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*Translated from the original in spanish*

**Original article**

## **Corrective physical exercises program for patients with idiopathic scoliosis**

### **Programa de ejercicios físicos correctivos para pacientes con escoliosis idiopática**

### **Programa de exercícios físicos corretivos para pacientes com escoliose idiopática**

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## ABSTRACT

The problem of the study lies in the fact that the treatments for children with scoliosis in Chile lack integration from physical exercise. The objective was to analyze physical exercise for the treatment of children with idiopathic scoliosis. The various forms of physical treatment in idiopathic scoliosis were studied through the review of official documents (patient medical records, exercise programs and intervention methods). The research was carried out at the Cuban Center for Physical Rehabilitation in Temuco, Chile. The indirect or non-interactive empirical method was applied: analysis of official documents, analysis-synthesis and modeling, which allowed the theoretical systematization of physical exercise in treatment. As a fundamental result, the program for the treatment of idiopathic scoliosis is designed through corrective physical exercises in a period of 18 months.

**Keywords:** Corrective physical exercises; Idiopathic scoliosis; Postural examination; Treatment.

## RESUMEN

La problemática del estudio recae en que los tratamientos para niños con escoliosis en Chile carecen de la integración desde el ejercicio físico. El objetivo fue analizar el ejercicio físico para tratamiento de niños con escoliosis idiopática. Se estudiaron las diversas formas de tratamiento físico en la escoliosis idiopática a través de la revisión de documentos oficiales (historias clínicas de los pacientes, programas de ejercicios y métodos de intervención). La investigación se llevó a cabo en el Centro Cubano de Rehabilitación Física de Temuco, Chile. Se aplicó el método empírico indirecto o no interactivo: análisis a documentos oficiales, análisis-síntesis y modelación, que permitieron la sistematización teórica del ejercicio físico en el tratamiento. Como resultado fundamental se diseña el programa para el tratamiento de la escoliosis idiopática mediante ejercicios físicos correctivos en un período de 18 meses.

**Palabras clave:** Ejercicios físicos correctivos; Escoliosis idiopática; Examen postural; Tratamiento.

## RESUMO

O problema do estudo reside no facto de os tratamentos para crianças com escoliose no Chile carecerem da integração do exercício físico. O objectivo era analisar o exercício físico para o tratamento de crianças com escoliose idiopática. As várias formas de tratamento físico para a escoliose idiopática foram estudadas através da revisão de documentos oficiais (registos médicos dos pacientes, programas de exercício e métodos de intervenção). A investigação foi realizada no Centro Cubano de Reabilitação Física em Temuco, Chile. O método empírico indireto ou não-interativo foi aplicado: análise de documentos oficiais, análise-síntese e modelação, o que permitiu a sistematização teórica do exercício físico no tratamento. Como resultado fundamental, foi concebido um



programa para o tratamento da escoliose idiopática através de exercícios físicos corretivos durante um período de 18 meses.

**Palavras-chave:** Exercícios físicos corretivos; Escoliose idiopática; Exame postural; Tratamento.

## INTRODUCTION

The advances in science and technology are among the factors that have made it possible for a good number of children and adolescents to increase their life expectancies, therapeutic physical culture is inserted here, as part of a scientific movement in the world and Cuba to the vanguard. Postural deformities affect part of the world population and especially Chile.

Within the resources used in the physical rehabilitation of patients with idiopathic scoliosis, therapeutic physical culture is usually used, using physical exercise as a fundamental element.

In Chile, the Ministry of Health does not have an established protocol for the treatment of idiopathic scoliosis, there is a lack in clinics and hospitals. However, those who treat this alteration are kinesiologists and have treatments that date back to 1977.

Idiopathic scoliosis is a morphological and three-dimensional deformation of the spine, characterized by a lateral deviation of the spine accompanied by rotation of the vertebral bodies, being an aggressive and deforming condition.

Old long-term studies of putative idiopathic scoliosis presented a dismal prognosis, perpetuating the common misperception that all types of idiopathic scoliosis inevitably lead to disability, with back pain and cardiopulmonary compromise. Hresko (2013), Lao *et al.*, (2013) and González *et al.*, (2016) state that idiopathic scoliosis varies with the etiopathogenesis, location and type of curves.

There is a lack of knowledge among health professionals about the form of treatment for idiopathic scoliosis and in state and private schools students with this type of condition are not treated. Obviously, these external manifestations are given by the following dialectical contradiction: an improvised and decontextualized technological approach that affects how to correct idiopathic scoliosis.

In this sense, to the Cuban Center for Physical Rehabilitation, in Temuco, Chile, patients with idiopathic scoliosis attend, being ineffective the physical rehabilitation process due to the lack of a specific methodological instrument that guarantees the reintegration of those affected into society.

The research focuses its objective on the design of a corrective physical exercise program for patients with idiopathic scoliosis who attend the Cuban Center for Physical Rehabilitation in Temuco, Chile.



## MATERIALS AND METHODS

The research has a holistic character since it develops the description of the facts and phenomena from the qualitative to the quantitative for a type of non-experimental design. Depending on the variable control that is carried out, it is a minimum control with pretest- posttest for a single group in a type of descriptive study.

A sample of 20 specialists was selected: two rheumatologists with more than ten years of experience, three physiatrists with more than 12 years of experience, five traumatologists with more than eight years of experience, seven Physical Education teachers with more than seven years of experience, a massage therapist with more than nine years of experience and a physical trainer with more than eight years of experience.

The assessment by criteria of the specialists was based on the level of knowledge they have on the subject addressed. The criterion that prevailed among the specialists was seven, on a scale from 0 to 10, which represents a high score for the degree of influence of each of the sources of argumentation in their criteria.

The preparation of the program starts from the application of the analysis method to the official documents that made possible the study on the various forms of physical treatment in idiopathic scoliosis and the following methodological tools were reviewed:

- Therapeutic Physical Culture Programs of the National Institute of Sport, Physical Education and Recreation (Inder in Spanish).
- Corrective therapeutic exercise program for lower limbs and spine. • Chile telethon programs. Rehabilitation model.
- Training programs for Physical Education teachers and physical trainers in Chile.
- Most used methods in rehabilitation in idiopathic scoliosis Charriere, Schroth and Klapp.

### Procedure

The research was carried out at the Cuban Center for Physical Rehabilitation in Temuco, Chile. The medical records of the patients and the official documents were analyzed. The program for the treatment of idiopathic scoliosis through corrective physical exercises was structured in a period of 18 months.

## RESULTS AND DISCUSSION

### Analysis of official documents on the treatment of idiopathic scoliosis

A. Inder`s Therapeutic Physical Culture Programs. Program of corrective therapeutic exercises for lower extremities and spine *Losada et al., (2005)*: in 2005, the national methodological workshop of physical exercises of the Inder is carried out, in which different experts meet at the national level for the analysis, update and development of physical exercise programs for the treatment of different diseases. Within these programs, there is the program of corrective therapeutic exercises for lower limbs and spine, it develops a large amount of content, resulting in an insufficient approach to idiopathic scoliosis. On the other hand, the way of organizing the exercise program is



highlighted and this structure, in general, is the one that is assumed for the development of the program proposed in this research.

B. Chile Telethon Programs: the telethon is a charity television event that has been held annually since 1978. They are physical rehabilitation centers for children and adolescents up to 18 years of age with any type of disability. The physical rehabilitation that the telethon points to is not enough to serve people with disabilities, once they reach 20 years with congenital disabilities and 18 years for acquired disabilities they are ruled out by age, Chile is far from that reality, suffice it to say that the majority of children and adolescents, with disabilities of any type and degree, do not have the possibilities of specialized and appropriate medical care for real integration into study.

### **Shortcomings:**

- Promotes negative stereotypes about disability.
- The kinesiotherapists who work at the telethon institute are scarce for the number of children who are seen daily, they have few opportunities for adequate training to perform, they do not perform any type of specialization (neurological, traumatological, orthopedic).
- There is no continuity in the treatment because every year it closes its doors during the month of February.
- The sessions are not controlled, there is no dosage of programmed loads.
- Patients are seen by the kinesiotherapist who is that day, it is not always with the same one.
- They continue to create centers, but do not train their staff.

C. Training Programs for Physical Education Teachers in Chile: Physical Education programs in Chile have the general objective of training a university professional with the pedagogical and technical knowledge required to promote the practice of physical activity, sports and physical activities, recreational activities linked to skills that allow them to identify and evaluate the physiological, motor, psychological and behavioral characteristics of the population. Unlike other countries, for example, Cuba, where the Bachelor of Physical Culture can work with children with certain diseases from Physical Education in special schools, in Chile they only adjust to the Physical Education program of conventional schools. Physical Education teachers lack professional training and do not delve into certain subjects such as anatomy, biomechanics and physiology, which are decisive for their good performance. The Physical Education career only aims to work on areas of development in schools.

D. Physical trainers' programs in Chile: these programs aim to train physical trainers in the area of physical activity and sports training. Their education is focused on prevention within the concept of health in terms of physical activity, the teacher is trained in the field of physical training of athletes and in specialized work for the development of physical activities.

E. Most used methods



**Charriere`s method (1965)**: based his method on the flexibility of the scoliotic muscles in the sense of correction, as well as muscle strengthening so that the patient maintains corrected postures throughout the day. He defends using different techniques of different methods and always adapting them to each case, as well as readjustment through daily repetition of the exercises until the automation of the correction is achieved. The adherence of the subject and a rigorous protocol are essential, as long as flexibility, harmonization and strengthening are carried out individually and according to each phase of treatment, it must be carried out as a team, with the elaboration of therapeutic objectives by the entire team of specialists and a kinesiotherapy personalized, which must be taught and corrected by a kinesiologist.

Schroth method **Watkins et al., (2012)** Created by German physical therapist Katharina Schroth promulgates the three-dimensional treatment of scoliosis, a sensorimotor-based, kinesthetic method that seeks to correct the scoliotic posture, three-dimensionally altered, and the correction of the scoliotic breathing pattern **Martin, (2014) and Bettany-Saltikov, (2014)**. The patient is trained individually by the kinesiologist to correct altered posture through proprioceptive and exteroceptive stimuli and mirror control.

Klapp`s method: Klapp based his method for spinal deformities on his observation of animals, he advocates that quadrupedal animals, man is no longer there, did not have spinal problems in their frontal plane, since lateral deviations being in four points are almost nil, its purpose, from the initial position, is unloading, mobilization, and with it, it is corrected by means of maximum muscular tension, thus the patient is placed leaving the spine suspended from four support points, which eliminates the force of gravity on the scoliotic curve. It is based on the work of the vertebral muscles from the quadrupedal or crawling position, so that the concave side of the curve is stretched and the convex side is strengthened (**Rodríguez, 2017**).

### **On the design of the corrective physical exercise program for the treatment of idiopathic scoliosis**

The program for the treatment of idiopathic scoliosis, through corrective physical exercises, was conceived in its structure in a period of 18 months, the program design of **Hernández (2005)** is assumed, which has: introduction, objective, stages, contents, control and evaluation and methodological indications.

### **Corrective physical exercise program for idiopathic scoliosis**

It is based on the general idiopathic scoliosis rehabilitation programs used at the Cuban Center for Physical Rehabilitation in Temuco, Chile. It is aimed mainly at kinesiologists and physical trainers in order to provide tools and knowledge to help improve the postural alteration of patients with idiopathic scoliosis, and can be applied in centers, hospitals, offices, private clinics and family health centers that provide the physical rehabilitation services.

General objective: to improve scoliotic curves in patients with idiopathic scoliosis in the Chilean health system.



## Program stages

Stage I: muscular re-education: the patient is received with idiopathic scoliosis, with an "S" or "C" shape deviation of the spine, and greater than  $10^{\circ}$ , with unknown cause, with radiological measurement, decreased muscle tone and in some cases with hump, respiratory distress, back pain and psychologically affected. It consists of 21 exercises.

### Objectives:

1. Facilitate adequate dynamic and static muscle proprioception.
2. Make the concave segments more flexible.
3. Extend shortened muscles with passive mobilization exercises.

Start and progression of treatment: treatment at this stage is about reducing pain and increasing joint range, joint reactivity before proceeding to the treatment itself. Sustained grade 2 movements and tractions of the joint surfaces are used, maintaining the joint in a position of rest or in a position of maximum relaxation. The immediate joint response regarding irritability and muscle amplitude should be observed.

Therapeutic intervention: adequate dynamic and static muscular perception, make the concave segments more flexible, extend the shortened muscles, passive mobilization exercises.

II: Postural Reeducation: the patient presents an improvement in his/her dynamic and static posture, presents greater respiratory volume and decreases back pain. Emphasis is placed on improving dynamic and static posture, the conceptualized work of increasing respiratory volume and reducing pain. It consists of 19 exercises.

### Stage objectives:

1. Continue the work of the previous stage.
2. Work stretching exercises to compensate both sides of the spine.
3. Work breathing exercises to strengthen the abdomen and improve respiratory capacity.
4. Work on exercises to increase physical endurance.

Therapeutic intervention: it is based on stretching to compensate both sides of the spine, breathing exercises are performed to achieve an improvement in respiratory capacity, abdominal strengthening work is increased and activities in front of mirrors are included.

Stage III: muscle definition: work continues on improving posture, flexibility and mobility, and respiratory volume. This allows new objectives to be set in search of a rapid and effective rehabilitation. It consists of 13 exercises.

### Stage objectives:

1. Continue the work of the previous stage.
2. Work on four point exercises to stabilize and balance both sides of the spine and continue with stretching exercises.





3. Begin to strengthen the muscles in its four anterior, posterior and oblique points.
4. Train muscle function and develop endurance to achieve postural control.

Therapeutic intervention: exercises will be performed at four points with the purpose of destabilizing and compensating both sides of the spine, stretching exercises are maintained and work is continued aimed at strengthening the muscles at its four points, ventral, dorsal and oblique.

Stage IV: muscle strengthening: work is focused on strengthening the abdominal, gluteal and oblique muscles and improving muscle tone. It consists of 11 exercises.

#### **Objectives of the stage:**

1. Continue the work of the previous stage
2. Strengthen the abdominal, paravertebral, oblique, and gluteal muscles
3. Improve paravertebral muscle strength and tone
4. Strengthening of the lumbar extensor muscle groups in the range of motion.

Therapeutic intervention: the strengthening of the gluteal, abdominal and oblique muscles is intensified, in addition to improving strength and paravertebral muscle tone.

#### **Orientations**

It should be taken into account that due to the complications associated with idiopathic scoliosis in children, such as back pain, respiratory complications (shortness of breath), early or late menarche, humps and deformities; rehabilitation is best done through the coordination of a team of physical rehabilitation and exercise professionals; as a guiding element, the objective that leads to the establishment of the stages appears.

The distribution of contents by stages corresponds to the needs of the patient because postural alterations can have various manifestations in their body segments.

Treatment or session methodology: the treatment session lasts 60 minutes, divided into three parts, initial, main and final. The initial part consists of an initial preparation with the boys/girls, where they are informed of the objectives and achievements to be achieved in each work session, and then go on to carry out control tests and continue with a warm-up, and this lasts for 5 to 7 minutes. Then the main part comes to fulfill the objectives of the session, its duration is between 45 to 50 minutes. To finish, the final part in which the patient recovers from the main part and lasts between 5-7 minutes.

#### **Recommended actions**

- Treatment planning through physical exercises.
- Rigorous monitoring of postural control.
- Pulse check.
- Control of heart rate and ventilation.



- Determine the right time for the increase in physical loads.
- Comply with work and rest times.

### **General methodological guidelines**

Recommendations for patients: maintain a correct posture during the sessions. Follow the guidelines of the kinesiologist or rehabilitator. Meet the objectives set for each session. Perform physical exercises with maximum efficiency.

General recommendations for the rehabilitator: carry out evaluation and control at the beginning of each class. Carry out dosage per work session (batches, exercises, repetitions, loads). Have planned objectives for classes. Individual characterization of physical work. Carry out individual and personalized treatment. Variation of the type of exercise.

### **Evaluation and control of the patient with idiopathic scoliosis**

Spinal evaluation should be performed as part of the monthly clinical check-up with special attention to preadolescence and adolescence. Children and adolescents with idiopathic scoliosis can be followed up by their primary physiotherapist or by the multidisciplinary team, if the curve presents a low risk of progression and any underlying pathology has been ruled out.

Idiopathic scoliosis is a diagnosis of exclusion. The clinical history and physical examination will try to rule out other secondary causes of deformity or the increase or decrease of vertebral alteration during the program.

The standard for the evaluation of idiopathic scoliosis is an anteroposterior radiograph in the lateral standing position. It is recommended to perform at least two X-rays, one before entering the physical exercise program for children and adolescents with idiopathic scoliosis (previous case study), the second and last when the program is finished, taking into account the short age of the participants in the program (especially children and adolescents), bearing in mind that a spinal X-ray is equivalent to 100 chest X-rays, it is necessary at all times to take care of the health of the participants to reduce the radiation dose, it is Therefore, the following is recommended:

- Whenever possible, the postero-anterior projection should be used, which reduces breast and thyroid radiation by up to 75 %.
- Gonadal protection (alterations in the timing of puberty).
- In analog equipment, it is suggested to use breast protectors, unnecessary in automatic digital equipment (all clinics do not have digital).

The physical examination: it is carried out every two months, three times in the program period, it takes into account:

- Height: serial determination of height, helps to determine the peak of pubertal thrust, which is a good predictive factor related to the degree of progression of the curve.
- Calculation of the peak of pubertal thrust: it is necessary to have sizes at regular intervals of six months, at least twelve times (two per month, 6 months of the



program) this value is 9 cm/year in girls and occurs, on average, at 12 years of chronological age and, in males, it is 10 cm/year and occurs on average at 14 years of chronological age.

Spine examination: the patient must be standing, barefoot, with the legs extended and the back uncovered and accessible to the examiner with their usual posture and without corrections.

With the patient on his back, observe: shoulder level. Scapula level. Pelvic level. Trunk centering or plumb line sign (must coincide between the spinous process of the seventh cervical vertebra and the intergluteal line).

The exam is carried out once every two months. In this way, the increase or decrease in hump/s, clinical expression of vertebral rotation, was evaluated. The maneuver is positive when the hump is present and is called "Positive Adams", and negative when it is absent and is called Negative Adams. The maneuver detects when there is vertebral rotation, but does not quantify it.

Scoliometer during the Adams maneuver and can be used to provide an objective measure of curvature rotation.

### **Control evaluations through tests**

Adams test: it allows to identify the existence of vertebral rotation, initial and the periodic control test that is carried out (advancement or retreat), of the curve during treatment, it is measured with a scoliometer, which is a good indicator for the evaluation of the patient; in the event that the curvature progresses a lot, it is referred to neurology. It is used to eliminate pelvic obliquity in lower extremity asymmetry and its specificity increases because it eliminates discrete asymmetries due to lower extremity length discrepancies, hip alterations or pelvic distortion.

Cobb angle ([Esperanza, 2014](#)): X-ray twice, at the beginning and end of the program, allows the value of the curve to be measured, usually using the Cobb test that expresses the magnitude of the curve in degrees. The upper and lower limits of the curve steepest in the opposite direction are identified.

### **Assessment of the corrective physical exercise program by specialist criteria**

The assessment by criteria of the specialists was based on the level of knowledge they have on the subject addressed. The criterion that prevailed among the specialists was seven on a scale of 0 to 10, which represents a high score for the degree of influence of each of the sources of argumentation in their criteria.

The corrective physical exercise program was submitted to the evaluation of the specialists in two rounds.

Criteria issued by the specialists when evaluating the program in the first round:

- The proposed program does not show a practical application logic.
- The contents are not guiding and tend to disorient the rehabilitator.
- To base from the theory the importance of corrective physical exercises and their function.



- Lack of classical methods and techniques for the correction of idiopathic scoliosis.
- Clarify which professional or professionals are responsible for making the diagnosis.
- It does not make clear the condition to move from one stage to the other.

Once the indications made by the specialists have been resolved, a second round of evaluation of the specialists is carried out on the corrective physical exercise program and they state:

- The 95 % value the corrective physical exercise program as very adequate and consider it necessary.
- The 100 % of the specialists surveyed value the corrective exercise program as very adequate in relation to the different content proposals it presents and consider that it contributes to the correction of idiopathic scoliosis.
- The 89 % of the specialists value the theoretical and practical conception of the corrective exercise program as very adequate and 11 % as adequate in relation to the theoretical support that supports them.
- The 97 % value the structure, organization, planning and content of the corrective physical exercise program as very adequate and 3 % as adequate, since it fulfills the objective and is relevant for practical application.
- The 100 % of the specialists value the proposal of the corrective physical exercise program as very adequate in relation to the fact that it allows patients to acquire skills and knowledge about idiopathic scoliosis and its form of correction.
- The proposed program is highly relevant given its importance and social utility
- Exercises were considered very well described by 88.8% of the experts, fairly well by 7.4%, and well by only one expert (3.7 %).
- There was consensus in considering the program's evaluation and control system to be very adequate and quite adequate.
- On the methodological orientations, criteria were poured that led to its improvement, above all it was necessary to expand them and write them with greater precision.

The theoretical-methodological conception of the program contributes to the theory of comprehensive rehabilitation **Fuhrer, (1989) cited by Amate, (2006)**.

## CONCLUSIONS

The structure of the proposed physical exercise program, its content and methodology, are determined by the theoretical and methodological conception that supports it, given in the adjustment to the objectives of the rehabilitation of the patient with idiopathic scoliosis in the context to which it is directed - Center Cuban Physical Rehabilitation, from Temuco, Chile -, the harmonic integration of elements of the most used methods



and programs in the rehabilitation of these patients, the description of a variety and quantity of therapeutic physical exercises that allow enriching the development of the sessions of rehabilitation, the methodological orientation to the rehabilitator for a correct planning and dosage of the exercises, as well as the development of actions with the patients and their relatives that favor the rehabilitation process.

The theoretical conception of the program and its possibilities of application and success in practice were favorably valued by the specialists.

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**Conflict of interests:**

Los autores declaran no tener conflictos de intereses.

**Authors' contribution:**

The authors have participated in the writing of the work and analysis of the documents.



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