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A worksite physical activity program and its association with biopsychosocial factors: An intervention study in a footwear factory

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ABSTRACT

Objective: The objective of this study was to evaluate the effect of a worksite physical activity program on psychophysiological and social factors.

Methods: A worksite physical activity program included 1113 workers from a footwear factory in northeastern Brazil. The participants were classified based on their frequency of attendance in the program. The dependent variables were psychophysiological factors, including the relief of musculoskeletal pain, the improvement of physical and psychological well-being, perceived difficulty in performing tasks, and willingness to work; and social factors related to interpersonal relationships among employees. The obtained data were processed, and the analysis of the correlations between the variables was modeled using ordinal logistic regression.

Results: The frequency of physical activity was a determining factor for the effectiveness of the intended outcomes for all analyzed variables. The participants who attended more weekly exercise sessions were twice as likely to experience relief of musculoskeletal pain, 74% more likely to report psychophysiological well-being, 30% less likely to have difficulties in performing tasks, and 87% more likely to perceive improved interpersonal relations.

Conclusions: Regular physical activity is associated with consistent benefits for work dynamics and the health status of employees and effectively and rapidly improves the desired outcomes.

Relevance to industry: Worksite physical activity programs are used as strategies to prevent diseases and address complications caused by exposure to occupational risk factors. However, data on the effects of these interventions that consider the frequency of physical activity and work-related social factors are inconsistent.

1. Introduction

Recent technological advancements in modern society and the productivity demands of companies affect the way work is performed by increasing the complexity of work and favoring the emergence of health problems. Greater job demands impact quality of life, motivation, and task performance and ultimately lead to social and financial problems (Dyniewicz et al., 2009).

To understand and meet current demands, studies have evaluated the most effective strategies for preventing diseases and addressing complications caused by exposure to occupational risk factors (Macedo et al., 2011; Knardahl et al., 1186). An integrated management approach is fundamental to effectively articulate the organizational demands that arise from workers' needs.

From this perspective, worksite physical activity interventions, including active pauses in the work routine combined with stretching and muscle strengthening, have been investigated as strategies to reduce the physical and emotional problems caused by repetitive and monotonous

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work and improve common health indicators (Rossato et al., 2013; Brito and Martins, 2012; Grande et al., 2011; Arrogi et al., 2017).

In addition, the workplace is an ideal environment for promoting actions that encourage the adoption and maintenance of healthy living habits, improve physical and mental health, and increase service time, reducing health costs and absenteeism and resulting in higher productivity. Moreover, these strategies reduce medical costs caused by chronic diseases by approximately USD 347.2 per year per individual (Arrogi et al., 2017; Méndez-Hernández et al., 2012).

Previous studies demonstrated the benefits of physical activity programs at work, including the reduction of systolic blood pressure (−6.63 mmHg), total cholesterol (−10.12 mg/dL), and the rate of adverse cardiovascular events (Arija et al., 2017), as well as improvements in quality of life (Costa et al., 2013; Grande et al., 2013), motor function (Mezzomo et al., 2014), occupational stress and musculoskeletal pain (Freitas-Swerts and Robazzi, 2014; Lowe and Dick, 2014), muscle flexibility (Brito and Martins, 2012; Andrade et al., 2015), muscle strength (Martins et al., 2015), overall physical fitness (Grande et al., 2014), the ability to work, and perceived physical exertion during work execution (Jakobsen et al., 2015a, 2015b). These programs also improve social factors, including trust and interpersonal cooperation (Andersen et al., 2015). It is worth noting that exercise can supply additional energy for brain functions in the form of glucose and lactate and decrease calorie intake after mental work (Neumeier et al., 2016). Many companies adopt physical activity programs during part of the workday. Other companies propose fitness interventions that involve stretching exercises. Under stressful work conditions, some companies create lounge rooms where workers can relax (Iida and Guimarães, 2016).

However, the results depend in on the adopted method, the intended objectives, and the organizational and psychophysiological characteristics of the work. For this reason, data on the actual effects of this intervention, considering the effects of the frequency of physical activity and social aspects of work, are inconsistent (Grande et al., 2011), as this measure improves not only pathophysiological characteristics but also the workplace environment and productivity. Thus, there is a lack of studies that evaluate the effect of this strategy at the personal, collective, and corporate levels by considering pathophysiological, organizational, and social characteristics in the same population, as well as the frequency of physical activity.

Therefore, the objective of this study was to evaluate the effect of a worksite physical activity program on workers' psychophysiological and social factors and the effect of the frequency of application of the program to improve decision-making among occupational health professionals.

2. Methods

2.1. Company description

This study was conducted in a footwear factory located in northeastern Brazil. The company has been in business for more than 100 years. The company produces sports footwear, apparel, and accessories for eight international brands, and the targeted customers are men, women, and children. The company headquarters is located in Brazil, but the factories and offices are located in two additional countries in the Americas and six countries in Europe. The sales network includes 21 outlets distributed in eight Brazilian states, which sell products from the eight brands.

The evaluated unit is one of the five manufacturing units in Brazil. According to data from the Specialized Service in Safety Engineering and Occupational Medicine, this unit has 2045 employees, of whom approximately 2/3 are allocated to production sectors and 1/3 are assigned to administrative sectors. The production sectors run 6 days a week, including 5 days with three 8-h production shifts and 1 day with two 6-h production shifts. Production is performed in three large warehouses, which are used for the preparation, assembly, and finishing of the footwear. Each warehouse contains small production units called cells. Each unit produces approximately 272,500 shoes per day, which corresponds to an average of approximately 200 shoes/day/worker.

2.2. Sample selection

The sectors involved in the physical activity program were initially chosen by random sampling. The workers were randomly classified into four groups: workers who did not participate in the program (group 1) and workers who participated 2 days per week (group 2), 4 days per week (group 3), and 5 days per week (group 4).

The inclusion criteria were being aged 18 years or older, having completed the training period, and not having quit or missed work during the study period.

2.3. Exercise protocol

The physical activity program was run by a team of four physical educators, who were members of the Industrial Social Service. The program ran for 12 months in the administrative and shoe manufacturing sectors, from 7:00 a.m. to 5:00 p.m.

The exercise protocol was developed by a physical educator. The duration of the program was 10 min per shoe production cell and per administrative subsector. The number of workers in each unit or subsector was ≤30.

The exercises were performed during the workday and involved compensatory exercises. The general exercise protocol included 2 min of warm-up activities, self-stretching for 6 min, and relaxation for 2 min (Box 1) and involved the use of balls of various sizes, elastic bands, handheld massagers, medicine balls for proprioceptive training, rods, and audio and video resources.

Another important point was the execution of complementary activities during the program, including group facilitation exercises focused on current themes, which were performed in groups of two, three, or four people.

The warm-up activities included walks with synchronous or alternating movements of the upper and lower limbs, depending on the sector or production cell.

2.4. Study variables

The independent variable was the frequency of application of a worksite physical activity program using a previously established protocol. The dependent variables were psychophysiological aspects

Box 1
General protocol for worksite physical activity.

Field variable	Equilibrium conditions $\forall \boldsymbol{x} \in \mathscr{V}$	Jump conditions on Γ	Boundary conditions on $\mathscr{A}_1 \vee \mathscr{A}_\Xi$
$\boldsymbol{u}$	$\mathrm{div}(\boldsymbol{\sigma}) = 0$	$[\![\boldsymbol{\sigma}]\!]\ \boldsymbol{n}_\Gamma = 0$	$\boldsymbol{\sigma}[\boldsymbol{n}] = \bar{\boldsymbol{t}}$
$\check{\gamma}$	$\pi = \mathrm{div}(\boldsymbol{\xi})$	$\Xi = [\![\boldsymbol{\xi}]\!] \cdot \boldsymbol{n}_\Gamma$	$\boldsymbol{\xi} \cdot \boldsymbol{n} = \bar{\Xi}$

related to the relief of musculoskeletal pain and improvements in different parameters, including psychophysiological well-being, perceived difficulties in performing work tasks, willingness to work, and interpersonal relationships among employees.

2.5. Data collection

Data collection complied with the precepts of ethics, respect, and protection of the physical integrity of the study participants, as established in Resolution No. 466 of December 12, 2012, of the National Health Council. The research project was approved by the Research Ethics Committee of the Health Sciences Center of the Federal University of Santa Catarina and was approved under CAEE No. 61602616.6.0000.0121.

The data were collected using a structured interview, in which the participants were initially informed about the scope of the research. After acceptance, the participants were instructed to sign the informed consent form.

Each participant was interviewed during work hours in an air-conditioned room, away from external stimuli. The collection instrument included two components. The first component evaluated psychophysiological aspects and was intended to assess workers' perceptions of "psychophysiological well-being," "willingness to work," "relief of musculoskeletal pain," and "perceived difficulties in performing work tasks" using the following questions: *"Have you noticed an improvement in your physical and psychological well-being during the past* 6 months *of work?"*; *"Have you noticed an improvement in your willingness to work in the past* 6 months*?"*; *"In the past* 6 months*, have you perceived pain relief or reduction after and during work?"*; and *"Do you think that in the past* 6 months*, your work was more difficult?"*

The second part of the instrument evaluated workers' perceptions of social support by asking the question: *"In the past* 6 months*, have you noticed an improvement in your relationships with your coworkers?"* For statistical analysis, the workers' responses were dichotomized into "Yes" and "No."

2.6. Statistical analysis

The internal consistency of the collection instrument was initially analyzed using Cronbach's α coefficient. Subsequently, data normality was assessed using the Shapiro-Wilk test. For non-normal variables, the chi-square test was used to evaluate the presence of gender differences in age, body mass index (BMI), length of service, frequency of execution of the exercise protocol, and answers to the questionnaire. The coefficient of determination (R^2) was extracted from linear regression models and was used to calculate the explanatory power of the parameters age, BMI, and length of service for the independent variables "psychophysiological well-being," "willingness to work," "alleviation of musculoskeletal pain," and "perceived difficulties in performing work tasks." The associations between the independent variables were tested using Cramer's V coefficient.

The effect of an increase in the frequency of physical activity on the dependent variables was determined using the odds ratio (OR) estimator extracted from ordinal logistic regression models. The ordinal logistic regression model is shown in equation (1).

$$F = e^{\beta_{0j}} * \prod_{p=1}^{P} \left[\prod_{s=1}^{2} e^{\left(\beta_{sp}\right)^{PL_{sp}}} \right] \quad (1)$$

where F is the OR related to the frequency of performance of physical activities at work; j is the frequency of performance of physical activities at work (j = 1, 2, 3, and 4 corresponded to 0, 2, 4, and 5 days per week, respectively); $e^{\beta_{0j}}$ is the intercept for each j; $e^{\beta_{sp}}$ is the OR associated with category s (s = 1, "yes"; and s = 2, "no"), which is associated with factor p (variables "psychophysiological well-being," "alleviation of musculoskeletal pain," "perceived difficulties in performing work tasks," and "social support"); P is the nth factor; and $PFsp$ is the s category of factor p.

Model accuracy was used to assess the validity of the logistic regression model. Silva et al. (2017) reported that model accuracy consists of classifying the observations and comparing them with the studied variables; the percentage of correct classifications expresses the accuracy of the model. All analyses were conducted using the R software, version 3.4.0 (R Core Team, 2017), with a confidence level of α = 0.05.

3. Results

3.1. Collection instrument

The consistency of the collection instrument was evaluated using Cronbach's α coefficient, which presented a relative value of 0.70 and a confidence interval of 0.67–0.73, indicating strong internal consistency. Therefore, the instrument was appropriate for data collection and analysis, according to Landis and Koch (1977).

3.2. Exploratory analysis

Using the established selection criteria, 1556 workers who were eligible for the study were initially identified, which corresponded to 74.45% of the company's professional staff. Of these workers, 102 (4.88%) workers refused to participate in the study and 341 (16.32%) workers were absent from work. Therefore, the study sample included 1113 individuals, which corresponded to 53.25% of the company's total workforce. None of the evaluated variables had a normal distribution; for this reason, the non-parametric chi-square test was used to identify intergroup differences in sociodemographic variables and workers' perceptions of the variables included in the questionnaire.

Table 1 shows the characteristics of the sample and the results of the chi-square test. There were significant intergroup differences in BMI, age, length of service, and workers' perceptions of relief of musculoskeletal pain, interpersonal relations, willingness to work, psychophysiological well-being, and perceived difficulties in performing work tasks.

The number of women was greater than the number of men for all groups. Most workers were aged 20–29 years, with a normal weight and a length of service of less than 1 year in all groups. Most workers who did not perform physical activity at work did not perceive improvements in interpersonal relations, willingness to work, psychophysiological well-being, or relief of musculoskeletal pain in the past 6 months, in contrast to the groups that performed the exercise program. Furthermore, less difficulty in performing work tasks was reported by most workers in all groups.

3.3. Analysis of sociodemographic variables

Considering the significant differences in sociodemographic variables between the groups (Table 1), we investigated whether these differences affected the dependent variables. Table 2 presents the coefficient of determination (R^2) values. Age, BMI, and length of service had a low explanatory power for "interpersonal relations," "willingness to work," "psychophysiological well-being," and "relief of musculoskeletal pain." Therefore, despite the significant differences in age, BMI, and length of service among the groups, these differences did not affect the variables of interest. For this reason, a separate ordinal logistic regression analysis among the groups was not justified.

3.4. Association between factors

Table 3 shows the Cramer's V contingency coefficient values and the associations between the dependent variables.

Table 1
Sample characterization and chi-square test.

Variables	Frequency of physical activity (days per week)								p-value
	0 (n = 65)		2 (n = 141)		4 (n = 170)		5 (n = 737)		
	No.	**%**	**No.**	**%**	**No.**	**%**	**No.**	**%**	
Gender									
Female	49	73.38	94	66.67	114	67.06	462	62.69	0.158
Male	16	24.62	47	33.33	56	32.94	275	37.31	
BMI (kg/m^2)									
Normal weight	35	53.85	84	59.57	112	65.88	475	64.45	**0.020**
Underweight	1	1.52	2	1.42	7	4.12	44	5.97	
Overweight	20	30.77	44	31.21	40	23.53	180	24.42	
Obese	9	13.85	11	7.80	11	6.47	38	5.16	
Age (years)									
15–19	2	3.08	4	2.84	10	5.88	41	5.56	**0.004**
20–29	30	46.15	75	53.19	102	60.00	459	62.28	
30–39	20	30.77	41	29.08	44	25.88	185.0	25.10	
40–49	11	16.92	15	10.64	13	7.65	44	5.97	
> 50	2	3.08	6	4.26	1	0.59	8	1.09	
Length of service (months)									
< 12	30	46.15	58	41.13	98	57.65	471	63.91	**5*10^{-7}**
13–60	12	18.46	42	29.79	46	27.06	162	21.98	
61–120	8	12.31	19	13.48	16	9.41	49	6.65	
121–180	10	15.38	16	11.35	8	4.71	32	4.34	
181–240	5	7.69	4	2.84	1	0.59	15	2.04	
> 240	0	0.00	2	1.42	1	0.59	8	1.09	
Relief of musculoskeletal pain									
No	45	69.23	37	24.11	40	23.53	80	10.85	**2*10^{-16}**
Yes	20	30.77	107	75.89	130	76.47	657	89.15	
Improved interpersonal relationships									
No	40	61.54	35	24.82	21	12.35	74	10.04	**2*10^{-16}**
Yes	25	38.46	106	75.18	149	87.65	663	89.96	
Increased willingness to work									
No	40	61.54	20	14.18	27	15.88	64	8.68	**2*10^{-16}**
Yes	25	38.46	121	85.82	143	87.12	673	91.32	
Higher psychophysiological well-being									
No	39	60.00	20	14.18	18	10.59	48	6.51	**2*10^{-16}**
Yes	36	40.00	121	85.82	152	89.41	689	93.49	
More difficulty in performing work tasks									
No	53	83.08	111	78.72	139	81.76	649	88.06	**0.009**
Yes	11	16.92	30	21.28	31	18.24	88	11.94	

Chi-square test ($\alpha = 0.05$). P-values less than 0.05 are indicated in bold.

Table 2
Determination coefficients (R^2).

Variables	Age	BMI	Length of service
Relief of musculoskeletal pain	0.004	0.000	0.001
Perceived difficulty in performing work tasks	0.000	0.000	0.004
Perceived psychophysiological well-being	0.011	0.001	0.001
Willingness to work	0.015	0.001	0.004
Improvement in interpersonal relationships	0.015	0.000	0.004

Legend: BMI = body mass index.

Table 3
Values of Cramer's V contingency coefficient.

		1	2	3	4	5
1-	Relief of musculoskeletal pain	–				
2-	Improvement in interpersonal relationships	**0.38**[a]	–			
3-	Increased willingness to work	**0.39**[a]	**0.46**[b]	-		
4-	Perceived psychophysiological well-being	**0.45**[b]	**0.50**[b]	**0.48**[b]	–	
5.	Difficulty in performing tasks	0.08	0.07	0.05	0.03	–

Legend: a = moderate association; b = strong association.

There was a strong association between "perceived psychophysiological well-being" and "improvement in interpersonal relations," suggesting that mutual support between workers and supervisors improves physical and psychological factors. These findings appear to be supported by George and Jones (1997), who found a correlation between interpersonal relationships and well-being. Similarly, Hughes (2005) found that workers with better interpersonal skills had less fatigue and stress and consequently improved well-being.

There was a strong association between "improvement in interpersonal relationships" and "willingness to work." In this respect, Butler and Waldroop (2004) found that a stronger ability to socially relate to work colleagues led to gains in work performance, capacity to work for the organization, and job satisfaction, and these factors had a strong influence on willingness to work.

Furthermore, there was a strong association between "perceived psychophysiological well-being" and "willingness to work." A similar result was observed by Outi Kanste (Outi Kanste, 2011), who concluded that variables related to willingness to work, such as professional engagement and commitment, were essential and improved well-being at work.

There was a strong association between "perceived psychophysiological well-being" and "relief of musculoskeletal pain." Malmberg-Ceder et al. (2017) evaluated the relationship between well-being and musculoskeletal pain and indicated that improvements in the parameters that contribute to the onset and aggravation of pain, such as psychosocial factors, should receive special attention due to their strong correlations with perceived well-being among workers.

The results indicated that the variables "improvement in interpersonal relations," "willingness to work," "perceived psychophysiological well-being" and "relief of musculoskeletal pain" influenced each other, suggesting that a reduction in musculoskeletal pain symptoms might improve willingness to work, the perceived physical and

Table 4
Odds ratios for an increased frequency of physical activity at work.

Variables	Coefficients	Odds ratio	95% CI	p-value	Accuracy
Relief of musculoskeletal pain	0.9237	2.52	1.78–3.57	< 0.0001	65.23%
Psychophysiological well-being	0.5534	1.74	1.07–2.83	0.0256	
Perceived difficulty in performing tasks	−0.3570	0.70	0.50–0.98	0.0366	
Willingness to work	0.4273	1.53	1.01–2.34	0.0468	
Improvement in interpersonal relationships	0.6269	1.87	1.24–2.82	0.0033	

Legend: CI = odds ratio confidence interval.

psychological well-being of workers, and social relations in the workplace. Moreover, a better relationship with co-workers may increase willingness to work and worker well-being. The variable "difficulty in performing work tasks" was not directly associated with the other evaluated factors due to its higher complexity.

3.5. Physical activity at work and psychophysiological and social factors

The odds ratio (OR) estimator extracted from ordinary logistic regression models was used to evaluate the effect of an increase in the frequency of physical activity on the dependent variables. Table 4 shows the odds ratios for each dependent variable considering the frequency of physical activity. The variable that was most strongly affected by higher physical activity was relief of musculoskeletal pain, and this variable is a protective factor against perceived difficulty in performing tasks.

An increased frequency of physical activity at work was significantly correlated with a 53% increase (OR = 1.53) in the willingness to work and an 87% increase (OR = 1.87) in interpersonal relationships (Table 4). Moreover, an increased frequency of physical activity increased the likelihood of relief from musculoskeletal pain by more than 2-fold (OR = 2.52), improved perceived psychophysiological well-being by 74% (OR = 1.74), and decreased the perceived difficulty in performing tasks by 30% (OR = 0.70). The model accuracy of 65.23% was satisfactory, indicating that the model values were adequate and valid.

4. Discussion

Our results indicated that the desired outcomes of a worksite physical activity intervention were strongly affected by the frequency of application of this intervention. Therefore, workers who participate in exercises more often might experience up to twice as much relief from musculoskeletal pain, as well as improvements in other parameters, including willingness to work, psychophysiological well-being, and interpersonal work relations. Less difficulty in performing work tasks was also observed.

These programs are useful for tertiary prevention and therapeutic relief of symptoms, at least in the short term (Lowe and Dick, 2014). However, organizational or personal barriers affect the adherence and continuity of these programs in companies, and such barriers resulted in 102 refusals to participate in the study. Several factors are associated with adherence to these programs, including gender. For instance, Rossato et al. (2013) reported a higher percentage of women (54%) than men in their sample. Additionally, those authors observed that 81% of the participants practiced physical activity during their time off, 49% had a period of schooling longer than 12 years, and 34% performed work activities with light or moderate loads. In our study, gender was not a limiting factor for access to the program; thus, the sample is considered homogenous.

The relief of musculoskeletal pain was directly associated with the weekly frequency of physical activity and could be improved up to twofold depending on the regularity of participation. Machado Júnior et al. (Machado Júnior et al., 2012) observed that exercising twice a week was not sufficient to decrease the rate of musculoskeletal complaints. However, activities performed three to five times per week improved many parameters, including the use of analgesics, the frequency of onset and intensity of pain, muscle strength, and subjectively measured parameters, such as well-being and job satisfaction (Macedo et al., 2011; Jakobsen et al., 2015c; Candotti et al., 2011; Zebis et al., 2011).

Workers who participate in physical activity on a regular basis also have less difficulty performing work tasks (Costa et al., 2013; Jakobsen et al., 2015c). Physical activity at least three times per week improves several parameters, including peripheral strength (Martins et al., 2015), overall motor coordination (Mezzomo et al., 2014), flexibility (Andrade et al., 2015; Martins et al., 2015), body awareness, and postural habits (Candotti et al., 2011), and these outcomes may decrease the limitations perceived by workers in executing work tasks. In this study, these limitations were inversely proportional to the frequency of physical activity, resulting in a reduction of 30% in the perceived difficulty of performing tasks and a 53% improvement in the willingness to work.

These parameters are essential for the well-being of workers. Perceived well-being is strongly correlated with quality of life, the adoption of healthy behaviors, and physical status among workers and is improved by performing physical activity at least three times per week, stimulating a physically active and healthy lifestyle (Brito and Martins, 2012). It has been observed that groups of individuals who practiced physical activity more frequently were 74% more likely to perceive improvements in well-being and to experience the health benefits of physical activity, including better health-related behaviors, when physical activity was performed five times a week, considering that the study participants had a lower prevalence of physical inactivity in their time off and lower alcohol consumption in comparison to their nonparticipant peers (Grande et al., 2011). However, such activities do not strongly affect physical fitness components (Grande et al., 2014), as they do not significantly improve health-related outcomes, such as weight, fat percentage, heart rate, and systolic and diastolic blood pressure.

It is possible that these programs do not strongly affect characteristics related to metabolic and cardiovascular performance in the short term, given that aerobic exercises are not performed. However, these programs have been found to be effective in reducing complications related to pain, posture, and musculoskeletal and psychosocial factors and to reduce cardiovascular and metabolic parameters by encouraging the adoption of a healthy lifestyle, although the effects are indirect.

These programs significantly affect social components and improve interpersonal relationships at work. Individuals who participated more frequently in the exercise programs had an 87% higher likelihood of reporting better relationships with their colleagues. Exercises are performed in groups, stimulate communication and contact, and affect emotional and social factors, as reported by Costa et al. (2013). When executed five times a week, these programs help build social capital within work teams, establish informal networks, and create values and understanding that facilitate intra- and intergroup cooperation, which improves trust and cooperation between colleagues and therefore boosts productivity (Andersen et al., 2015).

Therefore, the frequency of physical activity affects the effectiveness of the program and the manifestations of the intended outcomes. It is possible to observe a progression in the therapeutic power of these programs because the effects are delayed in programs that are executed

less often. However, programs that are performed more regularly present higher short-term effectiveness by directly enhancing physical, cognitive, and social parameters at work and thus improving the productivity of the sector/company.

In the long term, these practices may lead to an annual decrease in healthcare costs of USD 138,880 per year for chronic diseases, including type 2 diabetes and hypertension; therefore, every dollar invested in physical activity could reduce treatment costs by USD 5.3 (Méndez-Hernández et al., 2012) and have a direct impact on public health and savings for businesses and governments.

4.1. Advantages and limitations

This study was conducted in a multinational company, and all protocols were followed strictly. The main advantage of the study was sample representativeness, which provided greater reliability to infer and obtain consistent outcomes. Workers were randomly extracted from several sectors with distinct functions, providing support for generalizations, in contrast to other studies that applied such procedures in a single sector.

The main limitations of this study were the data collection strategy, as the variables investigated were based on perceptions. Thus, the data had a strong tendency toward distortions. Another limitation was the dichotomization of the data, which led to a loss of sensitivity for the intensities of the intended outcomes.

5. Conclusions

The results indicated that the access of workers to the program was similar between genders. Although the sociodemographic characteristics differed between men and women, those differences did not affect the response variables.

Worksite physical activity programs improve occupational health and positively affect psychophysiological and social parameters, particularly those related to the relief of musculoskeletal pain, willingness to work, perceived difficulty in performing tasks, sense of well-being, and interpersonal relations. The effectiveness of the investigated program was dependent on its frequency of execution by workers, as the likelihood of success was twice as high with a higher frequency of physical activity.

Therefore, as the frequency of physical activity was identified as a key factor, this study provides support for the implementation of regular physical activity programs in companies that seek to optimize the program's proposed objectives and objectively plan short-, medium-, and long-term results.

Future studies may elucidate aspects related to the effects of the frequency of application of physical activity programs on the intensity of therapeutic relief of symptoms, quality of life at work, and health-related behaviors, as well as organizational and economic factors.

Abbreviations

BMI: body mass index; OR: odds ratio.

Ethics approval and consent to participate

Information related to ethical considerations is presented in the body of the article, in section 2.5, “Data collection,” on page 5.

Consent for publication

Not applicable.

Availability of data and materials

The data sets analyzed during the study are not publicly available because the data are private and belong to a private company rather than the study authors.

Conflicts of interest

The authors have no financial or non-financial competing interests to declare.

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