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The impact of two workplace-based health risk appraisal interventions on employee lifestyle parameters, mental health and work ability: results of a randomized controlled trial

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Abstract

Health risk appraisals (HRA) are a common type of workplace health promotion programme offered by American employers. In the United Kingdom, evidence of their effectiveness for promoting health behaviour change remains inconclusive. This randomized controlled trial examined the effects of two HRA interventions on lifestyle parameters, mental health and work ability in a UK context. A total of 180 employees were randomized into one of three groups: Group A (HRA augmented with health promotion and education activities), Group B (HRA only) and Group C (control, no intervention). After 12 months, changes in mean scoring in 10 lifestyle, mental health and work ability indices were compared, Groups A and B demonstrated non-significant improvements in 70% and 80%, respectively, compared with controls (40%). Odds ratios revealed that, compared with the control group, Group A was 29.2 (95% CI: 9.22–92.27) times more likely to report a perceived change in lifestyle behaviour; Group B 4.4 times (95% CI: 1.65–11.44). In conclusion, participation in the HRA was associated with a higher likelihood of perceived lifestyle behaviour change which was further increased in the augmented HRA group, thereby providing preliminary evidence that HRA and augmented HRA in particular may help UK employees make positive healthy lifestyle changes.

Introduction

Conditions such as cardiovascular disease, cancer, chronic obstructive airway diseases and diabetes mellitus are among the most prevalent of all public health problems in the United Kingdom [1]. These leading diseases share key risk factors, in particular tobacco use, lack of physical activity, alcohol use and poor diet [2]. In other words, there are many modifiable risk factors which, if addressed through individual and population-based interventions, could significantly reduce their prevalence and the associated cost to patients, health services and society. It has therefore been argued that because lifestyle behaviours are as strongly associated as risk biomarkers with the onset of chronic disease, healthy lifestyle promotion should be a critical element of efforts to improve public health [3].

From the public health perspective, the workplace is an ideal setting for promoting healthy lifestyles as the majority of adults is in employment and thus represents a large and 'captive audience' for health promotion messages. Workplace health promotion (WHP) is a strategy that combines the efforts of

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employers, employees and society to improve the health and wellbeing of working people [4]. Primary prevention interventions, which seek to reduce risks in the entire population, are an important aspect of WHP. These interventions are directed at generally healthy employees to help them maintain or improve their health through lifestyle programmes focusing on, for example, physical activity, healthy eating and sensible alcohol consumption [5]. With primary prevention interventions the goal is to help the employee population move in a healthier direction, as even small changes in behaviour across a population can have an enormous impact on public health [6, 7]. It has also been argued that such programmes are beneficial for employers, as they can improve employee productivity and ultimately an organization's bottom line [8]. Studies have also linked unhealthy lifestyle behaviours and obesity with increased sick leave and productivity loss at work [9–11], both of which lead to elevated indirect costs to employers. Primary, lifestyle-based interventions may therefore contribute to maintaining a more productive workforce and generate indirect cost-savings [9].

Nowhere has this perspective been so wholeheartedly adopted by organizations as in the United States, where the 'good health is good business' maxim has been formally enshrined in a managerial approach known as 'health and productivity management' (HPM), a strategy employed by organizations to manage employee health risks and productivity. In recognition of the relationship between health and productivity, the goal of HPM is to integrate health promotion into all corporate functions [5].

In the United States, where the employer is likely to be responsible for an employee's medical care costs, HPM is widely regarded as a critical and integral part of an organization's business strategy. As a result, over 90% of US organizations with 50 or more employees offer at least one health promotion initiative [12]. This is not surprising considering that research shows healthier employees cost US organizations less in medical expenditure costs and sickness-related absenteeism [13]. A number of US-based studies also demonstrate that offering WHP programmes can result in lower costs and a significant return on investment [14–16]. Such positive evidence-based outcomes are a major factor in the popularity of WHP programmes in the United States [17].

In comparison with the United States, WHP is a relatively new phenomenon in the United Kingdom and organizational uptake of programmes has been slow [18–21]. A primary factor in the limited adoption of these programmes is the fact that medical care costs are met by the National Health Service, thereby limiting the obvious financial benefits of WHP programmes [19, 22]. Although awareness of the importance and benefits of WHP is increasing, many UK employers are still reluctant to provide interventions due to a lack of relevant evidence on which interventions are the most effective, and how they compare with the option of doing nothing [23]. Even though many US-based studies have demonstrated the health and cost benefits of WHP programmes, more rigorous research on how these programmes might perform in a UK context is needed [19].

Health screening has been advocated as a critical component of WHP programmes in the United Kingdom by both academics [24] and Government in Great Britain [25] and Northern Ireland [26]. One promising health screening tool is the health risk appraisal (HRA), by far the most popular offering in the US WHP repertoire. Traditionally, HRAs produced a risk profile for individuals based on their demographic and behavioural information, assessed by questionnaire, with feedback consisting of information regarding an individual's risk of developing a chronic disease in comparison with that of the general public [27]. In recent years, HRAs have become much more sophisticated and are often supplemented with biometric measures, with feedback including educational messages and counselling rather than mere risk information alone [28].

However, despite their pervasiveness in the United States, evidence on the effectiveness of HRAs for promoting health behaviour change remains unclear. A recent systematic review by Soler *et al.* [28] concluded that there is insufficient evidence to determine the effectiveness of HRAs

alone, although there is 'strong evidence' of effectiveness for behaviour change when HRA feedback is combined with additional health education and promotion activities. However, although this systematic review has provided a valuable and current overview of the evidence on HRA effectiveness, the authors argued that it was greatly hampered by, among other things, the absence of an untreated comparison group in the majority of studies reviewed. Many of the effect estimates for augmented HRA programmes therefore reflected incremental benefits when compared with HRAs alone. From a UK perspective, this is a critical deficiency considering that Dame Carol Black, the United Kingdom's first National Director for Health and Work (2006–11), has highlighted the need for research on the effectiveness of WHP interventions in comparison with each other, and in comparison with 'doing nothing' [29].

Considering the inconclusive evidence on HRA effectiveness and the lack of research on these screening tools in a UK context, the aim of this study was to assess the impact of two HRA interventions on various health- and productivity-related outcomes, using an untreated control group to compare their relative effectiveness. One intervention offered an HRA augmented with additional health education and promotion activities, whereas the other offered an HRA alone. The main research objective was to assess the impact of the two HRA interventions across a range of lifestyle parameters and mental health measures in a group of Northern Ireland Civil Service (NICS) employees. Another primary objective was to assess the impact of these interventions on the productivity-related outcome of work ability, which has been identified as an important concept for HPM in a European context [30]. The concept of work ability was developed in Finland in the 1980s and is defined as the physical and mental capacity of a person to perform ordinary, remunerative work [31]. It is largely determined by health and functional capacity, although skills, values and attitudes also contribute to work ability [32]. Research has shown that improving work ability can lead to greater work productivity and quality of work [33], thereby making it an appropriate outcome measure from an HPM perspective.

We hypothesized that employees who received an augmented HRA would show greater improvements in measures of lifestyle parameters, mental health and work ability compared with those who received an HRA alone and those who received neither (the control). We also hypothesized that employees who received the HRA alone would show greater improvements across these measures compared with the control group.

The study received ethical approval from the Research Ethics Committee of the University of Ulster. Approval to undertake the study in the NICS was obtained from the Department of Finance and Personnel (DFP) and the Chief Medical Officer of the Department of Health, Social Services and Public Safety Northern Ireland; trades unions were also consulted.

Methods

Study design and study population

The study was a randomized controlled trial (RCT) conducted over a 12-month period. Subjects were recruited from the DFP within the NICS. A pre-entry health questionnaire was issued to all staff in Administrative Assistant, Administrative Officer and Executive Officer grades. These grades were chosen as they represented the largest component of employees within the department and were also the group which had, proportionately, the greater prevalence of absence from work attributed to sickness. The exclusion criteria were all staff employed by DFP not in the appropriate employment grades and those who did not complete all parts of the pre-entry questionnaire. The pre-entry health questionnaire assessed general health; physical activity levels; body mass index (BMI); smoking history; alcohol intake; work ability with respect to work demands, health and mental resources using the standard Work Ability Index (WAI) [34]; mental health as measured by the WHO-Five Well-being Index (WHO-5) [35], the 12-item version of the General Health Questionnaire (GHQ-12) [36] and

the Mental Health Continuum-Short Form (MHC-SF) [37]; and general individual demographics. The study was limited to 180 participants due to logistical constraints regarding the delivery of the HRA interventions within the required timeframe.

Pre-survey publicity consisted of two explanatory emails sent to all 1503 employees in Administrative Assistant, Administrative Officer and Executive Officer grades. These emails provided information on the nature of the study and included a web link to the Occupational Health Service (OHS) website where further information was available, including a set of 'Frequently Asked Questions'. Staff were informed that 180 participants would be selected to proceed with the study. A consent form and pre-entry questionnaire were subsequently issued to all employees that had indicated their interest in participating in the study. Participants were granted approximately 30–35 min to complete the questionnaire at work.

There were 334 pre-entry questionnaire returns of which 241 were fully completed. A total of 180 participants were randomly selected and stratified before further randomization into three groups (A, B and Control Group C) by age (in bands: <25, 25–34, 35–44, 45–54, >55), BMI (<18.5, 18.5–24.9, 25–27.49, 27.5–29.9, >30), smoking (current smoker: yes or no) and reported level of physical activity (very physically active, fairly physically active, not very physically active, not at all physically active). The study took place over 16 months in total (September 2009–January 2011).

Intervention

The NICS provides a range of initiatives to promote health among its workforce. One of these, the lifestyle and physical activity assessment (LPAA) programme, is a nurse-based programme with assessments carried out 5 days per week, throughout the year, in the NICS OHS facility in Belfast. Departments within the NICS are offered appointments for their employees on a shared basis proportionate to the number of staff they employ. Participation is voluntary and the programme is marketed as a personal, confidential lifestyle assessment using leaflets, posters and the OHS website. The programme has been running for 13 years with around 800 civil servants attending annually. LPAA primarily, but not exclusively, attracts those with a sedentary lifestyle with all employees having equal access to the programme regardless of employment location, job grade, gender and any perceived disability. The assessment takes approximately 45 min to complete and those attending complete a pre-assessment questionnaire to establish current exercise activity levels, smoking status, dietary habits, perception of stress and alcohol consumption. Physiological measurements are recorded for each individual comprising: height, weight, BMI, body fat, grip strength, urinalysis, blood pressure, peak expiratory flow rate and serum cholesterol. If no contraindications are present, stamina is assessed using a stationary ergometer (exercise bicycle) and a flexibility test is performed. Details of these parameters are entered into a commercial, computer-based ergometric activity and lifestyle assessment system which is widely used throughout the United Kingdom and is scientifically validated [38]. The LPAA is an HRA which, on completion, provides a printout of the participant's personal health risk profile (including smoking, alcohol intake, physical activity, stress and cholesterol) and general advice on how to make health behaviour changes where required, with additional advice and guidance given by the nurse who has carried out the assessment. Research shows that the LPAA is an effective health promotion intervention in a workplace setting, with participants making and maintaining positive healthy lifestyle changes [39].

The Northern Ireland Civil Service Sports Association (NICSSA) is the largest public sector sport and leisure organization in Ireland. One of its principal objectives is to encourage civil servants to participate in sporting, recreational and social activities to improve their health and wellbeing. In addition to a range of sports facilities and activities, NICSSA's team of health and fitness practitioners delivers a programme known as Healthworks. The Healthworks team assesses an individual's personal health and wellbeing profile and assists them with the development of an action plan. In addition, they

deliver a range of health and wellbeing education and training modules. The overall aims of the Healthworks programme are to raise awareness of fitness and health, and to encourage and support behavioural changes that lead to improved health and work ability.

The Healthworks intervention consisted of an initial half-day health and wellbeing session covering a range of topics, such as physical activity, smoking, dietary habits, alcohol consumption and stress. Participants were then able to choose three specific modules which would be undertaken during the following 12 months. The various modules (each lasting 2 h) separately addressed one health issue, including physical activity, healthy eating, alcohol awareness, smoking cessation, back care, weight management, life coaching and psychological counselling. In addition, all participants were given access to a website resource which involved an online personal trainer, complete with motivational and monitoring tools personalized to their needs.

'Group A' had an initial LPAA assessment augmented with participation in the Healthworks programme. Participants completed a health and wellbeing education session and a healthy behaviour action plan was developed based on the outcome of the LPAA profile. Health coaching was delivered by a team of health (and other allied) professionals and continued for a period of 12 months, which included monitoring of participants at 4 and 8 months to review and adjust action plans as necessary. Participants in Group A also had access to a wide range of web-based lifestyle tools, including an online personal trainer, to help maintain motivation levels.

'Group B' had an initial LPAA assessment as outlined earlier, with no further intervention during the following 12 months.

'Group C' had no intervention and acted as a control.

At the initial stage, all participants completed a consent form to enter the study. Participation was voluntary and employees could withdraw at any time. All participants in the study were given time off work within the working day to attend LPAA sessions and the Healthworks components. Taking account of travel time, the facilitated time allowance for Group A was approximately 4 days in total and 1 day in total for Group B.

At the end of the 12-month period, all groups completed a post-intervention health questionnaire which was similar to the pre-entry version with some additional questions added to assess perceived health behaviour change and the presence of external life events that may have led to changes in health and wellbeing.

Measures

The primary outcome measures are measures of lifestyle parameters (BMI, alcohol consumption and physical activity), mental health (WHO-5, GHQ-12 and MHC-SF) and work ability (WAI). Self-perceived health behaviour change is the main secondary outcome of interest.

Lifestyle parameters

BMI was calculated from self-report data on participants' weight and height, using the formula: weight (kg)/height $(m)^2$. Self-report data were used here to enable comparisons between all three groups, as Control Group C did not undertake the LPAA assessment. Alcohol intake was assessed by asking participants to quantify the total number of units consumed in a typical week. A unit measurement guide (e.g. 1 small glass of wine = 1.5 units) was provided to help respondents determine the total number of units consumed per week. Physical activity was assessed with a single item: 'Which of the following best describes your overall level of physical activity'? Four response categories ranged from 'very physically active' (1) to 'not at all physically active' (4). Lower scores indicate higher levels of physical activity.

Mental health

Mental health was assessed by a number of measures, including the GHQ-12, a self-report questionnaire for the detection of minor psychiatric disturbance. Respondents rate how much they have been affected by each of the 12 symptoms of distress over the previous few weeks on a 4-point

Likert scale. In this study, the GHQ-12 was used as a summed score (range 0–12) of the dichotomized items (0 = no distress, 1 = distress) [36]. Also included was the WHO-5, a shortened form of the WHO Well-Being Scale which measures 'positive' psychological well-being [35]. A self-administered five-item scale, the WHO-5 measures the degree of positive psychological well-being present in the last 2 weeks using a 6-point Likert scale ranging from 0 (not present) to 5 (constantly present). The total raw score ranges from 0 to 25; higher scores indicate better mental health [35]. The last mental health measure included was the MHC-SF, a 14-item questionnaire measuring psychological wellbeing (six items), social wellbeing (five items) and emotional wellbeing (three items). Respondents rate how often they have experienced each item over the past month (never, once or twice a month, about once a week, two or three times a week, almost every day, every day). Higher scores indicate better mental health [37].

Work ability

Work ability was assessed by the WAI, a self-administered questionnaire consisting of seven items which assess different aspects of work ability: current work ability compared with the lifetime best, work ability in relation to the demands of job, number of current diseases diagnosed by a physician, estimated work impairment due to diseases, sick leave during the past 12 months, own prognosis of work ability 2 years from now and mental resources. Each WAI item is scored individually with an overall score obtained by adding all single item scores together. Higher scores indicate better work ability [34].

Self-perceived health behaviour change

Self-perceived health behaviour change was assessed with a single item: 'Have you made a positive change to your lifestyle behaviour that has been related to your involvement in the study?' Respondents who answered 'yes' were asked to further indicate which of the following changes they had made: 'eating a healthier diet', 'taking more exercise', 'losing weight', 'reducing alcohol consumption', 'stopped smoking' and 'other'.

Self-perceived health

Self-perceived health was assessed with a single item: 'In general would you say your health is'. Five response categories ranged from 'excellent' (1) to 'poor' (5). Lower scores indicate higher levels of self-perceived health.

Job satisfaction

Job satisfaction was assessed with a single item: 'Taking everything into account how satisfied are you with your current job'? Responses ranged from 'very satisfied' (1) to 'very dissatisfied' (5). Lower scores indicate greater job satisfaction.

Statistical analysis

A one-way between-groups analysis of covariance (ANCOVA), with baseline values as covariates, was conducted to compare the effectiveness of the two interventions. The independent variable was the type of intervention (HRA, augmented HRA and control group), and the dependent variable was each individual outcome measure. Preliminary checks were conducted to ensure that there was no violation of the assumptions of normality, linearity, homogeneity of regression slopes and reliable measurement of the covariate. Binary logistic regression was applied to the data, treating the dependent variable (self-perceived health behaviour change) as dichotomous (i.e. change or no change). Odds ratios (ORs) were calculated from the analyses to determine the relative likelihood of (self-perceived) health behaviour change for Groups A and B in comparison with the control group. All analyses were performed in SPSS v. 20.

Results

Table I displays the characteristics of the final sample. Males and females were evenly represented across the three groups, the total sample being 49% ($n = 65$) male and 51% ($n = 67$) female. The

Table I. *Participants' demographics*

	Group A ($n=41$)	Group B ($n=43$)	Group C ($n=48$)	Total: bottom of form
Gender (%)				
Male	20 (49)	23 (54)	22 (46)	65 (50)
Female	21 (51)	20 (46)	26 (54)	67 (50)
Work pattern (%)				
Full time	35 (85)	39 (91)	41 (85)	115 (87)
Part time	6 (15)	4 (9)	7 (15)	17 (13)
Age in years (%)				
<25	2 (5)	3 (7)	1 (2)	6 (4)
25–44	21 (51)	26 (60)	24 (50)	71 (54)
45+	18 (44)	14 (33)	23 (48)	55 (42)
Healthy BMI (%)	17 (41)	13 (30)	14 (29)	44 (33)
Fairly to very physically active (%)	22 (54)	28 (65)	20 (42)	70 (53)
Smokers (%)	9 (22)	7 (16)	9 (19)	25 (19)

majority of participants (87%) were full-time employees ($n=115$) with only 12% working part-time ($n=17$). There was an almost even split between participants in the 25–44 ($n=71$) and 45+ ($n=55$) age brackets (54% and 42%, respectively), although 4% were aged under 25 ($n=6$). Only 33% of the total sample ($n=44$) had a BMI in the healthy range (i.e. 18.5–24.9). Approximately half (53%) the participants were classified as 'fairly to very physically active' ($n=70$) and, finally, 19% were current smokers ($n=25$).

There were initially 180 participants (with 60 in each of the three groups)—48 dropped out during the course of the study leaving 132 who subsequently completed the post study-questionnaire, representing a response rate of 73%. The rate of drop-out was higher in Groups A and B (32% and 28%) compared with Group C (20%), yet the profile did not indicate any particular selectivity for age, gender or work pattern (Table I). Although only a small number provided reasons for dropping out, a personal health issue was most commonly cited and, for non-attendance at Healthworks or LPAA, difficulty travelling. All those in Group A attended the initial Healthworks induction session and during the course of the year, the attendance rate at the Healthworks modules for those completing the programme was 90–95%.

All participants were asked to report if they had experienced a significant life event during the course of the study that may have affected their health and wellbeing and, if so, to give details (Table II). For Group A (augmented HRA), 29% ($n=12$) reported the occurrence of a significant life event, the top three events being a personal health problem, family bereavement and getting married/a relationship issue. Of Group B (HRA only), 28% ($n=12$) experienced a significant life event; bereavement, personal health problems and moving house were the top three events cited. Finally, almost half (44%) of Control Group C experienced a significant life event ($n=21$), with bereavement, getting married/relationship issue and moving house being the top three events reported. Overall, one-third (34.1%) of participants indicated that they had experienced a significant life event with the most common events being bereavement, personal illness, getting married/relationship issues and moving house. Group C had a much higher proportion of life event reporting (43.8%) compared with Group A (29.3%) and Group B (27.9%).

Improvement for a health index was defined as a numerical change in the scoring scale in a positive direction between that recorded at baseline and at follow-up. Differences in pre- and post-intervention mean values were calculated for the groups. Based on changes in mean scoring, Group A demonstrated non-significant improvements in 7 (70%) out of 10 lifestyle, mental health and work ability indices (which also included single-item measures of job

Table II. *Occurrence of significant life events during course of the study*

	Yes (%)	No (%)	**Top three life events**
Group A ($n = 41$)	12 (29)	29 (71)	Personal health problem Family bereavement Getting married/relationship issue
Group B ($n = 43$)	12 (28)	31 (72)	Family bereavement Personal health problem Moving house
Group C ($n = 48$)	21 (44)	27 (56)	Family bereavement Getting married/relationship issue Moving house
Total ($n = 132$)	45 (34)	87 (66)	

satisfaction and self-perceived health), Group B improved in eight (80%), and the control group improved in four (40%) (Table III).

The between-groups analysis showed that there were no statistically significant effects of the interventions on lifestyle factors, work ability or any of the mental health measures. The effect sizes (partial eta squared) ranged from 0.01 to 0.04, indicating that the interventions' effects are of limited practical significance. A within-groups analysis also showed that there were no statistically significant changes in mean scores from baseline to follow-up on any of the outcome measures within each group.

However, when participants were asked if they had made a positive change to lifestyle behaviour in relation to their involvement in the study (a secondary outcome), statistically significant differences were found, with 85.4% of respondents in Group A ($n = 35$) indicating a positive change compared with 46.5% and 16.7% in Groups B ($n = 20$) and C ($n = 8$), respectively (Table IV). ORs were calculated to determine the likelihood of reporting a perceived change in health behaviours for Groups A and B in comparison with the control group. The ORs revealed that Group A was 29.2 (95% CI: 9.22–92.27) times more likely to report a perceived change whereas Group B was 4.4 times (95% CI: 1.65–11.44) more likely. Overall, for those that made a positive lifestyle change, improved diet and better physical activity were most common (88.9% and 81%) with quitting smoking the least common (1.6%) (Table V).

Discussion

Overall, Group A (augmented HRA) made non-significant improvements on 7 of the 10 lifestyle, mental health and work ability indices whereas Group B displayed non-significant improvements across eight indices. Beyond their statistical significance, the changes reported for Groups A and B were small in size with partial eta-squared values ranging from 0.01 to 0.04, indicating that the two interventions' effects are of limited practical significance.

With regards to the secondary outcome of self-perceived health behaviour change, the results are far more encouraging. Not only were Groups A and B far more likely to report making a lifestyle change in comparison with the control group, Group A was considerably more likely to report a change (OR 29.2, 95% CI: 9.22–92.27) compared with Group B (OR 4.4, 95% CI: 1.65–11.44). This indicates that participation in the HRA was associated with a higher likelihood of lifestyle change and that this was further enhanced when augmented with the Healthworks programme.

The strength of this study was the use of an RCT to assess differences in two HRA interventions delivered in a workplace setting. This addressed the main methodological weaknesses of prior studies, namely the lack of a control group, imprecise success criteria and outcomes measured over a short timeframe [28, 40].

Table III. *Health Index Improvement—results of repeated measures ANCOVAs*

	Cronbach's alpha	Group	m *N*	Baseline Mean	SE	Post-test Mean	SE	Adjusted post-test Mean	Adjusted post-test SE	*F*-ratio	*P*	Partial η^2
GHQ12	0.85	A	41	2.66	0.45	2.34	0.46	2.20	0.42	0.17	0.84	0.001
		B	43	1.79	0.41	1.72	0.37	1.85	0.41			
		C	47	2.17	0.43	2.01	0.45	1.98	0.39			
WHO-5	0.91	A	41	11.49	0.88	12.76	0.89	13.27	0.71	0.73	0.48	0.01
		B	43	13.33	0.85	13.88	0.89	13.35	0.69			
		C	47	12.32	0.85	12.28	0.75	12.32	0.66			
WAI	0.82	A	41	35.56	0.67	35.32	0.66	35.77	0.49	0.06	0.94	0.001
		B	42	36.24	0.59	36.02	0.65	36.00	0.49			
		C	47	35.89	0.64	35.59	0.69	35.93	0.46			
Current WA		A	41	8.32	0.20	9.37	0.23	9.35	0.23	0.37	0.70	0.01
		B	43	8.42	0.25	9.56	0.22	9.49	0.22			
		C	47	8.13	0.22	9.15	0.28	9.23	0.21			
Mental Health Continuum	0.93	A	41	36.05	1.85	35.78	2.35	37.36	1.89	1.47	0.23	0.02
		B	43	40.74	2.28	41.93	2.47	40.37	1.85			
		C	47	38.34	1.95	36.02	2.01	36.07	1.76			
Job satisfaction		A	41	2.63	0.14	2.39	0.13	2.36	0.13	0.24	0.79	0.004
		B	43	2.40	0.15	2.42	0.15	2.48	0.13			
		C	47	2.64	0.14	2.45	0.13	2.41	0.12			
BMI		A	32	27.99	0.90	28.24	0.91	27.94	0.58	1.20	0.31	0.02
		B	38	27.50	0.68	27.43	0.71	27.96	0.54			
		C	35	28.29	0.72	29.30	1.01	29.01	0.56			
General health		A	41	2.95	0.13	2.80	0.13	2.80	0.10	0.53	0.59	0.01
		B	43	2.88	0.11	2.86	0.13	2.90	0.09			
		C	47	2.98	0.13	2.81	0.13	2.78	0.09			
Alcohol intake (units)		A	32	10.73	1.94	9.17	1.67	10.84	1.07	1.06	0.34	0.02
		B	37	14.00	2.45	11.71	1.79	11.17	0.99			
		C	43	12.00	1.64	12.45	1.43	12.72	0.92			
Physically active		A	41	2.49	0.10	2.32	0.11	2.30	0.08	2.38	0.10	0.04
		B	43	2.30	0.10	2.26	0.08	2.35	0.08			
		C	47	2.57	0.13	2.60	0.11	2.53	0.08			

Table IV. *Odds ratio—healthy lifestyle behaviour change*

	Yes (%)	No (%)	Odds ratio (95% CI)	*P* (Pearson chi-square)[a]
Group A ($n = 41$)	35 (85)	6 (15)	29.2 (9.22–92.27)	**0.001**
Group B ($n = 43$)	20 (46)	23 (54)	4.4 (1.65–11.44)	**0.004**
Group C ($n = 48$)	8 (17)	40 (83)	—	—
Total	63 (48)	69 (52)		

[a]Significant outcomes ($P < 0.05$) are printed in bold.

The main limitations included the small number of participants completing the study which has likely reduced the power of the statistical analysis. As discussed previously, logistical constraints limited the sample size of the study to 180 participants, thus no a priori power calculations were performed for the primary outcomes. No *post hoc* power calculations have been attempted. Although

Table V. *Healthy lifestyle behaviour change*

	Group A (%) ($n = 35$)	Group B (%) ($n = 20$)	Group C (%) ($n = 8$)	Overall (%) ($n = 63$)
Eating a healthier diet	32 (91)	17 (85)	7 (88)	56 (89)
Taking more exercise	28 (80)	17 (85)	6 (75)	51 (81)
Losing weight	16 (46)	13 (65)	6 (75)	35 (56)
Reducing alcohol consumption	8 (23)	5 (25)	2 (25)	15 (24)
Stopped smoking	1 (3)	0 (0)	0 (0)	1 (2)
Other[a]	3 (9)	0 (0)	1 (13)	4 (6)

[a]Included: reducing number of cigarettes smoked; reducing caffeine intake.

not a pilot, the trial is the first of its kind in the NICS and much valuable experience has been obtained in undertaking the study which will inform the design and implementation of future trials, including the use of prior power analysis.

In addition, as this was a prospective study over 12 months, it was not possible within that timescale to add new recruits to fill voids without altering the dynamic of the process. General health status on entry was not taken into account in the randomization process. Other limitations included the potential impact of external influences or interventions (both positive and negative) unrelated to the health promotion process, for example life crises such as bereavement, development of physical illness, pregnancy and engaging in other health promoting activity such as joining a gym.

Although the findings of our study are consistent with previous research concerning the LPAA [39], and HRAs in general[28], we must be careful in our interpretation. Although the ORs revealed that Groups A and B were considerably more likely to report a perceived lifestyle change compared with Control Group C, no significant differences were found in actual behavioural health outcomes between these groups. However, although statistically significant results are an important indicator of intervention effectiveness, achieving statistical significance in this study would have been highly impractical. With primary prevention initiatives such as the LPAA and Healthworks programme, the goal is to achieve small risk reductions in the majority of the generally healthy population; in order to identify small effects of statistical significance in multifaceted trials such as this study, trials need to be very large (and expensive). The maximum sample size for the study was unfortunately limited to 180 participants, as discussed previously; therefore, definitive conclusions on the effectiveness of the interventions cannot be made. In order to detect statistically significant effects, a larger trial may be required.

Concerning the practical significance of the interventions, both the HRA and augmented HRA produced small-size effects; however, considering that the goal of primary preventions is to help employees make small, positive changes, effects of a large magnitude were not expected. Furthermore, small, positive changes throughout a population can make a large public health impact [6, 7]; therefore, the modest effects of the interventions are not necessarily indicative of failure when considered in this light.

The relatively small sample size also leaves our study more vulnerable to the potentially confounding impact of life events. It is possible that an individual may engage in positive health behaviour change yet any improvement in health-related outcomes may be negated by recent life crises (e.g. family bereavement). A larger sample size within future studies would reduce the impact of these potentially confounding events. Another point worth consideration is the length of time necessary for positive health behaviour to translate into positive health outcomes. Measureable improvements in health- and productivity-related indices may take longer to achieve than the relatively short timescale

of the study. This potential longitudinal limitation could be further explored by continuing future investigations beyond a 12-month time period.

Participant perceptions on the effectiveness of the interventions were considered an important criterion for assessing their success. Individual perceptions of health are a critical component of many models of health behaviour change; for example, Prochaska's transtheoretical model begins with the stages of precontemplation (lack of awareness that life can be improved by a change in behaviour) and contemplation (recognition of the problem, initial consideration of behaviour change, and information gathering about possible solutions and actions) [41, 42]. This study suggests that the HRA interventions helped raise participants' awareness of their health and lifestyle behaviours and, therefore, may be beneficial in the contemplative stages, assisting people through to the other stages of preparation, action and maintenance.

Overall, the two interventions (HRA and augmented HRA) did not produce statistically significant effects. The effects were small in size, although this was expected as the study did not target 'at risk' employees. With regards to self-perceived health change the LPAA alone was of limited success in comparison with the LPAA programme augmented with Healthworks. Although it has been argued that HRAs can improve employee productivity [8], our study failed to find a relationship between the interventions and work ability, although definitive conclusions regarding this outcome (and others) cannot be drawn considering the small sample size.

From an employers' perspective, the study does not provide much concrete evidence on the effectiveness of the interventions or their impact on productivity. Nevertheless, compared with the option of doing nothing, the study provides preliminary evidence that HRAs may help some employees to maintain or improve health behaviours, whereas augmented HRAs may potentially help a larger proportion of employees. A larger RCT conducted over a longer time period should more definitively determine the effectiveness of HRAs for behaviour change.

Although improving the health of the working age population has been advocated by the Government [23], employers may be understandably reluctant to accept that this falls to them alone and need support and guidance to identify priorities and ensure that any investment is going to be both effective and consistent with the nature of the organization [41]. Brief health interventions adopting the HRA model have the potential to improve employee lifestyle parameters, and health. Enhanced benefits may be obtained from ongoing augmentation with a health mentoring programme. Further research into which type of brief intervention and ongoing augmentation might achieve the best outcome in a business context, particularly in regard to work ability and sickness absence, would be a useful next step.

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Conflict of interest statement

None declared.

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