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Exercise program based on the pilates method for muscle flexibility in poultry workers

Programa de exercícios beseados no método pilates para flexibilidade muscular em avivuculistas

Programa de ejercicios basado en el método pilates para la flexibilidad muscular en trabajadores avícolas

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ABSTRACT

Background: Musculoskeletal (MS) disorders in poultry workers range from mild ailments to severe pain and illness; caused by lack of flexibility. Pilates exercises have positive effects on physical condition. Objective: Apply a Pilates-based exercise program to improve muscle flexibility in poultry workers. Methods: A study was developed in 29 workers who met the inclusion criteria. The intensity of pain was assessed with the visual analog scale and the level of flexibility with the Flexitest, to determine the needs of the workers and design the program based on Pilates. The program was validated by expert judgment and applied for 12 weeks, pain intensity and flexibility level were reassessed. Results: They demonstrated significant clinical and statistical improvements in the entire population, decreasing the intensity of pain from moderate and severe to mild ($p<0.005$) and improving flexibility from levels 1 and 2, which are poor and medium, to level 3, which is good flexibility. ($p<0.005$) after the program. Conclusion: The Pilates-based exercise program improves muscle flexibility and decreases pain intensity in poultry workers.

Keywords: Musculoskeletal Pain; Exercise; Absenteeism; Poultry.

RESUMEN

Antecedentes: Los trastornos musculoesqueléticos (TM) en trabajadores avícolas van desde molestias leves a dolores y enfermedades graves; causados por falta de flexibilidad. Los ejercicios de Pilates tienen efectos positivos en la condición fisica. Objetivo: Aplicar un programa de ejercicios basado en pilates para mejorar la flexibilidad muscular en trabajadores avícolas. Métodos: Se desarrolló un estudio en 29 trabajadores que cumplieron con los criterios de inclusión. Se valoró la intensidad de dolor con la escala analógica visual y el nivel de flexibilidad con el Flexitest, para determinar las necesidades de los trabajadores y diseñar el programa basado en pilates. Se validó el programa por juicio de expertos y se aplicó durante 12 semanas, se reevaluó la intensidad del dolor y el nivel de flexibilidad. Resultados: Demostraron mejorías clínicas y estadísticas significativas en toda la población, disminuyendo la intensidad del dolor de moderado y severo a leve ($p<0,005$) y mejorando la flexibilidad de niveles 1 y 2 que son pobre y media a nivel 3 que es buena flexibilidad ($p<0,005$) luego del programa. Conclusión: El programa de ejercicios basado en Pilates mejora la flexibilidad muscular y disminuye la intensidad del dolor en trabajadores de avícolas.

Palabras clave: Dolor Musculoesquelético; Ejercicio Físico; Ausentismo laboral; Avícolas.

RESUMO

Antecedentes: Distúrbios musculoesqueléticos (EM) em trabalhadores aviários variam de doenças leves a dor e doença severas; causados pela falta de flexibilidade. Os exercícios de Pilates têm efeitos positivos na condição física. Objetivo: Aplicar um programa de exercícios baseados em Pilates para melhorar a flexibilidade muscular em avicultores. Métodos: Foi desenvolvido um estudo em 29 trabalhadores que atenderam aos critérios de inclusão. A intensidade da dor foi avaliada com a escala visual analógica e o nível de flexibilidade com o Flexiteste, para determinar as necessidades dos trabalhadores e desenhar o programa baseado no Pilates. O programa foi validado por julgamento de especialistas e aplicado por 12 semanas, a intensidade da dor e o nível de flexibilidade foram reavaliados. Resultados: Eles demonstraram melhorias clínicas e estatísticas significativas em toda a população, diminuindo a intensidade da dor de moderada e intensa para leve ($p<0,005$) e melhorando a flexibilidade dos níveis 1 e 2, que são fracos e médios, para o nível 3, que é uma boa flexibilidade ($p<0,005$) após o programa. Conclusão: O programa de exercícios baseados em Pilates melhora a flexibilidade muscular e diminui a intensidade da dor em avicultores.

Palavras-chave: Musculoskeletal Pain; Exercice physique; Ausentismo; Aves Domésticas.

INTRODUCTION

The hectic pace of life and changes due to globalization worldwide have contributed to the creation of new occupational risks or sharpen existing ones, highlighting musculoskeletal disorders (MSDs) as the most frequent (Zamora Macorra et al., 2019); since they are the first cause of disability in the world, affecting more than 1710 million people (Cieza et al., 2020), causing deaths from work accidents and occupational diseases to 2,78 million workers per year and 360 million of nonfatal injuries resulting in more than 4 days off work according to the International Labour Organization (ILO) (ILO, 2019). Additionally, MSDs are one of the conditions with the greatest need for rehabilitation services worldwide (Cieza et al., 2020).

In such away, MSDs are considered a serious socio-sanitary problem in the working population, and although their prevalence varies according to age and diagnosis, these injuries occur in people of all ages (Cieza et al., 2020). Low back pain is a MSDs symptom and the most frequent worldwide, reaching a prevalence of 568 million people; this is greatly related to the lack of flexibility of the body (Caicedo-Molina et al., 2013), initially with persistent pain, followed by a mobility limitation, dexterity, and functioning in general way; reducing the ability of people to work (Cieza et al., 2020). In addition, it affects the back, neck and upper limbs (National Institute of Medicine and Safety at Work-Spain et al., 2018).

The problem of MSDs, linked to the mobility limitation and dexterity; altering functional capacities, especially those related to flexibility; consequently, causing early retirement; lower levels of well-being, a lower capacity for social participation, and even generating a permanent disability; which translates as affectation in the quality of life of the worker (Cieza et al., 2020).

In Latin America, in a study conducted to Chilean farmers, it was shown that the physical pain they present the most is in the lower back with a total of 62%, upper back 30%, knee 29%, wrist 25% and hand 23% (Madriz-Quirós & Sánchez-Brenes, 2021). In Brazil, in a study carried out in a poultry production plant, it was demonstrated that the musculoskeletal pain prevalence is between 85% to 95.8% in production workers, as well as in office workers with a 2.9 probability that women of production workers develop musculoskeletal pain, the sites with the most pain in production workers in the body were the upper and lower back and shoulders (Caieiro et al., 2019).

In Ecuador, a study of farmers in Tungurahua province was detailed a 70% of ergonomic risk due to extended work or long working hours, highlighting a 100% risk of contracting musculoskeletal problems in workers (Valeria Michelle Puente Rodríguez & José Luis Herrera López, 2022).

According to INEC data, in San Pedro de Pelileo canton in Ecuador there is an 82.1% of the population living in the rural sector, specifically in Cotaló parish who belong to 42.67% to those dedicated to agro-industry; especially poultry production (INEC 2010, nd.).

One of the interventions with a focus on prevention, is the practice of regular exercises in manufacturing jobs, the active breaks at work, either through strengthening or stretching exercises that show the importance of MSD prevention (Soto Rodríguez et al., 2018). Based on what has been mentioned, the Pilates method is a physical and mental training system, as it works the body as a whole from deep to peripheral muscle strength, it combines motor control, breathing and relaxation. allowing to complete control of each body movement (Valldaura, 2007).

In a systematic review conducted by Tejada 2021, on physical intervention programs in older women through the Pilates method, 41 articles from 2014 to 2019 under inclusion and exclusion criteria were reviewed (Tejada-Medina et al., 2021), in which the article by Oliveira 2016 is highlighted, where the exercise program based on Pilates to improve body flexibility showing significant improvements versus a static stretching program is evidenced (Oliveira et al., 2016). Gholamalishahi 2022, stands out that Pilates is a very popular exercise system and is currently recommended for healthy people and people with chronic low back pain, reports that Pilates -based exercises improve flexibility, balance, and muscular endurance (Gholamalishahi et al., 2022).

Sahiner and Yesilyaprak 2022, analyzed neck pain as one of the most common MSD problems nowadays, proposes that the Pilates method helps to reduce the risk factors for this health condition, and concludes by stating that the Pilates method helps to reduce pain, disability and ROM increase (Sahiner Picak & Yesilyaprak , 2022).

Under these concepts, the problem of MSDs at a global and local level is evidenced, there are few studies carried out on workers of poultry plants at a national level. For this reason, research in this type of population is of interest with the objective of applying a Pilates -based exercise program to improve muscle flexibility in poultry workers.

METHODOLOGY

The scientific research concerned an observational type, at an analytical level, with a quantitative approach and longitudinal cohort. It was carried out in Cotaló parish, Pelileo Canton, Tungurahua Province, belonging to Zone 3 of the Economic and Social Development of Ecuador. Given the accessibility and availability of the farm owners, the study was carried out on the farm with the highest production in the belonging parish (Avícola Cecilita).

For the collection of information, a socialization of the research problem regarding pain and MSDs due to the lack of flexibility in different body segments was carried out, from a total of 50 workers, 29 workers were selected between men and women, after application it was explained the program and the objective of the study, the informed consent was signed with the approval by resolution 018-CEISH-UTA-2023 of the bioethics committee for their respective participation in the study, respecting the inclusion criteria; workers who feel physical fatigue, with MDS, those who refer pain when carrying out their work and exclusion; people with degenerative pathologies, joint limitations, the ones who have recently undergone surgery, with some physical disability and people who are undergoing private or public physical rehabilitation treatment.

In order to obtain quantitative data, an initial and final evaluation were performed, for the belonging study. The Flexi test method was used for the study, based on the evaluation of passive static flexibility of 20 body movements, 8 in the lower limb, 3 in the trunk and 9 in the upper limb with high reliability standards of the test carried out by (Soares De Araújo , 2005). It is easy to apply as it is performed on the right side of the body for bilateral movements, from 0 to 4 in relation to the ROM obtained passively, being 0=very poor, 1=poor, 2=medium, 3 =good, 4=very good. The VAS pain analogue scale was applied to measure pain at a given reference moment, in the study pain is not being evaluated as research, it is collected in a referential way at the time of applying the Flex test (Kersten et al., 2014). Its evaluation is quick and subjective, and carried out on a line with a scale from 0 to 10, obtaining the information in which pain number is found, 0: no pain, 1-3: mild, 4-7: moderate, 8-9: severe, 10: maximum pain.

A series of existing exercises of the Pilates method were selected for the program, in total there were 11; breathing, neutral position, shoulder depression and scapula retraction, arm elevation and thoracic location, Leg drops, Bridges, Hip rolls, Cat, Shell stretch, Single Straight legs stretch (Scissors), Spine stretch forward (Isacowitz, 2016). Its application was carried out during 12 weeks, in sessions of 3 days per week, with a repetition of 6 for each exercise in the first 2 weeks, 8 in week 4 and 5, later ended in 10 repetitions for each exercise. The entire intervention was evaluated and approved by a committee of experts.

RESULTS AND DISCUSSION

The following results were obtained in the current research.

Table 1. Pain intensity in poultry workers with MSD, initial and final evaluation

VAS		Initial evaluation		Final evaluation	
Pain intensity	**Points**	**Fr**	**%**	**Fr**	**%**
No pain (0)	0	0	0	13	45
Mild (1-3)	1	0	0	5	17
	2	0	0	9	31
	3	0	0	2	7
Moderate (4-7)	4	0	0	0	0
	5	0	0	0	0
	6	9	31	0	0
	7	9	31	0	0
Severe (8-9)	8	9	31	0	0
	9	2	7	0	0
Maximum pain (10)	10	0	0	0	0
Total		29	100	29	100

Elaborated by: BSc. P.T. Alex Pérez.

When comparing the pain intensity presented by poultry workers, before and after the application of the break program, a considerable decrease was found, evidenced by the change in pain intensity of moderate in 62% and severe in 38% of the population at a mild pain intensity for 55% and no pain in the remaining 45% of the population.

Table 2. Flexibility evaluation (FLEXITEST) in poultry workers with MSD, initial and final evaluation

Flexitest parameters		Initial evaluation										Final evaluation									
		0		1		2		3		4		0		1		2		3		4	
Mov.	Kinesiological description	Fr	%	Fr	%	Fr	%	Fr	%	Fr	%	Fr	%	Fr	%	Fr	%	Fr	%	Fr	%
I	Ankle dorsiflexion	0	0	15	52	14	48	0	0	0	0	0	0	0	0	1	3	28	97	0	0
II	Ankle plantarflexion	0	0	6	21	22	76	1	3	0	0	0	0	0	0	0	0	29	100	0	0
III	Knee flexion	3	10	13	45	12	42	1	3	0	0	0	0	0	0	0	0	29	100	0	0
IV	Knee extension	0	0	5	18	23	79	1	3	0	0	0	0	0	0	0	0	29	100	0	0
V	Hip flexion	0	0	4	14	15	52	10	34	0	0	0	0	0	0	0	0	29	100	0	0
VI	Hip extension	0	0	2	7	19	66	8	27	0	0	0	0	0	0	1	3	28	97	0	0
VII	Hip adduction	1	3	4	15	21	72	3	10	0	0	0	0	0	0	0	0	29	100	0	0
VIII	Hip abduction	0	0	4	15	20	68	5	17	0	0	0	0	0	0	0	0	29	100	0	0
IX	Trunk flexion	3	10	3	10	16	55	7	25	0	0	0	0	0	0	5	18	24	82	0	0
X	Trunk extension	0	0	6	21	18	61	5	18	0	0	0	0	0	0	5	18	24	82	0	0
XI	Ttrunk lateral flexion	0	0	1	3	13	45	15	52	0	0	0	0	0	0	0	0	29	100	0	0
XII	Wrist flexion	0	0	8	27	20	70	1	3	0	0	0	0	0	0	0	0	29	100	0	0
XIII	Wrist extension	0	0	8	27	20	70	1	3	0	0	0	0	0	0	0	0	29	100	0	0
XIV	Elbow flexion	0	0	8	27	21	73	0	0	0	0	0	0	0	0	0	0	29	100	0	0
XV	Elbow extension	0	0	9	31	19	66	1	3	0	0	0	0	0	0	0	0	29	100	0	0
XVI	Posterior shoulder adduction from 180º abduction	0	0	2	7	14	49	13	45	0	0	0	0	0	0	0	0	29	100	0	0
XVII	Posterior adduction or shoulder extension	3	10	15	53	10	34	1	3	0	0	0	0	0	0	0	0	29	100	0	0
XVIII	Posterior shoulder extension	0	0	5	18	21	72	3	10	0	0	0	0	0	0	16	55	13	45	0	0
XIX	Shoulder lateral rotation with 90º abduction and 90º elbow flexion	0	0	15	52	13	45	1	3	0	0	0	0	0	0	1	3	28	97	0	0
XX	Shoulder medial rotation with 90º abduction and 90º elbow flexion	0	0	15	52	13	45	1	3	0	0	0	0	0	0	0	0	29	100	0	0

Flexibility levels: 0: very poor, 1: poor, 2: medium, 3: good, 4: very good.Elaborated by: BSc. P.T. Alex Pérez.

Considering that the Flexitest values are represented in scores that are interpreted with flexibility levels: 0: very poor, 1: poor, 2: medium, 3: good, 4: very good. Thus, in the comparative results between flexibility measures before and after the application of the exercise program based on Pilates, it was found that there were great changes in flexibility progressing from levels of 0, 1 and 2 to levels of 3 in all movements valued for more than 80% of the population. Mentioning that in the lower limb for ankle dorsiflexion and hip extension movements, a 97% of the population reached a 3 level on the Flexitest scale, for ankle plantar flexion, knee flexion, knee extension knee, hip flexion, hip adduction and hip abduction, an 100% of the population achieved level 3. In the trunk region, an 82% of the population reached level 3 on the Flexitest scale, both for flexion and trunk extension; while in trunk lateral flexion, an 100% of the workers reached level 3. In the upper limb, both in wrist flexion and extension, elbow flexion and extension, posterior shoulder adduction from 180º abduction, posterior adduction or shoulder extension and medial rotation of the shoulder with 90º abduction and 90º elbow flexion obtained a level of 3; Lateral shoulder rotation with 90º abduction and 90º elbow flexion obtained a 3 level of a 97% of the population; while in the posterior shoulder extension, a 45% had a level 3 and a 55% got 2 level. Consequently, a considerable improvement in body flexibility can be seen in all the poultry workers who participated in the study, presenting good flexibility in a general way.

Table 3. Wilcoxon test for pain intensity (VAS) in poultry workers with MSD

	Pain intensity Initial- Final
Z	-5,058[c]
Asymp. Sig, (bilateral)	,000

Elaborated by: BSc. P.T. Alex Pérez.

In order to verify the hypothesis, the Wilcoxon rank test was applied to workers with pain intensity, using a significance of 95%; Thus, a p value of 0.000 was obtained for pain intensity. Being lower than alpha (0.05), the alternative hypothesis was accepted and the null hypothesis rejected, stating that there are significant differences in pain intensity that poultry workers present between the measures before and after the application of the exercise program based on Pilates.

Table 4. Wilcoxon test for flexibility levels (FLEXITEST) from movement 1 to 20 in poultry workers with MSD

	Ankle dorsiflexion , IE - EII	Ankle plantar flexion , EI - EII	Knee flexion , EI - EII	Knee extension , IE -EII	Hip flexion , EI - EII	Hip extension , EI - EII	Hip adduction , EI - EII	Hip abduction , IE - EII	Trunk flexion , EI - EII	Trunk extension , EI - EII
Z	-4,849 [b]	-4,919 [b]	-4,724 [b]	-4,963 [b]	-4,065 [b]	-4,491 [b]	-4,765 [b]	-4,613 [b]	-4,472 [b]	-4,811 [b]
Asymp. Sig, (bilateral)	,000	,000	,000	,000	,000	,000	,000	,000	,000	,000
	Trunk lateral flexion , EI - EII	Wrist flexion , EI - EII	Wrist extension , EI - EII	elbow flexion , IE - EII	elbow extension, IE - EII	Hip extension , EI - EII	Shoulder adduction , EI - EII	Shoulder extension , EI - EII	lateral rotation shoulder , IE - EII	Rotation shoulder med , EI - EII
Z	-3,638 [b]	-4,850 [b]	-4,850 [b]	-4,944 [b]	-4,824 [b]	-3,819 [b]	-4,736 [b]	-3,873 [b]	-4,765 [b]	-4,768 [b]
Asymp. Sig, (bilateral)	,000	,000	,000	,000	,000	,000	,000	,000	,000	,000

Elaborated by: BSc. P.T. Alex Pérez.

The Wilcoxon rank test was applied to verify the hypothesis since the variable is categorical and the study is longitudinal. In this way, a p value of 0.000 was obtained for all movements valued in the Flexitest, which is lower than alpha (0.05), hence the research hypothesis was accepted and the null hypothesis rejected, stating that there are significant differences. in the flexibility level of poultry workers between the measurements before and after the application of the exercise program based on Pilates.

DISCUSSION

MSD disorders include a series of work-related symptoms and diseases, which mainly affect workers in production areas, causing chronic injuries development, work absenteeism, job losses that represent a high socio-sanitary cost. They are generally associated with handling loads, forced postures, repetitive movements, muscle weakness, and lack of body flexibility. Under this context, the research was carried out on the effects of an exercise program based on the Pilates method to improve muscle flexibility in poultry workers; through an initial evaluation of pain intensity and flexibility; finding moderate pain levels in 62% of the workers and 38% severe pain according to the VAS scale which relates to the results obtained by Herrero 2015, where he found a higher prevalence of pain intensity in Spanish workers, the population being more affected women between 20 and 25 years old from the age of 45 (Vicente Herrero et al., 2015); In this way, the pain intensity that Poultry workers present would be limiting their daily life and work activities. Regarding the flexibly level measured through Flexitest application, the majority of workers presented level 1 and 2, which correspond to poor and medium flexibility respectively; some workers also presented scores of 3 in hip, trunk and shoulder movements and very few had scores which demonstrates good flexibility in these regions; while few ones had a 0 score in the knee and trunk flexion, and posterior shoulder adduction movements, which is equivalent to very poor flexibility. Thus, the ankle, knee, elbow, wrist and hand are the most affected regions by flexibility. In this way, it can be shown that body flexibility can be a pain determinant in MSDs, as mention Renkawitz, Boluki , Grifka 2006, in their study where they identified the trunk flexibility of the trunk extensor musculature as a protective factor against low back pain. (Renkawitz et al., 2006).

The program has been designed based on the literature review and the results of the initial assessment of pain intensity and the Poultry workers' flexibility which lasted 12 weeks, with a frequency of 3 times a week (Monday, Wednesday and Friday), and 30 min per session; Besides, a variability in the intensity of six repetitions per exercise was programmed in week one and two; and eight repetitions per exercise in week three and four; and ten repetitions per exercise from week five which agrees with the suggestions about the positive effects of Pilates exercises in improving flexibility from significant

increases with practice from 5 to 6 weeks, 3 times a week, to 12 weeks with a frequency of 2 to 3 times per week and 26 weeks from 1 to 3 days (Manuel et al., 2023; Renkawitz et al., 2006) (Cristóbal et al., 2015).

The exercises included were: Breathing, Neutral position, Shoulder depression and scapula retraction, Arm elevation and chest position, Leg drops, Bridges, Hip rolls, Cat, Shell stretch, Single Straight leg stretch (Scissors), Spine stretch forward; intended primarily to improve body flexibility (Isacowitz , 2016).

Regarding the differences between means of pain intensity and flexibility level after the application of the program, when comparing the pain intensity, a decrease in pain was found from moderate in 62% and severe in 38% to a mild pain in 55% and no pain in the remaining 45%, and statistically significant differences p = 0.000 were obtained. These results are similar to what was found by Caicedo, Barbosa, Cruz, Sanabria 2013, where after flexibility training pain decreased in 84% of the population and an absence of pain in 37% of the subjects (Caicedo I., Barbosa, Cruz, & Sanabria, 2013). Likewise, after the application of the active breaks program in the flexibility level, significant clinical and statistical changes were observed, where levels 0, 1 and 2 improved to level 3, which means good flexibility in all movements evaluated (p =0.000); whereby the muscular flexibility of the whole body was significantly improved. Although the evidence is scarce regarding the measurement of flexibility after interventions based on Pilates in similar populations, studies such as those of Vidarte 2020 have been found, concluding that it was evidenced a significant increase in the athletes' flexibility after training with Pilates, demonstrated with significant differences at a general level in lower limb movements (p= between 0.000 to 0.02) (Armando et al., 2020). Moreover, De Oliveira 2019, in a comparative study, found out that Pilates improved flexibility in all the movements evaluated, compared to static stretching that only improved trunk and hip flexion (NTB De Oliveira et al., 2019); Kao 2015 confirms that Pilates exercises can improve flexibility in women (Kao et al., 2015), like Machado 2021, in the vertical distance test between the ground and the tip of the third finger, where he found significant differences after Pilates exercises (p<0.001) (Santos M, 2021), Cruz and Liberali 2016, in finger-floor and neck-wall distance measurements after Pilates application (p<0.001) (Josiane et al., 2016).

In view of findings and evidence of other authors, it is established that exercise programs are an effective instrument to improve the physical condition of workers, as well as their performance at work improvement (César & Klever, nd) (Sociedad et al., 2020), and when Pilates exercises are applied for this purpose, the benefits are even greater, especially in MSD associated with flexibility.

CONCLUSION

The changes in pain intensity and flexibility after the application of Pilates-based exercise program were significant both clinically and statistically. In this way, the pain intensity decreased and the flexibility improved in the entire population, evidencing significant differences for the two dimensions (p=0.000), agreeing with the results of different authors who measured the variations in the pain and flexibility level; and comparative studies between Pilates and other techniques of stretching or physical activity. Accordingly, it is concluded that the findings in the study and the evidence from other authors allow to establish that an exercise program based on Pilates reduces pain intensity and improves muscle flexibility in poultry workers. Scientific evidence shows that Pilates exercises are effective in improving the physical condition of those who practice them, and if applied to workers through active breaks, they can reduce symptoms and reduce musculoskeletal disorders risks without leaving the job or the treatments and above all having an extra expense.

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