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Pilates method program for the management of scoliosis of GADYTRA health personnel

Programa do método Pilates para o tratamento da escoliose do pessoal de saúde GADYTRA

Shirley Abigail Quishpe Barroso
https://orcid.org/0009-0000-3445-4199
Master in Physical Therapy with mention in Neuromusculoskeletal
Faculty of Health Sciences
Technical University of Ambato
squishpe3053@uta.edu.ec

Gerardo Fernando Fernández Soto
https://orcid.org/0000-0002-0246-0380
Master in Physical Therapy with mention in Neuromusculoskeletal
Faculty of Health Sciences
Technical University of Ambato
gfernadez@uta.edu.ec

Gabriela Estefanía Robalino Morales
https://orcid.org/0000-0002-9301-3411
Master in Physical Therapy with mention in Neuromusculoskeletal
Faculty of Health Sciences
Technical University of Ambato
ge.robalino@uta.edu.ec

Valeria Alexandra Cepeda Acosta
https://orcid.org/0009-0002-3775-6525
Master in Physiotherapy and Rehabilitation Mention: Musculoskeletal
Faculty of Health Sciences
Physiotherapy Career
Technical University of Ambato-Ecuador
vcepeda1767@uta.edu.ec

Milton Alejandro Pacheco Guzmán
https://orcid.org/0009-0006-5751-5162
Master in Physiotherapy and Rehabilitation Mention: Neuromusculoskeletal.
Technical University of Ambato
Faculty of Health Sciences
mpacheco3851@uta.edu.ec

ABSTRACT

Introduction: Scoliosis corresponds to the misalignment or deviation of the spine to the side. It can be accompanied by rotation of the vertebrae. In the adult population, 60% suffer from scoliosis, altering posture and pain. Analyzing research studies, Pilates have been selected for the management of the pathology. **Objective**: Implement a Pilates-based exercise program to improve scoliosis in the health personnel working in GADYTRA (Diagnostic and Therapeutic Gastroenterology of the Amazon Region). **Methods**: The research was carried out with a population of 28 people. It was quasi-experimental, observational, longitudinal, and quantitative approach. The results were analyzed before and after with the Nordic questionnaire, VAS, and anatomical angles. The pilates program was used in a period of 12 weeks. For the analysis and data processing, Shapiro Willk, T Student, and Wilcoxon were used. **Results**: Greater discomfort in the neck, upper and lower back, and hips was identified after the Pilates program and from the post-test it was obtained that there is a reduction in pain and a decrease in the angles of the shoulders and hips. It improved posture and pain in participants. **Conclusions**: The Pilates program works to improve pain and posture with adequate discipline in the population.

Keywords: Scoliosis; spinal curvature: pilates method; exercise; asymmetry.

RESUMEN

Introducción: A escoliose corresponde ao desalinhamento ou desvio da coluna para o lado. Pode ser acompanhado por rotação das vértebras. Na população adulta, 60% sofre de escoliose, alteração de postura e dores. Analisando pesquisas, o Pilates foi selecionado para o manejo da patologia. **Objetivo**: Implementar um programa de exercícios baseado em Pilates para melhorar a escoliose nos profissionais de saúde que trabalham no GADYTRA (Gastroenterologia Diagnóstica e Terapêutica da Região Amazônica). **Métodos**: A pesquisa foi realizada com uma população de 28 pessoas. Foi uma abordagem quase experimental, observacional, longitudinal e quantitativa. Os resultados foram analisados antes e depois com o questionário nórdico, EVA e ângulos anatômicos. O programa pilates foi utilizado em um período de 12 semanas. Para análise e processamento dos dados foram utilizados Shapiro Willk, T Student e Wilcoxon. **Resultados**: Foi identificado maior desconforto no pescoço, parte superior e inferior das costas e quadris após o programa Pilates e no pós-teste obteve-se que há redução da dor e diminuição dos ângulos dos ombros e quadris. Melhorou a postura e a dor nos participantes. **Conclusões**: O programa Pilates atua na melhora da dor e da postura com disciplina adequada na população.

Palabras clave: Escoliose; curvatura da coluna vertebral: método pilates; exercício; assimetria.

INTRODUCTION

The main study of this research work is scoliosis in adults. One of the manifestations that they present is postural alteration, mainly scoliosis. That is, from an ergonomic point of view, the loss of alignment of the spinal column with the axial axis. It is the result of poor posture since childhood, and adolescence. Lifestyle, over time, leads to an aesthetic alteration, presence of pain in some areas of the body, limitation of mobility, and extreme cases, it is associated with neurological or degenerative pathologies. (Zale & McIntosh, 2022)

At a global level, the prevalence of scoliosis in adults is 68%. Its values are equal to or greater than 10th Cobb and it is related to chronic, degenerative pathologies that can affect other areas of the body and favor the increase in other bone and visceral pathologies (9). In Latin America, it is 60%, of which it is also related to a muscular limitation and an aesthetic problem due to the asymmetry that manifests itself especially at the body level in a bipedal posture (10). In Ecuador, at the moment there are no real figures for the pathology. However, there are musculoskeletal pathologies associated with scoliosis according to the Ministry of Health, such as upper back pain and lumbar pain. (Sanabria Castillo & Álvarez Orozco, 2022) (Rosário, 2013)

The spine is made up of bones called vertebrae, intervertebral discs, ligaments, muscles, tendons, ligaments, curvatures called kyphosis and lordosis. They help maintain and execute movements in an efficient and harmonious manner. It is composed of 33 vertebrae in an aligned manner seen from the back and laterally with their respective curvatures that help maintain the verticality of the body in different positions. This gives better resistance in conjunction with the vertebral discs and the muscles that are stabilizers, in much of it, at the level of the column. (Llopis, et al, 2016) (Castro Chacón, et al, 2017)

Currently we have some diseases that have a negative impact on the musculoskeletal system due to the lifestyle we lead. Within this group, one of the most affected body structures is the spine since it is subjected to levels of stress, tension, unnecessary loads, postures and lack of mobility. It develops some deficits causing pathologies that trigger muscle pain and changes in soft and bone structures. (García-Salirrosas & Sánchez-Poma, 2020) (Catalán Edo, Serrano Ostariz, Sánchez Latorre, & Villarroya Aparicio, 2021) (Kamal & Rouhi, 2020)

Alterations that affect posture have been increasing in this century in the entire population from a very early age. Especially there is an increase in young adults who experience adaptations to replace unnecessary loads, often to carry out a job. Relief of pain and vicious postures are produced due to lack of muscular activity of the spine since we see that currently, due to the sedentary life of a large part of people. They adopt inappropriate postures to perform various activities and most of the times the person adopts the posture without correction (Ballester Aria & García, 2017) (Soares, et al., 2023)

Scoliosis is a deviation of the spine in the anteroposterior plane, that is, it forms a curve with lateral sliding and can give an "S" or "C" appearance. Generally, in posterior view, it appears in the shape of an "I". This deviation acts at the level of the vertebrae and when subjected to prolonged times there is a rotation of more of the vertebral facets of the shoulder blade, and hip. It causes a scapular and iliac crest asymmetry, which is characteristic of scoliosis. (Marín Andres, et al, 2020) (Negrini, et al, 2015)

Among the best-known symptoms of scoliosis are: back pain due to muscle tension, spinal weakness, asymmetric shoulders or hips, shoulder pain, in extreme cases breathing problems, stiffness in curves, stenosis syndromes of the canal, and loss of lordosis. The degrees of scoliosis are determined by the Cobb angle and it indicates that it is a mild scoliosis when it does not reach 20°, moderate when it is between 25° and 40° and severe when it exceeds the 50°. (Gómez Cristancho, et al, 2023) (Ceballos Laita, Jiménez Del Barrio, Tejedor Cuvillo, & Mingo Gómez, 2018)

Scoliosis currently encompasses an alteration of the spine that triggers aesthetic alterations. It can be accompanied by mild to intense pain, causing a problem in society. According to studies, the incidence is 2% to 3% globally, more frequently in females, in whom the first references begin to be observed between the ages of 12 and 16. Some types of scoliosis can worsen with age and be related to neurological problems. (Nishida, et al, 2017) In Latin America, some studies indicate that countries such as the United States report the incidence with values between 2.5% and 4%. In Ecuador, there is currently no global statistical data on the incidence of scoliosis in adults (Baquero Sastre, Buitrago Buitrago, & Ortiz González, 2011) (Won, Oh, & Shen, 2021)

The Pilates method is a set of movements that, with the use of lengthening and expansion of the chest, considerably improves the Cobb angle in moderate scoliosis. However, in severe cases it does not report significant changes. Furthermore, with the use of Pilates it has been observed improvement in posture, dynamic balance, curvature, strength in the extremities, aerobic resistance and global flexibility. It has also been observed that it is more effective in the area of fatigue because it allows the patient to synchronize the exercise with music and reduces the appearance of fatigue, which is why (González-Gálvez, Marcos-Pardo, & Carrasco-Poyatos, 2019) encourages physical activation. (Cobb, Bazett-Jones, Josh, Earl-Boehm, &

James, 2014) (Sampaio Queiroz, et al, 2016)

In elderly people, for example, the use of sports strategies should be done in a careful and planned way in order to avoid injuries (Vieira Costa & Silva Dias, 2024). The Pilates method is classified into exercises, in two forms of them. One that is with the use of the body and a mat, and another with the use of accessories such as balls, dumbbells, etc. The aim of Pilates is to achieve strengthening of the trunk, core, followed by stretching of the spine and trunk, and strengthening of the upper and lower extremities. It has been observed that there is an improvement in terms of thoracic and lumbar alignment. (Vaquero-Cristóbal, Alacid, Esparza-Ros, Muyor, & López-Miñarro, 2015) (Bulguroglu, et al., 2017)

Pilates as an alternative measure to improve the degree of scoliosis, especially in concave and convex curvatures, has been seen as a subject of study. It includes measurements on the distribution of body weight using mat exercises, sitting and standing. Postural changes are part of an adequate correction of the curvatures of scoliosis so that there is a better adaptation of the loads and the Cobb angle improves. (Su, Peng, Tien, & Huang, 2022) (Qiu, Yeung, Lee, & Cheng, 2006)

In the study, they mention that the practice of exercises in physical conditioning improves resistance at the level of the abdominal muscles, dynamic balance, back flexibility, and spinal alignment. Some of them in the assessment were detected with scoliosis of idiopathic origin and although not all of them presented pain, in practice at the end of the study the pain and symmetry indexes improved. The study was carried out on healthy people without neurological conditions. Pilates was performed on a mat 2 to 3 times a week for a duration of 5 to 12 weeks. For comparison tests, the abdominal test was performed for 1 minute in terms of muscular resistance. In this study no significant relevance was found between both sexes, however, the positive effects could be observed up to 6 months after the intervention. (Campos, et al., 2016) (Domingues de Freitas, Araujo Costa, Carvas Junio, & Tassoni Civile, 2020)

Scoliosis is a three-dimensional problem at the level of the spine and trunk and of all the cases detected, around 80% is idiopathic scoliosis, which means that it does not have a specific origin, but it is not associated with neurological problems or alterations. The progression of scoliosis causes a misalignment of the spine, affecting the mobility of the trunk and manifesting an asymmetry. Pilates is a physical conditioning technique that this study wants to determine if Pilates is capable of modifying the curvature that causes scoliosis and is able to reduce it in a preserved way and within the results it could be observed that there were improvements in the reduction of the Cobb angle with a significant statistical confidence. There were also positive changes in the trunk rotation angle, and an increase in the range of motion at the trunk level could be observed. The quality of life according to the application of the SMD questionnaire also had significant changes. Pain was evaluated with a pain scale and had a decrease and improvement in terms of $p<0.01$, being statistically significant. The study mentions that the changes that the person experiences are from the third week with a frequency of 3 times per week in periods of 30 to 60 minutes per session. The population mentioned is young adults. (Gou, Lei, Zeng, et al, 2021) (Ali, Fontanari, Fontana, & Schmöl, 2020).

In another study, it is mentioned that the alignment of the spine, as well as occasional pain and chronic pain in the neck and shoulder, is related to the biomechanics of the shoulder, meaning that the position of the shoulder due to scoliosis influences the appearance of symptoms. The study proposes the execution of Pilates to observe the effect on posture, shoulder flexibility and spine. The study is experimental, in which 19 people participate, of which 9 as a control group and 10 as an experimental group. The ages of the participants are 22-45 years. The study mentions that with Pilates training in a period of one hour for two sessions one to two times a week for 12 weeks, a smaller static scoliosis than the initial one in the sitting position and better strength in the abdominals could be observed. In turn, better results were seen in the upper part of the spine since posture improved. It could be evidenced a better muscle activation at the level of the spine, abdominals, the angles that caused deformity at the level of the spine such as scoliosis and kyphosis. Neck and shoulder pain decreased significantly (Bastos de Oliveira, et al, 2019) (Danielsson & Nachemson, 2003) (Park, Jeon, & Park, 2017)

Through the study carried out, the objective of this work is to implement an exercise program based on Pilates to improve the scoliosis of GADYTRA health personnel through training.

METHODOLOGY

The research project is a longitudinal study since samples are taken at the beginning and at the end of the application of the technique. It is observational analytical because the relationship of the variables that is observed in the determined time is taken through the application of the technique and the data obtained is analyzed by processing the results that are submitted to a statistics tool for proper analysis.

For the following research study, inclusion and exclusion criteria were applied to the health personnel who work in the GADYTRA private clinic in the city of Puyo. The inclusion criteria are: people who were previously reviewed by the local

traumatologist and presented an asymmetry of the iliac crests, asymmetry of the shoulder girdle, muscular symptoms in the trunk and lumbar areas, and work equal to or greater than eight hours within the establishment. The exclusion criteria were: people who are receiving treatment in another establishment, with vertebra fractures, radicular symptoms, acute processes at the dorsal level, and people who have pharmacological treatment or have undergone surgery.

Therefore, the population studied once evaluated and analyzed from the total group of 75 workers and through the use of the inclusion and exclusion criteria, 28 people were chosen in a range of 21 to 50 years who are health personnel who work in the selected establishment.

It was socialized with each person who participated in the research, and it was indicated that the research would last 16 weeks of intervention, beginning with the application of informed consent, followed by a data collection sheet from the participants, and the application of the tests before and after the program. The standardized Nordic questionnaire in its version translated into Spanish has reliability of 0.863, considered good, and with a validity of 0.72 in the Cronbach alpha index in which the test-retest has been applied in other studies. Similar results were obtained. Furthermore, the analog pain scale in its version translated into Spanish through some studies and the application of the test-retest has a reliability of 0.90. There was an acceptance and validation of 0.87 according to Cronbach's alpha with an application time between 2 and 5 minutes. And the Adams test, which is a test that helps us identify scoliosis, has a specificity of 66.7% and a sensitivity of 78.6%. It shows a notable deviation at the level of the scapulae and a bulge forms in the place where it occurs. Spinal inclination appears when the patient flexes his trunk when trying to touch his feet with his hands without bending his knee.

The Pilates method that was used in the research project is of a mixed type. The "Matwork" only uses the person's body and a mat. And the "Reformer" which uses has balls, machines, and dumbbells as auxiliaries. In this research project from week 1 to 8 was Matwork and from 9 to 12 the exercise protocol was approved by a committee of experts that included two manual orthopedic physiotherapists and a neuromusculoskeletal physiotherapist. In the intervention of the exercise program, there were 12 weeks of exercises and 4 weeks that were used for data collection and analysis. The exercise program was carried out in 3 phases, being; mild, moderate and intense with duration of 30 minutes. The first phase focused on exercises on costal breathing, stretching of the trunk and extremities. The second stage with duration of 40 minutes adding core strengthening exercises for the upper and lower extremities. Finally, the last phase lasted 45 minutes. The execution of the program took place in groups of 7 people in the morning hours: 8am-9am; 9.15am-10:15am; 10:30am-11:30; 11:45am-12:45. The morning schedule was taken so as not to interfere with their work days. The execution days were Monday, Wednesday and Friday.

Bioethical considerations were approved by the committee of the Technical University of Ambato with COD resolution 038-CEISH-UTA-2023, in which the committee detailed the considerations, publication, and reliability of the data and safety of people before, during and after the program. There was approval of the place to work and the study method, purpose, and results were socialized. An informed consent form was taken for each participant, as well as the approval of the place to work.

Statistical analysis: The results were collected in Excel. Shapiro Wilk was then used to observe the normality of the data, being greater than 0.05, with a normal distribution, in which our study exceeded the stipulated parameters. The T-Student test was used to measure and to fulfill the work hypothesis. The McNemar and Wilcoxon tool was used to measure the variation in pain before and after. The SPSS 29 program (Statistical Package for Social Sciences) allowed data to be analyzed.

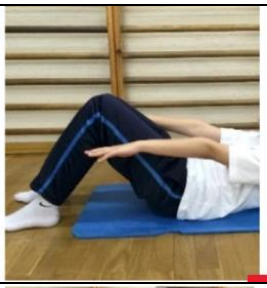
Diagram 1. *Bibliographic search strategies*

PHASE 1 (LIGHT INTENSITY)		
WEEK 1-4		
No.	**Description**	**Illustration**
	Costal breathing At this point it will be indicated how costal breathing is performed while using the method. Each rest period between sets will be 30 seconds and during the exercise change, it will be 40 seconds.	

1	**Half roll up** 4 min, 3 sets, 12 repetitions. Goal: strengthen abdominals and core stability	
2	**One leg stretch** 4 min, 2 sets, 12 reps. Goal: strengthen abs, core stability, hip mobilization and hamstring flexibility	
3	**Swimming I** 4 min, 2 sets, 12 repetitions. Goal: strengthening back muscles and breathing cycle	
4	**Mid-back Bending** 3 min, 5 reps. Goal: stretch your back and hamstrings and relax	

PHASE 2 (MODERATE)		
WEEK 5-8		
No.	**Description**	**Illustration**
	Prior to the initiation, a warm-up will be carried out without reaching fatigue. In the same way there will be a rest period between each repetition of 30 seconds and 40 seconds in change of exercise.	
1	**Half roll up with leg 90°** 4 min, 3 sets, 12 repetitions. Goal: strengthen abdominals and core stability	
2	**Criss-cross** 4 min, 3 sets, 12 reps. Goal: strengthen abs, core stability, neck strengthening; hip mobilization and hamstring flexibility	
3	**Swimming II** 4 min, 2 sets, 12 repetitions. Goal: strengthening back muscles and breathing cycle.	

4	**One-leg stretch with foot at mat** 3 min, 2 sets, 30 sec/set each leg. Objectives: stretch the hamstrings and relax	

PHASE 3 (INTENSE)		
WEEK 9-12		
No.	**Description**	**Illustration**
	Prior to the initiation, a warm-up will be carried out without reaching fatigue. In the same way, there will be a rest period between each repetition of 30 seconds and 40 seconds in change of exercise.	
1	**The hundred** 4 min, 2 sets, 50 repetitions. Objective: strengthen the abdominals, trunk stability and respiratory cycle	
2	**Front Support** 4 min, 2 sets, 50 repetitions. Objective: strengthen the abdominals, trunk stability and respiratory cycle	
3	**Shoulder Bridge** 4 min, 2 sets, 12 repetitions. Objectives: strengthening of the back muscles, mobilization of the spine, and hamstring flexibility	
4	**One-leg stretch with two leg stretch at mat** 3 min, 3 sets, 30 sec with each leg. Objective: stretch hamstrings and relax	

RESULTS AND DISCUSSION

: For this research work, we worked with a total of 28 people, of which 71% correspond to the age of 18 to 35 years and 29% to the age of 35 to 64. In gender we have 18 women, which corresponds to 64%, and 10 men, equivalent to 36%. Within the BMI, two categories were found: 16 people maintain a healthy weight equivalent to 57% and 43% are overweight, which is equivalent to 12 people. Among the most frequent occupations in the study, nursing was reported with the highest percentage, with 25% of the population equivalent to 7 people, 14% equivalent to 4 nursing assistants, 11% being equal to 3

laboratory workers. The rest of the population represent 1 or 2 people with less than 10% as indicated in table 1.

Table 1. *Sociodemographic results of the researched population in GADYTRA*

		FREQUENCY	PERCENTAGE (%)
AGE			
	18-35	20	71
VALID	35-64	8	29
GENDER			
	MALE	10	36
VALID	FEMALE	18	64
BMI			
	NORMAL	16	57
VALID	OVERWEIGHT	12	43
OCCUPATION			
	NURSE	7	25
	NURSING ASSISTANT	4	14
	PEDIATRICIAN	1	4
	LABORATORY	3	eleven
	TRAUMATOLOGIST	2	7
	GASTROENTEROLOGIST	1	4
	NUTRITIONIST	2	7
	GERIATRICIAN	1	4
	IMAGENOLOGIST	1	4
	DOCTOR	1	4
	RHEUMATOLOGIST	1	4
	PHYSIATRIST	2	7
	GYNECOLOGIST	1	4
VALID	OBSTETRICIAN	1	4

Table 1. Manifestations of muscular disorders before the intervention (Nordic questionnaire)

Body area	12 months before the intervention Presence of pain		Work impediment 12 months		7 days before the intervention Presence of pain	
	Absolute f.	Relative f.	Absolute f.	Relative f.	Absolute f.	Relative f.
Neck	20	71.4%	6	21.4%	9	32.1%
Right shoulder	0	0.0%	0	0.0%	7	25.0%
Left shoulder	6	21.4%	0	0.0%	3	10.7%
Right elbow	6	21.4%	0	0.0%	2	7.1%
left elbow	4	14.3%	0	0.0%	4	14.3%
Right wrist	4	14.3%	1	3.6%	2	7.1%
Left wrist	2	7.1%	0	0.0%	2	7.1%
High back	19	67.9%	6	21.4%	12	42.9%
Lower back	18	64.3%	11	39.3%	13	46.4%
Hips	10	35.7%	5	17.9%	4	14.3%
Knees	15	53.6%	3	10.7%	3	10.7%
Ankles or feet	11	39.3%	0	0.0%	3	10.7%

The Nordic questionnaire has 12 body segments that identify the manifestation of pain, discomfort or discomfort in the last 12 months of which in the population studied it was found that 71% expressed discomfort in the neck area equivalent to 20 people, followed by 64, 3% at the level of the dorsal or upper back area, being 19 people, at the level of the lumbar area 18 people with 64.3%, at the level of the knees 15 people reported pain equivalent to 53.6%, 11 people with discomfort ankle level equivalent to 39.3%. The rest of the population that presented pain in different areas was not statistically significant. Regarding work impairment in the last 12 months due to pain, it was found that 21.4% were due to neck pain,

21.4%, which is equivalent to 6 people reported discomfort at the upper back and lumbar levels. It was observed that 39.3%, equivalent to 11 people reported discomfort. The missing population reported minimal frequencies. The presence of pain in the last 7 days before the intervention corresponds to a higher incidence of 46.4% in the lower back, followed by 42.9% in the dorsal back. There are 9 people with neck discomfort, which is equivalent to 32.1%, followed by 7 people who represent 25% with discomfort at the level of the right shoulder, the remaining data is equivalent to a smaller number of painful findings.

Table 2. Results of the manifestations of the Nordic scale before and after the intervention

		Cases		Percentage			
		Yes	**No**	**Yes**	**No**	**Reason for the decrease**	**p value**
Neck	**Without pilates**	9	19	32.14%	67.86%	55.6%	.063a
	With pilates	4	24	14.29%	85.71%		
High back	**Without pilates**	12	16	42.86%	57.14%	25.0%	,250a
	With pilates	9	19	32.14%	67.86%		
Lower back	**Without pilates**	13	15	46.43%	53.57%	46.2%	.031a
	With pilates	7	21	25.00%	75.00%		
Knees	**Without pilates**	3	25	10.71%	89.29%	66.7%	,500a
	With pilates	1	27	3.57%	96.43%		

The Table 3 represents the topographic pain using the Nordic scale, in the last seven days before and after the Pilates intervention. The McNemar statistical test was used for the results obtained through dichotomous responses (YES/NO). In the results, the presence of neck pain was obtained in 9 people, which corresponds to 32.14% before the intervention and 4 maintained pain after the intervention. Therefore, there was a reduction in pain by 55.6%. At the level of the upper back, 12 people maintained pain and after the intervention there was a 25% reduction in 9 people. At the level of the lower back before the technique there was a population of 13 people with pain after the intervention. It was evident that 7 maintained their pain with a reduction of 46.2% At the knee level there was a result of 3 people with pain and at the end of the program there was one person with pain, which is equivalent to a reduction of 66.7%. The p value helps us to observe that the results are statistically significantly when their values are <0.05. In the results obtained using the Nordic scale we see that low back pain is statistically significant. However, there is a reduction that the other body sections represented with a decrement as indicated in the table.

Table 3. Results of pain manifestation with the VAS scale before and after the Pilates intervention.

		Cases	**Half**	**Median**	**Standard deviation**	**Statistical test (Wilcoxon test)**	**p value**
Neck	Without pilates	9	4.29	6.00	3.20	-2,527b	0.012
	With pilates	4	1.11	0.00	1.77		
High back	Without pilates	12	4.18	5.00	3.07	-2,966b	0.003
	With pilates	9	2.32	1.00	2.72		
Lower back	Without pilates	13	4.21	4.50	3.58	-3,188b	0.001
	With pilates	7	4.14	4.50	3.52		
Knees	Without pilates	3	2.46	2.50	2.62	-1,604b	0.109
	With pilates	1	1.54	0.00	2.24		

The results in Table 4 correspond to the results of the VAS scale regarding pain in the last 7 days, based on the correct results of the Nordic in which the participants rated the pain. They expressed from 1 to 10, before and after the pilates intervention. In the neck, before the intervention, an average of 4.29 is observed and after the intervention an average of 1.11 At the level of the upper back, we observed that the average before the intervention was 4.18 and after the intervention was 2.32 In the lower back we observed that the average result without Pilates was 4.21 and after the intervention there was a result of 2.46 At the level of the knees an average before the intervention of 2.46 and at the end of the intervention a result of

1.54 was observed. Regarding the p values, they were obtained through the Wilcoxon test due to the naturalness of the data in terms of response. The p value was favorable for the neck, upper back, and lower back data with values < 0, 05 which represent that they are statistically significant, at the knee level this value is not observed and part of the result is due to the number of results to be compared.

Table 4. Normality Test

Normality Tests				
	Shapiro-Wilk			
	Statistical	gl	**Significance**	
SHOULDER ANGLE- BEFORE	0.955	28	0.258	Normal distribution
ILIAC SPINE ANGLE- BEFORE	0.890	28	0.055	Normal distribution
SHOULDER ANGLE- BEFORE	0.928	28	0.055	Normal distribution
ANGLE OF ILIAC CRESTIA- BEFORE	0.935	28	0.082	Normal distribution
SHOULDER ANGLE -AFTER	0.927	28	0.052	Normal distribution
ILIAC SPINE ANGLE -AFTER	0.948	28	0.171	Normal distribution
SHOULDER ANGLES -AFTER	0.941	28	0.117	Normal distribution
ILIAC CREST ANGLES -AFTER	0.947	28	0.164	Normal distribution

The Shapiro Wilk test was applied in which a normal distribution was determined. That is, the normality of the data, in which they were normal since the values were greater than 0.05 Then a T-Student was applied to compare the before and after in terms of the angles of the participants.

Table 5. Results of angle values measured in Kinovea before and after Pilates

		Half	**Median**	**Standard deviation**	**Statistical Test (T-student for paired samples)**	**p value**
Shoulder angle - anterior view	Without pilates	4.31	4.30	0.68		
	With pilates	1.33	1.25	0.54	28,024	<0.001
Angle of iliac spines - anterior view	Without pilates	4.51	4.65	0.49		
	With pilates	1.80	1.65	0.64	29,129	<0.001
Shoulder angle - rear view	Without pilates	4.65	4.70	0.85		
	With pilates	1.64	1.50	0.57	20,685	<0.001
Angle of iliac spines - posterior view	Without pilates	5.40	5.15	1.01	20,359	<0.001

The results regarding the before and after angles measured in Kinovea were taken in anterior and posterior view with anatomical reference at the level of the acromioclavicular joint and the iliac crests. The T Student was used for analysis. An average was made with the values in the shoulder angle in anterior view that corresponds to 4.31 before the intervention, and at the end of the study the value of 1.33 was obtained. At the level of the iliac spines in the anterior view, an average of 4.51 was observed and at the end a value it was 1.80 In posterior view in the shoulder joint, the value was 4.65, and at the end an average value of 1.64 was obtained. At the level of the iliac spines, in posterior view, the value was 5.40 and at the end the average was 2.23. By processing the results we observed that the value of p was < 0.05, which is statistically significant.

Discussion

Personnel who work in the health area due to their work occupations, the hours at work, the type of activity they carry out are exposed to the appearance of muscular alterations such as scoliosis. It is one of the main alterations, either due to their lifestyle, infantile scoliosis, vicious postures, poor technique for performing an activity, muscular disorders, overweight, or idiopathic scoliosis. Therefore, the use of the Pilates method is suggested for this problem to achieve positive effects on scoliosis.

The purpose of this research was to analyze the effectiveness in terms of improving scoliosis pain and posture through the application of a Pilates method exercise protocol for GADYTRA health personnel. In the study, a data collection

sheet was applied, in which the age, gender, BMI and occupation of the personnel are asked. Also, the Nordic questionnaire was used to topographically identify the initial and final manifestations of pain in the body segments. The initial results of the study, mentioned that there is greater pain in the lumbar area with 47%, dorsal 43% and neck with 32% frequency. The results are similar to ones found in the research by (García-Salirrosas & Sánchez-Poma, 2020) They mention that the findings of pain manifestation in their study population are the same body segments, taking into account that within the sociodemographic characteristics of both research studies, the age of the participants is 18 to 37 years, which are relatively similar to the research carried out. Just as in the BMI in which there is a population with normal weight and overweight. Once the areas with the highest frequency of pain in scoliosis were identified, the sensation of pain was corroborated using the VAS scale in the last 7 days of the participants in relation to scoliosis and the previously identified areas. It was observed that the pain is categorically at two levels of intense and moderate in the aforementioned areas. These findings are related to the misalignment that the population presents.

At the end of the Pilates method program, data on pain reduction can be observed, which implies improvement in the population studied. Posture was assessed through photogrammetry in two anterior and posterior planes and a misalignment could be found in terms of two structures with greater frequency such as the shoulder joint and the iliac spines. In another similar study carried out, an asymmetry was observed at the level of the right shoulders with respect to the right hip. While the asymmetry of the research corresponds to a misalignment of the right side corresponding to 50% and the asymmetry of the right iliac spine in 60% of the population studied. It could be evidenced by occupying a grid, in this case the kinovea grid. It was possible to determine which structure was descended. The study by Rosero & Vernaza occupied reference points to see the incidence of scoliosis with posture. In this study they use the Nordic questionnaire to assess the presence of pain and to determine the segment. They mentioned that their population presented greater asymmetry in the shoulder and right iliac spine of the population studied and the ranges of age were from 18 to 28 years. Another article mentions that taking angles digitally to assess a posture and be able to identify that the variation has good results after an intervention in terms of the postural angles of the shoulders and iliac spines in anterior view. Reliable and valuable data were observed.

The Pilates program for 12 weeks had positive results with significant statistical data. A decrease in scoliotic degrees taking the anatomical points as a reference, reduction of pain in body segments and generally improving alignment and therefore posture in people was observed.

CONCLUSION

The application of tools such as the VAS test, Kinovea and Nordic questionnaire, allowed a correct assessment of the GADYTRA health personnel, being able to topographically identify the pain and categorize it. The participants manifested pain most frequently at the neck level, upper back, lower back, and knees. The results of the population's posture were observed with asymmetry at the shoulder level, with a higher incidence of antepulsion. Retropulsion at the hip level was observed through postural assessment. At the level of the angles, an asymmetry of the anatomical reference points was found.

The results of this research show that there is a higher incidence of pain in the neck, lumbar, dorsal and hip areas. The other body segments showed a lower frequency of appearance in the last twelve months. However, this was not a reason for the considerable number of absences from work. In the last 7 days before the intervention, the population manifested pain more frequently in the aforementioned areas but with a lower intensity than that of 12 months. Regarding the posture, the anatomical points were taken as reference and a greater variation of angles was observed in the acromioclavicular joint and anteroposterior iliac spines. Therefore, it was determined that the topographic pain identified is related to the asymmetry of the most prominent reference points.

Finally, a reduction in pain can be observed in the study population through the VAS scale. The results regarding AP show that statistically significant changes could only be observed at the level of the lower back, since it corresponds to < 0.05 However, the population expressed a reduction and cessation of pain, which is a contribution to this research that responds to its objective of improving pain. A decrease in pain was observed in 55.6% at the neck level, 25%, at the level of the upper back, 46.2% at the level of the lower back, 66.7% at the level of the knees and the cessation of painful symptoms. Through the results and comparison in the initial and final assessment of pain with the Nordic test, a decrease in the reference angles with the practice of the Pilates method in people with scoliosis was observed. We also see that the study is viable in terms of the execution of the analysis of the variables since it responds effectively to the hypothesis having a result of $p < 0.05$, highlighting that it is statistically significant.

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