An Exercise Program Improves Health-Related Quality of Life of Workers

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Abstract

Low back problems are associated with decreased quality of life. Specific exercises can improve quality of life, resulting in better professional performance and functionality. The purpose of this study was to evaluate the effect of following a 21-month exercise program on the quality of life of warehouse workers. The population included 557 male warehouse workers from a food distribution company in Oporto, Portugal. Upon application of the selection criteria, 249 workers were deemed eligible, which were randomized into two groups (125 in the intervention group and 124 in the control group). Then, subjects were asked to volunteer for the study, the sample being formed by 229 workers (112 in the intervention group and 117 in the control group). All subjects completed the SF-36 questionnaire prior to beginning the program and on the 11th and 21st months following it. The exercises were executed in the company facilities once a day for 8 min. Data were analyzed using SPSS® 17.0 for Windows®. After 11 months of following the exercise program, there was an increase in all scores for the experimental group, with statistically significant differences in the dimensions physical functioning (0.019), bodily pain (0.010), general health (0.004), and rolephysical (0.037). The results obtained at the end of the study (21 months) showed significant improvements in the dimensions physical functioning ($p = 0.002$), rolephysical ($p = 0.007$), bodily pain ($p = 0.001$), social functioning ($p = 0.015$), role-emotional ($p = 0.011$), and mental health ($p = 0.001$). In the control group all dimensions showed a decrease in mean scores. It can be concluded that the implementation of a low back specific exercise program has changed positively the quality of life of warehouse workers.

Keywords

Occupational health, Workers, Quality of life, SF-36, Specific exercises

Introduction

Health and well-being at work are the main focuses that the European Working Conditions Observatory will advocate to the next years (Giaccone *2007*). Musculoskeletal disorders are among the most widespread illnesses reported by European workers. According to the fourth European Working Conditions Survey, carried out in 2005, about 20% of EU15 workers complain of back problems and muscular pains (Giaccone *2007*). Low back pain (LBP) is considered one of the major causes of disability (Deyo et al. *1998*). After an initial episode of LBP, 44–78% of people suffer a relapse of pain and 26%37% have a relapse of work absence. There is little scientific evidence on the prevalence of chronic non-specific LBP: best estimates suggest that the prevalence is approximately 23%; 11–12% population is disabled by LBP and specific causes are unknown (Airaksinen et al. *2006*).

It is well-known that the low back region is an important area for support and transfer of force activities (van Tulder et al. *2007*). In fact, LBP is a common reason for reduced participation in social and leisure activities, as well as in professional tasks (Brox et al. *2005*; Galukande et al. *2005*). Different studies have reported that chronic LPB, besides being an economic burden to companies, is a serious public health problem, being more costly than cancer treatment (Steenstra et al. *2003*). In fact, musculoskeletal problems are assumed to be associated with decreased quality of life (QoL). In specific working populations, the prevalence of musculoskeletal disorders can be as high as 22–40%, according to a review by van Tulder et al. (*2007*).

Exercise programs have proved more efficient than conventional therapies in the prevention and treatment of LBP, resulting not only in the reduction of pain and disability but also in lower costs, decreased healthcare needs, and reduced absenteeism from work (Moffett et al. *1999*). In systematic literature reviews, Bigos et al. (*2009*) present strong evidence that exercise programs are effective in preventing episodes of back problems. In another study, Rainville et al. (*2004*) recognized that there is evidence supporting the use of exercise as a therapeutic tool to improve impairments in back flexibility and strength. In fact, several studies have observed improvements in global pain ratings and in behavioral and cognitive aspects of back pain syndromes. Exercise programs have been shown to promote improved QoL, resulting in better professional performance and functionality (Airaksinen et al. *2006*; Claiborne et al. *2002*).

Interventional preventive measures have been tested in randomized controlled trials, but results have been controversial. Daltroy et al. (*1997*) found that back schools are not an effective intervention of industrial low back injury. On the other hand, Brox et al. (*2008*) also noted that back schools were effective in reducing pain and disability in the short-term, but not in the long-term. Ijzelenberg et al. (*2007*) did not observe significant differences in worksite prevention programs for LBP. Probably the lack of communication with a professional might introduce negative expectations and dissatisfaction (Goldby et al. *2006*; Sherman et al. *2005*).

A well-structured exercise program can lead to long-term improvements for back pain sufferers, (Norris *1995*) diminishing pain, disability, and the effort required to execute daily activities (Lang et al. *2003*) and resulting in improvements in health-related QoL (Airaksinen et al. *2006*; Arnold et al. *2000*; Carroll and Whyte *2003*). According to European guidelines for prevention of LBP (Burton et al. *2006*), physical exercise is recommended for prevention of LBP, for prevention of recurrence of LBP, and for prevention of recurrence of sick leave due to LBP (Level C).

As there is no recommendation for the type and intensity of exercise, the exercise program used in this study was designed specifically for this population after carefully analyzing all movements and tasks that workers performed throughout the working day. This study intends to contribute a deeper knowledge about the relation between exercise programs performed in the workplace and health-related QoL, taking into account cost benefit, as well as the characteristics of the company and its employees. Workers received instructions on the type of exercises they would perform, as well as training activities, which reinforced the idea that physical, social, and mental well-being are the foundations of QoL (Burton et al. *2006*).

The purpose of this study is to evaluate the effect of following a long-term specific exercise program on health-related QoL of warehouse workers. This assessment was made by analyzing if the exercise, performed on a daily basis, improved dimensions of physical functioning, physical role limitations, bodily pain, social functioning, emotional role limitations, and mental health after 11 and 21 months of following the exercise program.

Methods

Subjects

The population used in this study included 557 urban, male warehouse workers from a food distribution company in Oporto, Portugal. All workers were involved in a routine of overcharge tasks and/or repetitive movements and worked in low temperatures (between 0° and 4°C) during all seasons of the year. According to the company norms, all workers wore cold protective clothing, gloves, boots, and lumbar support belts.

After informing the clinical physician and human resources staff on the criteria that would have to be taken into account for subject selection, the company provided us with an alphabetically organized list of 249 eligible workers, corresponding to 45% of the population. The sample was randomized into two groups (125 in the intervention group and 124 in the control group). Then, subjects were asked to volunteer to participate in the study and give underwritten consent. The sample included 112 volunteers for the intervention group and 117 for the control group. At baseline, the sample was n = 229, corresponding to 41% of the population.

Workers were deemed eligible if they met the following criteria: a) they had a contract for three or more years; and b) they performed the same task type (assembly and disassembly of pallets. On the other hand, it excluded individuals who: a) were required to rotate work positions; b) were absent from work because of back pain; c) had severe back pain (VAS ≥ 5) in the last year; d) had undergone treatment (conservative or surgical) for LBP in the last year; and e) had been diagnosed with any kind of pathology, which could prevent them from participating in the prescribed exercises (Sculco et al. *2001*).

From the first evaluation moment to the second, there was a total loss of 37.5% of the subjects, 30% from the intervention group and 44.4% from the control group. From the second to the third evaluation moment there was a total loss of 34.2% of the individuals, 38.5% from the intervention group, and 29.2% from the control group. From the first to the third evaluation moment, losses in the intervention group and in the control group were 57% and 60%, respectively. After 21 months the sample was reduced to approximately 17% of the population. These losses resulted from workers leaving the company, changing workplace, losing motivation to continue in the study, or not answering the questionnaire.

Table 1 shows values for mean, standard deviation, minimum and maximum for age (years), height (cm), weight (kg), and body mass index (BMI) of workers included in the intervention group and in the control group.

Table 1 Values for mean, standard deviation, minimum and maximum of age (years), height (cm), weight (Kg), and BMI of workers included in the intervention group and in the control group

n=229	Intervention group *n*=112			Control group *n*=117		
	mean ± sd	min	max	mean ± sd	min	max
Age	34.41±8.36	20	49	33.05±10.19	18	56
Height	173±0.07	160	188	178±0.09	159	188
Weight	76.54±10.44	55	95	81.07±16.84	60	110
BMI	25.57	21.48	26.91	25.58	23.81	31.16

Instrumentation

Health-related QoL was measured using the Short Form Health Survey (SF-36) self-administered questionnaire, which is a generic health status survey questionnaire designed to assess the impact of illness on a patient's QoL (Ware and Sherbourne *1992*). The SF-36 was translated for the Portuguese population by Ferreira and yields an 8-dimension profile (Ferreira *2000a*): physical functioning, role limitations due to physical problems, bodily pain, vitality, general health perceptions, social functioning, role limitations due to emotional problems, and mental health. The SF-36 reports the patients' perceived QoL using scores ranging from zero to 100, zero being the worst score and 100 the best score. The SF-36 has been extensively used in studies addressing patients with chronic back disorders (Picavet and Hoeymans *2004*). The validity and reliability of the Portuguese translation of the SF-36 is well documented (Ferreira *2000b*).

Procedures

The exercise program was implemented in several stages. In the first evaluation, visits to the warehouse facilities allowed investigation of the types of tasks executed by workers and the most common injuries. Upon evaluation of the risks and most repeated gestures, an adequate exercise program was created. This program included nine easily executed exercises to promote stretching and strengthening of the soft tissues responsible for spinal stability, especially lumbar stability. This program was applied, with exercises being executed daily in the company facilities at the beginning of work and lasting approximately 8 min. To motivate workers to adhere to the program and follow it, there were several training sessions, and posters illustrating the exercise program were distributed in the company facilities.

Facilitators of the program included physiotherapists, who visited the warehouse facilities every 15 days to correct possible execution errors or to answer doubts and questions from workers about the exercise program. The program efficacy was evaluated in three moments—prior to (M1), at 11 months (M2), and at 21 months (M3) following participation in the program—by application of the SF-36 questionnaire.

The control group participated in the pre- and post-program tests. At the end of the study this group was offered the possibility of executing the same exercises that were implemented in the intervention group.

The study was conducted between February 2005 and March 2007 with authorization by the company and according to a protocol between the institutions involved. All participants provided written, informed consent before entering the study. All procedures were in accordance with the Helsinki Declaration. The study design was approved by the ethics committee of Escola Superior de Tecnologia da Saúde do Porto, in Portugal.

Statistics

Exploratory data analysis and sample characterization were performed using descriptive statistics. Therefore, to check the existence of statistically significant differences between the data analyzed, before and after implementing the exercise program, the repeated measures test and the Friedman ANOVA test were used. The student's t test for paired samples was used to analyze differences between mean values in both groups. To analyze differences between mean values in both groups at the different moments, the student's t test for independent samples was used. The level of significance was set at 0.05, with 95% confidence intervals. Statistical analysis was conducted using SPSS® 17.0 for Windows®.

Results

Results in Table 2 indicate that at baseline, workers in both groups had a good perception of their QoL. Mean scores of the SF-36 are generally near or above 80%. However, the analysis does not show statistically significant differences between groups. It can be observed that the physical functioning dimension obtained the best mean scores throughout the study in the intervention group, while both groups showed lower scores in the general health dimension. The bodily pain dimension obtained the lowest score in the control group while in the intervention group the worst score obtained was in the vitality dimension (Table 2).

Table 2 Values obtained for the 8 dimensions of SF-36 in the form of means and standard deviations, in the intervention group and in the control groups at the three evaluation moments; proof values obtained in the student's t test for independent samples, between the intervention and control groups, in each evaluation moment

Variables	M1			M2			M3		
	Intervention group mean ± sd	Control group mean ± sd	*p* value	Intervention group mean ± sd	Control group mean ± sd	*p* value	Intervention group mean ± sd	Control group mean ± sd	*p* value
Physical functioning	91.02±11.325	90.25±11.209	NS	94.22±9.595	88.11±12.020	**	97.50±5.028	84.15±15.481	***
Role-physical	89.00±15.867	88.38±14.539	NS	92.00±12.974	85.28±14.616	**	97.01±7.423	85.00±15.608	***
Bodily pain	74.51±22.158	69.22±21.484	NS	82.74±19.108	66.84±21.251	***	89.67±15.001	61.79±20.741	***
General health	70.63±13.535	73.04±15.944	NS	76.20±14.364	71.44±16.531	NS	73.37±11.521	64.84±15.416	**
Vitality	69.11±20.261	74.17±20.798	NS	74.17±17.309	71.82±19.367	NS	76.04±16.237	63.23±18.866	**
Social functioning	85.30±19.609	85.73±17.669	NS	87.99±16.538	83.91±17.468	NS	94.39±11.492	78.05±18.689	***
Role-emotional	89.12±15.103	90.10±14.189	NS	93.93±12.555	90.55±13.018	NS	96.39±8.234	89.18±13.125	**
Mental health	78.30±17.470	78.70±18.597	NS	80.44±17.486	81.22±16.014	NS	89.28±11.097	76.86±19.081	***

**$P<0.01$, and ***$P<0.001$

After 11 months of follow-up, groups showed statistically significant differences in the dimensions physical functioning (0.002), role-physical (0.006), and bodily pain (0.000) (Table 2). At the end of the exercise program, all dimensions showed increased scores in the intervention group, with the exception of general health, which obtained a lower score.

The control group obtained the best mean values in the dimensions role-emotional and role-physical, while lower scores were obtained for the dimensions bodily pain, vitality, and general health. Nevertheless, it can be observed that mean values, in all dimensions, decreased throughout the 21-month period in the control group.
When analyzing subjects' health-related QoL, results have shown that there were significant differences between the three evaluation moments in almost all variables, both in the intervention and control groups, as reported in Table 3.

Table 3 Differences between the three evaluation moments in the intervention group and in the control group obtained using the *Friedman ANOVA test*

Variables	Intervention group (P value)	Control group (P value)
Physical functioning	*	**
Role-physical	*	NS
Bodily pain	**	NS[a]
General health	NS	*[a]
Vitality	NS	***
Social functioning	*	*
Role-emotional	*	NS
Mental health	**	**

*$P<0.05$, **$P<0.01$, and ***$P<0.001$

[a] Repeated Measures test

In the second evaluation moment (after 11 months of follow-up) there was an increase in all dimensions for the intervention group, although only scores for dimensions physical functioning (0.019), bodily pain (0.010), general health (0.004), and role-physical (0.037) are significant, whereas in the control group all dimensions showed a decrease in mean scores, with scores in dimensions physical functioning (0.049) and role-physical (0.006) being the ones with statistical significance (Table 4).

Table 4 Values for mean, standard deviation of SF-36 and proof values obtained in the student's *t* test for paired samples in the intervention group and in the control group between the first (1st) and second (2nd) and the first (1st) and third (3rd) moments of evaluation

Variables	Intervention group					Control group				
	M2 mean ± sd	*p* value	M1 mean ± sd	*p* value	M3 mean ± sd	M2 mean ± sd	*p* value	M1 mean ± sd	*p* value	M3 mean ± sd
Physical functioning	94.22±9.595	*	91.02±11.325	**	97.50±5.028	88.11±12.020	*	90.25±11.209	**	84.15±15.481
Role-physical	92.00±12.974	NS	89.00±15.867	**	97.01±7.423	85.28±14.616	**	88.38±14.539	**	85.00±15.608
Bodily pain	82.74±19.708	*	74.51±22.158	**	89.67±15.001	66.84±21.251	NS	69.22±21.484	**	61.79±20.741
General health	76.20±14.364	**	70.63±13.535	NS	73.37±11.521	71.44±16.531	NS	73.04±15.944	**	64.84±15.416
Vitality	74.17±17.309	NS	69.11±20.261	NS	76.04±16.237	71.82±19.367	NS	74.17±20.798	**	63.23±18.866
Social functioning	87.99±16.538	NS	85.30±19.609	*	94.39±11.492	83.91±17.468	NS	85.73±17.669	**	78.05±18.689
Role-emotional	93.93±12.555	*	89.12±15.103	*	96.39±8.234	90.55±13.018	NS	90.10±14.189	NS	89.18±13.125
Mental health	80.44±17.486	NS	78.30±17.470	*	89.28±11.097	81.22±16.014	**	78.70±18.597	NS	76.86±19.081

*$P<0.05$ and **$P<0.01$

From the beginning of the study to the end, after 21 months, all dimensions of the SF-36 have increased in the intervention group, with differences being statistically significant, except for dimensions general health and vitality. In the control group, mean values

decreased, with scores obtained in dimensions role-emotional and mental health being not statistically significant.
From the second to the third moment of evaluation (11th to 21st months), the intervention group showed statistically significant differences in the dimension mental health (0.009), whereas in the control group there was a statistically significant decrease in all dimensions, except for role-physical (Table 5).

Table 5 Values for mean, standard deviation of SF-36 and proof values obtained in the student's *t* test for paired samples in the intervention group and in the control group between the second (2nd) and third (3rd) moments of evaluation

Variables	Intervention group			Control group		
	M2 mean ± sd	M3 mean ± sd	*p* value	M2 mean ± sd	M3 mean ± sd	*p* value
Physical functioning	94.22±9.595	97.50±5.028	NS	88.11±12.020	84.15±15.481	**
Role-physical	92.00±12.974	97.01±7.423	NS	85.28±14.616	85.00±15.608	NS
Bodily pain	82.74±19.708	89.67±15.001	NS	66.84±21.251	61.79±20.741	**
General health	76.20±14.364	73.37±11.521	NS	71.44±16.531	64.84±15.416	**
Vitality	74.17±17.309	76.04±16.237	NS	71.82±19.367	63.23±18.866	**
Social functioning	87.99±16.538	94.39±11.492	NS	83.91±17.468	78.05±18.689	**
Role-emotional	93.93±12.555	96.39±8.234	NS	90.55±13.018	89.18±13.125	*
Mental health	80.44±17.486	89.28±11.097	**	81.22±16.014	76.86±19.081	*

*$P<0.05$ and **$P<0.01$

Discussion

The sample included young male workers (mean age 33–34), with a BMI close to overweight. Although there is no evidence showing increased weight as a cause of LBP, several epidemiologic studies showed that there can be a modest positive association between BMI and LBP (Borenstein *2000*). In fact, several studies have demonstrated the importance of low back exercise for spine stabilization, providing better functionality and a consequently better QoL (Airaksinen et al. *2006*; Descarreaux et al. *2002*; Tuncel et al. *2006*; Tuzun *2007*).

In this study, an analysis of the SF-36 dimensions throughout the 21-month period shows the efficacy of an exercise program, as mean scores obtained in all dimensions have increased, with results in dimensions physical functioning, role-physical, bodily pain, social functioning, role-emotional, and mental health being statistically significant. These results are in accordance with the results of another study in which the subjective effects of exercise on the participants' health and well-being were significantly better in the intervention group than in the control group (Tveito and Eriksen *2009*). A similar situation occurred in other studies, where the intervention group tended to have a higher median baseline physical functioning and bodily pain score on the SF-36 (Santos et al. *2011*).

In the first 11 months of intervention, only three dimensions showed significant improvement (physical functioning, role physical limitations, and bodily pain) although all of them tended to improve. These results are consistent with other studies, which have also used pain-specific exercises and obtained similar results on health-related QoL (Bendix and Bendix *1997*; Carroll and Whyte *2003*; Walsh and Radcliffe *2002*). In the control group there was a significant decrease in the dimensions physical functioning and role limitations physical and a decreasing tendency in the scores of the remaining dimensions. One possible explanation could be the fact that workers have to execute heavy tasks all the time and they do not have good motor control. Also, we cannot forget that 55% of the population suffers episodes of severe back pain every year. These kinds of factors influence QoL.

From the second to the third moment of evaluation there were no statistically significant differences that showed exercise efficacy on health-related QoL, with the exception of the dimension mental health in the intervention group. In the control group there was a steep decrease with significant differences in all dimensions, except in the dimension role-physical. A possible explanation for this occurrence could be the fact that during this period there were changes imposed by the company in terms of working times, shift work, and increased workload, which could have led to dissatisfaction and changes in family and social activities. In a large study, Butler and Johnson (*2011*) found that workers' satisfaction with the effectiveness of their health care is influenced more by reduced perceptions of pain and increased physical functionality than by the "bedside manner" of health care professionals. In other words, differences in the type of care provided are important in the early stages of episodes of back pain but disappear at the 12-month mark. The dominant influences at 12 months become the workers' perceptions of the manner in which they have been treated by the employer. Several studies suggest that socio-economic and psycho-social factors can negatively affect attitudes and behaviors (Buchbinder et al. *2001*; Walsh and Radcliffe *2002*)

At the final evaluation (21 months), the intervention group showed statistically significant differences in all dimensions, except in mental health and vitality, showing that a specific exercise program can be efficient in increasing functionality and health-related QoL. These results are consistent with the ones obtained by Merkesdal and Mau (*2005*), which have shown that following an exercise program is efficient in improving daily activities, social relations, and functional capacity and in diminishing pain, thus contributing to an overall increase in QoL (Walsh and Radcliffe *2002*). In the intervention group, the dimension bodily pain improved significantly between evaluation moments, with individuals feeling less pain, which shows that physical exercise is a good therapeutic resource in preventing and treating LBP, as it improves weakness and low isometric resistance of lumbar extensors associated with pain (Pengel et al. *2003*). Bendix and Bendix (*1997*) and Claiborne et al. (*2002*) mention that increased activity leads to decreased pain levels and to better physical performance. This is consistent with the findings obtained in the present study, which show significant improvement in the control group and a significant decrease in the intervention group at the end of the study.

Improvements in physical function and performance may also result from the subjects' awareness of the risks they face and their attempt to compensate these risks with physical exercise. This results in improved physical condition, increased functionality, and decreased pain, which is in accordance with the study of Salo et al. (*2010*), who had similar results in a study applied to women.

At baseline, 55% of the individuals had severe lower back problems, which reduced the sample to less than half. In the second year, losses were a little higher than in the first, which could be explained by the fact that during this period the company demanded more production and changed some intermediate managers, changes not very well understood by workers. However, in the study by Santos et al. (*2011*) there was a loss of 28% of the sample after 9 months of intervention and in the study by Butler and Johnson (*2011*) the loss rate was 58% in 1 year.

Another strong reason for losses throughout the program was the novelty to do exercise in the company, and also the fact that this was seen as an extra obligation to the intervention group. Moreover, subjects in the control group did not seem to understand the importance of their role, despite all the information and motivation actions taken. The study nature could have also been a limitation, as it was not possible to control the individuals outside the workplace. Some factors, such as having more than one job, insufficient rest, holidays, and non-existence of other entertainment activities, although workplace-independent, can negatively affect the physical and psychological status of individuals, as seen in the subjects of this study. The ideal would be to find the best balance between the costs and benefits for both individuals and companies (Giaccone *2007*).

This study provides valuable information because it is the first longitudinal study based on a representative sample of warehouse workers. Because of the relative insufficiency of evidence on the effectiveness of specific exercise programs to workers, future trials are needed. In this context, training institutions and professional organizations should provide continuing education in pain assessment and management concerning QoL to health professionals at all levels.

Conclusions

In the long term, a low back specific exercise program positively modified the quality of life of warehouse workers. After 21 months of following the exercise program, the dimensions physical functioning, role-physical, bodily pain, social functioning, role-emotional, and mental health have improved significantly.

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