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RUNNING HEAD: Weight loss program for male shift workers

Efficacy of a workplace-based weight loss program for overweight male shift workers: the Workplace POWER (Preventing Obesity Without Eating like a Rabbit) randomized controlled trial

Philip J. Morgan[1], Clare E. Collins[2], Ronald C. Plotnikoff[1], Alyce T. Cook[1], Bronwyn Berthon[1], Simon Mitchell[3] & Robin Callister[4]

[1] School of Education, Faculty of Education & Arts, University of Newcastle, Australia;

[2] School of Health Sciences, Faculty of Health, University of Newcastle, Australia;

[3] Tomago Aluminium, Tomago, Australia;

[4] School of Biomedical Sciences and Pharmacy, Faculty of Health, University of Newcastle, Australia.

Corresponding Author:

Associate Professor Philip Morgan
School of Education
Faculty of Education and Arts
University of Newcastle
Callaghan NSW Australia 2308
+ 61 2 4921 7265 (PH)
+ 61 2 4921 7407 (Fax)
Philip.Morgan@newcastle.edu.au

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ABSTRACT

Objective: To evaluate the feasibility and efficacy of a workplace-based weight loss program (Workplace POWER - WP) for male shift workers.

Method: A prospective, two-armed randomised controlled trial of 110 overweight/obese (BMI 25-40) (mean [sd] age = 44.3 [8.6] years; BMI = 30.5 [3.6]) male employees at Tomago Aluminium aged 18-65. In October (2009) men were randomized to either (i) WP program (n = 65) or (ii) 14-week wait-list control group (n = 45). The 3-month program involved one information session, program booklets, group-based financial incentives and an online component. Men were assessed at baseline and at 14-week follow-up for weight (primary outcome), waist circumference, BMI, blood pressure, resting heart rate, and self-reported physical activity and dietary variables, and physical activity and dietary cognitions.

Results: Intention-to-treat analysis using linear mixed models revealed significant between group differences for weight loss after 14 weeks (P<.001,d=0.34). Significant intervention effects were also found for waist circumference (P<.001,d=0.63), BMI (P<.001,d=0.41), systolic blood pressure (P=.02,d=0.48), resting heart rate (P<.001,d=0.81), physical activity (P=.03,d=0.77), sweetened beverages (P<.02,d=0.5-0.6) and physical activity-related cognitions (P<.02,d=0.6).

Conclusion: The WP program was feasible and efficacious and resulted in significant weight loss and improved health-related outcomes and behaviours in overweight male shift workers.

Keywords: weight loss, men, shift work, Internet, intervention, workplace

Trial Registration: Australian New Zealand Clinical Trials Registry No: ACTRN12609001003268

INTRODUCTION

Industrialization in many countries has led to an increase in the number of adults employed in shift work. In Australia, 16% of employees are shift workers, with over two-thirds of shift workers full-time (Australian Bureau of Statistics, 2010). Shift work is particularly common in mining, manufacturing, and service-based industries (Harrington, 2001). It is of concern that numerous studies have found that exposure to shift work is associated with increased health problems compared with working normal daytime hours (Atkinson, et al., 2008). Shift workers are at heightened risk of insomnias, chronic fatigue, anxiety, depression, and cardiovascular and gastrointestinal problems. Shift work is also an independent predictor of increased body mass index (Atkinson, et al., 2008). This is a particular problem in male workers where shift work and obesity have been found to be strongly related (Karlsson, et al., 2003, Suwazono, et al., 2008). Moreover, overweight men are not only at higher risk of cardiovascular disease (Australian Bureau of Statistics, 2009) but may have major work disadvantages in terms of impaired work-related capacity, performance and increased sick leave (Atkinson, et al., 2008).

There is an urgent need for well-designed weight loss programs that engage male shift workers as it has been found that they may not otherwise seek weight loss treatment (Benedict and Arterburn, 2008) and because obesity rates in men have been increasing in many countries (Australian Bureau of Statistics, 2009, Muto and Yamauchi, 2001, Leslie, 2002). However, many weight loss programs do not appeal to men (French and Jeffery, 1994) and it has been reported that men would prefer weight loss programs that include participants with whom men can identify and are workplace based for convenience (Sabinsky, et al., 2007). This convenience may be particularly important for shift workers. Therefore, workplace-based weight loss programs may represent a key strategy for reducing obesity prevalence in men. Most adults spend approximately 60% of their waking hours at work, and worksites provide many opportunities to improve dietary and physical activity behaviors. Workplace interventions have the potential to reach large populations of men who might not otherwise access health services or engage in health promotion programs.

A recent systematic review of workplace-based weight loss programs identified a paucity of research in this area and found that studies have been limited by weak methodologies (underpowered, no comparison group, lack of intention-to-treat analysis and objective outcome measures), and recruitment and retention have been problematic (Benedict and Arterburn, 2008, Mhurchu, et al., 2010). Additionally, few studies have been conducted with blue collar workers (Anderson, et al., 2009) who generally have less access to programs, yet may benefit most from interventions (Groeneveld, et al., 2010) as they are more likely to be at increased risk of weight-related morbidity (Carnethon, et al., 2009).

To the authors' knowledge, no studies have been conducted to evaluate a weight loss program for male shift workers. The primary aim of this study was to evaluate the feasibility and efficacy of a workplace-based weight loss program that targeted overweight and obese male shift workers. We hypothesized that weight and health-related outcomes and behaviors of men would improve in the intervention group when compared to a wait-list control group. The design, conduct and reporting of this study adhered to the Consolidated Standards of Reporting Trials guidelines (Moher, et al., 2010).

METHODS

Study design

The study was a prospective, two-armed randomized controlled trial (RCT). Men were randomly allocated to one of two groups: the Workplace POWER (Preventing Obesity Without Eating like a Rabbit) program or a 14-week wait-list control group. Men worked in crews (n = 15) and were randomly allocated in four crew clusters based on the timing and rotation of shifts worked, to avoid contamination within the worksite. Outcome measures were obtained from all participants at baseline (November, 2009) and at 14-week follow-up (January/February, 2010). Measurements were taken in the Health Services Department of the workplace by trained staff with experience in anthropometric assessments, using the same instruments at each time point. Participants and assessors were blind to group allocation at baseline assessment.

Participants

Overweight or obese (BMI between 25 and 40kg/m^2) men aged 18-65 were recruited from Tomago Aluminium in September 2009. Tomago is one of Australia's largest producers of Aluminium, employing around 1200 staff. The site is located around 13km northwest of Newcastle, NSW in the industrial suburb of Tomago. Crews of shift workers were recruited via a staff email and through promotion at crew meetings. Exclusion criteria included history of major medical problems such as heart disease in the last five years, diabetes, orthopaedic or joint problems that would be a barrier to physical activity, recent weight loss of ≥4.5kg, or taking medications that might affect body weight. Men also completed a pre-exercise risk assessment screening questionnaire (Norton 2005) and provided written informed consent.

Ethics approval was obtained from the University of Newcastle Human Research Ethics Committee.

The Workplace POWER (WP) program

The 3-month WP program was based on Bandura's Social Cognitive Theory (SCT) (Bandura, 1986). Table 1 details the specific WP program content, intervention strategies and resources alignment with SCT using a taxonomy of behavior change strategies (Abraham and Michie, 2008). The WP program consisted of four major components:

(i) Information session: one face-to-face session (75 minutes) was delivered by one of the male researchers (PJM). The first 60 minutes of the session covered education about energy balance, the challenges of shift work relating to diet and physical activity, weight loss tips for men, and behavior change strategies including self-monitoring, goal setting and social support.

(ii) Study website: The second part of the information session was a 15 minute technical orientation to familiarize and teach participants how to use a publicly accessible, free weight loss website (www.calorieking.com.au) utilized in the study. Men were asked to enter their weight once each week online and submit online daily eating and exercise diaries for the first four weeks, for two weeks in the second month and for one week in the third month. Each participant who provided diary entries received up to seven individualized feedback documents via email over the three months from the research team. Each sheet gave feedback on a week of diary entries and suggested personalized strategies to address weight loss, reduce energy intake and increase energy expenditure. Men were able to email the research team with any questions, which were answered weekly by two research assistants with qualifications in health and physical education or nutrition and dietetics.

(iii) Resources: Men in the WP group were also provided with a weight loss handbook, a website user guide and a YamaxSW200 pedometer.

(iv) Group-based financial incentive: Men in the study were offered two modest financial incentives. Crews were offered a $AU50 gift voucher per person to be spent at a local sporting equipment store for the crew with the highest mean percentage weight loss after one month and at the conclusion of the program.

The WP program was modeled on a previous successful Internet-based weight loss program for men – the SHED-IT program (Morgan, et al., 2009, Morgan, et al., 2010). However, various elements of the intervention (information session, booklet, feedback provided) were modified to be more relevant to shift workers and suggested strategies taking into account the additional challenges of losing weight as a shift worker (Atkinson, et al., 2008).

Outcomes

The primary outcome was body weight (kg) at 14-week follow-up. Weight was measured with men wearing light clothing, without shoes on a digital scale to 0.1kg (Model no. UC-321PC, A&D Company Ltd, Tokyo Japan). Secondary outcomes assessed including:

Waist circumference: Waist circumference was measured level with the umbilicus with a non-extensible steel tape (KDSF10-02, KDS Corporation, Osaka, Japan).

BMI: Height was measured to 0.1 cm using a stadiometer (model KaWe 44440; Medizin Technik, Mentone Education Centre, Morrabin, Australia). BMI was calculated using the standard equation (weight [kg]/height[m]^2).

Blood Pressure and Resting Heart Rate (RHR): Systolic and diastolic blood pressures were measured using a NISSEI/DS-105E digital electronic blood pressure monitor (Nihon Seimitsu Sokki Co. Ltd., Gunma, Japan).

Self-reported measures

A questionnaire was used to assess a number of self-reported variables. Scale/item descriptions and sources, example items and internal consistency are reported in Table 2. Variables assessed included leisure time and workplace-based physical activity. To reduce participant burden, only selected dietary variables were assessed including specific foods (fruit, vegetable, bread) and beverages (milk/cola/, soda, diet and alcohol). Key physical activity (self efficacy, pros and cons, behavioural intention) and dietary cognitions (attitudes, stage of change) were also measured.

Socio-demographic information: Age and socioeconomic status (SES) data were also collected. SES was based on postal code of residence using the Index of Relative Socioeconomic Advantage and Disadvantage from the Australian Bureau of Statistics census-based Socio-Economic Indexes for Areas (SEIFA) (Australian Bureau of Statistics, 2008).

Process evaluation

The feasibility of the program was evaluated using a number of metrics including recruitment (achievement of target sample size), retention (retention rates at follow-up) and attendance (at sessions). Adherence to self-monitoring was calculated from website usage data. Data were also collected on the number of emails received by the research team and the topic of the email.

Sample size and randomization

Based on 90% power to detect a significant weight loss (primary outcome) difference between groups of 3kg, assuming SD=5 (P = 0.05, two-sided), and a correlation between pre and post scores r=0.80 (Morgan, et al., 2009), a sample size of 41 participants for each group was needed. The random allocation sequence was generated by a computer-based random number-producing algorithm to ensure an equal chance of work crews being allocated to each group, without restriction. To ensure concealment, the sequence was generated by a statistician. Randomization and participant study arm assignment was completed by a researcher who was not involved in the assessment of participants and the allocation sequence was concealed when enrolling participants by work crew. Participants were enrolled by Health Services staff at Tomago

Statistical analyses

Analyses were performed using PASW Statistics 17 (SPSS Inc. Chicago, IL). Prior to analysis, normality and equal variance of the data were assessed using a Kolmogrov–Smirnov test (with Lillefors' correction) and Levene median test, respectively. Means and standard deviations were calculated for all normally distributed variables. For Total Met minutes a natural log transformation was used. Medians and interquartile ranges were calculated for variables that were not normally distributed. Characteristics of completers versus dropouts were tested using independent *t* tests for continuous variables and chi-squared (χ^2) tests for categorical variables. The significance level was set at 0.05 for all analyses.

Mixed models were used to assess all outcomes (primary and secondary) for the impact of group (Intervention and Control), time (treated as categorical with levels baseline and 14-weeks) and the group-by-time interaction, these three terms forming the base model. This approach was preferred to using baseline scores as covariates, as the baseline scores for subjects who dropped out at 14-weeks were retained making this an intention-to-treat analysis. To examine potential clustering of effects at the crew level, crew was nested within both the treatment and treatment-by-time terms as fixed effects and these terms were used in the final models. Age and SES were examined as covariates to see if they contributed significantly to the models. If a covariate was significant, two-way interactions with time and treatment were also examined and all significant terms were added to the final model to adjust the results for these effects. Differences of means and 95% confidence intervals (CIs) were determined using the linear mixed models. Analyses included all randomized participants. Effect sizes were determined using Cohen's *d* (Cohen, 1988) and calculated using mean differences from the mixed model and the pooled standard deviation of the two groups at baseline ($d = (M_1 - M_2) / \sigma_{pooled}$).

In addition, men who complied well (compliers) with the assigned treatment (defined as submission of greater than 50% of daily eating and exercise diaries and bi-weekly check-ins) were compared with non-compliers in the Internet group and the control group for weight only.

RESULTS

Participant flow

Figure 1 illustrates the flow of participants through the trial. A total of 15 crews (n = 127) were recruited in October 2009 through promotion by crew leaders and Health staff in crew meetings. In total, 110 overweight or obese men attended baseline assessments and were randomized by crew into Intervention (n=65) or Control groups (n=45). As crews were randomly allocated based on crew shift clusters, we had an uneven number of men in intervention and control conditions. Seven men did not attend the information session. In terms of retention, measurements were obtained for 81% of the sample at 14-week follow-up in January/February 2010 (n = 89). There was no difference in retention between the WP and control groups (χ^2 = .48, df = 1, P = .49). All randomized participants with baseline data were analyzed for outcomes at 14-week follow-up. There were no significant differences (P >.05) in baseline characteristics between those lost to follow-up and those retained for weight or any of the secondary outcomes. Six men were identified as outliers in the total MET minutes variable and were omitted from the physical activity analyses as their reported physical activity levels were not plausible (Tabachnick and Fidell, 2001).

Baseline data

Table 3 and Table 4 present baseline characteristics. Mean (SD) age was 44.4 years (8.6) and mean BMI was 30.5 (3.6). Mean weight and waist circumference were 94.9kg (13.4) and 100.7cm (10.0), respectively with 45.5% of the sample considered obese (BMI>30). There were no significant differences in baseline scores for any variables between intervention and control men (P > .05).

Change in primary outcome

There was a significant treatment effect for change in weight at 14-week follow-up (P <.001; d = .34) with a mean difference between groups of 4.3kg (see Table 5). There was also a significant difference in percentage weight loss between groups (P < .001). Mean percentage weight loss in the WP group was -3.7% vs +.4% in the control group. At follow-up, significantly more participants (33.3%) in the WP group had lost more than 5% of their baseline weight compared to the control group (0%) (χ^2 = 13.6, df = 1, *P* <.001).

Planned per-protocol analysis

Only 28% complied with the online component. There was no significant difference between compliers and non-compliers for age or SES (*P* > .05). A significant group-by-time interaction (*P* <.001) was found with compliers reducing their weight (-8.0kg; 95%CI -9.5, -6.4) more than non-compliers (-2.0kg; 95%CI -3.0, -1.0) and the control group (0.3kg; 95%CI -0.1, 1.7).

Change in secondary outcomes

Significant treatment effects were found for waist circumference, BMI, systolic blood pressure, resting heart rate and physical activity. Medium-to-large effect sizes (range from d = .41 - .81) were found. No treatment effect was found for diastolic blood pressure. For dietary variables, there was no treatment effect for intake of fruit, vegetables, bread, milk, or diet drinks. There were intervention effects for cola and soda/soft drink but not for alcohol risk score which remained high. In terms of physical activity and dietary cognitions (Table 6), we found a significant intervention effect for physical activity cons and behavioural intention but not for self-efficacy or physical activity pros. For other dietary attitudes and stages of change variables, we only found significant intervention effects for ‘eating breakfast’ and ‘balancing food intake and physical activity’.

Process evaluation

We were able to recruit our target sample size and retain 81% of men at follow-up. The mean (sd) number of diet and exercise entries by Internet group participants was 42 (34) and 24 (25) respectively. Participants recorded an average of 6 from 14 possible weekly weight check-ins. Significant correlations were found between weight change and the number of days of diet entries (*r* = 0.42, *P* < .04) and number of weekly weight entries (*r* = 0. 52, *P* = . 01), however there was no significant correlation between weight and exercise entries (*r* = 0.26, *P* = . 24). We received only 24 email questions over the three months: 11 of these related to issues with username/passwords, four asked an exercise-related question, two related to diet, four apologised for lack of use and three thanked the research assistants for the quality of feedback.

DISCUSSION

The primary aim of this study was to evaluate the feasibility and efficacy of a workplace program for overweight/obese male shift workers. The WP program resulted in significant treatment effects for mens' weight, waist circumference, systolic blood pressure, resting heart rate, physical activity behavior, and some physical activity cognitions, represented by medium-to-large effect sizes. However, we found no treatment effect for most of the dietary variables measured other than soda drinks.

The WP program is the first study to exclusively target male shift workers and represents an important contribution to the field of workplace-based interventions as it has demonstrated health improvements in an at-risk sub-group of the population. The weight loss findings (4.0kg mean difference) are clinically important and comparable to other workplace weight loss studies reported in the literature (Benedict and Arterburn, 2008, Anderson, et al., 2009). However, one of the only other Australian worksite lifestyle interventions found no intervention effects for weight in a sample of casino employees (73% shift workers; 52% female), although improvements were observed in waist circumference after a 6-month supervised exercise and diet program (Atlantis, et al., 2006). Compared to previous workplace-based interventions, the WP program was relatively low dose (Benedict and Arterburn, 2008), and it is notable that program effectiveness has been found to be related to the amount of face-face contact (Benedict and Arterburn, 2008). Previous RCTs in this area have had more face-to-face contact (more than monthly) and/or have involved individual counselling whereas WP involved only one information session and Internet support.

Workplace-based RCTs that have exclusively targeted men (Muto and Yamauchi, 2001, Leslie, 2002, Pritchard, et al., 1997, Maruyama, et al., 2010) have varied considerably in their approach but their findings for weight loss are also comparable to WP. Intervention approaches have included one-on-one counselling every fortnight for three months and email follow-up (Leslie, 2002), prescribed exercise and eating plans (Pritchard, et al., 1997), and individual counselling sessions with a dietitian and physical trainer and monthly website advice for four months (Maruyama, et al., 2010). Additionally, Muto et al.'s study (Muto and Yamauchi, 2001) of Japanese male employees was shown to be effective in improving obesity rates but was also described as high intensity and extensive.

The intervention approach and intensity of these trials is quite different to WP which used a single information session, booklets, the Internet and group-based incentives and was modelled on the successful SHED-IT male program (Morgan, et al., 2009, Morgan, et al., 2010) but modified for shift workers. Our weight loss findings in SHED-IT were greater but possible explanations may be that the SHED-IT trial recruited university staff and students who may have felt more comfortable with a web-based program than the blue collar shift workers of WP. A negative relationship has been identified in adult health education interventions between computer literacy and ease of using websites (Oenema, et al., 2001). Only 28% of the WP men complied with the web-based component compared to 41% in SHED-IT, however this is comparable to other studies that have reported low levels of engagement in web-based tasks (Neve, et al., in press). Increasing the time spent educating men on website use, allowing men to engage with the website during the information session, or increasing Internet support during the program may be important considerations for improvement. Despite this recognised limitation, our per-protocol findings demonstrate the effectiveness of the web-based component. Further research is required to determine optimal intervention dose and medium, particularly in relation to online support.

As with most previous interventions, the WP program was a multi-component intervention and it is difficult to determine the relative effects of each intervention component. However, the general success of WP may in part be explained by the nature of the intervention which may have appealed to men in terms of the minimal time commitment and targeted approach, supporting previous findings in our work with overweight men (Morgan, et al., 2010). Additionally, findings have been inconsistent regarding the effectiveness of financial incentives for weight loss (Kane, et al., 2004), but the focus on competition in crews for prizes may have increased the motivation of men and contributed to the success of the study. It would also be of interest in future studies to consider and/or measure the impact of peer influence on both recruitment and participation in programs of this nature.

We found a significant intervention effect for self-reported physical activity, represented by a large effect size. Findings for the effectiveness of workplace physical activity interventions in a recent meta-analysis have been mixed reporting generally small effect sizes (Conn, et al., 2009). The provision of pedometers to the men and the focus on increasing daily step counts may explain our positive findings. The intervention appeared to influence some physical activity cognitions. The intervention group revealed a greater intention to participate in physical activity and perceived fewer disadvantages to physical activity participation.

We had limited impact on most dietary variables measured, which may be explained by several factors. Firstly, the WP program may not have changed these behaviours sufficiently to observe a treatment effect. We have previously shown using a comprehensive measure of dietary intake that men are able to improve some aspects of their eating habits, but may struggle to increase vegetables or reduce alcohol intake (Collins, et al., 2010). The WP program focused on individual responsibility and a multilevel ecologic perspective including implementing changes to the worksite dietary environment may be required. We did not measure total usual dietary intake nor was the study powered to detect changes in these secondary dietary habit measures. Our findings are similar to other studies, as highlighted in Mhurchu et al.'s (2010) review of the effects of worksite dietary interventions where programs improve some but not all dietary behaviours with generally small effect sizes. It is important to acknowledge the unique challenges to healthy eating for shift workers. Shift work is associated with increased snacking of energy-dense foods and drinks, using high sugar foods to overcome tiredness and cravings, poorer food choices at work, disruption to normal eating habits and timing of meals and disturbance of sleep patterns (Atkinson, et al., 2008). It is of note that men reported more favourable changes in relation to balancing food intake with activity level and eating breakfast.

Study strengths and limitations

Our study was found to be feasible as we recruited our target sample size, retention of men was high and there were no adverse events reported. This is an encouraging finding as the recruitment and retention of shift workers in studies is challenging and has been highlighted in the literature (Atkinson, et al., 2008) and noted in another Australian worksite lifestyle intervention (Atlantis, et al., 2006). Our study addressed many of the weaknesses identified in recent systematic reviews (Benedict and Arterburn, 2008, Mhurchu, et al., 2010) and its strengths included a randomized design, high retention rate, intention-to-treat analysis, theoretically-based framework and use of an objective measure for our primary outcome. There were some study limitations which need to be noted. The WP program only involved a 14-week follow-up and longer term follow up as well as a cost effectiveness evaluation would provide important additional information. We only targeted one employer and generalisability of our findings may be limited to male shift workers at Tomago. There is also a need to determine the impact of the program delivered by trained facilitators. However, work-site research studies are challenging and decisions around study design must also factor in both employee and employer needs and generally be conducted within short timeframes and constrained budgets.

CONCLUSION

Given the mean waist circumference of men at baseline (102cm), which exceeded the upper health risk cut point (Hans, et al., 1995), we accessed a high CVD risk population who may not otherwise seek weight loss treatment (Benedict and Arterburn, 2008). In summary, a program targeting an at-risk group of the population, overweight male shift workers, was effective in achieving statistically significant and clinically important weight loss and positively impacted on a number of health-related behaviours.

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CONFLICT OF INTEREST STATEMENT

Simon Mitchell is the Health and Safety Services Leader at Tomago Aluminium. PJM has worked as consultant to Tomago Aluminium on a casual basis. All other authors declare that they have no competing interests.

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This study was funded by Tomago Aluminium and the Hunter Medical Research Institute. Tomago had no involvement in study design, analysis and interpretation of data or the decision to submit the manuscript for publication. Simon Mitchell from Tomago reviewed the drafted manuscript for accuracy and also organised the data collection at Tomago.

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FIGURES

Figure 1: Participant flow through the trial and analysed for the primary outcome (weight [kg]) (Tomago, Australia, 2009-2010)

Table 1 Mapping of SCT constructs for the Workplace POWER intervention (Tomago, Australia, 2009-2010)

Intervention component	SCT construct	Behaviour change techniques
Information session	* Outcome expectations * Behavioural capability * Perceived barriers * Self-efficacy	* Provide information about behaviour-health link * Verbal persuasion from credible information source * Prompt self-monitoring of behaviours * Prompt specific goal setting * Information on consequences
Handbook	* Behavioural capability * Outcome expectations * Perceived barriers * Goal setting & intention * Self-efficacy	* Provide information about behaviour-health link * Facilitate mastery by encouraging gradual behaviour change * Prompt self-monitoring of behaviours * Prompt specific goal setting (implementation intention) * Identification of key perceived barriers associated with shift work
Study website	* Self-monitoring * Behavioural capability * Goal setting * Self-efficacy	* Prompt self-monitoring of behaviour * Increase knowledge and skills relating to key weight loss behaviours * Prompt goal setting
Website tutorial and user guide	* Behavioural capability * Self-efficacy * Perceived barriers	* Step-by-step demonstration of how to use the website * Facilitate mastery and address perceived barriers by a focus on the most basic website functions
7 individualized dietary feedback sheets	* Social support * Outcome expectations * Self-efficacy	* Provide information about behaviour-health link * Provide social support and general encouragement * Target specific problem areas for shift workers (e.g. eating breakfast) * Prompt self-monitoring
Group-based financial incentive	* Social support * Goal setting	* Incentives for crews working together * Encourage social support and motivation
Pedometer	* Self-monitoring * Goal setting	* Facilitate self-monitoring of behaviours * Prompt specific goal setting (implementation intention)

Table 2 Self-reported variables assessed in the Workplace POWER study (Tomago, Australia, 2009-2010)

Variables	Description	Range (No. of items)	Source
Leisure-time physical activity	Measured using a modified version of the Godin Leisure-Time Exercise Questionnaire. *How many times per week engage in strenuous, moderate, and mild physical activity for a minimum of 10 minutes per session?* The total leisure activity score was calculated by: (N·MET) moderate + (N·MET) strenuous + (N.MET) mild where N = number of bouts per week lasting > 10 minutes multiplied by the time in minutes for each category.	N/A	(Godin and Shepard, 1985)
Additional physical activity items (workday and usual)	(i) *How much do you incorporate physical activity into your workday (during breaks, active commuting to and from work)?* scored on a 5-pt scale from (1) none to (5) a great deal, (ii) *Is the amount of activity you did in the past month less, more, or about the same as your usual physical activity habits?* from (1) *I am now much less active* to (5) *I am now much more active*.	1-5 (2)	(Prodaniuk, et al., 2004)
Physical activity self efficacy	Response options ranged from (1) not at all confident to (5) extremely confident. e.g. '*In the next 6 months, I am confident that I can participate in regular physical activity when I have many other demands on my time*.' In our sample, α= 0.92 (pre); 0.93 (post).	1-5 (9)	(Plotnikoff, et al., 2001, Plotnikoff, et al., 2001).
Pros and Cons for physical activity	5 items 'pros' and 6 items 'cons' ranging from (1) not at all to (5) very much. Pros e.g. '*Physical activity would help me have a more positive outlook*' and Cons e.g. '*Physical activity would take too much of my time*.' In this sample, α = pros of 0.88 (pre); 0.86 (post) and for cons = 0.74 (pre); 0.81 (post).	1-5 (11)	(Plotnikoff, et al., 2001, Plotnikoff, et al., 2001).
Behavioral intention for physical activity	Ranging from 0% to 100% '*On a scale of 0% to 100%, how likely is it that you will get regular physical activity within the next 6 months?*'	0-10 (1)	(Courneya, et al., 2001)
Selected dietary variables	Items from the Victorian Cancer Council Food Frequency questionnaire examining fruit, vegetable, bread and milk intake were used. An additional item measured a healthy eating practice 'I currently eat breakfast every day' (5 response options).	1-6 (4)	(Giles and Ireland, 1996)
Beverage intake	Assessed using a 10 level scale (from never to 3 or more times per day). Beverages included full strength cola, soda drinks and diet drinks.	0-9 (3)	(Women's Health Australia, 2001)
Alcohol Intake	Measured using 3 questions from the Alcohol Use Disorders identification test; frequency of drinking, number of drinks consumed on each occasion and frequency of drinking >6 drinks. A combined alcohol risk score was calculated.	0-12 (3)	(World Health Organisation, 2008)
Dietary attitudes	Single items used, measured on 5-point scales from (1) strongly disagree to (5) strongly agree. Items related to balance ('I try to balance my food intake with my activity level'), enjoyment ('Mealtime for me is an enjoyable time'), enjoyment for cooking ('I enjoy cooking and preparing food'), external cues ('At a meal, I feel that I should clean my plate even if I am not hungry' – reverse scored), variety ('I eat a wide variety of different foods'), & desire to change ('I would like to eat healthier').	1-5 (6)	(Plotnikoff, et al., 2005)
Dietary stage of change	Do you normally; (1) 'choose to buy low-fat versions instead of high-fat versions of food?' (2) 'cook your meals using techniques to reduce fat?' (3) 'prepare your food at the table in ways that reduce fat?' & (4) 'In general, do you consistently avoid eating high-fat foods?' 5-point response option scales: (1) 'No, I do not intend to within the next 6 months' to (5) 'Yes, I have for more than 6 months.'	1-5 (4)	(Plotnikoff, et al., 2005). (Green, et al., 1994)

Table 3 Baseline characteristics for anthropometric, metabolic, physical activity and dietary behaviour variables of men randomized to the Workplace POWER intervention and control group (Tomago, Australia, 2009-2010)

	Control (n =45)		*Intervention (n =65)*		*Total (n = 110)*	
	Mean	*(sd)*	*Mean*	*(sd)*	*Mean*	*(sd)*
Age (years)	43.7	9.1	44.8	8.3	44.4	8.6
Weight (kg)	92.9	14.1	96.3	12.9	94.9	13.4
Height (m)	1.75	.07	1.77	.06	1.76	.06
BMI (kg/m^2)	30.2	3.5	30.7	3.6	30.5	3.6
Waist (cm)	99.4	10.3	101.6	9.7	100.7	10.0
Systolic Blood Pressure (mmHg)	136.2	15.5	134.2	14.5	135.0	14.9
Diastolic Blood Pressure (mmHg)	87.1	8.4	84.2	9.5	85.4	9.2
Resting heart rate (bpm)	75.1	9.8	75.4	9.0	75.3	9.3
Physical Activity[b]						
Total MET minutes[c]	620	1290	900	1550	800	1462
Current physical activity level	3.0	0.7	2.9	0.5	2.9	0.6
Workday physical activity	2.3	1.2	2.3	1.2	2.3	1.2
Dietary [d]						
Fruit (serves p/day)	3.0	1.3	3.2	1.2	3.1	1.3
Vegetables (serves p/day)	3.9	1.3	4.3	1.0	4.1	1.2
Bread intake	4.1	1.6	4.6	1.3	4.4	1.5
Milk	4.1	3.1	4.6	2.8	4.4	3.0
Cola drinks	6.4	2.7	6.1	2.5	6.2	2.6
Diet drinks	2.7	2.9	3.4	3.4	3.1	3.2
Other soda drinks	7.3	2.0	6.7	2.1	7.9	2.1
Alcohol Risk Score[e]	8.0	3.5	8.9	2.6	8.5	3.1
	n	%	n	%	n	%
SES[a]						
1-2 (lowest)	1	2.7	6	11.5	7	7.9
3-4	7	18.9	9	17.3	16	18.0
5-6	23	62.2	24	46.2	47	52.8
7-8	6	16.2	10	19.2	16	18.0
9-10 (highest)	0	0.0	3	5.8	3	3.4
BMI category						
Overweight	27	50.8	33	50.8	60	54.5
Obese	18	49.2	32	49.2	50	45.5

Abbreviations: sd = standard deviation; SES = socioeconomic status; BMI = Body Mass Index; MET = metabolic equivalent of tasks.
[a]Socioeconomic status by population decile for SEIFA Index of Relative Socioeconomic Advantage and Disadvantage. [b]N = 83 (n = 48 Intervention; n = 35 Control) [c]Median (Interquartile range) [d] N = 89 (n = 50 Intervention; n = 39 Control) [e]Maximum possible score is 12, a score of 6 or 7 may indicate a risk of alcohol related harm and potential harm for groups susceptible to effects of alcohol

Table 4 Baseline characteristics for physical activity cognitions and dietary practices and stages of change of men randomized to the Workplace POWER intervention and control group (Tomago, Australia, 2009-2010)

	Control (n =37)		*Intervention (n =49)*		*Total (n = 86)*	
	Mean	*(sd)*	*Mean*	*(sd)*	*Mean*	*(sd)*
Physical activity cognitions						
Self efficacy	3.1	0.7	3.1	0.7	3.1	0.7
Pros	3.8	0.8	3.7	0.9	3.7	0.8
Cons	1.8	0.6	2.0	0.6	1.9	0.6
Behavioural intention	8.8	2.4	7.9	2.8	8.3	2.6
Healthy eating practices						
Breakfast	3.4	1.5	3.7	1.2	3.6	1.4
Balance	3.2	0.9	3.1	0.9	3.1	0.9
Enjoy cooking and preparing	3.5	1.2	3.6	1.0	3.5	1.1
Enjoy mealtime	4.0	1.0	4.0	0.7	4.0	0.8
External cues	2.9	1.4	3.0	1.1	2.9	1.3
Variety	4.0	0.9	4.1	0.7	4.0	0.8
Desire to change	4.2	0.6	4.2	0.7	4.2	0.7
Dietary stage of change (SOC)						
SOC-buying	3.3	1.8	3.7	1.6	3.5	1.7
SOC-cooking	3.8	1.5	3.9	1.5	3.8	1.5
SOC-preparation	3.7	1.5	3.5	1.6	3.6	1.6
SOC-general diet	3.4	1.6	3.4	1.5	3.4	1.5

Abbreviations: sd = standard deviation

Table 5 Changes in anthropometric, metabolic, physical activity and dietary behaviour variables for participants by treatment group from baseline to 14-weeks and differences in outcomes among the treatment groups at 14-weeks (ITT analysis) (n=110) (Tomago, Australia, 2009-2010)

Outcome	*Treatment group* — *Mean change from baseline (95% CI)*[a]		*Mean difference between groups (95% CI)*[b]	*Group time P-value*	*Effect size (Cohen's d)*
	Control (n=45)	*WP program (n=65)*			
Weight (kg)[c]	0.3 (-0.1, 1.7)	-4.0 (-5.1, -2.9)	4.3 (2.6, 6.1)	<0.001	0.34
Waist circ. (cm)	1.5 (0.2, 2.9)	-4.4 (-5.5, -3.3)	5.9 (4.2, 7.6)	<0.001	0.63
BMI (kg/m^2)[d]	0.1 (-0.3, 0.6)	-1.3 (-1.6, -0.9)	1.4 (0.9, 2.0)	<0.001	0.41
SBP (mmHg)[d]	-1.3 (-5.4, 2.7)	-7.3 (-10.6, -4.1)	6.0 (0.8, 11.2)	0.02	0.48
DBP (mmHg)[d]	-2.5 (-5.3, 0.3)	-3.7 (-5.9, -1.4)	1.2 (-2.4, 4.7)	0.52	0.18
RHR (bpm)	1.7 (-1.3, 4.7)	-6.2 (-8.5, -3.9)	7.9 (4.0, 11.7)	<0.001	0.81
Physical Activity[e]					
Total MET minutes[f]	0.1 (-0.1, 0.3)	0.4 (0.2, 0.5)	0.3 (0.0, 0.5)	0.03	0.77
Current PA level	-0.2 (-0.5, 0.1)	0.4 (0.1-0.6)	0.6 (0.2, 1.0)	<0.001	0.75
Workday PA	0.4 (-0.1, 0.8)	0.8 (0.4, 1.2)	0.4 (-0.2, 1.0)	0.18	0.38
Dietary[g]					
Fruit (serves p/day)	0.1 (-0.2, 0.4)	0.5 (0.2, 0.7)	0.4 (-0.0, 0.8)	0.06	0.32
Vegetables (serves p/day)	-0.1 (-0.5, 0.2)	0.0 (-0.2, 0.3)	0.2 (-0.2, 0.6)	0.39	0.19
Bread intake	-0.2 (-0.7, 0.3)	-0.8 (-1.3, -0.4)	-0.6 (-1.3, 0.1)	0.09	0.38
Milk	-0.1 (-0.1, 2.1)	-0.6 (-1.6, 0.3)	1.3 (-1.1, 1.8)	0.65	0.48
Cola drinks[c]	-0.7 (-0.1, -0.0)	0.4 (-0.2, 1.1)	1.2 (0.2, 2.1)	0.02	0.47
Diet drinks	-0.1 (-0.9, 0.8)	0.7 (-0.1, 1.4)	0.8 (-0.3, 1.9)	0.17	0.27
Other soda drinks	-1.1 (-1.8, -0.3)	0.4 (-0.3, 1.6)	1.4 (0.4, 2.6)	0.01	0.60
Alcohol Risk Score[h]	-0.1 (-0.8, 0.5)	0.1 (-0.5, 0.8)	0.3 (-0.7, 1.2)	0.57	0.10

Abbreviations: ITT = intention to treat; - = minus; CI = confidence interval; WP = Workplace POWER; Waist circ. = Waist circumference; BMI = body mass index; SBP = Systolic blood pressure; DBP = Diastolic blood pressure; RHR = Resting heart rate; bpm = Beats per minute; PA = physical activity; MET = metabolic equivalent of tasks.

[a] Time differences were calculated as (14 week - baseline); [b]Between group differences at 14 weeks for mean change (Control – Treatment); [c] model adjusted for age; [d] model adjusted for SES; [e] n = 75; [f] log transformed; [g]n = 86; [h]Maximum possible score is 12, a score of 6 or 7 may indicate a risk of alcohol related harm and potential harm for groups susceptible to effects of alcohol

Table 6 Changes in physical activity cognitions and dietary practices and stages of change for participants by treatment group from baseline to 14-weeks and differences in outcomes among the treatment groups at 14-weeks (ITT analysis) (n=90) (Tomago, Australia, 2009-2010)

Outcome	*Treatment group*		*Mean difference between groups (95% CI)[b]*	*Group time P-value*	*Effect size (Cohen's d)*
	Mean change from baseline (95% CI)[a]				
	Control (n = 37)	*WP program (n = 49)*			
Physical activity cognitions					
Self efficacy	-0.2 (-0.4, 0.0)	0.0 (-0.2, 0.2)	-0.2 (-0.5, 0.1)	0.22	0.25
Pros[c]	-0.1 (-0.4, 0.2)	0.0 (-0.2, 0.3)	-0.1 (-0.5, 0.2)	0.48	0.12
Cons	0.2 (0.0, 0.4)	-0.2 (-0.4, 0.0)	0.4 (0.1, 0.7)	0.01	0.56
Behavioural intention [cd]	-0.5 (-1.4, 0.4)	1.0 (0.2, 1.8)	1.4 (0.2, 2.6)	0.02	0.60
Healthy eating practices					
Breakfast	-0.0 (-0.3, 0.3)	0.6 (0.3, 0.9)	0.6 (0.2, 1.1)	0.01	0.44
Balance	0.0 (-0.3, 0.3)	0.9 (0.6, 1.2)	0.9 (0.4, 1.4)	<0.001	0.90
Enjoy cooking and preparing	0.1 (-0.2, 0.4)	0.2 (-0.0, 0.5)	0.1 (-0.3, 0.5)	0.49	0.10
Enjoy mealtime	-0.1 (0.3, 0.2)	0.3 (0.0, 0.5)	0.3 (-0.0, 0.7)	0.07	0.42
External cues	0.1 (-0.3, 0.5)	0.2 (-0.1, 0.6)	0.1 (-0.4, 0.6)	0.71	0.10
Variety	-0.1 (-0.4, 0.2)	0.0 (-0.3, 0.3)	0.2 (-0.2, 0.6)	0.44	0.21
Desire to change [d]	-0.1 (-0.5, 0.2)	-0.4 (-0.7, -0.0)	-0.2 (0.7, 0.2)	0.33	0.24
Dietary stage of change					
SOC-buying	0.5 (-0.0, 1.0)	0.5 (0.1, 1.0)	0.0 (-0.6, 0.7)	0.89	0.00
SOC-cooking	0.1 (-0.4, 0.6)	0.4 (-0.6, 0.4)	0.3 (-0.3, 1.0)	0.35	0.23
SOC-preparation	0.1 (-0.4, 0.6)	0.6 (0.1, 1.0)	0.4 (-0.3, 1.1)	0.24	0.28
SOC-general diet	0.3 (-0.2, 0.8)	0.6 (0.1, 1.1)	0.3 (-0.4, 1.0)	0.39	0.23

Abbreviations: ITT = intention to treat; - = minus; WP = Workplace POWER; CI = confidence interval; SOC = Stage of change

[a] Time differences were calculated as (14 week - baseline); [b] Between group differences at 14 weeks for mean change (Control – Treatment); [c] model adjusted for age; [d] model adjusted for SES.