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Efficacy and costs of a workplace wellness programme

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Background	Research investigating the efficacy of workplace wellness programmes to promote exercise, and by extension, reduce obesity and increase productivity has proliferated in recent years. Although preliminary work is encouraging, more work is needed.
Aims	To evaluate the effects and overall cost of a workplace exercise programme on multiple physical outcomes, including body mass index, aerobic fitness and muscular fitness.
Methods	Data from the Bruin Health Improvement Programme .5 (BHIP) between August 2013 and July 2018 were analysed. BHIP is a 12-week workplace wellness programme that assesses multiple areas of physical and mental health. For this study, changes in weight, waist-to-hip ratio, aerobic fitness and muscular endurance were analysed using paired samples *t*-tests and chi-squared tests. Using results from a prior analysis of Medical Expenditure Panel Survey, the estimated medical expenditure savings associated with weight loss were also analysed.
Results	A total of 518 participants (84% female) took part in the BHIP programme (mean age = 41 years, SD = 1.17). There were significant decreases in all anthropometric indices and significant increases in all fitness outcomes ($P < 0.01$) from baseline to follow-up. Estimated programme cost per participant, per session was $473 US Dollars (USD), and weight loss is estimated to reduce annual medical care costs by ~$2200 USD.
Conclusions	Results showed significant improvements in all physical outcomes of interest. Additionally, there appears to be an inverse relationship between improvements in employee health and employer healthcare costs. Strengths, limitations and future directions are discussed.
Key words	BMI; obesity; physical activity; workplace wellness programmes.

Introduction

Obesity is a significant and growing public health concern in the USA [1]. An increase in sedentary jobs, easy access to high-caloric foods and insufficient amounts of physical activity has led to an increase in obesity rates over the three decades, with current prevalence rates reaching close to 40% compared to 12% three decades ago [2]. Risks associated with obesity include hypertension, cardiovascular disease, type 2 diabetes and dyslipidaemias [3]. Prior studies have shown a 28-fold increased risk for diabetes among those with a body mass index (BMI) > 30 and a 93-fold increase for those with a BMI > 35 [4]. Similarly, adults with a BMI > 30 have a 50–100% increased risk for developing cardiovascular disease [5]. Although obesity-related chronic diseases are currently the leading cause of death among Americans [6], physical activity is a modifiable health behaviour that is shown to prevent and treat various obesity-related chronic diseases [7].

The US Department of Health and Human Services and the American College of Sports Medicine recommend 150 min per week of moderate intensity physical activity, 75 min per week of vigorous intensity physical activity or a combination of the two to achieve substantial health benefits [8]. For example, meeting these weekly

Key learning points

What is already known about this subject:

- An increase in sedentary jobs, easy access to high-caloric foods and insufficient amounts of physical activity have contributed to the obesity epidemic.
- Given the considerable amount of time individuals spend at work, there is an emerging body of research investigating the efficacy of workplace wellness programmes to promote exercise.
- Reduction in body mass index leads to savings in medical expenditures according to prior research.

What this study adds:

- Over the course of the programme, participants improved their physical fitness and reduced all anthropometric indices.
- Our study calculated the overall programme cost, demonstrating that workplace wellness programmes can be delivered with minimum additional cost to the workplace.
- Weight loss is estimated to reduce annual medical care costs by ~$2200.

What impact this may have on practice or policy:

- Develop a programme on minimal additional costs by building on existing fitness infrastructure.
- In addition to savings in medical expenditures, physical activity interventions impact absenteeism and overall mental health status.
- Creating flexible workplace wellness programmes to extend the reach to employees, including those with less flexible schedules and longer work hours.

physical activity guidelines can reduce the risk of cardiovascular and metabolic disease, cognitive decline and aid in the treatment of other chronic diseases (e.g. osteoarthritis, mental illness) [8]. Additionally, studies have demonstrated the mental health benefits of engaging in physical activity, citing increases in anxiety and depression among individuals with low activity levels and improvements in overall self-reported mental health status among those who are physically active [9,10]. Despite these well-known benefits, upwards of 80% of US adults do not meet the physical activity guidelines which highlights the need for effective programmes to increase physical activity [11].

The economic ramifications associated with obesity are also significant, as health expenditures in the USA reached $3.6 trillion in 2018 [12]. In fact, the USA spends twice as much on healthcare per capita compared to similarly developed, high-income countries [13]. In addition, businesses are incurring higher costs for disability and unemployment benefits, as obesity-related absenteeism and reduced productivity (presenteeism) can cost employers up to $11.7 billion per year [14].

Since most individuals spend a considerable amount of time at work, there is an emerging body of research investigating the efficacy of workplace wellness programmes to promote exercise, and by extension, reduce obesity and increase productivity [15]. Some of these preliminary studies have shown reductions in absenteeism and presenteeism among employees, ultimately lowering healthcare costs for employers. For example, one study found that rates of absenteeism among physically inactive employees was almost three times higher compared to those who met the CDC physical activity guidelines [16]. Low levels of physical activity may also influence mental health status, which in turn can affect an employee's productivity and ability to effectively perform their work [17]. Another study reported that for every dollar invested in wellness programmes, medical expenses drop by an average of $3.00 and absenteeism-related costs drop by an average of $2.73 [18]. These encouraging results have increased the interest of employers to develop workplace programmes to improve employee health, and to curb the escalating costs related to employee inactivity.

Another benefit to workplace programmes is that they can circumvent common barriers to exercise such as lack of time and exercise-related knowledge, financial constraints, unreliable public transportation and poor (or non-existent) workout facilities [19,20] by providing access to onsite exercise classes and certified trainers, multiple times per day. Numerous qualitative studies have explored the feasibility and acceptability of workplace wellness programmes among employees, citing benefits such as social support from peers and co-workers, access to facilities and resources, and convenience in regards to location [21,22].

One such programme that was developed to simultaneously address employee and employer needs while also addressing common barriers to exercise is the Bruin Health Improvement Programme .5 (BHIP). BHIP is a 12-week physical activity and nutritional education programme located at the University of California, Los Angeles (UCLA) and targets faculty and staff ≥ 18 years of age who are inactive and at least 50 pounds overweight.

Although the importance of mental health in work productivity and healthcare costs are clear, improving

physical health is just as important. Thus, the primary aims of this study are to evaluate the effects of BHIP on multiple domains of physical fitness (e.g. muscular endurance, aerobic fitness) and anthropometry (e.g. BMI, waist-to-hip ratio). We hypothesize that BHIP improves each physical outcome of interest. The overall cost of the intervention is reported per person and per session. Additionally, we provide estimated medical expenditure savings associated with weight loss from a prior study using data from the Medical Expenditure Panel Survey (MEPS). Costs and savings are reported to benefit employers and researchers who are developing workplace programmes to reduce obesity and conducting cost-effectiveness analyses.

Methods

All participants were UCLA faculty and staff ≥ 18 years of age who participated in the BHIP programme between August 2013 and July 2018 (N = 518). The target population sample, i.e. UCLA faculty and staff, was recruited through the university e-mail listservs. Those interested in the programme were instructed to submit an online application. Of those who applied, participants were subsequently chosen at random to participate by the UCLA FITWELL staff. Those not able to secure a spot in the current session of BHIP were added to a waitlist and invited to reapply to the programme the following session.

Once enrolled, participants attend three physical activity sessions and one nutrition seminar per week for 12 weeks. In addition to the weekly nutrition seminar, participants were allotted three one-on-one sessions with a registered dietician. The topics covered in the one-on-one sessions are determined by the participant. Topics range from goal setting, addressing barriers to healthy eating, developing a healthy grocery list and meal plan, etc. Physical activity sessions were led by UCLA Recreation Centre fitness trainers and focus on strength training and cardiovascular conditioning. Participants were allowed up to three absences during the duration of the programme before they are excused from the programme.

Data were collected through online surveys and in person by the BHIP trainers leading the physical activity sessions. Demographic measures were collected such as age, highest completed level of education, sex and race/ethnicity. During the initial class (i.e. 'Pre'), the trainers assessed participant weight (pounds), waist circumference (inches), hip circumference (inches), maximum time (seconds) the participant could remain in a plank pose and number of metres ran in 15 min. The same measures were collected at the end of the 12-week programme (i.e. 'Post').

Weight was assessed at the first BHIP class using a calibrated scale and BMI was calculated (weight/height^2). Waist and hip circumference were assessed using a measuring tape with standard procedures, and waist-to-hip ratio was calculated as waist circumference/hip circumference. Aerobic fitness was assessed by measuring how many metres participants could walk in 15 min. Muscular endurance was assessed by measuring how long participants could hold a plank pose in seconds. Changes in study outcomes from pre- to post-assessments were analysed using paired samples t-test for continuous measures and chi-squared test for differences in BMI categories for statistical significance.

Further analyses were conducted to determine programme cost (i.e. administration fees, physical trainer and nutritionist salaries, graduation supplies) per person, per session. To estimate the potential medical expenditure cost savings associated with weight loss, we used results from Cawley's two-part model of medical expenditures [23]. Using MEPS data from 2000–2010 surveys, Cawley calculated average cost savings associated with a 5% change in BMI for those with a starting BMI between 30 and 45 kg/m^2. Results from that study estimated that a 5% reduction in weight for those with a BMI 35, 40 and 45 equates to annual savings of $528, $2137 and $10 030 USD, respectively. All analyses were performed using SAS 9.4 (SAS Institute Inc., Cary, NC, USA).

Results

A demographic description of the sample is presented in Table 1. The mean age was 41 years of age (SD = 11.7). The majority of participants were female (84%) and were mostly White (31%). The average level of education was about 16 years, which is equivalent to an undergraduate degree.

A detailed description on the changes in physical fitness and anthropometry is presented in Table 2. The average bodyweight of the sample at baseline was 216.8 pounds (SD = 44.4), and the average waist-to-hip

Table 1. Baseline characteristics of BHIP programme sample (N = 518)

	Mean, SD
Age (years)	41 ± 11.7
Education (years)	16 ± 2.7
	n (%)
Sex (female)	437 (84)
Race/ethnicity	
White	159 (31)
Hispanic or Latino	133 (26)
Black	101 (19)
Asian	77 (15)
Other	20 (4)

Table 2. Before and after BHIP physical health measurements

	Before (n = 518)		After (n = 445)		
	Mean	SD	Mean	SD	P-value
Weight (pounds)	216.8	44.4	204.9	41.0	<0.01
Waist-to-hip ratio	0.88	0.11	0.85	0.07	<0.01
Plank (seconds)	64.8	33.9	115.1	56.7	<0.01
Lap time (metres)	1270.2	246.1	1408.7	230.2	<0.01
BMI (kg/m^2)	36.0	6.5	34.1	6.6	<0.01
	n	%	n	%	P-value
BMI category					
Obese	315	33	102	73	<0.01
Overweight	45	5	30	21	
Normal	10	1	8	6	

Table 3. BHIP programme costs[a]

	Classes	Instructor hours/week	Weeks	Pay (rate) per hour	Adjusted with benefits	Total
Administration and assessment				$1200[a]	$1716	$1716
Fitness classes, FTE	3	3	12	$25	$36	$1296
Fitness classes, PTE	3	3	12	$25	$30	$1080
Nutrition lecture	1	2.5	12	$37	$43	$1290
Nutrition sessions	20	1.5/person		$37	$43	$1290
Graduation supplies						± $420
Total cost						$7092
Cost per participant per session						**$473**

FTE, full-time effort; PT, part-time effort. Currency listed is in US Dollars (USD).
[a]Cost based on a class size of 15.

ratio was 0.88 (SD = 0.11). At the completion of the 12-week programme, there were significant reductions in bodyweight (mean difference = 11.9 pounds, $P < 0.01$), waist-to-hip ratio (mean difference = 0.03, $P < 0.01$), BMI (mean difference = 1.9, $P = 0.01$), and the percentage of participants categorized as obese at baseline (85%) dropped to 73% over the span of 12 weeks. There are missing BMI calculations due to weight not recorded at pre- (n = 148, 29%) and post-BHIP assessment (n = 305, 69%). With regards to physical fitness, participants ran an additional 138.5 (SD = 230.2) m in 15 min ($P < 0.01$) and increased their maximum time in a plank pose by 50.3 (SD = 56.7) s ($P < 0.01$) after the 12-week BHIP programme.

Table 3 presents total programme costs per person and per session, as well as component costs (i.e. administration fees, physical trainer and nutritionist salaries, graduation supplies). Administrative and assessment fees were calculated at $1716 per session. Salary and benefits for three full-time fitness trainers, three part-time fitness trainers and one part-time nutritionist totals $4956 per session. BHIP graduation supplies total $420 per session. Thus, based on a class size of 15, the total programme cost per participant, per session, is $473. Finally, in calculating the potential medical expenditure cost savings associated with weight loss using Cawley's two-part model of medical expenditures, given a limited number of participants who were obese (i.e. BMI > 30) with both pre- and post-assessment (n = 115), we estimated an average savings of $2208.22 per participant in BHIP programme.

Discussion

Our hypotheses were mostly supported, as participants significantly improved their physical fitness and reduced all anthropometric indices over the course of the programme. These findings are consistent with the results of other workplace wellness programmes. In a recent meta-analysis, for example, small, but significant, effects were seen for aerobic fitness and muscular endurance across

17 studies [15]. Although there are several methodological differences between the studies included in the meta-analysis and BHIP including length of the exercise programme, session frequency (per week) and the inclusion of a nutrition component, these data support the use of workplace wellness programmes as a viable way to improve the physical fitness and health of employees.

Furthermore, the significant reductions in all anthropometric indices align with findings from previous studies. For example, one study examining the effects of a workplace wellness programme found significant reductions weight and BMI [24], while other studies have shown reductions in waist [25] and hip circumference [26] following the course of the programme. One of the major differences between these previous studies and the BHIP programme is that they did not include a nutrition component, whereas BHIP did have a nutrition component. Therefore, it remains difficult to determine if the exercise component or the nutrition component of BHIP. 5 contributed more to the change in these anthropometric indices.

The results also estimate that the beneficial physical effects of BHIP. 5 could result in average medical expenditure cost savings of $2208 per obese participant. Previous work suggests that the annual cost per obese individual is nearly $3500, which equates to roughly $315 billion nationwide [23]. Thus, reducing obesity through programmes like BHIP could have significant financial benefits for employers nationwide. It should be noted, however, that a linear relationship exists between BMI and medical care costs, and the BHIP data used for this study did not include participants with a BMI over 45. Thus, the cost savings found for this study, may, in fact, be understated.

This study had some limitations. Although there were no significant differences related to BMI for participants who completed the programme compared to those who did not, there were substantial missing data for participants' weight at both assessments. As a result, an aggregate BMI calculation was not available, and may only be reflective of those who finished the full 12-week programme and attended both the pre- and post-assessments where weight was measured. In other words, it is possible for participants to complete most of the programme but be absent from one of the assessment days, thus not having complete data. Additionally, since all questions were optional to complete, some participants did not fully complete all pre- and post-BHIP assessments. The high percentage of BHIP participants who did not fully complete the surveys could be because there were no incentives to do so, or because of the excessive time burden associated with completing all study assessments.

Second, given that participants were inactive at the start of the programme, the moderate to vigorous intensity exercise protocols used during the programme may have resulted in too much muscular pain and discomfort, and nausea. An abundance of research has shown that exercise intensity, at or above, the ventilatory threshold results in negative affect and reduced exercise enjoyment, both of which are predictors of future exercise adherence [27]. Thus, the participants who dropped out may have felt too sore to return to subsequent classes (or did not enjoy them), and by the time they were ready to return they were dismissed from the study for accumulating three absences.

Third, despite all BHIP participants being inactive at the onset of the programme, it is unlikely that all have been inactive throughout their lifespan. Thus, individuals with varying levels of exercise experience could be in the same class, resulting in some individuals mastering the exercises more quickly than others. Some of the participants who have less exercise experience may have felt discouraged about not mastering the exercises as quickly as others, which may have led to them dropping out of the programme. Classes that are scheduled and tailored by perceived exercise ability (i.e. beginner, intermediate, advanced) may increase adherence rates.

Fourth, although BMI is often used as a measure to demarcate normal and obese status, among others, it most notably does not take into consideration muscle mass. Bodyfat % is a better indicator of cardiovascular disease and metabolic disease [28] and can be assessed in a simple and time-efficient measure of bodyfat % using bioelectrical impedance. Future research that assesses bodyfat % could better identify those at an increased risk of metabolic disease. Lastly, muscular strength is not assessed in the current iteration of the programme but is a predictor of all-cause mortality [29] and can be assessed before and after a workplace exercise programme with minimal to no equipment (e.g. handgrip strength, push-up).

Despite these limitations, this study has several strengths. First, a workplace exercise programme like BHIP has strong external validity and can implemented at universities and other companies and employers worldwide who have access to fitness facilities and trainers. Second, the convenience of the BHIP programme being offered at multiple times each day and each year and on-campus helps circumvent known barriers to exercise such as time, scheduling conflicts and unreliable transportation. Third, in addition to the physical health benefits of BHIP, this specific study highlights the economic ramifications of reducing BMI. Fourth, BHIP and other programmes like it have the potential to reduce absenteeism and increase productivity. Lastly, at the completion of BHIP, participants can transition into more advanced BHIP programmes to continue to exercise. This mitigates the risk of participants going back into their pre-programme sedentary lifestyle.

In conclusion, improvements in physical and mental health, work productivity, and reductions in healthcare costs and absenteeism underscore the value

of programmes like BHIP. Although improvements in the programme could result in better adherence and more comprehensive findings, such as offering classes by perceived exercise ability and assessing bodyfat % and muscular strength, respectively. It may also be informative to conduct exit interviews with participants to determine the acceptability of the programme to increase adherence in future iterations. Assessing the feasibility of workplace wellness programmes in areas where the weather differs from that of Los Angeles may provide greater insight into whether exercising indoors or outdoors affects adherence and other psychological, physiological, economic and work productivity variables of interest. BHIP is offered year-round and these changes can be easily implemented in future iterations.

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Competing interests

None declared.

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Alcan, occupational medicine and golf

The name Alcan might be synonymous (well, perhaps to older readers!) with a popular brand of aluminium foil but there are deeper connections with occupational medicine extending into the Society of Occupational Medicine and golf.

Alcan was a Canadian mining company and aluminium manufacturer. The name was derived from the Aluminum Company of Canada and was one of the world's largest aluminium manufacturers. It is now a subsidiary of the multi-national Rio Tinto group.

Despite the well-known tinfoil brand, it and its alloys are essential to the aerospace industry and widely used in building for facades and window frames. Aluminium has a remarkably low density and ability to resist corrosion through the phenomenon of passivation where a material becomes passive and less affected or corroded by the environment of future use.

Aluminium production is typically achieved by extracting aluminium in a smelting process from its oxide, alumina, generally by what is known as the Hall–Héroult process. Alumina is also extracted from the ore bauxite by means of the Bayer process at an alumina refinery.

Because this is an electrolytic process, an aluminium smelter uses huge amounts of electricity. Smelters often tend to be located close to large power stations, often hydro-electric ones, to reduce the overall carbon footprint. This is an important consideration, because a large amount of carbon is also used in this process, resulting in significant amounts of greenhouse gas emissions.

There is now only one remaining smelter in the UK left, Liberty British Aluminium. Based at Fort William in the Scottish Highlands, the smelting facilities are powered by two neighbouring hydro-electric stations. This combination of renewable energy sources makes the site one of the greenest metal production plants in the country. Up until 2000, there had also been another smelter at Kinlochleven in the Highlands, constructed in 1907.

Smelting has a wide range of occupational hazards including heat stress, noise, EMF exposure, respiratory symptoms including obstructive and restrictive defects and the colloquially known 'potroom asthma', a condition somewhat specific to the industry, and a continuing although not established concern around cancer.

Those wide and varied health concerns make occupational health a critical business component and that in turn links us to the Scottish Group of the Society of Occupational Medicine who play annually for the Alcan golf Trophy. The origins of the trophy remain somewhat shrouded in mystery, presumably we think, an Occupational Physician providing services to Alcan persuaded them to donate this trophy and we would be keen if any reader has more information to get in touch.

So, the next time you wrap your chicken or other food item in tinfoil, you will think about the history and challenges of this fantastically useful multi-purpose culinary tool.

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