

## Comparison of muscle strength and flexibility between Pilates and bodybuilding

## Comparação da força muscular e flexibilidade entre praticantes de Pilates e musculação

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**ABSTRACT | BACKGROUND:** In recent years, it has increased the number of studies concerned with investigating the relationship between the dysfunction of transverse abdominal muscle and the history of lower back pain, as well as the deficiency in flexibility. **OBJECTIVE:** to compare the muscular strength of the transverse abdomen and flexibility of Pilates and bodybuilding. **METHOD:** The study included 20 female volunteers divided into 2 10 voluntary groups, with at least 6 months of activity in Pilates or bodybuilding. Muscle strength abdomen transversus was evaluated by modified sphygmomanometer test (TEM) and flexibility the sit-reach test (TSA). We used descriptive statistical analysis to the data collected, and the amounts are expressed as mean and standard deviation as well as applicability of test T student ( $p < 0.05$ ). **RESULTS:** It was found significant values of ( $p < 0.05$ ) being superior to muscle strength Pilates group of the transversus abdominis when compared to the bodybuilding. However, for the flexibility test, it was not found statistically significant differences between the two groups. **CONCLUSION:** It was observed that the Pilates practitioners obtained a better performance the abdomen transversus muscle and flexibility compared to the bodybuilding. The strengthening of the transverse abdominal muscle and flexibility becomes a corrective and preventive measure to reduce and prevent pains and back injuries.

**KEYWORDS:** Muscle Strength. Flexibility. Physical therapy modalities.

**RESUMO | INTRODUÇÃO:** Nos últimos anos, tem aumentado o número de estudos preocupados em investigar a relação entre a disfunção do músculo transverso do abdome e a história de dor lombar, assim como a deficiência na flexibilidade. **OBJETIVO:** comparar a força muscular do transverso do abdome e flexibilidade das praticantes do método Pilates e musculação. **MÉTODO:** Participaram do estudo 20 voluntárias do sexo feminino divididas em 2 grupos de 10 voluntárias, com no mínimo 6 meses de atividade em Pilates ou musculação. A força muscular do transverso do abdome foi avaliada pelo teste esfigmomanômetro modificado (TEM) e a flexibilidade pelo teste de sentar-alcançar (TSA). Foi utilizado a análise estatística descritiva para os dados coletados, sendo os valores expressos através da média e desvio padrão, bem como aplicabilidade do teste T de *student* ( $p < 0,05$ ). **RESULTADOS:** Foi verificado valores significativos de ( $p < 0,05$ ) sendo superior para a força muscular do transverso do abdome do grupo Pilates quando comparado ao grupo musculação. Entretanto para o teste de flexibilidade, não foi encontrado diferenças estatísticas significativas entre os dois grupos. **CONCLUSÃO:** Foi possível observar que as praticantes do método Pilates obtiveram um melhor desempenho da musculatura do transverso do abdome e flexibilidade em comparação ao grupo musculação. O fortalecimento do músculo transverso do abdome bem como a flexibilidade torna-se uma medida corretiva e preventiva para redução e prevenção das algias e lesões lombares.

**PALAVRAS-CHAVE:** Força muscular. Flexibilidade. Modalidades de fisioterapia.

## Introduction

Nowadays, the scientific community has devoted considerable emphasis to the discussion about the relationship between physical exercise, health conditions and quality of life and the harms that arose from the sedentary state<sup>1,2</sup>. This debate has led most health professionals to consider physical exercises an important ally for a healthy living and aging condition<sup>3</sup>.

In the case of prevention, muscle strength, muscle stability and flexibility are physiological parameters related to health and physical fitness. It is a fact that the sedentary lifestyle can affect the general health of women if not trained, increasing the risk of injuries, and decreasing the performance of activities of daily living<sup>4</sup>.

The stability of the spine is guaranteed by the performance of active components (muscles and tendons), passive components (bones, intervertebral discs, ligaments and fascias) and the neural control<sup>5</sup>. In highlight, the transverse abdomen has fibers in transverse orientation originating from the transverse processes of the lumbar vertebrae through the thoraco-lumbar fascia and inserting anteriorly in the midline. Contraction of this muscle results in increased tension in the thoraco-lumbar fascia and increased intra-abdominal pressure due to the depression of the abdominal wall. Therefore, the transversus abdominis contributes to lumbar stabilization through these two mechanisms<sup>6</sup>.

With regard to flexibility, it is the ability to move one or several joints in a smooth comfortable way through the unrestricted range of motion and without pain<sup>7</sup>. Studies show that good flexibility contributes to the patient's better quality of life, helps with postural re-education and can prevent musculoskeletal injuries<sup>8,9</sup>.

Therefore, there is a greater concern on the part of Physiotherapists, other health professionals and society in general to recognize the benefits of practicing the Pilates method, in which it has been growing and becoming popular, highlighting the benefits achieved by practitioners of all ages.

Pilates aims at physical and mental conditioning, contributing to the gain of strength, stretching, flexibility, balance, worrying about maintaining the physiological curvatures of the body and having the abdomen as a center of strength, which works constantly in all the exercises of the technical. In this context, most clinical trials in the last five years on the use of Pilates as a rehabilitation tool have found that it is effective in achieving the desired results, particularly for reducing pain and disability<sup>10</sup>.

Likewise, resistance exercises also called strength or bodybuilding exercises is a modality that has numerous neuromuscular and physiological, as well as social and behavioral benefits. Through regular practice, the increase in lean mass provides its practitioners with greater resistance and muscle strength, in addition to greater mobility<sup>11</sup>.

Given the above, this study aimed to compare the muscular strength of the transversus abdominis and flexibility of practitioners of the Pilates method and weight training.

## Methods

It is a quantitative, comparative and transversal research. Twenty women participated in this study, aged between 30 and 45 years old, living in the city of Brusque-SC, divided into two groups:

- Pilates group of 10 women.
- Group of bodybuilding practitioners composed of 10 women.

They were recruited from a Pilates studio and a gym, respectively, located in the city of Brusque / SC. All volunteers were informed about the procedures and objectives of the study and, after agreeing, signed a free and informed consent form. The applied procedures were approved by the Research Ethics Committee (CAAE: 55811316.3.0000.5636) of the University Center of Brusque – Unifebe.

The inclusion criteria were: practicing exclusively the Pilates method or weight training for a period of at least six months and who had clinical conditions to perform the tests. The exclusion criteria were: pregnant women, diagnosis of orthopedic, rheumatic or neurological pathologies or with some cognitive impairment that would make it impossible to understand the development of the study.

Data collection was performed by applying the modified sphygmomanometer test (MST) to measure the muscle strength of the transversus abdominis. MST involves the aneroid sphygmomanometer, a low-cost, easy-to-apply equipment and provides objective values that can be associated with muscle strength measurements. The reliability and validity of MST have already been analyzed in some populations, and appropriate results have been found<sup>12</sup>. To measure the flexibility of the spine and posterior thigh, the sit-reach test (TSA) originally proposed by Wells and Dillon in 1952 was applied, according to the Canadian Standardized Test of Fitness standardization (CSTF, 1986). It is one of the best known and most widespread methods for assessing flexibility in training centers and gyms, due to the fact that it is an easy-to-apply, low-cost and standardized test<sup>13</sup>.

To evaluate the activation of the transversus abdominis, the sphygmomanometer was used as a pressure biofeedback unit, from the SOLIDOR® brand. The subject, being positioned in a bench press, was taught to activate the deep abdominal muscles with verbal instructions, such as shrinking the abdomen, bringing the navel towards the spine in the expiratory time and trying to maintain it, while gently shrinking and depressing the abdominal muscles. With the device inflated to an initial pressure of 40 mmHg in the umbilical region. The more effective the contraction, the greater the pressure reduction. During the evaluations, a control was performed so that there was no compensation with other muscle groups, such as glutes, quadriceps and other lumbar muscles. The position adopted in the prone position for the test, as it is the best way to perform the correct contraction of the transverse abdomen, thus

reducing the compensations of other muscle groups during exercise<sup>14</sup>. The expected result was that after the contraction the pressure would drop from 4 to 10 mmHg and be maintained for 10 seconds. In this case, activation was considered satisfactory. If the pressure difference generated or the time was not within these parameters, the activation was considered unsatisfactory.

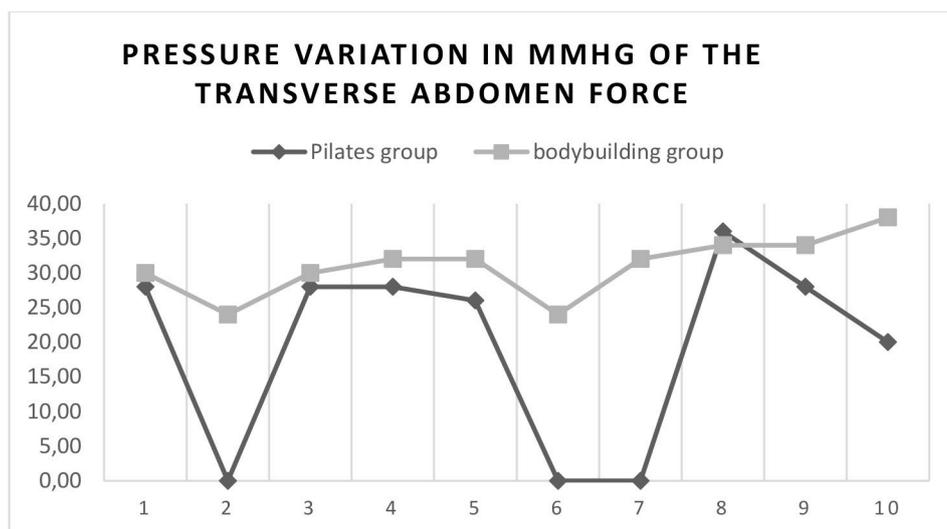
In the TSA it was performed with an instrument called Banco de Weels. It is a box measuring 12 cm x 30.5 cm x 30.5 cm with a scale of 58.0 cm in its extension, from the CARDIOMED® brand and the zero point is at the end closest to the evaluated and the 26° cm coincides with the footrest. The evaluated woman removes her shoes and in a sitting position she should touch her feet in the box with her knees extended. With flexed shoulders, extended elbows and overlapping hands, he performed the trunk flexion in front of him, which should touch the maximum point of the scale with his hands. Three attempts were made and only the best brand was considered.

For greater credibility of the presented study, a statistical study of results obtained was carried out regarding the muscular strength of the transversus abdominis and the flexibility of the participants. They were calculated by means of descriptive statistics and the values were expressed through the mean and standard deviation of the mean, as well as the applicability of the Student T test with a significance level of  $\alpha = 0.05$  to detect the difference in muscle strength and flexibility between groups.

## Results

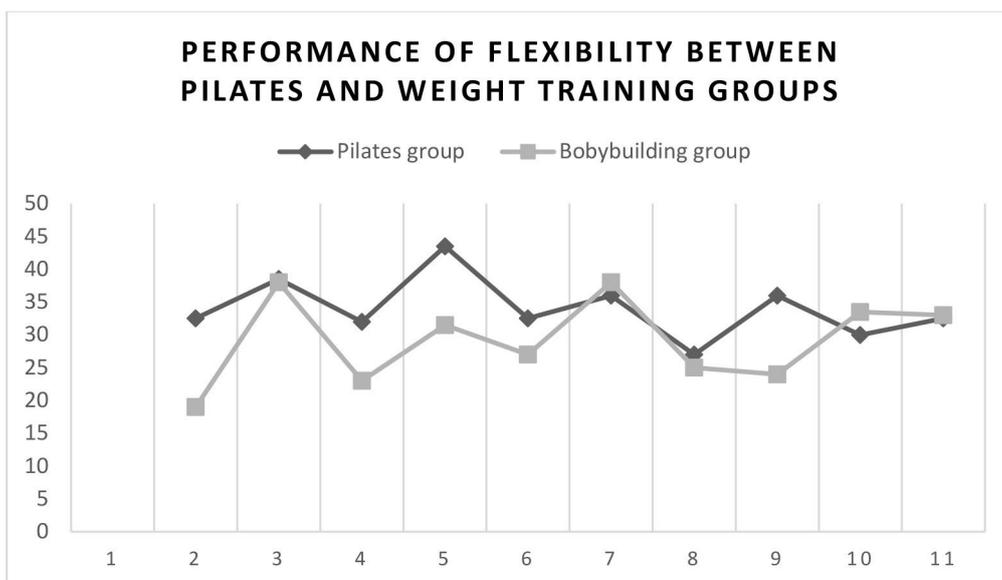
In figure 1, it represents the data collected from the modified sphygmomanometer test, evaluating the muscular strength of the transversus abdominis in mmHg among practitioners in the Pilates group and the bodybuilding group.

**Figure 1.** Comparative graph of the muscular strength of the transversus abdominis without a test sphygmomanometer modified between Pilates and weight training groups



Below in figure 2, it represents the data collected from the sit-reach test, evaluating the flexibility in cm between Pilates and bodybuilding group practitioners.

**Figure 2.** Graph representing the performance of flexibility in (cm) between groups Pilates and weight training through the sit-reach test



**Table 1.** shows the descriptive statistical summary of the results for the modified sphygmomanometer test in Pilates and bodybuilding group practitioners.

Domain	Pilates group	Bodybuilding group
Mean	19,40	31,00
Median	27,00	32,00
SD	13,92	4,35
Minimum	-	24,00
Maximum	36,00	38,00

In Table 1, it can be seen that, when the muscular strength of the transverse abdomen of the members of both groups was evaluated, the Pilates method practitioners showed an increase in abdominal pressure (in terms of pressure decrease per mmHg) on average of  $19,40 \pm 13.92$  mmHg, while those in the weight training group obtained an average of  $31.00 \pm 4.35$  mmHg. For the average of the Pilates group, those between 5.50 and 33.30 mmHg are considered to have normal muscle strength. Those below this first one present an excellent performance of the musculature while those above the second value can be considered of poor performance. The 50% of the sample is below or equal to 27 mmHg. The values below represent half of the best muscle performance. In contrast, the average of the bodybuilding group is considered to have normal muscle strength between 26.70 and 35.30 mmHg and 50% of the samples are below or equal to 32.00 mmHg. The minimum pressure values (in terms of increased abdominal pressure) found in the Pilates group are 0.00 mmHg, represented by the symbol (-), which was higher compared to the bodybuilding group: 24.00 mmHg.

**Table 2.** represents the descriptive statistical summary, referring to the TSA test in Pilates and bodybuilding group practitioners.

Domain	Pilates group	Bodybuilding group
Mean	34,05	29,20
Median	32,50	29,25
SD	4,65	6,54
Minimum	27,00	19,00
Maximum	43,50	38,00

In table 2, regarding the level of flexibility of the two groups collected, it was possible to observe that the average level of flexibility of the practitioners of the Pilates group was  $34.05 \pm 4.65$  cm, with the normal values considered being between 30.50 and 39.10 cm. The 50% of the Pilates group sample is above or equal to 32.50 cm, representing the half with the best flexibility performance. In contrast, the bodybuilding group had an average of  $29.20 \pm 6.54$  cm and the normal values then considered between 22.70 and 35.70 cm. The 50% of the sample of the bodybuilding group is above or equal to 29.25 cm, being considered the half with the best flexibility performance. The minimum and maximum values found for the flexibility of the Pilates group were 27.00 and 43.50 cm respectively, compared to the bodybuilding group are 19.00 and 38.00 cm respectively.

Table 3 represents the intergroup comparison of the results expressed as mean and standard deviation of TEM and TSA by means of the Student  $\alpha$  test = 0.05 for independent samples from the Pilates and weight training groups.

**Table 3.** Intergroup comparison of the results of the TEM and TSA applied expressed as mean and standard deviation (SD  $\pm$ ) using the Student's t-test for independent samples

	Grupo Pilates	Grupo Musculação	(p<0,05)
TEM	$19,40 \pm 13,92$	$31,00 \pm 4,35$	0,02
TSA	$34,05 \pm 4,65$	$29,20 \pm 6,54$	0,07

In Table 3, where the averages of the two tests between the two groups are compared, for TEM it was possible to verify the effects caused in response to specific training methods, with statistical differences in favor of the Pilates group. However, in the TSA, after analyzing the student's T test, no statistically significant differences were found between the two groups.

## Discussion

Through the application of the Student's T test, significant superior values were verified for the muscular strength of the transversus abdominis in the Pilates group when compared to the bodybuilding group. In this study it was possible to observe that the Pilates method practitioners obtained a better performance of the musculature of the transversus abdominis with an average of 19.40 mmHg in comparison to the bodybuilding group that obtained an average of 31. Therefore, the more effective the contraction, the greater it should be the pressure reduction, with greater muscle activation (due to the lower pressure recorded on the sphygmomanometer) in the Pilates group. A pressure reduction greater than or equal to 4 mmHg is considered an effective response for non-athlete individuals, and from 2 to 4 mmHg is considered an average response<sup>14</sup>. Therefore, both groups obtained an effective response to the activation of the transversus abdominis, with the exception of one practitioner from the bodybuilding group who did not obtain satisfactory muscle activation. According to Ferreira et al.<sup>15</sup>, they conducted a study with the objective of analyzing the influence of the Pilates method on 12 adult female volunteers, in which they emphasize that the Pilates method exerts significant stimulation on the stabilizing muscles of the spine, which includes the abdominal wall, in addition to improve conscious control of all muscle movements in the body.

It appears that a convenient Pilates exercise intervention can significantly improve muscle strength and trunk flexibility in women<sup>16</sup>. This finding is in agreement with that found in this research, where it was observed that women practicing the pilates method present muscle strength of the addomen's transverse muscle with statistically higher values when compared to the bodybuilding group.

As for flexibility, in the present study there was better flexibility in the Pilates group, although not significant, which corroborates the study by Siqueira et al.<sup>17</sup> who observed that in ten Pilates sessions it was not possible to change abdominal trophism and trunk flexibility. It was possible to observe that the Pilates group practitioners had an average performance of 34.05 cm and a maximum value of 43.50 cm, with higher scores when compared to the bodybuilding group, which were 29.20 cm and maximum values of 38.00 cm. According to the classification according to Canadian Standardizes Test of Fitness (CSTF) for the age groups of 30 - 39 years and 40 - 49 years according to the age of the group sample, the average of the Pilates group is classified as above average and on average<sup>18</sup>. For the average of the bodybuilding group, it comprises the classification below the average. In the study by Lima et al.<sup>9</sup>, twenty adult women were chosen, 10 of whom were Pilates practitioners and 10 bodybuilders in order to analyze the influence of the Pilates method and bodybuilding on abdominal muscle strength and flexibility in women. The study showed that both groups benefited from achieving adequate levels of motor skills, although, in the present study, among the different training methods, the Pilates method promoted greater stimulation for abdominal flexibility and resistance.

Several studies have shown that the Pilates method can promote an increase in range of motion in the joint<sup>17,18</sup>, which promotes greater levels of flexibility than other physical activity practices, which may be one of the explanations for the Pilates method having shown superior results than weight training<sup>9,10,15,16</sup>.

Spinal instability has been highlighted as a significant cause of low back pain and a causative factor in 20 to 30% of chronic spine diseases and changes in the recruitment pattern of abdominal muscles is a common finding in patients<sup>19</sup>. Studies show that individuals with chronic low back pain have dysfunction of the deep abdominal muscles, especially the transverse abdomen muscle. They also observed that this muscle in an episode of low back pain shows a decrease in strength, atrophy and delay in firing speed<sup>20</sup>. The Pilates method proves to be an alternative treatment for improving flexibility and strength and reducing low back pain<sup>21</sup>. Given this, it is evident the importance of the transverse muscle of the abdomen to generate stability and reduction of lumbar pathologies<sup>22</sup>.

Some scientific evidence reports that the Pilates method, although it does not have significant effects in relieving chronic low back pain, may be more beneficial than other types of physiotherapy<sup>23,24</sup>. However, according to studies carried out, it is evident that the Pilates method reduces low back pain independently of its nature in addition to promoting an improvement in quality of life and increased flexibility<sup>20,23,25</sup>.

## Conclusion

Through this study it can be concluded that women who practice the Pilates method presented superior abdominal transverse muscle strength than those who do weight training. Regarding flexibility, although no statistically significant values were found between the groups, there is a tendency for better performance also in Pilates practitioners according to Canadian Standardizes Test of Fitness.

## Author contributions

Pereira Júnior A.A. and Silva A. participated in the conception, design, supervision of the statistical analysis of the research data, interpretation of the results, and writing of the scientific article.

## Competing interests

No financial, legal or political competing interests with third parties (government, commercial, private foundation, etc.) were disclosed for any aspect of the submitted work (including but not limited to grants, data monitoring board, study design, manuscript preparation, statistical analysis, etc.).

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