The effectiveness of a corporate exercise intervention programme on cardiovascular risk profile, fitness and productivity: A South African view

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Background. Workplace wellness and disease-prevention programmes have been given increasing attention as a means to improve employee health and lower health costs. Health risk factors have been associated with improved work productivity. Further, health risk is reduced with improved cardiorespiratory fitness (CRF). Therefore, personal and workplace benefits may be achieved by workplace wellness programmes.
Objectives. To investigate the effect of an on-site exercise-based wellness programme in a South African (SA) corporation. The impact of the programme on health risk factors, physiological parameters and corporate productivity indices was assessed.
Methods. Members joining the on-site gym facility of an SA corporation embarked on an individualised 12-week exercise programme, designed using the MyWellness Technogym Cloud platform and based on the participant's cardiovascular risk stratification. Weight, height, body mass index (BMI), blood pressure, waist circumference, CRF and muscle strength measures were assessed at the start and the end of the 12-week intervention. The number of pre- and postintervention cardiac risk factors were also applied to the Association of Health Productivity Management formula to estimate the effect of the intervention on absenteeism, presenteeism and productivity loss.
Results. The number of cardiovascular risk factors decreased in the low-, medium- and high-risk groups (68.1%, 42.7% and 41%, respectively). Body mass and BMI decreased significantly (mean (standard deviation (SD) −0.3 (5.0)% and −0.3 (5.4)%, respectively). Waist circumference also decreased significantly by 2.2% (6.3%). Only the diastolic blood pressure component of blood pressure changed significantly (−1.2 (14.7)%) and VO_2 peak increased by 14.2%. Upper- and lower-body strength improved by 17.9% and 20%, respectively. VO_2 peak, BMI and lower-body strength were the only variables that changed significantly after effect size calculations were applied. Furthermore, the predicted impact on productivity loss showed a 1.1% improvement. This was the result of a predicted reduction in absenteeism (0.4%) and a reduction in presenteeism (0.8%).
Conclusions. This corporate on-site exercise intervention programme positively affected the cardiovascular risk factors, biometrics, muscle strength and CRF of employees. These health outcomes decreased employee productivity loss. On-site workplace wellness programmes should be encouraged.

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Workplace wellness and disease-prevention programmes have been given increasing attention as a means to improve employee health and lower health costs. Research has shown that medical costs decrease by USD2.71 - USD6.00 for every USD1.00 invested in a workplace wellness programme.[1,2] Furthermore, health risk factors have been associated with improved work productivity.[3,4] Studies have shown an improvement in cardiovascular disease (CVD) risk factors after exercise intervention.[5-8] Cardiorespiratory fitness (CRF) has been shown to be an independent risk factor for CVD and all-cause mortality.[9-14] CRF is also the risk factor that attributes the highest percentage to all-cause deaths compared with other traditional risk factors.[15] Gupta *et al.*[16] and Vigen *et al.*[17] found that CRF is a stronger predictor of CVD mortality than other risk factors. Moreover, the association between CRF and all-cause mortality is independent of existing CVD,[18] the presence of chronic disease and/or other CVD risk factors.[15,19,20] In addition, an individual's decline in CRF level has been shown to predict the development of hypertension, hypercholesterolaemia, metabolic syndrome and midlife metabolic outcomes.[21,22] Lee *et al.*[23] found that increases in CRF level decreased all-cause and CVD mortality. In contrast, changes in percentage body fat or body weight did not affect all-cause and CVD mortality. Furthermore, a single baseline measure of low fitness has been associated with CVD and non-CVD mortality across 3 decades of follow-up in men and women.[17] Recent studies have expressed CRF in the context of survival benefit per MET: each 1-MET increase (a relatively small increment achievable by most individuals) is associated with 10 - 25% improvement in survival.[24-26] Efforts to improve CRF have benefits not only for individuals, but also for corporates providing access to on-site gym facilities.

This study investigated the effect of an on-site exercise-based wellness programme in a South African (SA) corporation to determine the impact of the programme on health risk factors and

outcomes, and whether the return on investment was similar to that reported in other countries.

Methods

The setting of the study was an SA corporation in the financial business sector. The corporation established an on-site gym facility for employees. Using a prospective intervention design, the researchers invited all new members joining the facility to participate in the study, and those who signed informed consent were recruited. All employees of any gender and aged >18 years were considered for inclusion. Baseline measures were recorded prior to participants embarking on an individualised 12-week exercise programme, designed using the MyWellness Technogym Cloud platform. The outcome measures were repeated at the end of the exercise intervention. Participants underwent an initial assessment, were risk stratified, provided with a training programme and monitored for the duration of the 12-week programme, followed by reassessment.

Measuring tools

CVD risk classification

Each employee who joined the on-site exercise facility was screened using the American College of Sports Medicine/American Heart Association (ACSM/AHA) facility screening questionnaire[27] and was classified as low, moderate or high risk according to the ACSM risk stratification guidelines.[28] After signing informed consent, employees with low-risk stratification were assessed by a personal trainer. Employees classified as moderate or high risk were assessed by a registered biokineticist (clinical exercise specialist).

Assessment

Stature (m) and mass (kg) were measured using the Detecto height meter (Detecto, USA) and Tanita scale (BF-350) (Tanita, Japan), respectively. Blood pressure (mmHg) was measured three times in a seated position with a Rossmax International blood pressure cuff (Rossmax, Taiwan), using a standardised method. The average of the two closest measures was used. Waist circumference (cm) was measured at the greatest abdominal circumference between the lowest rib and the iliac crests.

CRF was measured using the Technogym (TG) submaximal test on a TG treadmill or cycle, depending on the participant's preferred mode of training. The TG test is a submaximal test that estimates maximal oxygen consumption (VO_2max) using the linear relationship between heart rate and VO_2max, without subjecting the individual to high levels of physical stress. During the TG submaximal exercise testing, predetermined workloads are used to elicit a steady state of exertion (plateau in heart rate and VO_2). The steady state heart rate at each workload is then calculated and extrapolated to the VO_2 at the age-predicted maximal heart rate. This is a double-stage submaximal test and its validity and reliability have been documented (r=0.75).[29]

Muscle strength was measured using the 10 repetition maximum method.[30] Two tests were used, i.e. an upper-limb push movement on a chest press machine and a lower-limb push movement on a leg press machine. The predicted 1 repetition maximum (1 RM) was calculated from the heaviest load that could be pushed 10 times, using the Brzycki formula.[31]

Exercise prescription

The exercise programme was designed for and assigned to an individual using the MyWellness TG Cloud platform. The platform allows for real-time exercise data to be collected from the exercise equipment and to be viewed by a health professional. The low-risk-stratified employees[28] were assigned 12-week exercise programmes based on the TG aspiration model.[32] The high-risk-stratified employees were assigned programmes based on their 5 primary non-communicable diseases (NCDs) of lifestyle (CVD, hypertension, dislipidaemia, diabetes and metabolic syndrome/obesity), using MyWellness TG Cloud technology. The FITT-VP principles (frequency, intensity, time, type, volume and progression), as described by the ACSM,[28] were used in the exercise prescription for each NCD group. Employees were inducted into their exercise programme during a one-on-one session with a biokineticist (for high-risk-stratified employees) or with a personal trainer/fitness professional (for low-risk-stratified employees).

Monitoring

The MyWellness TG online platform made it possible to record data of all exercise sessions of employees using the TG key that is inserted into the equipment. The data from the TG key were downloaded to the TG kiosk in the facility at the end of the exercise sessions. The kiosk then transmitted the data to the server of the professional site of the MyWellness TG platform. In this manner, all exercise parameters (i.e. treadmill/cycle duration, heart rate, workload, sets and repetition of strength exercises and session kcal value) captured in the facility can be considered as verified, trusted data. The trainer would investigate the exercise data of the employee on the professional site of the MyWellness TG platform once a week and provide feedback on the prescribed v. the actual exercise frequency and volume. The coaching application of the MyWellness TG Cloud platform allowed for communication via smartphone. Each high-risk employee had a weekly group appointment with the assigned biokineticist, during which the latter used MyWellness TG to monitor and adjust the exercise programme. This contact session was also used to motivate the employee. After the 12-week post-assessment, the trainer or biokineticist discussed the results and health outcomes with the employee.

Presenteeism and absenteeism

Presenteeism and absenteeism could not be calculated directly (corporate data were not available), and were predicted using the Association of Health Productivity Management (AHPM) formula.[3] The formula calculates the number of employees with 1 - 9 cardiac risk factors. These numbers are then used to calculate the presenteeism and absenteeism percentage for the group. The two percentages are then used to calculate the total productivity loss percentage.

Statistical analysis

Data distribution was analysed using Shapiro-Wilk's W-test, and any variables found to be significantly skewed were log transformed to normality, i.e. p>0.05 by Shapiro-Wilk's W-test. Student's t-test for paired values obtained at weeks 0 and 12 were used to analyse the changes before and after exercise intervention. Statistical significance was set at p<0.05. Effect size and 95% confidence intervals (CIs) were also calculated.

Presenteeism, defined as being present at work but working at a reduced capacity, was calculated based on the employee's number of health risk factors according to the AHPM formula.[3]

Results

Employees (n=251) in a corporate environment who consented and were cleared to participate in a workplace wellness intervention, completed a 12-week exercise intervention programme that resulted in improvements in cardiovascular risk category and the number of cardiovascular risk factors in each risk category (Table 1).

The number of participants with cardiac risk factors of inactivity, smoking, obesity and hypertension decreased after the intervention (Table 1).

Furthermore, body mass, body mass index (BMI), waist circumference, diastolic blood pressure, VO_2 peak, and upper- and lower-body strength improved significantly over the 12 weeks (Table 2). The greatest percentage change was found in VO_2 peak and upper- and lower-body strength (Table 2). However, once effect size calculations were applied, the only variables that changed significantly were BMI, VO_2 peak and lower-body strength (Table 2).

The predicted impact on productivity loss showed a 1.1% improvement (Table 3). This was the result of a predicted reduction in absenteeism (0.4%) and a reduction in presenteeism (0.8%) (Table 3).

Discussion

This study showed that a 12-week exercise intervention programme had a significantly positive effect on the cardiovascular risk category and CVD risk factors, physiological, muscle strength and cardiovascular fitness of employees. These health outcomes decreased employee productivity loss by 1.1%.

Studies have shown improvements in CVD risk factors,[5-8] some as many as 57% of employees having changed from high risk to moderate and low risk after an exercise intervention.[2] Our study showed a 40% change from high risk to moderate and low risk after the exercise intervention (Table 1). It should be noted that the benefit of reducing the number of cardiovascular risk factors of employees is a reduction in their cardiovascular risk. The effect of the exercise intervention has benefits in addition to those of risk reduction. Forty percent of the risk reduction associated with exercise cannot be explained by traditional risk factors.[33]

A study by Mora *et al.*[34] showed that a 20% reduction in mortality attributable to cardiovascular causes was observed for every 1-MET increase in exercise capacity among women. This study also pointed out the relative weakness of ischaemic electrocardiography responses in predicting CVD and all-cause mortality among women, similar to that reported among men. The importance of CRF as a vital sign was also recently published in a position statement.[35] Our data show that an exercise-based intervention can change CRF by 14.2% (Table 2). This translates to a reduction in CVD risk and predicted mortality.[9-12,16,17]

Our study showed a significant improvement in upper- and lower-body muscle strength. This improvement in muscle strength may have an impact on employee mortality. Roberts *et al.*[36] found that resistance training >30 min/week results in a 30% reduction in risk of CVD. Research data support this association between

Table 1. Risk stratification, anthropometric and physiological variables at T1 and T2 of the 12-week exercise intervention programme

Variables, *n*†	*n*	T1	T2	*p*-value
Low cardiac risk category	251	149	186	
Risk factors		94	30	
Moderate cardiac risk category	251	52	35	
Risk factors		117	67	
High cardiac risk category	251	50	30	
Risk factors		134	79	
Specific risk factors	251			
Age		3	3	
Family		29	29	
Obesity		99	82	
Dyslipidaemia		16	16	
Inactivity		139	5	
Hypertension		41	27	
Prediabetes		9	9	
Smoking		9	5	
Female	172			
Male	79			
Age (year), median (IQR)	250	31.0 (10.0)		
Body mass (kg), mean (SD)	251	79.5 (19.2)	79 (18.3)	0.04*
BMI (kg/m^2), mean (SD)	251	28.2 (6.16)	26.6 (6.9)	0.04*
Waist circumference (cm), mean (SD)	251	93.7 (16.3)	91.5 (15.4)	0.0001*
Physiological variables				
Systolic blood pressure (mmHg), mean (SD)	250	121.3 (6.16)	120.9 (16.2)	0.65
Diastolic blood pressure (mmHg), mean (SD)	251	78.9 (12.9)	76.8 (10.7)	0.003*
VO_2 peak (mL/min/kg), median (IQR)	243	38.0 (28.7)	43.1 (16.5)	0.003*
Upper-body strength (kg) (predicted 1 RM), median (IQR)	240	36.0 (28.0)	40.0 (37.6)	0.0001*
Lower-body strength (kg) (predicted 1 RM), median (IQR)	245	106.7 (68.0)	133 (86.9)	0.0001*

T1 = start; T2 = completion; IQR = interquartile range; SD = standard deviation; BMI = body mass index; RM = repetition maximum.
*$p<0.05$.
†Except where otherwise indicated.

Table 2. Percentage changes and effect size calculations

Variables	Change, %	Effect size (95% CI)
Body mass (kg), mean (SD)	−0.3 (5.0)	−0.03 (−0.20 - 0.15)
Body mass index (kg/m^2), mean (SD)	−0.3 (5.4)	−0.24* (−0.42 - −0.07)
Waist circumference (cm), median (IQR)	−2.2 (6.3)	−0.14 (−0.31 - 0.04)
Systolic blood pressure (mmHg), mean (SD)	0.2 (12.4)	−0.03 (−0.21 - 0.14)
Diastolic blood pressure (mmHg), mean (SD)	−1.2 (14.7)	−0.18 (−0.35 - 0.00)
VO_2 peak (mL/min/kg), median (IQR)	14.2 (36.5)	0.22* (0.04 - 0.40)
Upper-body strength (kg) (predicted 1 RM), median (IQR)	17.9 (37.1)	0.12 (−0.06 - 0.30)
Lower-body strength (kg) (predicted 1 RM), median (IQR)	20.0 (44.2)	0.33* (0.15 - 0.51)

CI = confidence interval; SD = standard deviation; IQR = interquartile range; RM = repetition maximum.
*Effect size change >0.20.

increased muscle strength and reduced all-cause mortality[37] and cardiometabolic health.[36]

The 12-week exercise intervention programme implemented in our study, via its effect on CVD risk factors, had a favourable impact on employee productivity loss (Table 3). Health risk factors have been associated with work productivity. Boles *et al.*[3] showed that a higher number of risk factors were strongly associated with greater productivity loss. Loeppke *et al.*[38] found that lost productivity costs (measured as a combination of presenteeism and absenteeism) are 2.3 times higher than medical and pharmacy costs. The meta-analysis of Goetzel *et al.*[39] found that the overall cost of presenteeism accounted for one-fifth to three-fifths of the total USD lost to 10 conditions. A 1.9% productivity loss has been associated with every risk factor changed and a USD950 per year per risk factor change.[4] Our results show that, in addition to the personal health benefits, financial benefits would result from the exercise intervention.

Mckenna and Coulson[40] found that use of a workplace exercise facility improved work productivity, supporting our use of the on-site facility.

Study limitations

Study limitations include lack of a control group, lack of control of nutritional/energy input, lack of blood tests and lack of actual absenteeism and presenteeism data from the corporate. Further research should include these outcome measures.

Conclusions

A corporate on-site exercise intervention programme can positively affect the CRF, biometrics, muscle strength and cardiovascular fitness of employees. These health outcomes can in turn decrease employee productivity loss. Despite the evidence, CRF is the only major risk factor that is not accurately, routinely and regularly assessed in the clinical setting[41] and in the workplace. The authors of this study strongly suggest that, in addition to targeting traditional cardiac risk factors as part of the primary prevention evaluation, exercise capacity (CRF) achieved on a maximal (or submaximal) graded stress test should be evaluated to fully assess a CVD prognosis. It is suggested that workplace wellness programmes regularly assess and reward employees for increasing and maintaining CRF within an optimal range. The long-term effects of improving CRF via increased physical activity should be given at least the same importance as weight loss with regard to reducing premature mortality.

Table 3. Absenteeism, presenteeism and impact on productivity loss at T1 and T2 of the 12-week exercise intervention programme

Variables	*N*	T1, %	T2, %
Absenteeism	251	0.6	0.2
Presenteeism	251	2.5	1.7
Impact on productivity loss	251	3.1	2.0

T1 = start; T2 = completion.

Declaration. None.

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