RESEARCH ARTICLE

Effect of an Exercise Programme for the Prevention of Back and Neck Pain in Poultry Slaughterhouse Workers

Lucia Bertozzi[1], Jorge H. Villafañe[2*†], Francesco Capra[1], Marsida Reci[1] & Paolo Pillastrini[3]

[1]University of Bologna, Bologna, Italy

[2]IRCCS Don Gnocchi Foundation, Milan, Italy

[3]Department of Internal Medicine, Geriatrics and Nephrology, University of Bologna, Bologna, Italy

Abstract

The objectives of this study were to determine the effectiveness of a programme of prevention exercises conducted in a corporate environment in poultry industry slaughterers suffering from musculoskeletal disorders. Forty workers, 70% female (mean ± SD age: 44.4 ± 8.4 years) were consecutively, in an alternative way, assigned to one of two groups receiving either set of 10 sessions (experimental or control group). The experimental group followed an exercise programme for a period of five weeks and a protocol of home exercises. The control group performed the exercise protocol only at home. The Roland Morris Disability Questionnaire (RMDQ) and the Oswestry Disability Index (ODI) to measure disability, the Visual Analogue Scale (VAS) score and the Pain Drawing to measure pain were used as outcome evaluations. A significant effect of time interaction (all $P < 0.001$ and; $F = 40.673$; $F = 33.907$ and $F = 25.447$) existed for lumbar VAS, RMDQ and ODI immediately after the intervention (all $P < 0.006$). No significant group effect or group-by-time interaction was detected for any of them, which suggests that both groups improved in the same way. This study shows that a programme of prevention exercises may have a positive effect in improving musculoskeletal disorders of slaughterhouse workers. Pain decreased in the lumbar region, and there was an almost significant reduction in disability.

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Keywords

musculoskeletal disorders; low back pain; neck pain work; prevention and control; exercise

***Correspondence**

Jorge H. Villafañe, IRCCS Don Gnocchi Foundation, Via Capecelatro 66, 20148 Milan, Italy.

†Email: mail@villafane.it

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Background

Work-related musculoskeletal disorders

Musculoskeletal disorders (MSDs) are the most common occupational disease in the European Union, and workers in all sectors and occupations can be affected. MSDs are increasing, and they are one of the most important causes of absence due to sickness. Besides the effects on workers themselves, MSDs may lead to high costs for enterprises and society (European Agency for Safety and Health at Work, 2010) The World Health Organization has defined work-related disorders as those resulting from various factors, and where the work environment and performance contribute significantly, but in varying magnitude, to the causation of the disease (European Agency for Safety and Health at Work, 2000; World Health Organization, 2003). Work-related MSDs can involve all parts of the body, although low back, neck and upper limbs are the most commonly affected areas. Biomechanical loading seems to be the most important occupational factor determining both recurrent low back pain and sick leave attributed to back disorders (Wickstrom and Pentti, 1998). Exposure to manual material handling activities is considered an important risk factor, consistently associated with work-related back disorders (Skovron, 1992; Burdorf and Sorock, 1997). Specifically regarding the spine, these diseases result from movements such as bending, straightening, gripping, holding, twisting, clenching, squatting, kneeling and reaching. These common movements are not particularly harmful in ordinary activities of daily life. What makes them hazardous in work situations is the continued repetition, often in a forceful manner, and, most of all, the speed of the movements and the lack of recovery time between them. Heat, cold and vibration also contribute to the development of MSDs (European Agency for Safety and Health at Work, 2010). Some authors reviewed aspects of physical load during work and leisure time, and they showed that heavy physical work and the manual handling are risk factors for back pain (Hoogendoorn et al., 1999).

Musculoskeletal disorders in slaughterhouse workers

Our study treats the activities and MSDs of slaughterhouse workers. According to the Lombardia Regional Guidelines for the prevention of MSDs, this category of workers is highly exposed to this risk (Regione Lombardia, 2009). The employees in this field perform repetitive work at a fast pace; they maintain an erect position of the trunk and a static position of the upper limbs for most of their shift to carry out the same cycle of movements in a continuous manner. People maintain awkward postures, and the temperature in the work environment is usually low. Tavolaro et al. (2007) claim that slaughterhouse work involves stressful and tiring tasks, and these workers suffer from serious occupational injuries and health problems including MSDs. Determining the effectiveness of treatment strategies for these workers is of vital importance.

Current evidence

Current evidence suggests that exercises seem to be the only effective preventive intervention, although most studies on which this is based were methodologically flawed, and the effects are weak at best (Linton and van Tulder, 2001). Conflicting results have been reported on the effectiveness of an exercise programme in the management of LBP (Hayden et al., 2005a; van Middelkoop et al., 2011). Current literature reports several extension-oriented treatment approaches involving combinations of active or passive movements to favour lumbar spine extension (Delitto et al., 1995; Garcia et al., 2011) and strengthening exercises of the primary spinal stabilizers (McGill, 2001; Hayden et al., 2005b). Several authors as well as most clinical practice guidelines claim that supervised exercise therapy has proven to be effective in reducing pain and improving functional performance in the treatment of patients with chronic non-specific low back pain (Airaksinen et al., 2006; van Middelkoop et al., 2010; Garcia et al., 2011). Other authors suggest that therapies involving manual therapy and exercise are more effective than alternative strategies for patients with neck pain (Hurwitz et al., 2009). The main purpose of our study is to determine the effectiveness of a programme of prevention exercises in reducing pain and improving the functional disability of slaughterhouse workers with MSDs.

Methods

Study design

This study is a double-blind Clinical Trial targeting a population of poultry slaughterhouse workers with MSDs. The protocol (No. PG-SA 02/11 del 04.15.2011) was approved by the local committee in "Amadori Group – Avicoop S.C.A.", "S. Vittore of Cesena (FC)", Italy. It was conducted in an agricultural cooperative. Ethical approval was granted, and all participants provided written informed consent. Every worker consented to the testing and treatment after being adequately informed. Informed consent was obtained from all participants, and procedures were conducted according to the Declaration of Helsinki.

Participants

All 180 slaughterhouse workers in one sector of an agricultural cooperative establishment were recruited. 80 of them did not adhere to the project, and 39 were excluded due to organizational reasons of the company. Inclusion criteria were ages between 18 and 80 and a diagnosis of non-specific back pain, with a duration of at least three months, as recorded by the company physician. Participants who had contraindications to exercise, serious spine injuries (fractures, tumours and inflammatory diseases such as ankylosing spondylitis), nerve root compromise, severe cardiopulmonary disease, severe medical conditions, previous spine surgery, disability and pregnancy were excluded from the study. Criteria for discontinuation of treatment were also provided: the will of the participant, onset of complications or surgical indications and cessation of work. Twenty-one workers did not fulfil the inclusion criteria. The participants were consecutively assigned in an alternating way to one of two groups receiving either set of 10 sessions (experimental or control group) by a researcher who was not involved in the recruitment and in the exercise programme of the participants. During the enrolment checkup, the following information was collected for each eligible individual: basic demographic data (age and gender); establishment (line cutting chickens, turkeys, cut and processed); individual characteristics such as height, weight and Body Mass Index (BMI); and lifestyle information (smoking habits and physical activity). We checked non-working individual factors because they may contribute to MSDs; some of them are constitutional (age, gender, heredity, obesity, etc.), while others are susceptible to changes (strength, exercise, smoking, postural attitudes, environment and activities in their free time). All workers of study (experimental group and control group) were highly exposed to the risk of MSDs despite the company guaranteeing the safety of workers according to the Italian legislation. The company made an intervention to improve worker safety through work breaks and workstations (larger spaces and desks higher), but despite this, the workers were still at risk of MSDs because there remained a high repetition of the movements, a standing posture at all times during work, the need for high precision and tasks executed in a very short cycle (<10 s) and a very fast pace in the production chain, where the pressure is highest. Also, the displacement of weights (turkeys weighed from 6 to 17 kg) was present. Machines that lifted turkeys were present, but they were used only for lifting off the ground and only for short distances on the bench.

Outcome measurements

The outcome measures used in this trial were the perceived level of disability as a result of back pain, assessed by the following self-administered evaluation scales: the Roland Morris Disability Questionnaire (RMDQ) and the Oswestry Disability Index (ODI) (Roland and Fairbank, 2000), and the evaluation of lumbar physical discomfort using a pain drawing associated with a Visual Analogue Scale (VAS). The VAS was selected as the outcome measure, based on its ability to detect changes (MCID, minimal clinically important difference, 2.0 cm) (Villafañe et al., 2013). The RMDQ is an instrument translated and cross-culturally adapted into Italian (Roland and Morris, 1983; Roland and Fairbank, 2000; Padua et al., 2002). It is widely used in research and clinical practice to assess disability associated with low back pain. It was proposed by Roland and Morris (1983) and was designed using eight items of the Sickness Impact Profile for daily activities. It is made up of 24 items that describe everyday situations that patients have trouble performing due to low back pain. The greater the number of questions marked, the greater the disability. The ODI, which was used in the Italian pre-tested version (Monticone et al., 2009), is structured in 10 sections corresponding to different activities of daily living, each scored on a six-point scale (0–5) (Fairbank et al., 1980; Fairbank and Pynsent, 2000). As far as lumbar physical discomfort is concerned, several studies have been published on the validity and reproducibility of pain drawing as a screening tool in the assessment of MSDs ($r = 0.73$ to 0.85). This instrument has been shown to be valid, reproducible and stable over time and to have low inter-rater variation (Margolis et al., 1988; Ohnmeiss, 2000). Pain intensity was measured with a 10-cm VAS, with 0 corresponding to no pain and 10 to the worst possible pain (Huskisson, 1974). The outcome measures were administered before the exercise (pre-treatment, T^0) and at the end of five weeks of treatment (post-treatment, T^1).

Interventions

The interventions started immediately after baseline evaluation. The 20 participants allocated to the experimental group were further divided into four subgroups to allow the physical therapist to better follow each of them. Furthermore, they received the same intervention in 10 treatment sessions, twice a week, lasting on average an hour. The sessions were conducted in groups at the headquarters, in a room used as a gym. They took part in the therapy programme before or after working time. In fact, to facilitate the workers, several sessions of therapy were organized and scheduled, so that these coincided with a time that preceded or followed the work shift. The worker could choose when to perform them. The same group also performed a home exercise protocol. The interventions were structured group exercises and included 11 bodyweight exercises. They provided for the development of simple postural exercises, relaxation, stretching and extension aimed at the lumbar spine (transverse abdominal, abdominal oblique, multifidus, quadratus lumborum and erector spinae muscles) (Pillastrini et al., 2009) and lower limbs. They kept the same sequence of exercises to allow everyone to internalize the proper execution and to be able to perform the exercises also at home. The 20 participants allocated to the comparative group study performed the exercise protocol only at home. The programme was provided based on theoretical and practical information (Lankhorst et al., 1983; Heymans et al., 2004) and was explained verbally by the physiotherapist to both groups in a meeting using a Power Point presentation. Moreover, illustrated cards were given to participants recruited. The exercises were similar to those in the experimental group held in a company under the supervision of a physiotherapist. A researcher verified that study participants did the exercises at home through telephone interviews. He asked the following questions to the workers: "did you do the exercises?", "for how many minutes?" and "how many times a week?".

Data analysis

Data were analysed using SPSS version 20.0 (SPSS Inc, Chicago, IL, USA), conducted following an intention-to-treat analysis using the last value forward method. Group data were summarized using means and standard deviations. The Kolmogorov–Smirnov test confirmed the normality of the distribution of the data. The Student's *t* test was used to determine the level of significance of the differences between the pre- and post-treatment measurements. We used a 2 × 2 repeated-measures analysis of variance (ANOVA) to determine the differences in time (pre-intervention and post-intervention) as the within-subjects factor and group (experimental or control) as the between-subjects factor. The main hypothesis of interest was group-by-time interaction. Between-group differences were expressed as mean differences with 95% CIs. Between-groups effect sizes were calculated using Cohen's *d* coefficient. An effect size greater than 0.8 was considered large, around 0.5 moderate, and less than 0.2 small. In all analyses, $P < 0.05$ was considered statistically significant.

Results

Forty workers (70% females), mean age ± SD: 44.4 ± 8.4 years, met all the inclusion criteria and agreed to participate. No significant differences in any outcome were found at baseline between groups. Baseline data of the participants are summarized in Table 1. Two workers of the control group left the project at the end of the experimentation (the withdrawal reasons were not received), while all the other workers completed the 10 sessions of the exercise programme or of the home programme and were then evaluated at the end of five weeks of treatment. In the experimental group, 10% of the subjects were smokers, compared with 15% in the control group ($P = 0.6$). Therefore, the results were not influenced by smoking in some workers. In the experimental group, 25% of the subjects did physical activity, compared with 10% in the control group ($P = 0.2$). All subjects worked in the same establishment, and no significant differences existed within each group concerning employment and work tasks. The VAS scores measured over the cervical and lumbar were not significant in the group-by-time interaction ($F = 1.30$, $P = 0.7$ and $F = 2.569$, $P = 0.1$, respectively). There was also a significant main effect for time ($F = 40.673$, $P < 0.001$) by lumbar VAS, but no significant group-by-time interaction for cervical VAS ($F = 0.878$, $P = 0.4$). The post-hoc analysis revealed significant differences between the 10 sessions for the experimental and control groups (both $P < 0.002$). It is interesting to note that the between-groups differences for pain improvements and the lower bound estimate of the 95% CI did not exceed the reported MCID of 2.0 cm, (see Table 2). There was no significant difference between the groups ($P > 0.05$). Between-groups effect sizes were small at the post-treatment period ($d < 0.2$).

Table 1. Baseline characteristics of participants

	Experimental group ($n = 20$)	Control group ($n = 20$)
Age (years)	42.7 ± 8.7	47.5 ± 7.5
Height (m)	1.6 ± 0.1	1.6 ± 0.1
Weight (kg)	68.7 ± 11.3	68.5 ± 15.6
Body Mass Index	26.0 ± 5.4	25.5 ± 4.7
Hour day labour	6.5 ± 0.3	6.4 ± 0.2
Labour experience (years)	13.1 ± 4.1	10.8 ± 6.8

Data are mean ± SD unless otherwise specified. There were no significant differences between groups for all variables.

Outcomes for RMDQ and ODI demonstrated a significant time factor ($F = 33.907$, $P < 0.001$ and $F = 25.447$, $P < 0.001$, respectively) but not for group-by-time interaction ($F = 2.458$, $P = 0.1$ and $F = 0.076$, $P = 0.8$, respectively). The post-hoc analysis revealed significant differences between the 10 sessions for the experimental group ($P < 0.001$) and for the control

Table 2. Mean (SD) for outcome at all study visits for each group, mean (SD) difference within groups and mean (95% CI) difference between groups

Outcome	Groups				Difference within groups		Difference between groups
	T^0		T^1		T^1 minus T^0		T^1 minus T^1
	Exp ($n = 20$)	Con ($n = 20$)	Exp ($n = 20$)	Con ($n = 20$)	Exp ($n = 20$)	Con ($n = 20$)	Exp minus Con
Cervical VAS	3.9 (4.2)	3.4 (3.7)	3.2 (3.7)	3.1 (3.6)	-0.7 (0.8)	-0.3 (0.8)	-0.4 (-2.0 to 1.4)
Lumbar VAS	7.3 (2.3)	7.3 (2.6)	5.4 (2.0)	6.1 (2.4)	-1.9* (0.3)	-1.2* (0.4)	0.7 (-0.7 to 2.2)
RMDQ	12.8 (4.7)	13.2 (5.3)	7.3 (4.3)	10.0 (5.2)	-5.5* (1.0)	-3.2* (1.1)	2.7 (-0.4 to 5.8)
ODI	33.0 (17.8)	39.3 (18.7)	20.6 (11.8)	25.5 (18.9)	-12.4* (3.6)	-13.8* (3.7)	4.9 (-5.3 to 15.2)

VAS: Visual Analogue Scale.

RMDQ: Roland Morris Disability Questionnaire.

ODI: Oswestry Disability Index.

*Significantly different within-group, $P < 0.05$ (95% CI).

group ($P = 0.006$). There was no significant difference between the groups ($P > 0.05$). Between-groups effect sizes were small at the post-treatment period ($d < 0.2$).

At the end of treatment, compliance with the home exercise programme was good in both the experimental group (65 %) and the control group (70%).

Discussion

This study sought to determine the effect of a programme of prevention exercises in a population of poultry slaughterhouse workers with MSDs. The exercise sessions given to the experimental group were conducted in the establishment of the agricultural cooperative. The significant improvement of low back pain suggests that these exercises have a potential impact on reducing low back pain and disability in slaughterhouse workers. This is a positive result because we know that low back pain is both a psychosocial and clinical problem. In contrast, improvement in the VAS pain score for neck pain was not different between the two groups. The MCID values for VAS were not those needed to detect important change. The low score at baseline might have precluded the ability to identify a difference between the groups by limiting the possible magnitude of improvement for either group. MDC estimates can help clinicians and researchers design future studies and interpret treatment change in both future research and clinical work. ODI and RMDQ scores showed a better outcome in the experimental group than in the control, but the differences were not significant, although we were close to significance for RMDQ. The poultry workers are people who usually come from a low socio-economic class, often with a low education level and may not be aware of the determinants affecting their health (Tavolaro et al., 2007). This could have a negative impact on a lack of correlation between patient perception of quality of life and reduction in lumbar spine pain, especially when the subjects have mild disabilities. Baker et al. (1989) found that the RMDQ is more sensitive in patients with mild disability and that ODI discriminates better in more severe disability, which is consistent with our results. At the end of treatment, compliance with the home exercise programme was good in both groups. It is important to note that the control group, who only did exercises at home, also showed improvement, in accordance with literature. In fact, a number of randomized trials have found home exercise programmes to be effective for improvement in LBP (Shirado et al., 2010). In our study, however, it should be noted that the results are slightly better if, in addition to home exercises, workers participate in an exercise programme under the supervision of a physical therapist.

Limitations and advantages of the study

The interpretation of these results must also be considered in light of the study limitations. We did not evaluate the impact of cognitive reconditioning on psychosocial variables. In fact, no measures related to important psychosocial variables (fear, anxiety, catastrophizing, etc.) were assessed during the study. We did not take into consideration patient satisfaction with treatment outcome and work disability, as suggested by Ostelo and de Vet (Shirado et al., 2010). This would have been important because we noted that patients did not always appreciate the treatment. They experienced it as an imposition by the company, and this could have influenced the results.

However, we did not investigate the psychological implications and satisfaction of workers in a systematic way at the end of the interventions. Furthermore, some authors suggest that patients suffering from chronic pain prefer passive treatment, which is helpful in symptom control (Ostelo and de Vet, 2005). In our study, the treatment was active because our final goal was to increase the activity levels of the patients, and this could be achieved only with adequate active therapies. Furthermore, inasmuch as this is a prevention programme, we asked all 180 workers employed to participate, but only 40 of them were available to be recruited. We then consecutively allocated the 40 subjects into two groups. Finally, this study had a short follow-up, so we did not assess whether the improvements appeared later and if they were maintained over time. However, one important advantage was that the programme of prevention had a good cost–benefit ratio; in fact, the presence of a physiotherapist in the company allowed a large number of interventions in a short time and with limited resources. The study design was imposed by the organization of the company that was in need of a pilot study. Evaluating the effectiveness of the programme will be necessary to provide for the construction of an RTC in a company with several follow-ups and possibly a cross-over study to involve all employees of the company. In this way, it will be possible to enrol patients randomly and could be useful using a matched control because it reduces the chances of an influential variable skewing the results by negating it.

Further investigation is needed to define other outcomes and the long-term results and treatments that combine passive exercises with active exercises.

Conclusion

The results obtained in this trial demonstrate that a programme of prevention exercises in a population of poultry slaughterhouse workers has a positive effect in improving MSDs for all the evaluation parameters used. Pain decreased in the lumbar region, and there was an almost significant reduction in disability.

Conflict of interest

The author declares no conflict of interest.

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