomic stressors ($r=.24, p<.001$), privacy ($r=-.16, p<.001$), excessive noise ($r=.24, p<.001$), light too bright ($r=.20, p<.001$) and light too dark ($r=.09, p<.001$). Significant correlations were observed between general distress and poor air quality ($r=.27, p<.001$), ergonomic stressors ($r=.24, p<.001$), privacy ($r=-.21, p<.001$), excessive noise ($r=.28, p<.001$), light too bright ($r=.17, p<.001$) and light too dark ($r=.08, p<.001$).

Work Environment Stress: A Snapshot Review

Authors	Year	Participants	Measures (abbreviated)*	Conclusions
Kweon, Ulrich, Walker & Tassinary	2008	Psychology students (n=210) Females=100; male=110	<p><i>Physical environment</i></p> <p>Office décor, three conditions: 1) office with abstract posters; 2) office with nature posters; 3) office with both abstract and nature posters; and 4) no posters.</p> <p><i>Psychological health</i></p> <p>State & Trait Anger scales (Spielberger, 1996)</p> <p>Stress Adjective Checklist (King, Burrows, & Stanley, 1983)</p>	Male participants experienced significantly higher levels of state anger in offices with no posters compared to the other three conditions [$F(3, 102)=3.09, p=.03$]. They also experienced significantly greater levels of stress in the no poster condition compared the nature poster and mixed art conditions [$F(3, 102) = 4.84, p=.004$]. High trait anger was associated with high state anger but it was not controlled for in the experimental design.
Leather, Beale & Sullivan	2003	Office workers in a government department (n=128) Female=72; Male=56	<p><i>Physical environment</i></p> <p>Subjective noise: 1) a subjective rating of how noisy employees considered their work environment to be (1-not at all to 7-extremely noisy); 2) noise disturbance for: air conditioning, telephones, office machines, people talking and noise from the street (1-never disturbs to 7-continuously disturbs).</p> <p>Objective noise: objective measures conducted using a portable Brüel & Kjær sound level meter</p> <p><i>Psychological health</i></p> <p>Psychosocial job stress, which was measured by the mean demand minus mean decision latitude, which was then mathematically transformed to remove negative values (by squaring) and preserve scale range (by taking the square root).</p>	It was concluded that noise did not have any direct effect upon self-reported ill-health symptoms runs counter to the many research studies reporting precisely such negative effects of exposure to occupational noise.

Work Environment Stress: A Snapshot Review

Authors	Year	Participants	Measures (abbreviated)*	Conclusions
Leather, Pyrgas, Beale & Lawrence	1998	Employees working in a vineyard (n=100) Female=34; Male=66	<p><i>Physical environment</i></p> <p>Level of illumination (Lux meter).</p> <p>Sunlight penetration (maximum floor coverage at maximum penetration)</p> <p>Views (extent of views of natural world)</p> <p><i>Psychological health</i></p> <p>Two suboptimal health scales from the General Wellbeing Index (Cox et al., 1983): Worn out (tired, emotional lability, cognitive confusion) and Uptight & Tense (worry, fear, anxiety, tension)</p>	<p>No significant relationships were observed between level of illumination and measures of psychological health.</p> <p>Significant negative relationships were observed between level of sunlight penetration and psychological health (Worn out: $r=-.28, p<.01$; Uptight/Tense $r=-.36, p<.001$).</p> <p>Significant negative relationship was observed between extent of view and Uptight/Tense ($r=-.27, p<.001$) but not Worn-out ($r=-.18, p>.05$).</p>
Leung, Chan & Yu	2009	Construction project managers (n=108)	<p><i>Physical environment</i></p> <p>Poor physical environment measured by four items: crowded office, noisy office, temperature too cold and too many environmental interruptions and disturbances ($\alpha= 0.81$).</p> <p><i>Psychological health</i></p> <p>Subjective stress (Banks et al. 1980; Maslach & Jackson 1996) but items not stated clearly.</p> <p>Objective stress as the deviation between actual and expected ability (Gmelch, 1982).</p>	<p>Significant positive relationship between poor physical work environment and subjective stress ($r=.36, p=0.01$) as well as objective stress ($r=.28, p=0.01$).</p>
Leung, Chan & Yuen	2010	Construction workers (n=142)	<p><i>Physical environment</i></p> <p>Poor physical environment measured by a four-item scale addressing temperature, air quality, noise and hazards.</p> <p>Unsafe physical environment measured by a three-item scale that addresses organisation of site, indicators and lighting.</p> <p><i>Psychological health</i></p> <p>Emotional stress measured by four items from the MBI (Maslach et al., 1996).</p>	<p>Higher levels of emotional stress were significantly associated with poorer physical environments ($r=.38, p<.01$) and unsafe physical environments ($r=.35, p<.05$).</p> <p>A regression analysis that included 12 job stressors as predictors (e.g. work overload, role ambiguity, unfair treatment etc) indicated that poor physical environment (but not unsafe environment) was a significant predictor of emotional stress (six out of the 12 predictors were significant).</p>

Work Environment Stress: A Snapshot Review

Authors	Year	Participants	Measures (abbreviated)*	Conclusions
Leung, Chan, Chong & Sham	2008	Engineers in the construction industry (n=173)	<p><i>Physical environment</i></p> <p>Poor physical environment measured by two items: crowded office, noisy office.</p> <p><i>Psychological health</i></p> <p>Stress measured by the ten-item Rustout-Burnout scale (RO-BO: Gmelch, 1982).</p>	Poor physical environment is associated with increased stress.
Leung, Sham & Chan	2007	Estimators in the construction industry (n=163)	<p><i>Physical environment</i></p> <p>Poor physical environment measured by two items: crowded office, noisy office ($\alpha = 0.78$).</p> <p><i>Psychological health</i></p> <p>Stress measured by the ten item Rustout-Burnout scale (RO-BO: Gmelch, 1982) measuring subjective and objective stress.</p>	No significant correlations were observed between physical environment and subjective stress ($r = .10$, $p > .05$) or objective stress ($r = .09$, $p > .05$).
Nassiri, Azkhosh, Mahmoodi, Alimohammadi, Zeraati, et al	2011	Printery workers (n=267)	<p><i>Physical environment</i></p> <p>Noise measurement: measured by a Brüel & Kjær sound level meter model 2236-Coo2 was used.</p> <p><i>Psychological health</i></p> <p>Depression was measured by the Beck Depression Inventory (BDI short form: Beck et al., 1974)</p> <p>Anxiety was measured by the Zung Self-Rating Anxiety Scale (SAS: Zung, 1971).</p> <p>Aggression was measured by the Buss-Perry Aggression Questionnaire (AGQ: Buss et al., 1992).</p>	<p>No significant relationships existed between psychological health and the two measures of noise: equivalent sound level ($L_{eq} 81.2 \pm 9.6$ dBA) and maximum sound level ($L_{max} 102.3 \pm 9.2$ dBA).</p> <p>Depression: L_{eq} ($r = .01$, $n = 212$ $p = .855$) and L_{max} ($r = .01$, $n = 212$ $p = .942$).</p> <p>Aggression: L_{eq} ($r = .09$, $n = 51$ $p = .541$) and L_{max} ($r = .06$, $n = 51$ $p = .67$).</p> <p>Anxiety: L_{eq} ($r = .08$, $n = 204$ $p = .261$) and L_{max} ($r = .07$, $n = 204$ $p = .297$).</p>

Work Environment Stress: A Snapshot Review

Authors	Year	Participants	Measures (abbreviated)*	Conclusions
Parkes	1992	Control room personnel in an oil company (n=172) <ul style="list-style-type: none"> Off shore (n=84) Onshore (n=88) Male=172	<p><i>Physical environment</i></p> <p>Offshore rig versus onshore terminals</p> <p><i>Psychological health</i></p> <p>Neuroticism scale (Twelve items: Eysenck et al, 1985)</p> <p>General mental health measured by GHQ-12 ($\alpha=0.84$).</p> <p>Specific symptoms scales from the GHQ-60: anxiety ($\alpha=0.83$), social dysfunction ($\alpha=0.66$) and somatic symptoms ($\alpha=0.81$).</p>	<p>No significant differences between onshore and offshore employees on the neuroticism score ($p>.05$).</p> <p>GHQ-12 scores were significantly lower for onshore compared to offshore [$t=2.17, p<.05$].</p> <p>Anxiety scores were significantly lower for onshore compared to offshore [$t=2.73, p<.01$].</p> <p>Somatic ($p>.05$) and social dysfunction ($p>.05$) scores were not significantly different between onshore and offshore employees.</p>
Raffaello & Maass	2002	Production employees manufacturing car appliances an bakery machines (n=62) <ul style="list-style-type: none"> Experimental group (n=38) Control group (n=24) Note: experimental group moved from pretest (noisy) to posttest (noise reduced) environment. Control group had same environment at pre and posttest.	<p><i>Physical environment</i></p> <p>Noise level on phonometer.</p> <p>Perceived noise in the workplace measured by four items ($\alpha=.73$ pretest; $\alpha=.86$ posttest).</p> <p><i>Psychological health</i></p> <p>Stress measured by six items which are describe as general and specific ($\alpha=.84$ pretest; $\alpha=.82$ posttest).</p>	<p>Reduction of noise for experimental group resulted in a significant reduction in stress symptoms from pretest to posttest conditions ($p<.01$). No significant differences observed between pre and posttest conditions for the control group.</p> <p>However, correlational analysis showed no significant correlations between noise levels and stress in pretest conditions ($r=.15, p>.05$) and significant moderate correlations were observed between noise levels and stress in the posttest conditions ($r=.61, p>.05$).</p>
Srivastava	2007	Employees in production organisations (n=360) <ul style="list-style-type: none"> Supervisory Blue collar Male n=360	<p><i>Physical environment</i></p> <p>Physico-Legal Work Environment scale (PLWE: Mohapatra & Srivastava, 2003) was used to measure employee perceptions of the work environment including a subscale on the external environment.</p> <p><i>Psychological health</i></p> <p>Hopkins Symptoms Check List was used to measure: Anxiety, depression, somatisation, overall distress (HSCL: Derogatis et al., 1974)</p>	<p>No direct test of physical work environment on psychological health.</p> <p>However, employees were divided into high and low physico-legal work environment groups. Those who described their work environment as inadequate, unfavourable and unsafe had higher scores on somatization and distress. No significant differences between groups regarding anxiety and depression.</p>

Work Environment Stress: A Snapshot Review

Authors	Year	Participants	Measures (abbreviated)*	Conclusions
Stellman, Klitzman, Gordon & Snow	1987	Clerical workers – all female (n=1032) <ul style="list-style-type: none"> • Typist (n=136) • Clerical (n=363) • VDT user (n=433) 	<p><i>Physical environment</i></p> <p>Ergonomic aspects measured by four items: enough work surface, convenient furniture arrangement, comfortable chair, comfortable desk height.</p> <p>Air quality measured by six items: too little air, uncomfortable temperature; humidity, stuffy, odours, dust, smoke, fumes.</p> <p>Privacy measured by seven items: privacy speaking, visual privacy, auditory distraction, traffic, crowding, people entering without permission, noise.</p> <p>Required to move around office, adjust lighting, adjust chair height, adjust chair back.</p> <p><i>Psychological health</i></p> <p>Depression (4 items) Anxiety (3 items) Hopelessness (4 items) Irritation (4 items)</p>	While physical environment differed between groups no direct systematic test for the impact of the physical environment on psychological health was conducted. No differences in scores on psychological health scales was observed between groups.
Stone & English	1998	University students (n=112) Female=62; male=50	<p><i>Physical environment</i></p> <p>Visual: office space was partitioned into a red space and a blue space; a poster of a sunset behind mountains across a lake, rated as pleasant in another study was also used in some conditions.</p> <p>Noise: audio-tapes of a short, repeated, conversation between two individuals playing as a telemarketer and a customer. Two levels, low attention and high attention.</p> <p>Other: ratings of room temperature (1) and a rating of room lighting levels (1).</p> <p><i>Psychological health</i></p> <p>Multiple Affect Adjective Check List (MAACL: Zuckerman & Lubin, 1985) that includes anxiety, depression and hostility scales.</p>	<p>Authors used a cut-off of $p < .10$ rather than $.05$ for most results indicating that there was no significant impact of colour or poster presence or absence on anxiety, depression or hostility.</p> <p>Direct impact of colour and poster presence or absence on anxiety, depression or hostility is difficult to estimate as they are reported as part of a three-way interaction with tasks performed (high demand vs low demand) by participants.</p>

Work Environment Stress: A Snapshot Review

Authors	Year	Participants	Measures (abbreviated)*	Conclusions
Suteeraroj & Ussahawanitchakit	2008	Managers in the petroleum and chemical industry (n=113) <ul style="list-style-type: none"> • General managers • Office managers 	<p><i>Physical environment</i></p> <p>Disturbance voice, air flow, poor lighting, odors, temperature work space, and office machine support ($\alpha=0.97$). Adapted from Goldenhar et al. (2001).</p> <p><i>Psychological health</i></p> <p>Stress is measured with five items: moody, burnout, job stress, job avoidance and sleeplessness ($\alpha=0.83$). Adapted Firth (2004) and Lambert et al. (2005).</p> <p>Anxiety is measured with four items addressing work-related anxiety ($\alpha=0.82$). Adapted from Goldenhar et al., (2001).</p>	Significant moderate correlations were observed between the physical work environment and stress ($r=.57, p<.01$) and anxiety ($r=.41, p<.01$). A regression analyses revealed that there is a significant impact of the physical work environment on both stress (<i>Adj</i> $r^2=.17$) and anxiety (<i>Adj</i> $r^2=.32$).

*Method and results are reported for physical work environment and psychological health, other non-relevant components of the study (e.g. job satisfaction, physical health, productivity) are not reported in these tables.

Appendix two: Links between physical work environment and psychological health

Study	Physical element	Psychological issue	Evidence of link
Stellman et al. (1987)	Air quality	Composite psychological	Inconclusive
Burke (1990)	Air quality	MBI (emotional exhaustion)	No
Klitzman et al. (1989)	Air quality	Psychological scale	Yes
Klitzman et al. (1989)	Air quality	Irritation	Yes
Applebaum et al. (2010)	Air quality – Odour	Stress – subjective	No
Leather et al. (1998)	Architecture – Views	Stress – Worn-out (ns)/Tension (s)	Yes – weak
Finnegan et al. (1981)	Architecture - Windows	Anxiety	No
Evans et al. (in press)	Composite physical/psychosocial	Composite psychological	Inconclusive
Srivastava (2007)	Composite physical/psychosocial	Psychological distress	Inconclusive
Srivastava (2007)	Composite physical/psychosocial	Somatic	Inconclusive
Srivastava (2007)	Composite physical/psychosocial	Anxiety	No
Srivastava (2007)	Composite physical/psychosocial	Depression	No
Alimoglu (2005)	Exposure to natural light	MBI (all subscales)	No
Applebaum et al. (2010)	Light	Stress – subjective	No
Klitzman et al. (1989)	Light	Psychological scale	Yes
Klitzman et al. (1989)	Light	Irritation	Yes
Leather et al. (1998)	Light – illumination - objective	Stress – Worn-out/Tension	No
Leather et al. (1998)	Light – sunlight- objective	Stress – Worn-out/Tension	Yes – weak
Raffaello et al. (2002)	Noise – objective	Stress – subjective	Inconclusive
Nassiri et al. (2011)	Noise – objective	Aggression	No
Nassiri et al. (2011)	Noise – objective	Anxiety	No
Nassiri et al. (2011)	Noise – objective	Depression	No
Leather et al. (2003)	Noise – objective	Stress – job	No
Jahncke et al. (2011)	Noise – objective	Stress – objective	No
Raffaello et al. (2002)	Noise – subjective	Stress – subjective	Inconclusive
Leather et al. (2003)	Noise – subjective	Stress – job	No
Klitzman et al. (1989)	Noise – subjective	Psychological scale	Yes
Klitzman et al. (1989)	Noise – subjective	Irritation	Yes
Applebaum et al. (2010)	Noise – subjective	Stress – subjective	Yes - weak
Bjerkan et al. (2011)	Onshore/Offshore	Composite physical/psychological	Inconclusive
Parkes (1992)	Onshore/Offshore	Neuroticism	No
Parkes (1992)	Onshore/Offshore	Social dysfunction	No
Parkes (1992)	Onshore/Offshore	Somatic	No
Parkes (1992)	Onshore/Offshore	Anxiety	Yes
Parkes (1992)	Onshore/Offshore	Psychological scale	Yes
Fairbrother et al. (2003)	Physical environment - composite	Psychological scale	Inconclusive
Godlenhar et al. (2003)	Physical environment - composite	Psychological scale	No
Goldenhar et al. (2001)	Physical environment - composite	Depression	No
Burke (1990)	Physical environment - composite	MBI (emotional exhaustion)	No
Leung et al. (2007)	Physical environment - composite	Stress – subjective	No
Suteeraroj et al. (2008)	Physical environment - composite	Anxiety	Yes
Suteeraroj et al. (2008)	Physical environment - composite	Stress – subjective	Yes

Work Environment Stress: A Snapshot Review

Study	Physical element	Psychological issue	Evidence of link
Goldenhar et al. (2001)	Physical environment - composite	Anxiety	Yes – weak
Leung et al. (2010)	Physical environment - composite	MBI (emotional exhaustion)	Yes – weak
Goldenhar et al. (2001)	Physical environment - composite	Stress	Yes – weak
Leung et al. (2009)	Physical environment - composite	Stress – objective	Yes – weak
Leung et al. (2009)	Physical environment - composite	Stress – subjective	Yes – weak
Leung et al. (2008)	Physical environment - composite	Stress – subjective	Yes – weak
Kweon et al. (2008)	Spatial - decoration (colour, art)	Anger	Inconclusive
Stone et al. (1998)	Spatial - decoration (colour, art)	Psychological scale	Inconclusive
Kweon et al. (2008)	Spatial - decoration (colour, art)	Stress	Inconclusive
Applebaum et al. (2010)	Spatial – Colour	Stress – subjective	No
Stellman et al. (1987)	Spatial – Crowding / Privacy	Psychological scale	Inconclusive
Klitzman et al. (1989)	Spatial – Crowding / Privacy	Psychological scale	Yes
Klitzman et al. (1989)	Spatial – Crowding / Privacy	Irritation	Yes
Stellman et al. (1987)	Spatial – Ergonomic	Psychological scale	Inconclusive
Klitzman et al. (1989)	Spatial – Ergonomic	Psychological scale	Yes
Klitzman et al. (1989)	Spatial – Ergonomic	Irritation	Yes
Danielsson et al. (2008)	Spatial – Office type	Depression (sadness)	No