Improving the health of male, blue collar construction workers: a social ecological perspective

Professor Helen Lingard and Dr Michelle Turner

School of Property, Construction and Project Management, RMIT University

Abstract

Construction workers are a high risk group for poor health and occupational disability. A participatory action research (PAR) project was undertaken at construction sites in Queensland, Australia. Using the PAR framework, a needs-based health promotion planning model was implemented. Health promotion measures designed to address the "SNAPO" health risk factors (i.e., smoking, nutrition, alcohol consumption, insufficient physical exercise and overweight/obesity). At the largest site participating in the research, preliminary health assessments revealed levels of physical health that were comparable with the Australian population. The construction workers' mental health was poorer than the general Australian population. A consultation workshop with a representative group of workers at the site identified healthy eating, smoking cessation and physical exercise as priority areas for intervention. Several health promotion measures addressing these issues were implemented, including a quit smoking program, a "healthy options" menu in the site canteen, healthy eating and cooking workshops and on-site yoga and stretching sessions. A sub-set of workers at the site reported their health behaviour in weekly "logs." The log data revealed fluctuations in health behaviour over a 14 week period. Evaluation interviews and a focus group revealed environmental impediments to the adoption of healthy lifestyle behaviours. Workers at the site were positive about the health promotion planning model and appreciated the activities implemented. However, sustained improvements in health behaviour were not evident. Workers' identified the need to provide a work environment that is supportive of healthy behaviour as critical to the effectiveness of specific health promotion measures.

Keywords

Occupational health, blue collar workers, job demands, physical and psycho-social risk factors

Introduction

Why is workers' health important?

Health is an important resource contributing to economic and social wellbeing (Welch, 2009). Poor health keeps people from working and causes significant hardship. Longer life expectancy and declining birth rates experienced in Organisation for Economic Cooperation and Development (OECD) countries have led to an ageing population. The increased ratio of retired people, to people in employment places a significant strain on the economy. Health is an important determinant of sustained workforce participation (AIHW, 2010) and research shows that poor health often precedes early retirement (van den Berg, 2010, De Wind et al., 2013).

Construction workers' health

Research has highlighted the health gap between blue and white collar workers (Chu et al. 1997). Male blue-collar workers are a disadvantaged socioeconomic group, associated with poor health and high levels of chronic disease (Kolmet et al. 2006).

Construction workers are more susceptible to physical health complaints, such as musculoskeletal problems and chronic lung disease than other blue collar workers (Peterson & Zwerling, 1998). In the UK, Stocks et al. (2010) analysed instances of medically reported work-related ill health among construction workers and found elevated rates of contact dermatitis, all types of skin neoplasma, non-malignant plueral disease, mesothelioma, lung cancer, pneumoconiosis and musculoskeletal disorders. In the USA, 40% of construction workers over the age of 50 are reported to experience chronic back pain (Dong et al. 2012).

Construction workers are also susceptible to mental illness. Melzer et al. (2008) report a high rate of suicide among construction workers in England and Wales compared to other occupations. The incidence of mental distress among construction workers is reported to be twice the level of the general male population (Borsting Jacobsen et al. 2013). Peterson & Zwerling (1998) similarly report construction workers experience a significantly higher incidence of emotional/psychiatric disorders than other blue collar workers. A Dutch study of blue collar construction workers also reports high levels of burnout leading to early retirement (Oude Hengel et al. 2012).

Research reveals a link between construction workers' experience of physical and mental health symptoms (Abbe et al. 2011). For example, burnout, particularly its emotional exhaustion component, has been linked to a range of mental and physical health disorders and also to unhealthy behaviours (see, for example, Shirom et al., 2005). Borsting Jacobsen et al. (2013) report mental distress in construction workers is strongly significantly associated with the experience of lower back pain, having two or more pain sites and the experience of injury. Boschmann et al. (2014) also found that mental health problems significantly impact on the physical ability of bricklayers and construction supervisors to perform their work.

Aim

Much occupational health and safety (OHS) research focuses exclusively on the prevention of accidents that give rise to acute effect injuries, such as falls from height, collisions and structural collapses. Many developed countries have experienced significant reductions in the rate of accidental injuries in recent years. However, relatively less attention is paid to construction workers' health.

A participatory action research (PAR) study focused on improving the health of construction workers was undertaken in Queensland, Australia. The aim of this paper is to describe the approach taken in the research and present some preliminary results. Objectives are to:

i) describe the PAR health promotion planning model used in the research,
ii) present qualitative and quantitative data collected at the largest of three construction projects participating in the research,
iii) draw on the data to reflect upon the effectiveness of the health promotion measures implemented and the health promotion planning model itself, and
iv) explore and discuss the organizational and environmental constraints to the improvement of workers' health in the construction industry.

Literature review

Construction workers' health

Many construction workers suffer from permanent work incapacity and are forced to stop working due to health problems before they reach the statutory pension age (Oude Hengel et al., 2012, Brenner & Ahern, 2000; Welch, 2009). Even compared to other blue collar occupations, construction workers experience high levels of work incapacity (Arndt et al., 2005). In Germany, for example, up to 63% of construction workers retire early due to permanent disability (Siebert et al. 2001). In Australia, the Construction, Forestry, Mining and Energy Union has expressed concern about calls to increase the statutory pension age due to the likely impact on workers engaged in physically demanding work (Collett, 2014).

The causes of work disability are complex. Thus far, much focus has been placed on exposure to the physical demands of construction work itself (see, for example, Szubert and Sobala, 2005). Construction workers are exposed to many hazardous physical working conditions, including manual handling and exposure to vibration, noise, chemicals and dust (Snashall, 2005; Stocks et al. 2011). Rushton et al. (2008) estimate that over half of the occupational attributable cancer deaths in Great Britain are the result of exposures within construction itself. Stocks et al. (2011) report that incidence ratios for work-related illness differ between construction trades, with pipe fitters, electrical workers, plumbing and heating engineers, carpenters and joiners, scaffolders and labourers in building and woodworking trades at higher risk of developing long latency respiratory diseases and roofers, painters and decorators and labourers at higher risk of skin neoplasma.

Hazards are also present in the psychosocial work environment experienced by construction workers (Abbe et al. 2011). Hannertz et al. (2005) report that construction workers on a major European infrastructure construction project experienced higher levels of work disability than construction workers in general. They suggest that characteristics of major projects, including the need to work long hours, create an elevated health risk. Long work hours, typical of project-based construction work, are related to cardiovascular disease, diabetes, illness leading to disability retirement, subjectively reported physical ill health and fatigue (van der Hulst, 2003). Construction work is characterised by high demands and low levels of control, which are known to contribute to emotional disorders and mental health problems. Further, construction workers' health problems are compounded because workers are often casually employed, without access to paid sick leave, making recovery from injury and illness harder (Meerding et al. 2005).

Research also suggests that physical and psychosocial risk factors associated with construction work interact with one another to produce occupational disability and early retirement in construction workers. Research strongly suggests that physical and psychosocial health risk factors interact with one another to impact workers' health, occupational disability and early retirement in construction workers. For example, in a prospective study of 389,000 Swedish construction workers, Stattin and Järvholm (2005) report that physical, ergonomic and psychosocial work demands all substantially increased the odds ratio of construction workers' seeking a disability pension. Further, the effects of physical and ergonomic risk factors were exacerbated when workers reported little control over their work. Similarly, a Danish study revealed that both physical and psychosocial work factors predicted the early retirement of workers in physically heavy occupations. Extreme bending of the back, low skill discretion and low decision authority were all associated with early retirement. Low skill

discretion (a psycho-social risk factor) was a significant predictor of early retirement, even after controlling for disease (Lund et al. 2001).

Some research indicates that construction workers' health complaints increase with advancing age (De Zwart et al. 1999). De Zwart et al. (1999) also report older workers are more adversely affected by psychosocial job demands, including working under time pressure, a lack of employment security and a concern about unfavourable changes in the work environment, than younger workers. However, although age is a significant factor in workers' health, it may not be the most important factor. Arndt et al. (2005) note that the incidence of work disability in construction workers increases with age but the dose-response relationship between work exposure to health risks and occupational disability persists even when age is controlled. They conclude that work-related causes of occupational disability outweigh age in importance.

Individual "lifestyle" health risk factors

Poor health and occupational disability are often attributed to health risk factors related to lifestyle behaviours and individual bio-medical characteristics. For example, Claessen et al. (2009) describe a longitudinal cohort study of construction workers which revealed a body mass index indicating obesity was related to occupational disability due to osteoarthritis and/or cardiovascular disease in a follow up period of approximately ten years. Similarly, Alavinia et al. (2007) report that health status determined by physical health examination of 19,507 Dutch construction workers (including high body mass index, the presence of pulmonary problems and a 10-year risk for cardiovascular disease) was a significant predictor of the ability to work.

Given the relevance of lifestyle factors in shaping health outcomes there is a growing emphasis on addressing lifestyle health risks in the construction workforce. Many programs have sought to improve construction workers' health through individual behaviour change programs (Groeneveld et al., 2010; Ludewig et al., 2003). For example, Sorensen et al. (2007) describe how an individual information campaign produced significant benefits in smoking cessation and consumption of fruit and vegetables in US construction labourers. Gram et al. (2012) demonstrated improved aerobic capacity among Danish construction workers who participated in a physical exercise program. Notwithstanding this, the individual behaviour change focus of many health promotion programs has been criticised on the basis that it draws attention away from the socio-economic, environmental and organizational causes of poor health (Chu et al. 1997).

There is some evidence to suggest that workers' health and occupational disability are best understood as arising from the interplay between occupational risk factors and lifestyle factors, or health behaviours (Van den Berg et al. 2010). For example, Arndt et al. (2005) identify musculoskeletal disorders, cardiovascular disease and mental disorders as causes of occupational disability among construction workers in Germany and link these to both occupational risk and lifestyle factors. Oude Hengel et al. (2012) report a combination of occupational and individual factors to predict construction workers' ability and willingness to work until they reach the pension age in the Netherlands (i.e., 65 years).

In some instances the work-relatedness of health impacts may be difficult to "disentangle" from lifestyle risk factors because the links may be indirect and interactive. For example, research indicates psychosocial stress at work is linked to impaired sleep (Åkerstedt et al. 2006). Insufficient sleep is associated with high body mass index and obesity (Bjorvatn et al.

2007; Gangwisch et al. 2005) and is also an identified risk factor for cardiovascular disease and diabetes (Gottlieb et al. 2006; Gangwisch et al. 2006; Speigel et al. 2005). Thus, the health impact of psychosocial stress experienced at work may, in fact, manifest in health-related behaviour linked to illnesses more commonly attributed to "lifestyle."

Research indicates that the way that construction work is organized may in fact have a more substantial impact on workers' health than individual behavioural or lifestyle factors. For example, in the Netherlands, Alavinia et al. (2007) found work-related factors (such as low levels of job control, high work demands, job strain, a lack of support at work and ergonomic hazards) to be more significantly related to workers' health than individual factors. Similarly, in Sweden, Stattin and Järvholm (2005) report features of the physical and psychosocial work environment (including physical and environmental hazards, work-life strain, lack of job control, work stress and high work demands) were stronger predictors of construction workers experience of musculoskeletal, cardiovascular, psychiatric and respiratory diseases than individual factors.

Research has also identified social and cultural determinants as being relevant to the health of male, blue collar workers. For example, Kolmet et al. (2006) interviewed Anglo-Australian male blue collar workers and found that, although workers are concerned about their health, they also experience a tension between cultural constructs of masculinity (for example, the need to feel "in control") and their work situation. In construction, employment is rarely secure, work is performed under extreme time pressure, workers often spend significant amounts of time away from their families and have little ability to control the way that they perform their work. Kolmet et al. (2006) describe how the socio-economic vulnerability experienced by the workers they interviewed created a sense of disempowerment and resignation to the likelihood of diminished life expectancy.

Given the emerging evidence that the way that construction work is organized and conducted is likely to interact with and influence workers' lifestyle and health behaviours in a complex but significant way, there is a need to better understand the circumstances in which workers can be encouraged and supported to improve their health behaviour. This research attempted to address this gap in the extant literature.

The research context

The research was undertaken as part of the "Workplaces for Wellness" program, an initiative of the Queensland Government designed to support workplaces to implement programs that improve the health and wellbeing of workers. The scheme specifically focuses on "SNAPO" health risk factors (i.e, smoking, poor nutrition, excessive alcohol intake, physical inactivity, and obesity) (See Begg et al. 2008). Thus, the focus is on addressing lifestyle health risk factors.

The PAR process (described in detail below) was implemented at three construction projects in Queensland. The remainder of this paper describes the implementation and evaluation of the PAR process and specific health promotion measures focused on the SNAPO risk factors at the largest construction project participating in the research.

Research methods

Participative action research

The participative action research (PAR) approach engages people in the research environment (in our case in participating construction sites) in the generation of context-specific solutions to their own problems. During the research, participants analyse and reflect on data and determine what actions should follow. Once actions have been implemented, further analysis and reflection occurs in an iterative process (Baum et al. 2006). Those involved are actively engaged in the process of reflection, change and evaluation (Patton, 1990). In contrast to conventional research, PAR assumes equality between researchers and those being researched. Participants become co-learners in the process of change.

The PAR approach is ideally suited to the implementation of workers' health programs because, when workers actively participate in the design, implementation and evaluation of programs, they more likely to produce interventions that fit well with the organizational context and culture, and will be accepted and utilised (Nielsen et al. 2010). The fundamental assumption of the PAR process is that male, blue collar construction workers know what affects them and are in the best position to provide ideas about how to improve their health (Kolmet et al. 2006).

The health promotion planning model

The health promotion planning model implemented in the research was informed by previous examples of work health planning processes (see, for example, Goetzel et al. 2007; Chu et al., 1999). The model was based on the PAR approach previously described. Steps in the process were:

(1) Engagement

At each participating worksite initial contact was made with the project management group, whose approval for the research to take place at the site was sought. Management expectations about issues, such as the health promotion process steps, the scope of the project (i.e, limited to blue collar workers) and resourcing requirements were established.

(2) Coordination mechanism

A working group was formed at each site to oversee the PAR process. A site coordinator was appointed. Existing frameworks were used as far as possible, for example, the health and safety representatives working for each of the major subcontractors were invited to join the working group. This group subsequently facilitated communication between the research team, project management team and workers on-site.

(3) Needs assessment

A preliminary needs assessment was undertaken. A survey was undertaken with as large a sample of workers as possible. A representative group of workers was invited to participate in a workshop to consider the results of the survey and discuss the types of health promotion measure that would benefit workers in their work areas. The needs assessment was a reflective process with the objective of determining what type of health promotion measures should be implemented at each site.

(4) Consultative action planning

Following the workshop, a series of recommendations was made to the project management group at each site. The site-based working group and project management team agreed on specific health promotion measures to be introduced at each site.

(5) Implementation

The agreed health promotion activities were implemented at each site. The implementation was overseen by the site-based working group.

(6) Evaluation

The impact of the health promotion measures was evaluated. During the implementation, a continuous stream of data was also collected using weekly "logs." This longitudinal data could be examined to ascertain changes in lifestyle and health-relevant behaviour over the research period. The log data could also be examined in relation to the construction schedule at each site to ascertain whether time-critical construction activities impacted workers' health-related behaviours and experiences. A sample of workers was interviewed to explore their opinions about the use, benefits and effectiveness of the health-promotion measures implemented at each site.

(7) Model reassessment and refinement

The health promotion planning model was subjected to a formative process evaluation. Oude Hengel et al. (2011b) argue that process evaluation is important because it provides detailed information about the context of the workplace which can be useful in understanding how or why a health promotion activity has been effective or not. Thus a formative process evaluation focus group was held with workers to elicit their feedback on the implementation of the PAR process.

Data collection

Throughout the research period a number of different methods were used to collect data. Qualitative and quantitative data collected were combined to provide insight into workers' health, the impact of the health promotion measures and participants' experiences of the health promotion planning model. These data collection methods are described below.

Health survey - At the beginning of the PAR process a health survey was conducted with workers. The Australian version of the SF-36 instrument was used to measure health status. The SF-36 is a generic, multi-purpose short form survey that produces an 8-scale profile of health and wellbeing (Ware, 1999). The SF-36 is widely used and accepted as a reliable measure of health status (Garratt et al, 2002; McDowell & Newell, 1996). Further, the construct, criterion and content validity of the SF-36 has been demonstrated (Maruish, 2011). The SF-36 was selected because it is suitable for use in all age groups and Australian weighted population norm scores are available against which we are able to compare results (Hawthorne et al., 2007; Butterworth & Crosier, 2004).

Weekly logs – Workers at each participating site were invited to complete a weekly log. This was a short instrument that collected data relating to health behaviour on a week by week basis. Questions related to the SNAPO factors as follows:

- smoking, e.g., "in the past week how many cigarettes did you smoke on a typical day?" (scored on a four point scale ranging from 10 or less, 11-20, 21-30 and 30 or more cigarettes).
- nutrition, e.g., "in the past week, how many serves of fruit/vegetables did you eat in a typical day?" (scored on a five point scale ranging from 1 or less, 2, 3, 4 or 5 or more serves) and "how many days in the past week did you consume junk food?" (scored on a seven point scale ranging from 0 to 7 days).
- alcohol consumption, e.g. "in the past week, how many days did you drink alcohol?" (scored on a three point scale from 1-2, 3-5, and 6-7 days) and "how many standard drinks did you have on a typical day that you drank alcohol?" (scored on a two point scale from 1-2 and 3 or more standard drinks).
- physical exercise, e.g., "in the past week, outside of work hours how often did you do 30 minutes or more of physical exercise?" (scored on an eight point scale from 0 to 7+ times)

Participants were asked about intentions to quit smoking, whether they considered themselves to be overweight and, if so, whether they had done anything in the preceding week to lose weight. Participants were also asked to provide reasons for their responses in a free text field at the end of each log.

Consultation workshop – A consultation workshop was held with a representative group of workers from each project. The workshop was facilitated by the research team and elicited workers' preferences for the types of health promotion measures to be implemented at each site. The research team posed the following questions to workshop participants: (1) What would you like to do to improve your health? (2) What would you need to achieve this? (3) What challenges or barriers might you face? and (4) How can these be overcome? Responses and discussion were documented for later analysis.

Evaluation interviews – After the implementation of the health promotion measures, semi-structured interviews were conducted with a subset of workers at each site. These interviews explored workers' experiences and perceptions of the effectiveness of the health promotion measures, as well as factors that help and hinder changing health-related behaviours. The interviews were recorded by a stenographer skilled in short hand and transcription, to enable reliable transcripts to be produced for later analysis.

Focus group – A focus group was held to seek workers' feedback on the health promotion planning model itself and the implementation of the PAR process. The focus group was recorded by a stenographer skilled in short hand and transcription.

Data analysis

The health survey data was analysed using a customised software package developed specifically to analyse the SF-36 data (i.e., the Quality Metric Health Outcomes Scoring Software, version 4.5). Data are standardised using a norm-based scoring method enabling scores for the eight health domains and the component summary measures to be compared against population norms. Scores for all dimensions are expressed on a scale 0-100, in which higher scores indicate better health. The procedures for item recoding, summing the responses for each of the variables that make up the scale, transforming the scales into scores ranging from 0 to 100, and standardisation and normalisation, were performed according to procedures recommended by the SF-36 developers (see Maruish, 2011).

The weekly log data was collated and visually examined to determine whether changes in lifestyle behaviours could be discerned over the research period. The qualitative interview and focus group data was subjected to content analysis to identify themes relating to:

(1) the effectiveness of the specific health promotion measures implemented at each site, including factors that supported and impeded health behaviour change, and
(2) the overall usefulness of the health promotion planning model, including opportunities to improve the implementation and effectiveness of the model.

Results

Case study: hospital construction project

To illustrate the health promotion planning model in practice, data collected at the largest construction project involved in the research is presented below. The project is a $1.8 billion 738 bed public hospital which will be constructed over four years.

A total of 90 construction workers completed the health survey at the hospital construction site, representing 37.5% of the blue collar workforce at the time.

Table 1 presents the demographic characteristics of survey participants. More than half of the participants were 39 years of age or younger (57.8%, n=52). The majority of participants (67.8%, n=61) indicated they live with a partner/spouse and most also indicated that they have children (62.2%, n=56). The most commonly represented occupations were technicians and trades workers (52.2%, n=47) and labourers (17.8%, n=16). A very large proportion of participants indicated they are employed by a subcontractor engaged by the principal contracting organization at their worksite (95.6%, n=86). The majority (38.9%, n=35) reported working 46-50 hours each week, with 31.1% working more than 50 hours each week.

Table 1. Demographic characteristics of survey participants

	N	%		N	%
Age			**Living arrangement**		
Under 30	29	32.2	Live with partner/spouse	61	67.8
30 - 39	23	25.6	Live alone	28	31.1
40 – 49	18	20.0	Missing	1	1.1
50 – 59	16	17.8	**Employment status**		
60 or over	3	3.3	Directly employed	3	3.3
missing	1	1.1	Sub-contractor	86	95.6
Parental status			Missing	1	1.1
Children	56	62.2	**Work group**		
No children	34	37.8	Technicians and trades workers	47	52.2
Hours worked per week			Machinery operators and drivers	12	13.3
40 or less	9	10.0	Labourers	16	17.8
41-45	17	18.9	Supervisors	10	11.1
46-50	35	38.9	Other	5	5.5
51-55	16	17.8			
56 and over	12	13.3			
Missing	1	1.1			

Health status relative to Australian population norms

Figure 1 shows the scores for the construction workers for each of the eight health domains measured by the SF-36. The scores are presented adjacent to Australian norm scores for each domain (see, Hawthorne et al. 2007). The construction survey participants had slightly higher scores for physical functioning, role-physical, bodily pain, and general health and vitality compared to the Australian population norm scores. However, the construction participants' scores for social functioning, role-emotional, and mental health were below the Australian population norm scores.

INSERT FIGURE 1

Figure 2 show the physical component summary score (PCS) and mental component summary score (MCS) relative to the Australian population norm scores. The PCS score of the male blue collar construction workers in our sample was slightly above the Australian norm score. While, the MCS score was below the Australian norm score.

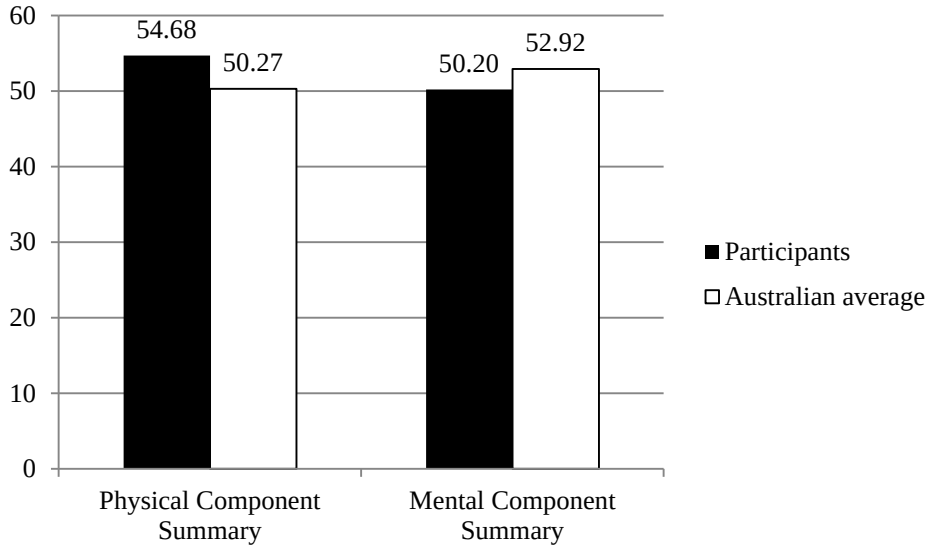

Figure 2. Physical component summary score and mental component summary score relative to the Australian population norm scores.

Workers' health concerns and priority issues
Twenty-four people participated in the initial consultation workshop. In response to the question, "What would you like to do to improve your health?" participants identified a desire to eat more healthy food, give up smoking and engage in more physical exercise as priority issues. When asked what they would need to help them achieve improved health behaviour in relation to these issues, participants commented that the provision of awareness and support for healthy eating would be beneficial. Participants perceived they lacked the knowledge required to make healthy food choices. One participant commented: "*There's a lack of education. They don't teach healthy eating in schools. People come out of school unarmed*". There was a perception that lack of education had led to formation of poor eating habits, and that education was required. A participant commented that knowledge about food was important: "*We need knowledge about what's in the food we're eating. How's it healthy? What's it doing to us?"* There was a concern that lack of awareness was perpetuating bad habits, and this was evident on site. A participant noted that: "*We get 18 year olds show up on the job and they don't have breakfast*". Participants suggested that healthy food options be provided at the site canteen, alongside information about nutrition and healthy food choices. Participants also identified smoking cessation and increasing levels of physical exercise as priority areas for improvement.

Participants identified the limited time they have outside of work as a significant barrier to being able to engage in healthy behaviour. Workers worked six days per week, and often had to travel long distances for work. During the summer months, the site operated from 6am, and during winter from 6.30am. Finishing time varied according to overtime worked. Participants indicated they were frequently unable to find the time to prepare and eat healthy food or engage in physical exercise. For example, one participant commented that "*long work hours does not leave enough time to do anything else"*.

Participants also commented that long working hours impacted upon energy levels. After a long working day, participants indicated they had little energy to engage in physical activity. There was a sense workers needed some "time out" to rest and relax after a full and demanding day of work. Many participants however, struggled to find time to relax on their

day off as it was spent on chores. One participant commented: "*You spend your day off doing chores…we're just not getting time to relax – you have one day off and its back to work*". Another participant commented: "*Sometimes I just decide I will take time out - just not do the chores. Just so I can have some time to myself. The grass is just going to keep growing regardless of whether I cut it or not".*

Making and sustaining change was a challenge identified by participants. Willpower, motivation, and changing bad habits were highlighted as important factors required for maintaining a healthy life style. While participants understood that making changes to support their health would be beneficial, such change was deemed a challenge. Changing poor habits was difficult, and this was highlighted by a participant who commented: "*You get into a cycle. There's not enough time. It's hard to step back and make a change in your lifestyle. You get into a pattern of eat, smoke, drink, sleep. Then you wake up and do it all again. Before you know it you have put on 20 kilos"*.

Given their time poverty, participants suggested that opportunities to engage in physical exercise and healthy behaviour during work hours would be most helpful to them. Participants also suggested that mentoring, role modelling and peer support may assist with making sustained changes to lifestyle health behaviours. For example, one participant explained: "*A bit of reassurance from people you know. Your mates saying 'good effort' when you've given up smoking. A bit of peer support*".

Workers' lifestyle and health-related behaviours
Weekly logs were collected for 13 weeks. The number of logs received ranged from 19 to 99 per week and the average was 40.

Figure 3 shows the weekly log data relating to daily serves of fruit and vegetables, and the number of days of the week in which junk food was eaten. The daily serves of fruit and vegetables and frequency of junk food consumption fluctuated over time. There was a public holiday (Easter) break during weeks 6 and 7. During this period, the log data suggests workers' junk food intake increased. Participants explained that they were "out of routine", and "on the go" during this time. For example, one participant explained: "*[we are] out doing things that you might not usually be doing – eat a lot of food on the road, do a few trips here and there*". Another participant commented on actively choosing to eat unhealthy takeaway food during time away from work: *"[I] want to get out of the routine. Go home for a few beers, then send the kids down the road to get fish and chips*". During week 8, the site canteen opened with healthy food options, and there was a healthy eating and food tasting session for workers at the site. Daily serves of vegetables increased from week 8 through to week 10, while junk food intake declined. During week 11, there was a decrease in daily consumption of fruit and vegetables and junk food was also consumed on more days of the week. In week 12, workers reported eating junk food less frequently but also indicated eating fewer serves of fruit and vegetables.

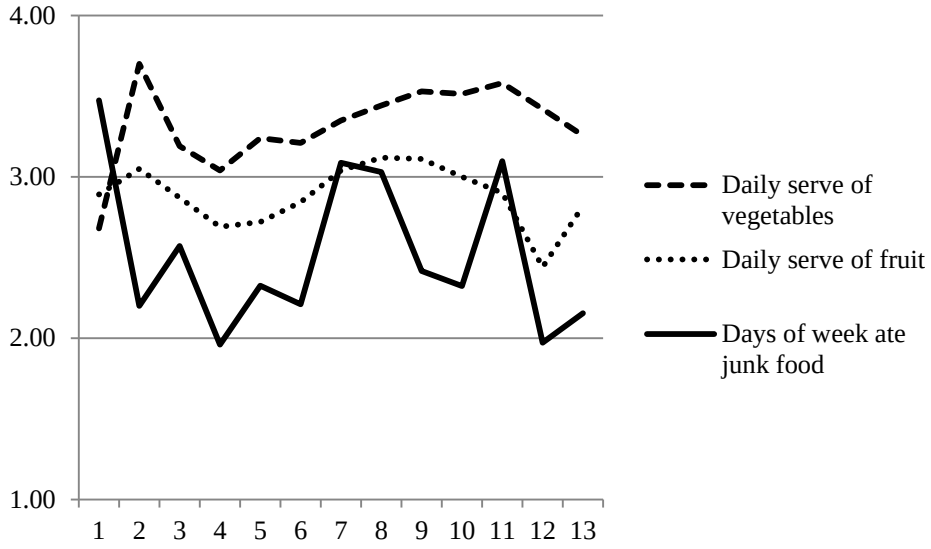

Figure 3. Serves* of fruit and vegetables per day, and number of days per week junk food was eaten.

*1 serve of vegetables = ½ cup cooked vegetables or 1 cup salad vegetables; 1 serve of fruit = medium sized apple/orange/banana or 2 apricots/kiwi fruit or ½ cup tinned fruit.
#junk food is defined as food high in fat, salt or sugar (such as deep fried foods, hot chips, pies, pastries, chocolates, donuts).

On average 10.6 log participants each week indicated they smoked. Figure 4 shows weekly data relating to these smokers' intention to give up smoking. During week 4, a "Quit" smoking cessation program commenced at the site. The program was available to workers and their family members. Log data for week 4 suggests that intention to give up smoking decreased. From week 5 to week 7, intention to give up smoking slightly increased. Week 8 and week 10 indicated a decrease in workers' intention to give up smoking. The fluctuations may be due to some workers attempting to give up smoking, and then reverting back to smoking due to physical side effects and mood swings. For example, one participant explained: "*There have been a lot of grumpy guys getting around including myself. I tried (giving up smoking) for a couple of days but it didn't work out but I had a go and I might have another go*".

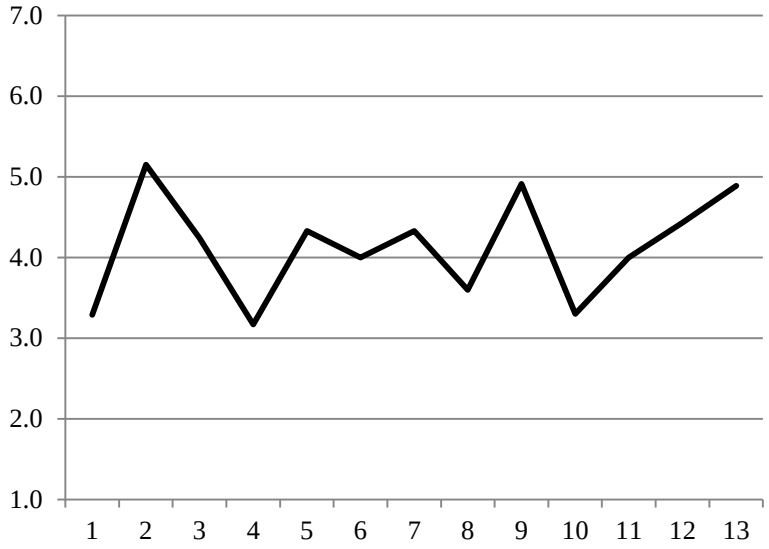

Figure 4. Intention of smokers to give up smoking (1=not at all keen to stop smoking; 7=very keen to stop smoking).

Figure 5 shows the frequency of physical exercise reported by participants. Physical exercise increased slightly during week 2 and then again during weeks 6 and 7, and weeks 9 and 12. During weeks 2 and 12, workers had an extra day off due to a rostered day off. During weeks 6 and 7, workers were on an extended Easter break. The increase in physical exercise levels during these weeks is possibly related to the availability of time to engage in physical exercise and leisure activities. The reason for the increase in physical exercise in week 9 is unclear.

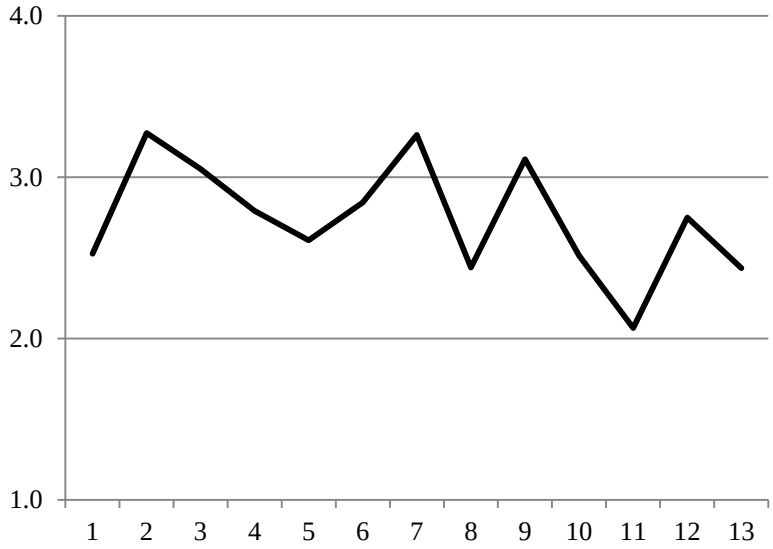

Figure 5. Average frequency of physical activity undertaken per week, which is conducted outside of work hours and is for 30 minutes or more.

Evaluation interviews

Twelve site-based workers participated in interviews to evaluate the specific health promotion strategies implemented at the project. Participants were asked to reflect on the strategies offered at the project, indicate which strategies they had engaged with, and consider the barriers and supports for engaging in healthy behaviour. Six themes emerged from the interviews; motivation, communication, culture, site environment, access to strategies, and value of strategies. These themes are summarised in Table 2. Generally workers' motivation to change their health behaviour was driven by individual family or personal health circumstances. Participants indicated that the strategies introduced to help workers to give up smoking and prohibit alcohol consumption at the project had produced positive health benefits. However, some workers perceived cultural or organizational impediments to utilising the health strategies. Notwithstanding the constraints on the use of the strategies, the workers interviewed expressed appreciation that the project management team were making efforts to help site-based workers to improve their health.

Table 2. Themes emerging from interviews.

Motivation	The strategies offered onsite did not motivate participants to change their behaviour. Instead, they acted to support established healthy behaviour. Family was a key motivator for living a healthy lifestyle. Some participants had given up drinking alcohol and smoking when their first child was born. Another key motivator for living a healthy lifestyle was the requirement to address serious health issues such as skin disorders and cirrhosis of the liver. Some participants were not motivated to change unhealthy behaviour such as drinking and smoking although they understood that it could be detrimental to their health.
Communication	Communication was a key issue in raising awareness and knowledge of strategies implemented at the site. Some participants were not aware of strategies implemented at the site as there had been no discussion at a group level. While it was acknowledged that there were some posters advertising strategies, these had been not noticed and therefore the message had not been effectively conveyed.
Culture	Culture was perceived as an impediment to utilising some strategies, particularly the yoga initiative. Some participants believed that they would be ridiculed by their co-workers for participating and therefore opted not to participate.
Site environment	Participants indicated that the site environment had impacted upon alcohol and smoking frequency, and this was perceived as a positive outcome. The site was alcohol-free and therefore workers were unable to "have a few beers with the crew" after work. Cigarettes were not sold at the canteen and smoking was not allowed in the lunch area. To support smokers to give up, a "Quit" smoking cessation program was offered to workers and members of their family. Some workers had participated in the Quit program.
Access to strategies	The way in which work was organised precluded some workers from participating in schedules sessions, such as the food tasting, and yoga and stretching. For example, a crane coordinator explained that if he or one member of his team had attended a session then the crane was unable to operate, as all team members were required for the crane to operate. Strategies that were accessible at all times were

	considered helpful as all workers could participate at a time that suited them. For example, the fresh fruit stall was available all day and workers could access it during their break.
Value of strategies	For many workers, this was the first time they had experienced a site which was implementing strategies to improve workers' health. The program was valued by workers, irrespective of whether they had participated in the health initiatives or not.

PAR process evaluation focus group

Twenty-two workers participated in a focus group to evaluate the PAR process and health promotion planning model. Participants were asked to reflect on the specific health promotion strategies offered at the project, and indicate how work, structural and cultural factors had impacted on the uptake of strategies. Themes emerging from the focus group are summarised in Table 3. Themes included time and trade-offs, impact of physical work, age, increased awareness of healthy eating, smoking, and the drinking culture. Workers indicated that the way that work was organized (including very long hours) made it very hard to engage in healthy lifestyle behaviours, particularly as they were physically exhausted at the end of the working day. However, participants did perceive that awareness of nutrition and healthy eating had increased as a result of the action research.

Table 3. Themes emerging from the evaluation workshop.

Time and trade-offs	Lack of time was considered the biggest barrier to maintaining a healthy lifestyle. Limited time outside of work forced workers to prioritise and trade-off activities. Time with family was prioritised over physical activity and exercise. As a result, there was no time left for physical activity and exercise. Some participants traded-off sleep and rest for physical activity and exercise. For example, one participant reported walking his dog at 3.45am before he commuted to the site.
Impact of physical work	Some participants perceived that they did enough exercise during the day as part of their job, and therefore did not need to do additional exercise when they left work. The project worksite was very large and there were a lot of stairs. Other participants explained that working on manual tasks in the heat led to exhaustion by the end of the day, and that they had no energy left for exercise.
Age	It was acknowledged that as workers got older, energy levels decreased, injuries increased, and the ability to recover from work became more difficult. Some workers who had exercised in the past no longer had the energy to do so after finishing work. One participant explained: "*[I] Don't want to be more physical (outside of work). Most of us are over 50. I used to do the gym 3-4 times a week but I am getting more injuries now as I get older*".
Increased awareness of healthy eating	Free fruit and introducing healthy options into the canteen had a positive impact on workers. Awareness was raised through information, easy access to healthy food, and discussion about nutrition amongst workers had increased.
Smoking	The site offered a "Quit" smoking cessation program to workers and their families, and some participants had used the program. While some had successfully given up, others had gone back to smoking as they had been "*angry, grumpy, and hard to work with*". Participants

	acknowledged that giving up smoking was difficult and took motivation and willpower. However, these individuals were keen to try again due to the negative health impacts of smoking.
Drinking culture	Participants perceived that the drinking culture of the construction industry reflected the Australian drinking culture. Many of the participants drank alcohol most days. One participant explained: "*At 2.30pm that is all you think is a beer, particularly when it's hot*". Another participant commented: "*It is hard enough trying to stay off the drink Monday-Wednesday but Thursday to Sunday, I have given it a real nudge by Sunday*". Participants acknowledged that drinking alcohol was associated with an increase in smoking cigarettes and eating junk food.

Discussion

Workers' health status

Participants in the health survey at the hospital construction site reported higher levels of physical health than are reflected in Australian population averages. This finding is somewhat inconsistent with the extant literature that shows that construction workers' physical health is often poor. The workers who completed the survey were relatively young with 57.6% under the age of 40. It is possible that older workers are not represented in the sample because they have already left the workforce, leaving only healthy older workers in employment (Siebert et al. 2001). It is not possible to ascertain the extent to which a "healthy worker survival" effect is present in the data and future research into this possibility is required.

The results of the health survey also revealed that the mental health of the sample to be slightly lower than Australian population averages. The mental health of the construction workforce has been linked to excessive job demands and low levels of control and support (Leung et al., 2008; Love et al., 2010). However, previous research has focused exclusively on job stress and mental health of white collar construction workers. More research is needed to provide a better understanding of the mental health risk factors that affect blue collar construction workers. For example, concerns about continuity of employment may be felt more acutely by this group of workers because their employment relies on precarious subcontracting arrangements and sometimes casual employment relationships.

The effect of the health promotion measures

The weekly log data indicated that the specific health promotion measures implemented during the course of the research did not produce steady or sustained improvements in workers' health behaviour in relation to the SNAPO factors they addressed.
Although some short term improvements in consumption of fruit and vegetables and reduction in the frequency of consumption of junk food when healthy eating strategies were introduced at the site, these improvements were not sustained. The log data suggested that extraneous events may have had a greater impact on workers' health behaviour than the health promotion strategies implemented. For example, physical exercise appeared to increase when workers had more time off work (a rostered day off or public holiday). The data suggests healthy eating habits were also affected by time away from work. However, contrary to expectations, workers consumed less healthy food when they were not at work.

Some international research designed to improve construction workers' health behaviour has also yielded disappointing results (see, for example De Boer et al., 2007; Oude Hengel et al.,

2010; 2013). Neither of these large scale randomised controlled trials produced significant improvements in workers' health or work ability. Oude Hengel et al. (2012) suggest that health promotion programs can be subject to "theory failure" which describes a situation in which interventions designed to improve workers' health behaviour fail because organizational constraints and workplace cultures are not conducive to such change. Qualitative data collected during the individual interviews with workers suggests that cultural and organizational factors in the project work environment may have impeded the effectiveness of the specific health promotion measures introduced at the hospital construction site.

Organizational and workplace factors

The research findings strongly suggest that the way that work is organized, in particular the very long work hours and six day work schedules, are a major factor influencing workers' health/lifestyle behaviours. International research supports the contention that the way construction work is organized may have a more substantial impact on workers' health than individual or motivational factors (see, for example, Alavinia et al., 2007; Stattin & Järvholm (2005). These researchers found that poor work-life balance, low levels of job control, high work demands and low levels of support were stronger predictors of construction workers' experience of musculoskeletal, cardiovascular, psychiatric and respiratory diseases than individual factors.

Structural impediments to good health

Work hours, work-life imbalance and insufficient time outside work were frequently cited by participants in our sample as reasons why they could not engage in healthier lifestyle behaviours. Participants described getting up early in the morning for a 6.30am start, arriving home in the late afternoon, and going to bed early. One participant commented: "*I get up at 3.30am, home at 5.30pm, bed 9pm. Put the kids to bed then half an hour later I go to bed"*. Participants explained how they had limited time outside of work to engage in physical activities. For example, one participant commented that he would like to increase his physical activity but lack of time was the major barrier for him: "*Time is the biggest one (barrier), I would probably do more exercise by myself if I had more time. A swim or a bike ride*". Another participant commented: "*Time is the biggest barrier. If you don't have the time, you don't have the time. If you want to do something extra in your day, you will be doing it before you go to work in the dark. By the time you get home, you are exhausted and just want to sit down, you don't want to do anything*".

In the extant literature, long work hours and poor work-family balance are consistently linked to chronic disease risk factors including: (i) poor diet (Devine et al. 2006); (ii) high cholesterol (Van Steenbergen & Ellemers, 2009); (iii) lack of physical exercise and low physical stamina (Burton & Turrell, 2000; Van Steenbergen & Ellemers, 2009).); (iv) body-mass index (Van Steenbergen & Ellemers, 2009); and (v) harmful levels of alcohol consumption (Frone et al. 1997; Roos et al. 2006). Australian construction workers have, themselves, attributed their high levels of alcohol use to working long hours (MacKenzie, 2008). Similarly, Devine et al. (2007) reveal how negative spillover between work and family life interferes with meals and leads construction labourers to make unhealthy food choices. Arguably, changing the way that work is organized is required in order to create the requisite environmental conditions within which it is possible to improve construction workers' health behaviours.

Social and cultural factors

Some workers indicated they were reluctant to utilise the onsite yoga and stretching intervention provided because they perceived that this would result in them being ridiculed. One worker commented "*There are over 400 blokes here. Call it pride but there is no way you going to get me involved with yoga*". Kolmet et al. (2006) describe how cultural constructs of masculinity in male blue collar work environments negatively impact workers' health. Du Plessis et al. (2013) also describe how "hyper-masculine" subcultures develop in male, blue collar work environments. In these sub-cultures unhealthy lifestyle behaviours are often inadvertently promoted and workers who seek help with health problems are regarded as "weak" (Iacuoni, 2005).

The health promotion planning model

Participants in the focus group were generally positive about the health promotion planning model. For example, one participant commented: "*What they are doing is great – opening people's eyes up*". Another participant commented: "*The blokes see that (the lead contractors) are finally doing something for us, it is good. It says heaps*".

However, a number of areas for improvement were identified. These include the need for a more holistic approach to promoting workers' health that addresses the organizational and environmental barriers to healthy lifestyle behaviour.

Social ecological health models

Our results are consistent with social ecological theories of health, which recognise that aspects of the physical and organizational work environment significantly shape workers' health (McLeroy et al. 1988, Ettner & Grzywacz, 2001). The results suggest that, although the health promotion measures implemented at the hospital construction site were well intentioned and appreciated by workers, organizational and cultural barriers constrained the extent that these measures translated into sustained changes in workers' health behaviour. Social ecological health theories hold that promotion measures implemented in an environment that is not supportive of healthy behaviour will produce weak or short-lived benefits (Sallis et al. 2008). Our results suggest that long term and sustainable improvement in construction workers' health requires a holistic approach which addresses the environmental conditions that currently act as impediments to workers' adoption of healthy behaviours. Similarly, Boschman et al. (2014) argue that, to be effective, health promotion programs should not be solely focused on workers' lifestyle and behaviour but must also address physical and psychosocial risk factors in the construction work environment.

Conclusions

Our results reveal that health promotion measures designed to change workers' health behaviour, specifically in relation to the smoking, physical exercise and nutrition SNAPO factors, were of limited effectiveness. While construction workers at the hospital construction project appreciated the efforts of management to implement health promotion measures, workers identified aspects of the work environment that prevented them from changing their health-related behaviours. The results support social-ecological approaches to understanding construction workers' health because the work environment itself has an important influence on workers' lifestyle and health behaviour. Indeed, the way that project-based work is organized and conducted was identified as a significant constraint to the adoption of a healthy lifestyle. The masculinity of the prevailing work culture was also instrumental in shaping

workers' responses to the health promotion strategies that were implemented at the hospital construction project.

Our results suggest that the underlying environmental causes of construction workers' unhealthy behaviour may be structural and significant. The research provides important implications for the design and development of health promotion strategies for the construction industry. Most notably, the results reveal that male, blue collar construction workers are interested in and concerned about their health. They recognise the importance of healthy lifestyle behaviours but feel constrained in the extent to which they are able to change their lifestyle and health behaviour due to a lack of knowledge, the long hours that they work and competing demands on their time. The results of this research suggest that, to be effective, health promotion interventions designed to improve construction workers' health need to address the environmental and organizational constraints that presently militate against healthy lifestyle and behaviour. Indeed, health promotion measures will be more likely to succeed if they are informed by social-ecological health models and designed to create a work environment that is supportive of behaviour change while also making available the resources workers' need to change their health behaviour. It is likely that interventions focused on changing construction workers' health behaviour will be of limited benefit unless the cultural and organizational barriers to pursuing a healthy lifestyle identified in this research are not addressed. If the underlying environmental causes of poor health in construction do not change, then individuals' health behaviour will be difficult to change.

The research also highlights new areas for research. Most notably, further evaluation research is needed to investigate the potential benefits associated with designing and implementing holistic approaches to improving construction workers' health. In particular, the PAR process could be replicated to evaluate the impact of health promotion interventions that specifically target some of the environmental constraints to health behaviour change identified in this research. Key questions arise as to whether health promotion interventions targeting the way that project-based construction work is organized and conducted can create the necessary conditions to support health behaviour change. Important theoretical questions also arise as to whether organizational and behavioural health promotion interventions are most effective if they are implemented sequentially or concurrently. For example, is it important to create a supportive environment before attempting to change workers' health behaviour? The research presented in this paper is continuing in an attempt to answer these questions and develop a deeper understanding about how best to address and improve male blue collar construction workers' health.

Limitations

The research presented relates to the evaluation of a health promotion intervention at a single albeit large construction project in Queensland, Australia. The research findings cannot be generalised to the construction industry as a whole and no attempt is made to do so.

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