Article

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Effects of a Physical Therapy Intervention to Improve the Quality of Life of Visually Impaired People: Development of an Audio–Tactile Exercise Protocol

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Abstract

Introduction: The purpose of this study was to develop and implement an audio–tactile protocol for therapeutic intervention in individuals with visual impairments. **Methods:** The Physiotherapy Protocol for People with Visual Impairment (PP-PVI) was developed following five steps: physiotherapy evaluation, linguistic selection, protocol design, linguistic adequation for visually impaired, and linguistic adequation for English language. Three adolescents and three young adults with visual impairments participated in this longitudinal study and performed the protocol of therapeutic exercises twice a week for 12 months while being evaluated with respect to their quality of life before and after. The quality of life was evaluated using the 36-item Short Form Health Survey (SF-36). **Results:** The median score for all domains of the quality of life questionnaire improved after PP-PVI, with the exception of the body pain domain, which remained unchanged. **Discussion:** The PP-PVI was shown to be an important method of therapeutic intervention, and it was easy to understand and apply in persons with visual impairments. **Implications for practitioners:** The exercises of the PP-PVI facilitate the development of several physical and functional capabilities that are important to the independence of individuals with visual impairments.

Keywords

visual impairment, physical therapy modalities, quality of life, sedentary lifestyle

Visual impairment (i.e., blindness or low vision) is assessed by two parameters, visual acuity (what is seen at a given distance) and visual field (area reached by vision). Blindness is classified as a visual acuity of less than 0.05 or a visual field of less than 10°. Low vision is classified as a visual acuity less than 0.3 and greater than or equal to 0.05 or a visual field of less than 20° in the best eye with the best

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optical correction (Bourne et al., 2017; Ottaiano, Ávila, Umbelino, & Taleb, 2019). Low vision is further subdivided into mild, moderate, or severe/profound, depending on the degree of visual impairment (ICD-10-CM Codes H54) (WHO, 2019).

Vision is considered a major facilitator of the integration of motor, perceptual and mental activities. Therefore, its deprivation in the sensory function may cause functional limitations (Saydah, Gerzoff, Taylor, Ehrlich, & Saaddine, 2019). Individuals with visual impairments exhibit functional impairments or physical losses related to the deficit of static and dynamic balance (Horak, Wrisley, & Frank, 2009; Machado, Oliveira, Urquizo, Shimano, & Oliveira, 2019; Parreira, Grecco, & Oliveira, 2017; Rutkowska et al., 2015). Moreover, postural changes can lead to other disabilities such as loss of flexibility, cardiorespiratory fitness, or muscle strength and decreased motor coordination and body awareness (Aslan, Calik, & Kitis, 2012; Rutkowska et al., 2015; Silva, Shimano, Oliveira, Conti, & Oliveira, 2011). Furthermore, individuals with disabilities have shown increased sedentary behaviors and more precarious levels of physical fitness (Cervantes & Porreta, 2010). Physical inactivity worldwide is an important health issue for individuals with visual impairments (Starkoff, Lenz, Lieberman, & Foley, 2016).

In general, vision loss can cause psychological, social, economic, and physical function problems, resulting in a negative effect on the quality of life of the individual. It often involves a loss of self-esteem and social status, gradual impairment of motor and functional skills, as well as occupational restrictions and, consequently, a decrease in household income (Becker & Montilha, 2015; Brian et al., 2019; Elsman, van Rens, & van Nispen, 2017; Rainey, Elsman, van Nispen, van Leeuwen, & van Rens, 2016).

Physical therapy modalities play a significant role for people with visual impairments; interventions for health and wellness for this population can be targeted to acquire and improve autonomy, mobility, motor coordination, balance, body awareness, laterality, body posture, flexibility, muscular strength, cardiovascular conditioning, and general health improvement (van Leeuwen, Rainey, van Rens, & van Nispen, 2015). Children with visual impairments have difficulties with locomotor skills; for this, they need a valid intervention that prepares them for daily demands (Brian et al., 2019, 2020).

The challenge of a specific therapeutic approach for people with visual impairments is to ensure the learning of each proposed intervention. In physical therapy intervention, the main objective is to guarantee independence in the correct execution of each movement so that there is the gain of physical and functional skills and capabilities that are essential for good motor performance. This motor learning process for individuals with visual impairments can be promoted if the senses of hearing and touch are prioritized as a learning method (Alary et al., 2009; Joshi, Ray, Odierna & Smith, 2019; Urquizo, 2018).

In this context, audio–tactile protocols may be an appropriate strategy for health intervention. The linguistic construction of verbal commands becomes essential not only to understand the objectives of each exercise proposed but also to perform each movement correctly. In addition to verbal commands, tactile commands must be precise and objective, correcting postural errors during the performance of movements. These two commands should be designed to be applied simultaneously. Therefore, the development process of an audio–tactile protocol requires a cohesive team that includes professionals from different areas of health and education. For this reason, the fulfillment of health promotion approaches for people with visual impairments is a challenge because there are few adapted physical exercises protocols for these individuals that allow for the enhancement of their physical and functional conditions, social interactions, and, ultimately, improvement of their quality of life.

The purpose of this study was to develop and apply an audio–tactile protocol for health promotion intervention in individuals with visual impairments. Therefore, the linguistic

construction of verbal and tactile commands was accomplished by a team of experienced visual impairment professionals. Individuals with visual impairments performed the exercises in the protocol for an extended period, and they were evaluated with respect to their quality of life before and after. We hypothesized that a specific protocol for individuals would facilitate their learning of new therapeutic exercises and improve their overall health and quality of life.

Methods

Participants

Three adolescents and three young adults with visual impairments participated in this longitudinal study; they were treated at the Brazilian Mid-West Institute for the Blind (ICBC) in Uberaba, Minas Gerais, Brazil. This study was dedicated to develop and apply a therapeutic exercise protocol, and it was approved by the Research Ethics Committee of the Federal University of Triângulo Mineiro, Brazil (protocol 1965) and registered on the Brazilian Clinical Trials Registry (number: RBR-2ssg4w). Convenience sampling was performed over 3 weeks, in which a screening process established the following inclusion criteria: individual with blindness or low vision; aged between 18 and 59 years; cognitive autonomy assessed by the cutoff points of the Mini-Mental State Examination (Brucki, Nitrin, Caramelli, Bertolucci, & Okamoto, 2003); and no neurological, cardiac, or disabling musculoskeletal diseases. Exclusion criteria were missing three or more consecutive sessions of physiotherapy or missing five sessions during the period of the protocol performance or both. Furthermore, participants who clearly had difficulties understanding the questionnaire at any point of the study were excluded. Following examination of these criteria, 10 individuals were included and four were subsequently excluded. Thus, only six individuals with visual impairments were effectively analyzed in this study. Participants were verbally informed about the intention and procedures of the study and provided informed consent. This study was conducted in the physiotherapy room at the ICBC, with appropriate materials and equipment for assessments and interventions.

Development of the protocol

The development of the Physiotherapy Protocol for People with Visual Impairment (PP-PVI) followed these five steps: (1) physiotherapy evaluation, (2) linguistic selection, (3) protocol design, (4) linguistic adequation for people with visual impairments, and (5) linguistic adequation for the English language.

Step 1. Initially, a physiotherapy evaluation was performed to characterize the sample in order to guide the protocol development. For this reason, all participants responded to an oral questionnaire about their data and diagnosis of visual impairment. Data files of ICBC were also analyzed to confirm the information provided, as well as to compile further relevant data. Subsequently, physical therapy evaluations were performed, including anamnesis, vital data, anthropometric measurements, classic postural assessment, and evaluations of strength and flexibility. In addition, quality of life was evaluated through a fair reading of the 36-item Short Form Health Survey (SF-36) because most participants did not read braille. The SF-36 questionnaire was validated for Portuguese (Ciconelli, Ferraz, Santos, Meinão, & Quaresma, 1999), and it is a tool that is designed to assess health-related quality of life. It is composed of 36 items distributed among eight domains: physical functioning, role limitations due to physical health problems, body pain, general health perceptions, vitality, social functioning, role limitations due to emotional problems, and general mental health. The final score ranges from 0 (worst) to 100 (best) for each domain.

Step 2. Three physical therapists who had work experience in visual impairment (through courses in adapted pedagogy, assistive technology, and special education) and a young

woman with blindness who was a physiotherapy undergraduate student conducted a survey of words or terms commonly used to describe the exercises.

Step 3. The choice of exercises to be included in the protocol was based on the results of physical evaluations. The specific aims to be achieved were improving mobility, muscle strengthening, flexibility, and posture, with emphasis on the most important impairment finding, which was decreased flexibility. It was considered an intervention of approximately 40 minutes, with a total of 13 exercises included in the protocol, in which two exercises were selected for mobility, four for muscle strengthening, six to increase flexibility, and one exercise to effect global postural reeducation. Verbal and tactile commands were created for each exercise to ensure correct execution. Each exercise also received a specific name. Therefore, after the learning phase, the physiotherapist could call out the exercise's names, and the individuals with visual impairments would be able to perform the exercise with autonomy.

Step 4. The verbal and tactile commands were created with the participation of a physiotherapy undergraduate student who was blind. Two participants with visual impairments performed the exercises according to the verbal and tactile commands, and they described the difficulties in understanding some terms. These terms were revised accordingly, and the exercise protocol was retested. In addition to the linguistic adjustment, some unknown concepts or terms had to be explained in detail. They were required for the performance of the exercises and could not be replaced. For instance, the volunteers did not know the term *analog clock,* only the term *digital watch.*

Step 5. The participants were instructed in Portuguese. After instruction, the linguistic adjustment of the protocol into English followed two stages. The first was the translation of the protocol by a native Brazilian with expertise in the English language. The second step was the revision of the translation by a native English speaker with expertise in linguistics.

Following these five steps, the theorical part of PP-PVI was completed (see Table 1). Thus, its application and the evaluation of its effects began.

Protocol application

The protocol was carried out twice a week for 12 months, although there was a 1-month break in the middle of this period due to a holiday break at the institution. Each session lasted 40 minutes and consisted of 5 minutes of walking as a warm-up, followed by 30 minutes of the exercise protocol performance and 5 minutes of relaxation, which included diaphragmatic breathing exercises and passive movements. Every session included music that was played in the background that varied according to the type of exercise. The materials used during the sessions were sleeping mats, elastic bands, plastic balls (30 cm in diameter), and a stereo system.

To evaluate the effects of this protocol on quality of life, all participants were evaluated before and after this period using the quality of life questionnaire (SF-36) conducted by the same evaluator.

Data analysis

The Shapiro–Wilk test showed non-normal data. Descriptive statistics (median, maximum, and minimum values) and inferential analysis (Wilcoxon signed-rank Test) were based on the scores of the SF-36 questionnaire before and after the period (12 months) of the physiotherapy intervention. Statistical analyses were carried out using the Statistica Package 10.0, with a significance level of .05.

Results

The protocol was applied on six individuals with visual impairments. Table 2 shows the main characteristics of the participants. The mean age was 19.8 ± 5.5 years, four of them were women and two were men. Three participants

Table 1. Physiotherapy Protocol for People with Visual Impairment.

Finality	Exercise	Objective	Verbal command	Tactile command
Mobility	1 "Pelvic clock"	To gain mobility of the pelvic girdle	Lie on your back and press your buttocks and back against the stretcher. Imagine that your pelvis has the hands of a clock. Now position yourself at 12 o'clock. Good job! Now at 6 o'clock... now 3 o'clock (the watch concept has been previously taught). Repeat each move 10 times	The physiotherapist places his/her hand on the iliac bone and directs the movements in different directions
	2 "Squeezing clothes"	To gain mobility of scapular and pelvic girdles	Lie on your back. Take a deep breath and breathe out slowly. Now, imagine that your body is a piece of wet clothing you're going to wring (out). Hold your knees with and try to make them touch the floor. Keep focused and keep your right shoulder on the stretcher. Do not lift your shoulder. Count to 10, and stretch our legs again. Switch sides and do the exercises again. Repeat the move five times on each side	The physiotherapist should guide the movement and keep the contralateral shoulder supported
Muscle strength	3 "The bridge"	To enhance body awareness and strengthen glutes and abdominal muscles	Lie on your back, with both knees bent and feet flat on the stretcher. Take a deep breath. As you breathe out, try to lift your pelvis keeping your feet and shoulders flat on the stretcher. Now stay on this position and exhale. Make sure the patient is aligned to avoid lumbar lordosis. Repeat this move 10 times	The physiotherapist places his/her hand on the individual's abdomen and asks the person to raise the pelvis. After expiration, the therapist puts his/her hand on the individual's lumbar spine to support the final movement

(continued)

Table 1. (continued)

Finality	Exercise	Objective	Verbal command	Tactile command
	11 "Bird-dog"	To gain strength of the extensor muscles of the spine; to train balance; and to gain body awareness	Position yourself on the floor on your hands and knees. Imagine a dog that will change into a bird. Stretch one arm in front of you, extend the opposite leg holding it parallel to the floor. Count to 10. Now switch legs. Repeat the moves with both legs and arms 10 times	The physiotherapist should position the arm and leg that will be stretched, promoting a balance
	12 "Crazy bike"	To train motor coordination and to develop strength of the abdominal muscles and upper and lower limbs. Cardiorespiratory training and motor coordination	Lie on your back. Lift both legs and try to ride a stationary bike—you have certainly done this before! Keep your abdomen tight while cycling. At the same time, raise one arm above your head while lowering the other arm, switching sides. Five sets of 3 minutes with a 30-second rest between sets	The physiotherapist should touch the leg to be pulled along with the contralateral arm so that the individual understands that the upper limbs and the lower limbs perform alternate moves
	13 "Imaginary chair"	To control posture; to gain body awareness in sitting and standing positions; to train breathing; and to gain muscle strength of the lower limbs	Stand back to the wall. Good Job! Breathe in and fill your stomach with air. Very slowly, slide your back down the wall as if you were trying to sit down. Roll down until the joints of your hips, knees, and heels formed an angle of 90°. I'll tell you when you've reached the right angle. Right there! Great! Now breathe in again and rise as you exhale. Take 5 breaths with the full movement	The physiotherapist should ensure the support of hips and shoulders against the wall, stimulating the abdominal and quadriceps contraction and ensure the correct degree of knee flexion

(continued)

Table 1. (continued)

Finality	Exercise	Objective	Verbal command	Tactile command
Flexibility	4 "Ball on the foot"	To dissociate the scapular and pelvic girdle; and to increase the flexibility of the posterior muscles of the thigh and leg	Stand tall with back straight. Inhale and lift your arms as high as possible holding this ball in your hands. Now, exhale as you bring the ball to touch your right foot. Good job! Repeat the movement with the left foot. Repeat the move five times on each side	The physiotherapist should hit the ball above the individual´s head. This will encourage the person to bring the ball to his/her foot. At the same time the therapist should ensure that the individual knees are stretched as the ball touches the foot
	5 "Foot on the ball"	To dissociate the scapular and pelvic girdle; to increase the flexibility of the posterior muscles of the thigh and leg; and to train balance and motor coordination	Stand tall with back straight. Inhale and lift your arms as high as possible holding this ball in your hands. Now, exhale while bringing your right foot to touch the ball at waist height. Now, do the other side. Repeat 10 times on each side	The physiotherapist should hit the ball above the individual's head and it will be an encouragement to take the ball to his/her foot. At the same time the therapist should ensure that the individual knees are stretched as the ball touches the foot
	6 "Ballet in a lying position"	To increase flexibility of the muscles of the posterior muscle chain	Lie on your back and loop the strap around the ball of your foot holding the ends of the strap with both hands. Be sure to keep your chin down and shoulders back. Exhale while pushing your heel up toward the ceiling. Keep your knees stretched. Repeat the move three times on each side	The physiotherapist helps the individual placing the band around his/her foot and correcting the posture during the exercise
	7 "Curly"	To increase flexibility of the muscles of the thoracic and lumbar spine	Lie on your back. Take a deep breath. While breathing out, bend one leg over your torso, holding it just below the knee. Hold this position for 30 seconds. Repeat the moves three times on both sides	The physiotherapist corrects posture, the position of the head and back if necessary

(continued)

Table 1. (continued)

Finality	Exercise	Objective	Verbal command	Tactile command
	8 "Playing stork"	To increase flexibility of hip flexors muscles and knee extensors and to train balance and proprioception	Stand tall with back straight. Bend the left leg back toward your buttocks and hold your left foot with your left hand. Keep your body straight and do not move to the sides. Hold this position for 30 seconds. Repeat the moves with both legs three times	The physiotherapist corrects posture and prevents compensation for the correct execution of the movement
	9 "Ear on the shoulder"	To increase flexibility of neck muscles	Start in a sitting position. Take a deep breath. Hold one hand against the side of your head. Tilt your head sideways, so that your ear may touch your shoulder. Breathe out slowly. Switch to other side. Repeat the move three times on each side	The physiotherapist assists the individual in keeping the correct position for the exercises and reminds the individual not to raise his/her shoulders, by touching them
Posture	10 "Frog on the floor with open arms"	To increase flexibility of the diaphragm, sternocleidomastoid, scalene, intercostal, lower back muscles, pectoralis major and minor, and the iliopsoas muscles; to gain strength of abdominal muscles, rhomboids, quadriceps, and core muscles; and to gain body awareness	Lie on your back and keep your arms open. The knees are flexed and the feet are together. Feel your entire spine pressing against the stretcher and imagine a straight line starting at the center of your head until your buttocks, as if you wanted to stretch it. Good job! Take a deep breath until your belly is full. Now very slowly release the air through the mouth, expelling all the air, and imagine that you are pulling your belly button in toward the floor. Take five breaths with the full movement	The physiotherapist should avoid the individual lifting any part of his/her body. The therapist should also compress the abdominal muscles so that the person feels the contraction during expiration

Table 2. Characteristics of the participants.

Subject	Sex	Age in years	Visual impairment	Cause
1	Female	15	Blindness	Acquired (incubator)
2	Female	16	Profound low vision	Congenital (toxoplasmosis during pregnancy)
3	Female	16	Blindness	Leber's congenital amaurosis
4	Female	29	Profound low vision	Retinitis pigmentosa and cataracts
5	Male	19	Blindness	Retinal detachment
6	Male	24	Profound low vision	Incomplete cornea and retinal disorder

Table 3. Median score (minimum and maximum) of the SF-36 quality of life survey before and after intervention.

Domain	Before	After	*p*-value
Physical functioning	80 (45; 100)	85 (55; 100)	.92
Role limitations due to physical health problems	50 (25; 100)	87.5 (50; 100)	.06
Body pain	86 (40; 100)	86 (22; 100)	.59
General health perceptions	62 (50; 90)	74.5 (57; 92)	.67
Vitality	57.5 (30; 95)	80 (50; 100)	.17
Social functioning	56.2 (25; 100)	62.5 (12.5; 100)	.78
Role limitations due to emotional problems	33.3 (0; 100)	66.7 (0; 100)	.36
General mental health	54 (28; 72)	68 (32; 100)	.06

p-value: Wilcoxon test before and after intervention, with a significance level of .05.

had profound low vision and three of them were blind, according to the medical records of the institution's ophthalmologist. The causes of visual impairment were varied (see Table 2).

The results of the SF-36 health survey before and after the completion of the PP-PVI are presented in Table 3. After the implementation of the exercise protocol, the median score for all domains increased, demonstrating an improvement in the participants' health outcomes, although the domain to do with body pain remained unchanged. The statistical analysis showed no difference in any SF-36 domains before and after the PP-PVI intervention (significance level of .05).

Discussion

The steps to create the protocol were defined considering the clinical and functional conditions of the sample and the educational requirements for learning physical exercises. The physiotherapy evaluation aimed to measure the physical impairment of each individual in order to trace a profile of the group with visual impairments and guide the protocol development. From this physical and functional diagnosis, the choice of each therapeutic exercise was based not only on the clinical goal but also on the cognitive-motor learning process of people with visual impairments. Therefore, extensive research of scientific evidence on the types of exercises specific to physical and functional deficits was conducted.

Notably, the focus of the exercise protocol was to provide an effective and achievable exercise alternative that would change the sedentary lifestyle of these individuals. Thus, a lexical analysis was performed with the participation of pedagogues who specialized in visual impairment. According to each exercise that would be taught, this group of professionals defined what would be the best words (verbal commands) in the Portuguese language for a detailed description of the positioning and the way to accomplish the exercise. In addition,

the participation of a person with blindness in the process of the protocol development was essential to define the "adaptive" therapeutic exercises to be chosen. This person identified some terms that were not known to individuals with visual impairments. This information was crucial in determining which terms, if they were essential for an exercise, needed to be explained, such as the term "analog clock." In addition, working with an individual with visual impairment helped us understand that individuals who were familiar with the terms in the protocol could participate better in the exercises.

The PP-PVI was developed in an exercise blocks format. Each block contained physical, functional, and cognitive requirements that were carefully chosen to promote the gain of physical abilities and functional skills. For example, exercises 1 and 2 for mobility could be performed passively. However, since the participants required body awareness, these exercises were performed actively. This type of requirement ensures greater motor learning, particularly in the core muscles, which are essential for maintaining correct posture. These exercises also contribute to pelvic and shoulder girdles dissociation during gait. Exercises 3, 11, 12, and 13, which aimed to induce gains in strength, did not use resistance weights (dumbbells), but instead were calisthenic exercises. Thus, when using the resistance of body weight, the risk of injuries was lower and the strength gain, although gradual, was progressive throughout the protocol of the application period. Emphasis was placed on exercises that promoted flexibility gains (exercises 4–9) exclude. There was also the option for active exercises to gain flexibility. These exercises had secondary objectives: the stimulation of balance and coordination, which are especially important aspects to individuals with visual impairments. Exercise 10 was for respiratory control associated with all the muscles involved in maintaining proper posture. This global stimulus allows significant gains in body awareness, which is typically compromised in people with visual impairments. In addition, although it may promote postural corrections, it improves stability.

The range of motion limitation and balance for each participant were considered during the implementation of the PP-PVI, particularly when performing in the orthostatic exercises. Some participants needed external support when they began these exercises, and eventually they were able to complete them without support. According to these improvements, physical skills were required to perform the exercises without any support and with maximum amplitudes.

The understanding of words by participants was also a challenge for the final selection of the verbal commands for the protocol. Some terms like "clock" in exercise 1 and "riding" in exercise 12 needed to be clarified. Exercise 1 was explained through the use of an ethylene vinyl acetate paper analog clock, and the concept of pointers was explained with verbal description and tactile demonstration. Next, the clock was hung on the wall at hip level, and the movement of the pelvis was explained according to the position of the clock (12 h = retroversion, anteversion = 6 h, and 3 h and 9 h = side slopes). As for the concept of "riding a bicycle," the participants had practical experience on a stationary bike, and they were able to repeat the movement in a lying position.

Despite the good level of understanding of verbal commands, other adjustments were necessary to the linguistic adaptation once the protocol was translated into English to facilitate understanding. The review and analysis of the translation by a native speaker of English with a background in linguistics were fundamental in this process. Exercises 1, 2, and 6 had their verbal commands modified. For example, for exercise 1 (pelvic clock), there was a breakdown of the clock positions and their relationship to human anatomy. The command "Imagine that your pelvis has the hands of a clock" was replaced by "Imagine that there is a clock lying flat on your lower abdomen, where your hands are. Twelve o'clock is at your belly button, and six o'clock is at the top of your pubic bone. Your hip bones are at nine and three."

The PP-PVI was performed by six participants with visual impairments over an extended period (12 months). During this time, motor learning occurred gradually. In the first month, there was a greater emphasis on teaching the correct positioning of each exercise, and the verbal and tactile controls were fundamental to the understanding of the exercises. Then, by learning the sequence of movements of each exercise, only tactile commands were used to correct positioning. This period lasted for approximately one additional month. From this point, individual follow-up conducted by physical therapists allowed each participant to evolve in their execution of the PP-PVI exercises regarding load, number of sets, and repetitions according to their capabilities. The exercises were then carried out independently by participants, with only occasional verbal command corrections during execution. Moreover, physical therapists began to use verbal commands to encourage individual progress in each exercise. In the flexibility exercises, the largest range of motion and the maintenance of standing for a progressive time were stimulated. In the strength exercises, the increase in isometry time and the number of repetitions were encouraged.

The analysis results regarding quality of life after the application of the protocol, although not significant, demonstrated improvement in functional physical condition, overall health, vitality, social and emotional aspects, and mental health. These results corroborate the findings of Marques et al. (2015), who also used an audio–tactile method for teaching aquatic therapeutic exercises to people with visual impairments. However, a broader study is needed to attest to the positive influence of the PP-PVI on improving the quality of life of people with visual impairments.

The proposed protocol for people with visual impairments was shown to be effective due to adherence, learning, and practice of the audio–tactile exercises of the PP-PVI. Thus, the implementation of the PP-PVI could promote changes to the sedentary behavior of these individuals. This change is extremely important because a sedentary lifestyle is associated with higher mortality, hospitalization, cardiovascular diseases, diabetes, and cancer, and is a risk factor for poor bone health (Chastin, Mandrichenko, Helbostadt, & Skelton, 2014), which can further aggravate the living and health conditions of a person with visual impairments.

Therefore, breaking the vicious cycle of inactivity becomes an important protective factor. In doing so, ensuring accessibility to practice physical exercises (via architectural adaptations, facilitating communication, professional training, and development of specific protocols, such as the PP-PVI developed in this study) secures independence for people with visual impairments to develop their physical and functional abilities, which promotes physical, social, and psychological gains, as observed in this study.

This study is part of a project in which the university performs health promotion activities in the community, in partnership with the institution specializing in visual impairment. The project is called “Comprehensive health care for people with visual impairments” and has been running without interruption since 2008, guaranteeing the continuity of actions.

Conclusion

The development of a specific audio–tactile protocol for people with visual impairments was only possible through the combined efforts of many professionals and the active participation of individuals with visual impairments. As a result of this work, the PP-PVI was shown to be an important method of therapeutic intervention, and one that is easy to understand and apply with people with visual impairments. The exercises of the PP-PVI facilitate the development of several physical and functional capabilities that are important to the independence of people with visual impairments. The gain of independence was reflected in the perception of improvement of quality of life for these individuals.

Additionally, the exercises included in this protocol were performed twice a week for an extensive period of time, which promoted

changes in to the sedentary lifestyles of participants. This change may help prevent many diseases and ensure health. Besides having benefits, the application of PP-PVI represents a paradigm shift related to visual impairment. The first change is the modification of confidence of the person with visual impairment in relation to their own ability to perform exercises. Lack of confidence in this area can result in sedentary behavior and loss of health. The second change is the way society views the people with visual impairments, since various adjustments and changes can be included in social environments so that they may be included. It is important to understand that space can be redesigned or adapted in a simple way for a person with visual impairment, enabling the accomplishment of physical exercises or any other activity. Moreover, society's way of thinking should be reevaluated, seeking new ways to live, treat and prevent illness, and seek healthfulness. In doing so, the real inclusion of individuals with visual impairment occurs.

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