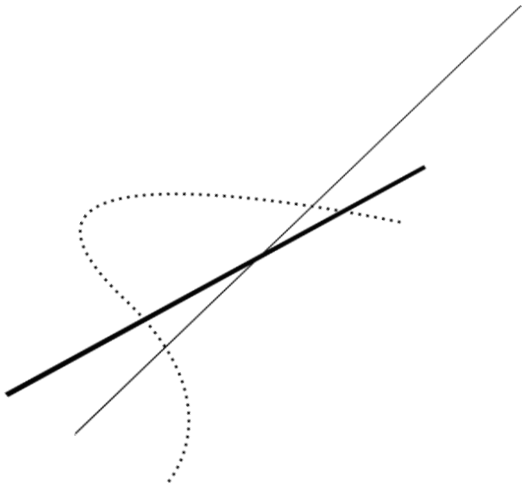

# SYSTEMATIC PHYSICAL EXERCISE TRAINING AND ITS EFFECTS ON PHYSICAL PARAMETERS AND PSYCHOLOGICAL DISORDERS IN FLUTISTS

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**Abstract:** This study aimed to investigate the effects of systematic physical exercise training targeting the upper limbs and trunk on physical parameters and psychological well-being in flutists. Twelve female flute students from a university music program and a conservatory were divided into two groups for a non-randomized, convenience-based interventional experimental study: an intervention group (IG; n=6) and a control group (CG; n=6). The IG participated in a 12-week training program, consisting of physical exercise practice twice a week, supplemented by one day of walking, while the CG followed their regular routine. Anthropometric, physical, and psychological parameters were evaluated for analysis. Post-training results revealed no significant changes in anthropometric parameters or body composition. However, improvements ($p<0.05$) were observed in isometric strength and power of the upper limbs [2.99 (0.31) vs 3.49 (0.21)], as well as reductions in depression and anxiety scores [36.83 (8.98) vs 81.67 (12.89)] among participants who completed the training protocol. These findings suggest that the proposed intervention serves as an effective tool for enhancing physical performance and may aid in the non-pharmacological management of anxiety and depression symptoms in flutists.

**Keywords:** psychological disorders, physical exercise, quality of life, musician´s health

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*EL ENTRENAMIENTO CON EJERCICIOS FÍSICOS SISTEMATIZADOS Y SUS EFECTOS EN LOS PARÁMETROS FÍSICOS Y LOS TRASTORNOS PSICOLÓGICOS EN FLAUTISTAS*

***Resumen:*** *Este estudio tuvo como objetivo investigar los efectos del entrenamiento con ejercicios físicos sistematizados de miembros superiores y tronco sobre los parámetros físicos y el bienestar psicológico de flautistas. Doce estudiantes de flauta del sexo femenino, de un programa universitario de música y de un conservatorio, fueron divididas en dos grupos para un estudio experimental de intervención no aleatorizado y por conveniencia: un grupo de intervención (GI; n=6) y un grupo control (GC; n=6). El GI participó en un programa de entrenamiento de 12 semanas, consistente en la práctica de ejercicios físicos dos veces por semana, complementada con un día de caminata, mientras que el GC mantuvo su rutina habitual. Se evaluaron parámetros antropométricos, físicos y psicológicos para su análisis. Los resultados post-entrenamiento no revelaron alteraciones significativas en los parámetros antropométricos o en la composición corporal. Sin embargo, se observaron mejorías (p<0,05) en la fuerza y potencia isométricas de miembros superiores [2,99 (0,31) vs 3,49 (0,21)], así como reducciones en las puntuaciones de depresión y ansiedad [36,83 (8,98) vs 81,67 (12,89)] entre los participantes que completaron el protocolo de entrenamiento. Estos hallazgos sugieren que la intervención propuesta constituye una herramienta eficaz para mejorar el rendimiento físico y puede auxiliar en el manejo no farmacológico de síntomas de ansiedad y depresión en flautistas.*

***Palabras clave:*** *Ejercicio físico, Calidad de vida, Salud del músico, Trastornos psicológicos.*

## 1. Introduction

Currently, an impact of studies and research in the field of human health, which have as their theme style and quality of life, has been observed. These studies show that to achieve a better quality of life, a healthy lifestyle must be considered (Silva et al., 2023; Castro; Soares; Carvalho, 2023; Oliveira et al., 2023).

According to data obtained by the Brazilian Institute of Geography and Statistics (IBGE), 47% of the Brazilian population is in a state of sedentary behavior. Based on these data, it is vital to consider that a healthier routine and the pursuit thereof are important for the population to achieve and maintain personal well-being. However, achieving this balance in life depends on various circumstances in a person's life and on multiple variables in order to attain well-being. Thus, lifestyle becomes the key element in the discussion on how to achieve physical and mental well-being.

Nahas (2017) defines lifestyle as a set of habitual actions that reflect attitudes, values, and opportunities in people's lives. In other words, actions that are taken daily, as well as ideas about life and ways of living, which form a set of activities that, when adopted, shape a lifestyle for each individual. Hence, lifestyle becomes a determining factor for measuring or predicting human health (Ferreira, 2015; Pieron, 2004). Furthermore, it is clear that healthy daily habits (e.g. practicing regular physical activities and exercises) impact the individual's well-being, resulting in the premise of health and quality of life.

Despite such scientific findings, the prevalence of sedentary behavior in Brazil is significant. As possible causes of such a situation, factors such as financial, social,

and cultural precariousness stand out (Monteiro, Medeiros, Oliveira 2007, Portes et al. 2018; Camel, Giatti, Barreto, 2016)

Considering that the concepts of quality of life and healthy lifestyle can have a major impact on individuals' health, it is essential to associate these concepts with the musician's daily life and musical practice.

A musician's performance, in a presentation, can be seen as something pleasurable and light from the perspective of common sense. However, this body image does not always correspond to the reality experienced, given that this professional's career is based on many hours and years of systematic practice aimed at achieving motor, emotional, and psychological skills for the best performance. Therefore, to achieve the best musical performance, care with body posture, maintenance of muscle and tendon capacity, correct dosage of musical practice time, as well as due rest become vital for this professional (Andrade; Fonseca, 2000).

For flutists to practice and perform, an asymmetrical body posture is required, which causes great stress to the musician's body (Teixeira, 2014; Fonseca, 2013). Such affection, together with the exhaustion in the search for performance efficiency, can lead to profound psychological and physical consequences related to performance, both due to intrinsic and extrinsic factors (Sinico; Winter, 2012).

As for the physical aspect, maintaining such an asymmetrical posture requires a lot of strength and resistance from the muscles to support the instrument and the body for hours of practice or performance (Andrade; Fonseca, 2000). It is worth mentioning that this is an important factor for the musician to be aware of and prevent possible problems arising from the exhaustive effort of one or more musculoskeletal segments.

Some studies demonstrate the prevalence of musculoskeletal pain and discomfort among musicians. Vilela et al. (2021) show that 89% of young violinists in the state of Rio de Janeiro have already experienced some discomfort or pain in their musical careers. In the studies by Kochem & Silva (2017) and Kochem & Silva (2021), adult musicians reported prevalences of monthly and weekly musculoskeletal pain throughout the year of practice and performance.

Regarding the psychological aspect, the mental stress caused by the search for efficiency and performance perfection can generate feelings and emotions that tend to cause psychological disorders such as anxiety, performance anxiety, stress, and depression (Rosines, 2010; Paz; Caeiro; González, 2020).

Such scenarios can lead the musician to an unhealthy lifestyle, as this professional has habits that can generate stressful triggers for the body that lead to sedentarism.

The prescription of resistance and other physical exercises differs for each purpose individuals seek in their personal or professional life. An example of this is in the description by Prazeres (2007, p. 17), when he states that the main objectives of prescribing physical exercises are: "prophylaxis, treatment, and rehabilitation of diseases and deformities, promotion of fitness for activities of daily living, work, leisure and sport, in addition to stimulation of body aesthetics and psychological well-being".

Accordingly, this study aimed to verify the effect of systematic physical exercise training, for upper limbs and trunk, on flutists' physical parameters and psychological disorders.

## 2. Methodological

This study followed the standards and resolutions approved by the National Research Council (CONEP), and was approved by the Human Research Ethics Committee of the Federal University of São João del-Rei (protocol: 5.792.921).

The research participants were female students of the undergraduate Music course at UFSJ and/or who work and/or study at the Padre José Maria Xavier State Music Conservatory, located in the city of São João del-Rei, Minas Gerais, Brazil.

The sample number was obtained non-randomly and for convenience. Participants between 18 and 59 years old, female, without complaints of musculoskeletal and/or tendon pain up to the month prior to the intervention, who did not use anti-inflammatory or analgesic medications, did not practice any activity or physical exercise in the month prior to the intervention, and who agreed on available times to practice the planned protocol were considered eligible to participate in the study.

After signing the free informed consent form, participants completed a history taking form for sample characterization purposes and a specific questionnaire to determine symptom scores related to psychological disorders. In addition, anthropometric parameters and body composition were measured, and tests were performed to assess isometric muscle resistance and upper limb strength/power and flexibility.

Following these procedures, the participants were subdivided into two groups of equal number [Control Group (CG) and Intervention Group (IG)]. CG participants were asked to maintain their normal daily routines without the addition of any physical activity or exercise during the study period. For members of the IG, they were advised to abstain from activities or physical exercises outside the proposed program during the study period.

The physical exercise protocol consisted of a program of physical exercises, twice a week, lasting 50 minutes for 12 weeks, with each exercise performed in 3 sets of 10 repetitions each. Such activities followed the physical exercises proposed by Ackermann, Adams, Marshall (2002), and Santos (2021), with the types and descriptions of exercises, and execution plan demonstrated in the chart below. In addition, this group was asked to take a 5-kilometer walk on a flat surface, with this activity being monitored by the group of researchers using the Strava app®.

**Table 1** – Protocol of physical exercises for upper limb and trunk in flutists populaion

| Physical Exercise | Brief description |
|---|---|
| Lateral Raise | Standing, hold a pair of dumbbells at your sides with a neutral grip. With arms slightly bent, perform shoulder abduction, raising the arms until they reach a 90° angle. Lower the arms in a controlled manner until they are back in the starting position. |

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| Supinated Front Raise with Bar | Standing with knees slightly bent, grasp the bar with a supinated grip, positioning it just in front of your hips. With elbows slightly bent and static, perform a shoulder flexion up to a 90° angle. Extend the shoulders in a controlled manner until back in the starting position. |
| Neck Stretch with Resistance | Standing, perform neck tilts to the right and left, forward and backward, holding with your hand. While stretching, apply force opposite to the stretching movement. Hold for three seconds and relax the muscle. Repeat three times for each position. |
| Unilateral Pulldown | With a Theraband (Super Band) anchored at a height greater than your total height, stand with your torso leaning forward, neck aligned with your spine, and abdomen contracted. Keep your elbow stationary, concentrating the movement in shoulder and scapular flexion and extension. |
| Shoulder External Rotation | Secure the band at an appropriate height, considering your arm position will be with elbow flexion at 90°. Grasp the end of the band with the hand farthest from the anchor, standing sideways to it with the band near your chest. Open your chest, keep elbow at 90°, and perform a shoulder rotation until your hand is in line with your shoulder, then return to the starting position. |
| Shoulder Internal Rotation | Secure the band at an appropriate height, considering your arm position will be with elbow flexion at 90°. Grasp the band with the hand closest to the anchor and with your forearm extended. Open your chest, keep elbow at 90°, and perform a shoulder rotation until your hand is in line with your shoulder, then return to the starting position. |
| Seated Alternating Hammer Curl | Seated on a bench or chair in an upright position with chest open and abdomen contracted. Hold dumbbells with a neutral grip and perform alternating elbow flexion and extension. |
| Lying Triceps Extension (Skull Crusher) with Dumbbell | Lying supine on a mat, bend your knees for better balance and dynamics. Hold dumbbells with a neutral grip, flex your shoulders with elbows extended until your shoulders are at 90°, and perform elbow flexion and extension. |
| Alternating Wrist Extension with Rope | Standing, hold a wooden rod with a rope tied to it and a weight attached. Hold the rod with a pronated grip and arms extended in 90° shoulder flexion. Perform alternating movements with your hands and wrists, trying to wind the rope around the rod to lift the hanging weight. Then unwind and start again. |
| **Standard Push-Up** | In a four-point stance on the floor (feet and hands or knees and hands), place your hands on the ground slightly wider than shoulder-width apart and keep your back straight, aligned with |

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| | your torso. Extend your elbows, lifting your entire body, then flex your elbows and return almost to the starting position without touching the floor. Pause briefly and repeat. During the movement, only your hands and feet (or knees) should have contact with the floor. |
| **Incline Push-Up** | In a four-point stance on the floor (feet and hands or knees and hands), place your hands on the ground at a level lower than your supported feet or knees, slightly wider than shoulder-width apart, and keep your back straight, aligned with your torso. Extend your elbows, lifting your entire body, then flex your elbows and return almost to the starting position without touching the floor. Pause briefly and repeat. During the movement, only your hands and feet (or knees) should have contact with the floor. |
| **Inverted Fly (Bent-Over Reverse Fly) with Dumbbell** | Standing with torso inclined, holding dumbbells, keep your spine neutral throughout the movement. With a neutral grip, perform a horizontal abduction until your arms are in line with your shoulders. Keep your wrist firm and neutral, immobile during the exercise. Slowly return to the starting position. |
| **Unilateral Pulley (Seated Row)** | Seated, with the band anchored at a higher level, start with torso semi-flexed forward and shoulder flexed. Perform a movement of shoulder extension and elbow flexion, keeping your elbow close to your torso. Switch hands and repeat with the other arm. |
| **Superman 1** | Lying prone on a mat with arms at your sides and palms facing down. Position your scapulae downward, slightly lift your torso, and finally lift your hands off the floor. |
| **Superman 2** | Lying prone on a mat with elbows flexed beside your shoulders and hands above your elbows, so your arms form an angle slightly greater than ninety degrees with your torso and your elbows form a ninety-degree angle. Slightly lift your torso, position your scapulae downward, then lift your hands and forearms off the floor while keeping your elbows supported. Perform the arm movement slowly and cyclically for the determined time, keeping your scapulae positioned and stable. |
| **Unilateral Row** | Standing, with a Thera Band anchored at chest height, grasp the band with a pronated grip, keeping knees slightly bent to help stabilize the movement and spine. Pull the elbow farthest from your torso. Perform elbow flexion and extension while keeping your scapulae retracted. |
| **Short Crunch** | Lying supine, with knees bent to assist in stabilizing the movement. Arms crossed over your chest. Perform a trunk flexion until your shoulder blades lift off the floor, then lower your |

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| | torso without letting your shoulder blades fully touch the floor. |
| **Isometric Abdominal Plank** | Start in a four-point stance (on forearms and toes), supporting your forearms on the floor with elbows flexed and legs fully extended on the balls of your feet. Ideally, position your head aligned, looking down. Your shoulders should be aligned with your elbows, palms facing down. With your body aligned, lift your hips. Place your feet slightly wider for more stability. Finally, the practitioner should contract the abdomen as if pulling the navel inward and upward, remembering to maintain normal, continuous breathing. |
| **Hip Bridge** | Lying supine on the floor. Keep your feet firmly on the ground and perform a hip lift, placing the force on your heels and contracting your gluteal muscles well. |
| **Aerobic** | Walking |

At the end of the 4th week, there was an increase in the number of repetitions of the proposed exercises to 12 to 15 repetitions. Finally, after the 8th week, the load (weight and tension of the elastic bands) was increased, with these exercises being performed in 3 sets of 8 repetitions each.

At the end of the 12 (twelve) weeks, the same procedures that preceded the physical exercise program were carried out in both groups (IG and CG). Additionally, IG participants answered questions through the *Google Forms*, about the impressions they had regarding carrying out the proposed physical exercises in their daily lives.

Regarding the variables collected, the anthropometric parameters followed the determinations suggested in the protocols described by Lohman *et al*. (1988), with body weight (kg) measured on a Digital Scale (Plenna Ice, model H482010, São Paulo - SP), heights (cm), stature (cm), and wingspan (cm) on a portable stadiometer (Caumaq, Cachoeira do Sul - RS), body length (cm) and diameters (mm) using an anthropometric tape (Sanny, model TR-4010, São Paulo - SP) and bone caliper (Sanny, São Paulo - SP).

Regarding body composition parameters, the skin fold technique (Skinfold Caliper Saehan, model SH5020, Europe) was used to measure the percentage of body fat (% BF), and this parameter was calculated using the equation proposed by Jackson and Pollock (1978), and Siri (1961). Furthermore, fat-free mass (kg) and Body Mass Index (BMI, kg/m²) were estimated by subtracting total body weight and fat mass and by the equation suggested by Quetelet (1795-1874), respectively.

The linear method was used to assess the participants' flexibility, quantifying the level of trunk flexibility, using the study by Wells and Dilon (1952) as a reference.

To assess the isometric resistance of the upper limbs, the frontal abdominal plank exercise was used, which consists of the participant remaining for as long as possible in a four-point position, with the soles of the feet and palms of the hands resting on the floor in a prone position with legs and arms stretched out (high isometric plank position). Moreover, to assess the power of the Upper Limbs, the medicine ball throwing test was performed, according to the protocol suggested

by Vossen *et al*. (2000) using a measuring tape (Idea, model ID-287), adhesive tape, and a 2-kg Medicine Ball.

Finally, to assess symptoms related to psychological disorders, the reduced version of the Depression, Anxiety and Stress Scale (DASS-21) questionnaire was used. Suggested by Lovibond (1995) and validated for Brazilian Portuguese by Vignola, Tucci (2014), this instrument aims to assess symptoms of stress, depression, and anxiety in an interactive and empirically oriented process, with its construction based on the tripartite model assessed in 21 items subdivided into three subscales with 7 items each. The items refer to symptoms experienced by the participant in the previous week and use a Likert scale ranging from 0 ("does not apply to me at all") to 4 ("most of the time applies to me").

All analyses were performed using the software *Social Program Science System*®, version 23.0 (IBM, 2013). To describe the results, continuous and ordinal variables were arranged as mean and standard deviation and mean and confidence interval (95% CI), respectively, with normality in the variables being verified using the Shapiro-Wilk test ($p>0.05$). For comparison between the groups evaluated, the ANOVA one-way repeated measures with Bonferroni test post-hoc. Significance level was of $p<0.05$.

## 3. Results

Twelve (twelve) female transverse flute students participated in the study, 10 (ten) from the Padre José Maria Xavier State Conservatory of Music, in the municipality of São João del-Rei, and 2 (two) from the undergraduate Music course at the Federal University of São João del-Rei. No difference in chronological age was observed between the groups [CG: 43.3 (10.6) and IG: 44.7 (12.8)]. In addition, regarding anthropometric parameters (height, body mass, length, and bone diameters), there were no significant differences between the two groups before and after the intervention (supplementary tables).

In respect of the body composition parameters evaluated, both groups did not present significant changes in the mean values found for the medical values of BMI, %BF, and FFM (table 1).

As for the average values of the physical tests of flexibility, isometric resistance, and upper limb strength found in both groups, an improvement was observed ($p<0.05$) in the resistance and power of the upper limbs after 12 weeks of practice of the proposed resistance training (table 2).

Table 1 – Mean values of the body composition parameters of BMI, body fat percentage, and fat-free mass, by assessed groups (n=12)

| | IG (n=6) | CG (n=6) | p-value* |
|---|---|---|---|
| BMI (kg/m²) | | | |
| Pre-intervention | 26.95 (2.13) | 26.62 (2.13) | 0.941 |
| Post-intervention | 26.60 (1.99) | 26.30 (1.99) | |
| %BF | | | |
| Pre-intervention | 28.97 (2.92) | 30.22 (2.92) | 0.656 |

| | | | |
|---|---|---|---|
| Post-intervention | 28.18 (1.69) | 30.14 (1.69) | |
| FFM (kg) | | | |
| Pre-intervention | 51.27 (3.90) | 45.60 (3.90) | 0.782 |
| Post-intervention | 51.51 (2.98) | 45.08 (2.98) | |

*interaction group (control and intervention) and time (pre-intervention e post-intervention); IG: intervention group; CG: control group; BMI: body mass index; %BF: body fat percentage; FFM: fat-free mass

Table 2 – Mean values of the parameters for flexibility, upper limb isometric resistance, and upper limb strength power, by assessed groups (n=12)

| | **IG (n=6)** | **CG (n=6)** | **p-value*** |
|---|---|---|---|
| Flexibility (cm) | | | |
| Pre-intervention | 21.25 (3.87) | 23.17 (3.87) | 0.201 |
| Post-intervention | 25.08 (4.14) | 23.83 (4.14) | |
| Isometric Resistance (s) | | | |
| Pre-intervention | 36.83 (8.98) | 58.33 (8.98) | 0.005 |
| Post-intervention | 81.67 (12.89)** | 57.50 (12.89) | |
| Upper limb strength power (m) | | | |
| Pre-intervention | 2.99 (0.13) | 2.78 (0.13) | 0.031 |
| Post-intervention | 3.49 (0.21)** | 2.88 (0.21) | |

*interaction group (control and intervention) and time (pre-intervention e post-intervention); IG: intervention group; CG: control group ** statistically different from the pre-intervention in the same group.

Finally, when evaluating the mean values obtained in the depression, anxiety, stress, and total DASS-21 scale scores, a decrease was observed ($p<0.05$) of the values with the practice of the proposed physical exercises in the depression, anxiety, and total scores (table 3).

Table 3 – Mean and 95% confidence interval (CI) for depression, anxiety, and stress scores, along with the total DASS-21 score, by assessed groups

| | **IG (n=6)** | **CG (n=6)** |
|---|---|---|
| Depression | | |
| Pre-Intervention | 8.83 (4.17-14.83)[a] | 6.33 (1.67-11.67) |
| Post-Intervention | 1.67 (0-4.33)* | 8.11 (1.00-17.67) |
| Anxiety | | |
| Pre-Intervention | 9.67 (5.0-15.33) | 4.67 (1.33-8.33) |
| Post-Intervention | 2.33 (0.67-4.00)* | 5.00 (1.33-9.00) |

| | | |
|---|---|---|
| Stress | | |
| Pre-Intervention | 14.00 (13.67-24.33) | 13.17 (4.50-22.66) |
| Post-Intervention | 8.00 (4.33-12.33) | 11.33 (4.33-18.66) |
| DASS-21 total | | |
| Pre-Intervention | 29.0 (8.67-50.32) | 22.63 (9.83-35.83) |
| Post-Intervention | 13.5 (2.67-25.00)* | 24.33 (9.00-40.32) |

[a] data expressed by scores; * significantly different from pre-intervention within the same group ($p < 0.05$); IG: Intervention group; CG: Control group.

## 4. Discussion

The present study sought to verify the effects caused by the practice of resistance training of upper limbs in female flutist musicians based on physical and psychological parameters. Based on the data found, despite the lack of observation of changes in anthropometric and body composition parameters, the parameters of resistance and strength of the upper limbs, as well as the depression and anxiety scores, showed improvements after the proposed intervention.

First, it should be highlighted that all variables in the present study were similar between the groups studied before the intervention period. These findings confirm the homogenization of the groups, allowing greater statistical power in the analyses (Guedes. Guedes. 1995).

The purpose of collecting height measurements of the upper limbs is to monitor growth and body development. Bone lengths and diameters indicate growth, development, and body proportionality (Schimitt; Bataglion, 2017). The measurement of these data in this study was necessary considering that the analysis of these parameters allowed assessing body development and its proportionality, with such variations being decisive in an effective intervention considering the ergonomics of the musician and his/her professional life. The non-observance of differences in these variables regardless of the groups studied was already expected considering the profile of the public studied (young and middle-aged adults), and such parameters are already at a plateau of their development in this age group. Furthermore, the intervention time may have been insufficient to demonstrate possible variations, and the implementation of a training program with longer intervention time is encouraged.

Regarding body composition and physical profile parameters, as demonstrated in the anthropometric parameters, the (non) performance of resistance training did not result in differences between the participants in these parameters. Body fat percentage is the variable that estimates the relative amount of fat in an individual's body. The fat-free mass index, expressed in kilograms,

corresponds to a measurement of the individual's weight without the percentage of fat (Schimitt; Bataglion. 2017).

Failure to observe changes in these parameters may be linked to multiple factors, the main ones being: lack of monitoring and maintenance of a nutritional program during the training proposal and/or possible insufficient caloric expenditure and/or insufficient intervention time.

When categorizing the physical profile, according to the WHO proposal (2025), of the study group, it was observed that 66% of the IG and 50% of the CG had a physical profile of overweight (between 25 kg/m² and 29.9 kg/m²) or obesity (equal to or greater than 30 kg/m²). Furthermore, 50% of the participants in both groups, CG and IG, had a high percentage of body fat according to the criteria adopted by Pollock Wilmore (1993). Our findings corroborate studies that demonstrate the high prevalence of eating disorders in this age group and how important the factors already mentioned are (Mcardle; Katch; Katch. 2018; Masson. 2005; Pitanga. 2002).

Given the specificity of the musical instrument, the physical tests used here sought to assess the powerful and resistant strength of the upper limbs, as well as the flexibility of the trunk. In this case, it was possible to notice a gain in the strength parameters evaluated in the participants' upper limbs after the proposed resistance training.

These findings corroborate the results by Ike et al. (2010), where a gain in strength and functional capacity of the upper limbs was observed, through resistance training, resulting in a gain in muscle strength for individuals with chronic obstructive pulmonary disease. Moreover, although lower gains were found in relation to the lower limbs, Ferreira (2005) found improvements in strength gain in the upper limbs after 12 (twelve) weeks of training with resistance exercises in women.

However, O'Bryant, Byrd, Stone (1988) point out that, with a longer training time (16 weeks), it is possible to obtain a greater gain in strength, as there is a stage of adaptation of the individuals who train with the new activity to be performed and the real gain in resistance and muscular strength.

The association of physical valences (powerful and resistant strength and flexibility) is essential for monitoring the intervention as it involves the practice of resistance exercises that aim to increase and gain the scores of these valences. Flexibility can be measured based on the movement of one or more joints that promotes muscle stretching (Schimitt; Bataglion, 2017). The test proposed to verify this valence was related to the study by Wells and Dilon (1952), and interference from the practice of physical activity on this physical valence was expected. However, the failure to observe this improvement in the IG may be due to the fact that the resistance training proposed in the present research, even having some exercises and elements related to this physical valence (e.g.: stretching the neck at the beginning of each meeting to carry out the activities), may have overemphasized exercises aimed at improving strength and muscle endurance.

The study by Silva and Oliveira (2014) corroborates this hypothesis by comparing the practice of classes with different types of exercises (classes with a

mixture of localized gymnastics, jumps, steps, and indoor cycling) and resistance training (8 weeks, 3 times a week). An improvement in flexibility was observed only in the mixed training proposal.

Regarding the parameters related to the scores of symptoms of depression, anxiety, and stress obtained in the DASS-21, there was a significant improvement in the IG compared to the CG. Furthermore, it was observed that the CG participants maintained their scores when the DASS-21 test was reapplied, after the 12 weeks of the study. Maintaining a physically active life, with physical exercise, can bring about physical changes, as well as great benefits in psychosocial issues. Gordon et al. (2020) and Muller (2022) allude to the significant reduction in psychological disorders, such as anxiety and depression, through resistance physical exercises, which indicates an agreement of results between this current research and other authors.

The study was limited by the fact that tests that could somehow assess the feelings of musical and performance perception of the participants who carried out the exercise protocol were not performed. This limitation is directly linked to the resolution of some psychological problems, such as performance anxiety and the lack of interest in continuing to practice, due to not being able to achieve the desired sound because of limitations such as musculoskeletal pain and discomfort. Another point to highlight is the small sample size, and new interventions with larger groups should be encouraged to obtain more robust findings, in addition to some relevant differences in the baseline data. Finally, it is regrettable that central body perimeters were not measured. This datum is associated with a cardiovascular risk factor (Rezende, 2006), which in a certain way may contribute to discussions and possible modifications in the proposed training.

Therefore, based on the findings and discussions held, it can be stated that the proposed resistance training had a positive effect on gaining strength and resistance in the participants' upper limbs, in addition to being efficient in reducing anxiety and depression scores after 12 weeks of intervention.

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## 5. Conclusion

This study highlights the importance of having an active lifestyle, not only in an attempt to prevent and treat diseases or psychological injuries and syndromes, but mainly as a vector for a quality of life that can assist in the daily and professional routines of every human being, including musicians.

In addition, regular physical exercise (at least three times a week) in a systematic and monitored manner led to physical and psychological changes in the musicians evaluated, pointing to an improvement in the performance of these professionals both in their professional lives and in their overall health.

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