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The impact of Risser exercises on plantar arch formation in kindergarten children with flat feet

O impacto dos exercícios de Risser na formação do arco plantar em escolares com pés chatos

Shirley Ivana Pizarro Soza
https://orcid.org/0009-0008-9704-2237
Technical University of Ambato
Master's degree in Physiotherapy and Rehabilitation.
Health Sciences Faculty
Ambato, Ecuador
spizarro7114@uta.edu.ec

Gerardo Fernando Fernández Soto
http://orcid.org/0000-0002-0246-0380
Technical University of Ambato
Master's degree in Physiotherapy and Rehabilitation.
Health Sciences Faculty
Ambato, Ecuador
gfernandez@uta.edu.ec

Franklin Hernan Cashabamba Padilla
https://orcid.org/0000-0001-7362-4648
University of the Americas. Ecuador
Public Health Master's Program
Postgraduate program of the Faculty of Health Sciences
franklin.cashabamba@udla.edu.ec

Diana Fernanda Sánchez Avelino
https://orcid.org/0009-0001-1398-4307
Master's degree in Physiotherapy and Rehabilitation.
Ecuadorian Institute of Social Security
Guayaquil, Ecuador
dsanchez3666@uta.edu.ec

Vanessa Santander Acosta
https://orcid.org/0009-0000-6364-0759
Master's degree in Physiotherapy and Rehabilitation.
Eloy Alfaro Secular University
Manta-Ecuador
esantander1551@uta.edu.ec

ABSTRACT

Background: Flat feet are an orthopedic problem that affects the biomechanics of the foot and also the musculoskeletal system. It manifests itself with the loss of the longitudinal arch due to a weakness of the intrinsic musculature of the foot. This type of foot is very common in school children, which must be addressed at this age, to avoid biomechanical complications in the future. **Objective:** to determine the effect of Risser exercises on the formation of the plantar arch of children with flat feet. **Methods:** the Hernández Corvo method was applied in the pre-evaluation for the analysis of the plantar footprint in children from a school in the city of Guayaquil, where children who had flat feet were identified. The Risser exercises were performed on them to strengthen the muscles of the sole of the foot and form the plantar arch. These were performed 3 times a week at school, and the exercises were taught to the parents by the physiotherapist. **Results:** the post-evaluation of the plantar footprint was carried out, the results showed the formation of the longitudinal arch of the foot with the Risser exercises, meaning that the flat foot improved, giving rise to a normal flat foot. **Conclusions:** with the Risser exercises, favorable effects were obtained in the formation of the plantar arch in childhood flat feet. The results showed the formation of the longitudinal arch of the foot with the Risser exercises, meaning that the flat foot improved, giving rise to a normal flat foot.

Keywords: Deformity, plantar footprint, Kindergarten, Early intervention, Societal benefits, Risser exercises

RESUMO

Introdução: Pés planos são um problema ortopédico que afeta a biomecânica do pé e também o sistema musculoesquelético. Manifesta-se com a perda do arco longitudinal devido a uma fraqueza da musculatura intrínseca do pé. Esse tipo de pé é muito comum em escolares, devendo ser abordado nessa idade, para evitar complicações biomecânicas no futuro. **Objetivo**: determinar o efeito dos exercícios de Risser na formação do arco plantar de crianças com pés planos. **Métodos**: aplicou-se o método Hernández Corvo na pré-avaliação para análise da pegada plantar em crianças de uma escola da cidade de Guayaquil, onde foram identificadas crianças que apresentavam pés chatos. Neles foram realizados exercícios de Risser para fortalecer a musculatura da planta do pé e formar o arco plantar. Estes foram realizados 3 vezes por semana na escola, e os exercícios foram ensinados aos pais pela fisioterapeuta. **Resultados**: foi realizada a pós-avaliação da pegada plantar, os resultados mostraram a formação do arco longitudinal do pé com os exercícios de Risser, significando que o pé plano melhorou, dando origem a um pé plano normal. **Conclusões**: com os exercícios de Risser foram obtidos efeitos favoráveis na formação do arco plantar em pés planos infantis. Os resultados mostraram a formação do arco longitudinal do pé com os exercícios de Risser, significando que o pé plano melhorou, dando origem a um pé plano normal.

Palavras-chave: Deformidade, pegada plantar, Jardim de infância, Intervenção precoce, Benefícios sociais, Exercícios de Risser.

INTRODUCTION

Flat feet is a variation of the normal structural anatomy of the foot that can occur unilaterally or bilaterally Molina, et al. (2022). The absence or deformity of the plantar arch is known as flat foot, which gives stability to the body and provides a stable gait. It also helps by correctly distributing the weight of the body. It allows adaptation to the irregularities of the ground. It is advisable that this condition be diagnosed and given treatment at school age. This is because, at birth, infants normally present adipose tissue in this part of the foot. This type of problem must be corrected early through adequate

physiotherapy intervention, Flat feet constitute a very common orthopedic condition in pediatric patients Motoche, et al. (2019)

In Argentina, 15% of the adult population has flat feet and does not present symptoms, but there is 7 - 15% of people who do present symptoms and therefore need treatment. Flat foot often goes unnoticed in childhood, but in adolescence and adulthood it manifests itself by generating pain or problems performing physical or daily activities, as well as causing injuries or affecting sports performance. They mainly cause pain, even affecting the knees and hips (Molina, Cristina; Rossi Sabrina; Lopez del Amo, Andrés; Perez Aitor: Ramos, Laura; Leal, 2022). In Riobamba, Ecuador, at the Francisco Chiriboga Children's Center for Good Living, 57% of schoolchildren were observed with flat feet, which is why It is extremely important to intervene in school children to correct flat feet since they represent a typical problem of the child population and have biomechanical repercussions in the future. Frequently, lack of knowledge in society as well as in parents is a factor for which early intervention is not taken and if it is not corrected at school age. Both in adolescence and in adulthood, there will be orthopedic alterations as consequences. For its correction, surgery can be needed in extreme cases. The plantar arch develops in childhood, so it is necessary to diagnose and treat it at this stage in order to correct it with physiotherapy treatment. Risser exercises are used to form the plantar arch since the structures are developing in childhood Motoche, et al.(2019)

The physiotherapy treatment for this type of foot is to strengthen the muscles and fascia of the plantar region; which gives rise to the formation of the longitudinal arch. The diagnosis and treatment of flat feet goes unnoticed at school age since in many cases there are no symptoms. With this research, the effect of Risser exercises on children with flat feet as a conservative treatment was determined. Parents of the Berea Educational Unit were also informed about the importance of diagnosis and treatment at this age. One of the specific objectives of this research was to identify the type of foot that school children present. This was carried out through the Hernández Corvo method which allowed us to analyze the plantar footprint and identify the type of children's foot. Normal, flat and cavus feet were found. (Motoche, et al. (2019).

BACKGROUND

Yamashita et al.(2022), in their article "Analysis of skeletal characteristics of flat feet using three-dimensional foot scanner and digital foot print", mention that flat feet can become a risk of knee osteoarthritis and is related to the lack of arch support of the foot. Insufficient flexibility of the plantar ligaments and tendons produce a collapse of the medial arch of the foot. It reduces the ability of the foot to absorb shock when walking or running. It can also increase the risk of foot injury and cause plantar fasciitis, metatarsal pain, knee pain, low back pain, and rearfoot deformity due to high forces of impact. Therefore, there is increasing interest in foot shape assessments for flat feet. Footprint analysis is simple and easy to access and it has been recommended as a tool to detect flat feet. For the diagnosis of flat feet, it is important to consider the following factors: subjective symptoms, physical findings, analysis of the footprint obtained, and diagnostic imaging which may include weight-bearing radiographs. To determine the degree of deformity, a set of radiological parameters is used to measure specific angles. They are obtained using standard dorsoplantar and lateral radiographs of the weight-bearing feet. The procedures to determine these angles are rapid, and depend on the quality of the radiograph and the skill of the observer (Yamashita et al., 2022).

Bachhouse, Parker (2022), in the study called "Using a modified nominal group technique to develop complex interventions for a randomized controlled trial in children with symptomatic pes planus", mentions that children with symptomatic flat feet frequently request health care, but questions remain about the best way to manage this condition. A three-arm trial was conducted to evaluate three commonly used interventions for flat feet (exercise and counseling, exercise and counseling plus prefabricated orthoses, and exercise and counseling plus custom-made orthoses). They used the Nominal Group Technique in consecutive meetings in combination with a novel questionnaire. This allowed the development of complex interventions that reflect clinical practice. 16 health professionals participated in this research, 11 podiatrists, 2 orthopedists, 2 physiotherapists and 1 orthopedic surgeon. Both meetings approved the broader amended logic model for flat feet and its treatment, with shared decision making through practice. Short lists of treatment options such as prefabricated and custom-made orthoses, stretching and strengthening exercises, and health promotion and counseling were agreed upon. They concluded that the process of combining data with face-to-face meetings ensured that the interventions are reflected in contemporary practice (Backhouse et al., 2022).

Rosero, et al. (2021), in the article "Addressing the Data Acquisition Paradigm in the Early Detection of Pediatric Foot Deformities", mention that analysis of plantar pressure through podometry has made it possible to analyze and detect various types of feet in pediatric patients. Early detection of improper weight distribution in children can prevent serious injuries to the knees and lower spine. In this article, a system capable of detecting the presence of normal, flat or arched footprints using resistive pressure sensors was proposed. To this end, related options for both hardware and software were

studied for data acquisition for the footprint analysis process. Subsequently, the algorithms made it possible to estimate the type of biomechanics of the footprint in preschool and school volunteer children. As a result, this algorithm used achieved very good classification accuracy, an accuracy rate of 97.2%. Thanks to this, a proportion of flat feet of 60% was found in a sample of 1000 preschool children. Flat feet were even observed in 52% of a sample of 600 school children (Rosero-Montalvo et al., 2021).

Riviera, et al. (2020), in the article "Flat foot index and areas of highest prevalence of musculoskeletal alterations in young athletes", mention that the alteration of the plantar footprint or longitudinal arch affects those individuals who practice sports, because foot is a body weight supporter. The article mentions how a flat foot and a cavus foot can impact the sporting performance of women or young men. The study was carried out on young people between 9 and 20 years of age. The sports considered were basketball, soccer, baseball among others. The results indicated a high percentage in young female athletes (30.2%) who had a pes cavus and a percentage of 19.2 in men. The knee is the most affected part of the body (Miguel-Andrés et al., 2020).

Fuentes, et al. (2020), in the study "Comparative assessment of flat feet in preschool children", explains that the increase or reduction of the medial longitudinal arch can affect main functions in the biomechanics of the foot with consequences for long-term health. The objective of this study was to determine the height of the medial longitudinal arch in children aged 3 to 6 years using five footprint analysis methods for the diagnosis of flat feet. They carried out a cross-sectional observational study with 367 children aged 3 to 6 years from a municipality in the State of Mexico. They performed a complete postural evaluation, plantoscopy and footprint analysis calculating the height of the longitudinal arch. The prevalence of flat feet with the podoscope was 57.7%. In this study, a high percentage of alteration of the plantar footprint with an affectation of the longitudinal arch is noted. They concluded from their results that footprint analysis should be performed for the diagnosis of flat feet and in addition to the classic podoscope evaluation. They always recommended including the diagnosis and monitoring of flat feet in the healthy child's consultation, since a breech alteration can be detected from an early age (Fuentes-Venado et al., 2020).

Hanreed, Baseer, (2020), in the study "Anthropometric Assessment of Pediatric Flat Feet: A Diagnostic Accuracy Study" explains that flat feet involves the total descent of the medial longitudinal arch in standing, that is, when children begin to stand. The objective of their study was to determine the precision of radiographic and pedometer measurements in the diagnosis of pediatric flat feet. It was a cross-sectional study with a total of 84 preschool and school-aged children equally recruited in the control and flatfoot groups. Each child was examined and further classified into pes planus and normal pes planus. Additionally, lateral and anteroposterior radiographs of the feet were taken, while the footprints were captured with a podoscope and analyzed in the footprint analysis software. The results were 42 children in the flatfoot group, 26 had normal flat feet while 16 had flat feet. Radiography had a sensitivity and specificity of 95% and 69%, respectively, while pedometry was 86% sensitive and 47% specific. It was concluded that the diagnostic accuracy of radiography and pedometry are very valid and, if necessary, can be complemented only when necessary. This combination with clinical evaluation is very useful in the treatment of pediatric flatfoot (Hanreed, 2020).

Ordinola, et al. (2019), in their article "Effectiveness of Risser exercises in flat feet in children treated at the Virgen de Fátima Chachapoyas Regional Hospital", mention that flat feet in children are usually asymptomatic. The population was made up of 24 children from 3 to 5 years old with a diagnosis of flat feet and attended the Virgen de Fátima Regional Hospital after the application of the Risser exercises. It was based on 10 therapeutic exercises with the aim of improving the fall or decreasing the longitudinal arch of the foot. They used Plantigraphy as an instrument. The patient had to sit with his feet painted in the plantar area. And then their feet were rested on a sheet of paper (Hernández corvo Method). It allowed us to observe the type of foot that the child has, 69.2% with flat feet (being the highest percentage). An evaluation form was used to collect data before and after the intervention with the exercises. 13 children had 53.8% flat feet and 30.8% normal flat feet (Ordinola, Carla ;Chauca, 2019).

Arcila, et al. (2019), mention in their work called "Analysis of the plantar footprint under the HERZCO method" (Hernández Corvo Method),that the analysis of footprints using a podogram or graphic impression of the sole of the foot is a very useful tool to observe the support of each foot in contact with the surface. Furthermore, it is a simple procedure that continues to have the same validity in recent years up to present days (Shiang et al., 1998). This is mainly used in subjects in the biomedical area such as Kinesiology and Biomechanics. It requires prior knowledge of Mathematics and Biophysics, such as the concepts of straight lines, parallelism, perpendicularity, angle, proportion, interval, percentage, physical concepts of force and pressure, also Newton's laws involved in the transmission of loads, forces, actions and reactions. These allow us to study the standing conditions of the human body, and identify pathological situations that affect posture and that can be intervened in a timely manner. The authors' objective of the article was to emphasize the importance of physical-mathematical tools for the typological analysis of the foot, using classic methods (Hernández, 1999; Mann, 1975; Izquierdo, 2008; Lara et al., 2011; Viladot, 2001). They are sensitive and low cost, allowing periodic evaluation in the study populations. This reason justifies promoting the practice in the biomedical areas of programs related to physical activity and sports, in

different sports and work fields (Arcila Arango et al., 2019).

Peralta, et al. (2018), in their article called Performance in the area of Physical Education and type of plantar footprint in Limeño schoolchildren, mention that the sole of the foot in children has an adipose cushion which is sometimes confused with false flat foot. It disappears during growth or development of the child almost completely around 4 years of age. The plantar arch or vault begins its development between 4 and 6 years of age as ambulation also matures and is influenced by internal and external factors sometimes obtaining a gait pattern with biomechanical alterations when flat feet persist, The authors' research was descriptive, correlational and explanatory cross-sectional. Non-probabilistic convenience sampling was used. They selected 31 subjects for each age group between 6 and 12 years, making a total of 217 students from a school in Lima, of which 116 were women and 101 were men. They carried out the analysis of the plantar footprint with the Hernández Corvo method with which they categorized the foot based on the elevation of the plantar arch. That is, flat foot, normal foot and cavus foot. This method, in clinical practice, has good precision both in the analysis and in the classification of foot type (Peralta, Sadith; Santiesteban, Jannet, 2018).

Rojano (2019), in the article, "Analysis of the plantar footprint in 4th year ESO schoolchildren", mentions that one of the most used classifications of the foot is the normal foot, flat foot and cavus foot. The author, in the study, aimed at determining the foot type of students within an age group of 15-16 years in the fourth year of secondary education. He used the Hernández Corvo Method, which is meant to be very useful to determine the morphology of the foot. It helps to classify the type, which can be, flat foot; normal flat foot; normal foot; normal cavus foot; cavus foot; strong cavus foot and extreme cavus foot. He also explains that there are several factors that influence the morphology of the foot such as age, sex and sports practice. He also states that the work carried out on school populations has been carried out mainly on primary school students, but there are few studies carried out on students in the last years of secondary education. Therefore, the objective of his study was to determine foot type, using the Hernández-Corvo method, at ages 15 to 16 years(Rojano, 2019).

Toullec (2019), mentions in the article "Static valgus flatfoot of the adult", that the collapse of the longitudinal arch of the foot, that is, the fall of the plantar vault, is associated with the valgus of the rearfoot and the abduction and supination of the forefoot. The consequences are the failure of the means of adaptation of the foot during walking, which leads to an effect on the biomechanics of the foot and also associates an involvement of the posterior tibial tendon which is the cause or consequence of the deformation. He highlights the fact of a clinical evaluation completed with weight-bearing x-rays to look for and know the location of the involvement and to see if there is congenital osteoarthritis or synostosis in the joints of the foot. He also refers to the fact that plantar orthoses, which is used in the treatment of flat feet, constitute a treatment for the symptoms of flat feet as a first choice but its effectiveness is debated (Toullec, 2019).

Old, et al. (2019), in the article "Cavus foot", defines it as a deformation of the longitudinal arch of the foot and an increase in it. It is sometimes associated with a claw deformity of the toes, depending on its etiology, which is mostly neurological. This must be a reason for study. Knowing the function of the foot, the etiology and its evolution according to the patient's tolerability, conservative medical treatments are used. The cavus foot is characterized by an increase in the plantar concavity. It is the opposite of the flat foot, which is found with too much elevation of the plantar arch. This does not allow good support on the ground, altering the morphology and statics of the foot leading even to an external rotation of the lower extremity with a misalignment of the lower limbs. Medical and podiatric treatment is necessary, as mentioned by the authors of this article, and surgery is proposed when the pain symptoms are not controlled, as in flat feet (Viejo-Fuertes et al., 2019).

González, et al. (2018), in the article "Retrospective analysis of flexible flatfoot treatments (1977-2018)" concluded that there is lack of studies with orthoprosthetic and conservative treatments in general, and childhood flatfoot is a variant and physiological condition throughout over time. Various authors have classified it into different types or degrees, the arch strengthens over time, and other authors define it as a deformity where there is no exact definition of the classifications of flat feet. There is an extensive bibliography on studies on a multitude of surgical techniques applied to flat feet. In future research, valid classification methods should be obtained that facilitate the study and provide adequately evaluated outcome measures for the intervention carried out (Alberto González Acosta et al., 2018).

Kirby (2017), in the article "Discharge distribution system of the longitudinal arch", mentions that the longitudinal arch of the foot has a unique system of loads which work synergistically with the bone elements, fascia and all the anatomical elements that make up the arch. They maintain the longitudinal arch in loading situations. The collapse or fall of the longitudinal arch was known as weak foot or flat foot. When there is a cavus foot, that is, a very high arch, it can lead to foot dysfunction and when there is flat foot, this generally produces pain, fatigue, and joint degeneration. The importance of the longitudinal arch is quite verifiable when there are alterations in this. The alterations in the biomechanics of the musculoskeletal system can be noticed with the naked eye, reaching the conclusion that it serves to support the loads of the individual and if it is altered, the activities cannot be carried out smoothly, effectively and without risk of injury (Kirby, 2017).

Cáceres (2014), in his article "Typification of the foot print in schoolchildren between 6 and 8 years of age from the urban population of the Municipality of Pamplona", mentions that according to Viladot (2000), the footprint impression serves to typify or classify flat feet into four categories of progressive severity. According to Hernández Corvo (2002), the method to analyze the type of foot according to the descent of the plantar vault results in the typification of the foot according to measurements that are made based on the plantar impression. It translates into a classification of the foot type, which starts from the flat foot and can reach the extreme cavus foot (Sirgo and Aguado, 1991; Sirgo et al., 1997; Abián et al., 2005; Zurita, Martínez and Zurita, 2007). In this cross-sectional descriptive study, the plantar vaults of the children's population in the urban area of the municipality of Pamplona were analyzed with a single data collection. Participants whose parents provided consent for the study were considered. The plantar imprint was analyzed and from this analysis the type of foot was determined. It depended on descent of the plantar vault according to the plantar impression method, with normal load taken, under the method of Hernández Corvo, 2002. The average value of the plantar imprint of 72 children was 29.6%, which allows us to affirm that the group of children was classified as having a flat plantar footprint (Cáceres, 2014).

Espinoza, et al. (2013), carried out a study called "Prevalence of foot anomalies in basic education children between 6-12 years old in school in the city of Arica Chile". They mentioned that orthopedic foot problems in children are the more frequent in these age groups. For this reason, it is important to differentiate between a normal foot and an altered foot. The objective was to determine the prevalence of flat feet and cavus feet in students from Arica. 420 students (210 girls and 210 boys) from 3 different types of schools in the city of Arica, aged between 6 and 12, were measured. They performed a podoscopy evaluation of the footprint to identify flat feet. A survey was administered to parents and teachers about the level of knowledge and implications regarding the foot disorder. Flat feet correspond to the decrease or disappearance of the plantar vault (Viladot & Rochera, 2009). It is made up of the base of the first and fifth metatarsals and the support of the calcaneus. This alteration can be of congenital or acquired origin. Young children between 4 and 5 years old present an image of a flattened foot, due to adipose tissue (fat), and this develops with the child's growth. The results showed in male children a prevalence of 31.6% for flat feet and 11.6% for pes cavus, in relation to 56.8% of children with normal feet. In girls the values indicate 24.3% for flat feet and 14.4% for cavus feet. It is concluded that flat foot has a higher prevalence in the student population of Arica, with 28% and cavus foot has a prevalence of 13% in total (Espinoza-Navarro et al., 2009).

Fernández, at al. (2012), mention in their article "Effects of treatment with Kinesio tape in flat feet" that the objective of their study was to evaluate the changes produced in the posterior pain of the leg and in the valgus of the rearfoot in patients with flat feet. This was applied from the posterior tibial to the internal longitudinal arch. The experimental results showed a significant decrease after the intervention, reducing pain, but no significant difference was observed post-intervention on the longitudinal arch since it remained the same. With this, it was proven that Kinesio tape helps with the pain caused by having a deformity in the plantar arch, and that it does not help to correct flat feet (Fernández Román et al., 2012).

Barchello, et al. (2008), in the study "Prevalence of flat feet in school children of Asunción and Great Asunción", analyzed 300 children of both sexes, schoolchildren between 5 and 13 years of age. They were evaluated by podoscopy with a podoscope to know the prevalence of flat feet. They also used a podogram which consisted of placing alcohol on the sole of the foot and then stepping on a fax sheet. This was done in public educational centers in Asunción and Great Asunción. The positive cases and subjects where their footprints were grouped to determine the degree of flat feet. A total of 97 schoolchildren had flat feet, with a prevalence of 32.2%, of which 52 patients were men (53.6%) and 45 women (46.4%). The highest frequency of flat feet in children was observed between 5 to 7 years, 46 patients (47.4%) (Barchello et al., sf).

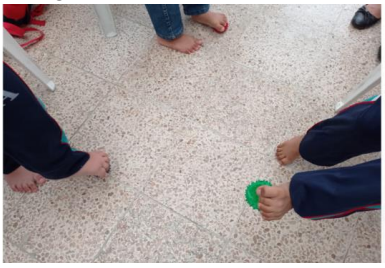
METHODS

The study had a descriptive methodology with a longitudinal quantitative approach. The research project was carried out at the Berea Private Educational Unit in the city of Guayaquil, Ecuador. The research population was 25 children between the ages of 5 and 7. The Hernández Corvo method was applied to determine the type of foot. From this population a sample of 8 children who presented flat feet was obtained. The Risser exercises were applied to them to form the plantar arch. The Hernandez Corvo Method was used, which consists of the typification of the plantar footprint. Talcum powder was impregnated on the soles of the children's feet and then they were made to step on a black cardboard to obtainin the plantar print. With this, the foot types in preschool children were identified,

The 8 children with flat feet received the physiotherapeutic intervention with the Risser exercises. Exclusion and inclusion criteria were established. The inclusion criteria were boys and girls aged between 5 to 7 years who have authorization from their parents or guardians for the pre-evaluation to be applied. The evaluation method and Risser exercises were validated by experts in the area. It included a sports doctor and two physiotherapists. The exercise scheme consists of a series of 10 exercises applied 3 times a week at school and reinforcement at home every day. The exercises were taught to the parent by the researcher so that they can be performed at home. The duration of the therapy session will be 30

minutes. The exercises were taught to the parent or representative in order to obtain better results and can also be performed at home. After 6 months, a post-evaluation was carried out applying the Hernández Corvo method. The formation of the plantar arch from flat feet to a normal flat foot was observed in the children.

Figure 1. Stream of the study

<table>
<tr>
<td>1.-Towel Exercises: According to Rivera 2013, for the first exercise, the child performs crumpling a towel on the floor with his toes, 30 times, 1 to 2 times a day.
  </td>
<td>2. Exercises with marbles or balls. The child must grab the marbles or balls with his feet. It should be done 30 times, 1 to 2 times a day.
  </td>
</tr>
<tr>
<td>3.- Exercise with pencils: Next, colored pencils will be placed on a carpet in a disorderly manner and the patient will be asked to pick them up with their toes and hand them to the opposite side to which they picked them up.
  </td>
<td> 
4.- With a wooden roller or something similar that simulates a roller, place it under the sole of the foot and proceed to move it from front to back, supporting the sole of the foot well. This procedure can be done at least 20 times alternating each foot.</td>
</tr>
<tr>
<td>5.- Place a ball on the floor and ask the patient to lift it 20 to 25 cm with the outside edges of their foot, repeating this action at least 10 times.
  </td>
<td>6.- The child will be asked to take a seat and place one of his feet and swing it from the inside out slowly and firmly, settling from the tip of the foot to the heel. It can be with a ball or rocker, even with its external edge supported on the floor. In order to exercise both the inside and outside of the foot, this exercise should be performed about 20 times on each foot.
  </td>
</tr>
<tr>
<td>7.- From the previous exercise, place it in the opposite way; and with the foot completely attached to the small platform it will swing from one side to the other slowly but firmly, exercising the entire lateral area of the foot.
  </td>
<td>8.-Outer edge: Stand on the outside edges of your feet, bending your toes at the same time, resting and repeating the exercise 10 times.
  </td>
</tr>
<tr>
<td>9.- Tiptoe: The patient will be asked to walk around the room leaning on the tips of their feet for a period of five minutes, rest and proceed to walk on tiptoe once again.
  </td>
<td>10.- Heel standing: Take a walk leaning on your heels, this should be done for a period of 5 minutes, rest one minute and repeat the procedure once again.
  </td>
</tr>
</table>

Source: Own elaboration with the research data (2024)

The research was carried out with the approval of the Human Research Ethics Committee of the Faculty of Health Sciences of the Technical University of Ambato. It issued an approval resolution with the code, 037-CEITSH-UTA-2023. Ethical and gender considerations were maintained throughout the research. The results of each child were coded and the children's faces were hidden in the photographs. This helped to guarantee the protection of identity in the photos, with due

confidentiality and privacy, when performing the exercises. Informed consent was used to protect and guarantee the rights of children. It was signed freely and voluntarily by the children´s parents who participated in the research project.

RESULTS

The results obtained from the pre-evaluation in the research were the identification of the type of foot in the schoolchildren applying the Hernández Corvo method. These data were collected in the observational record, the types of foot presented by the children from 5 to 7 years old were the following: Cavus foot, normal foot, normal cavus foot and flat foot.

Table 1: Identification of foot type in schoolchildren according to the Hernández Corvo Method in Pre-evaluation.

FOOT TYPE	**Frequency**	***Percentage (%)***
Flatfoot	**8**	**32**
Normal flat foot	**0**	**0**
normal foot	**10**	**40**
Normal foot Cavus	**4**	**16**
Cavus Foot	**3**	**12**
Strong Cavus Foot	**0**	**0**
Extreme Cavus Foot	**0**	**0**
Total	**25**	**100**

Percentages of the Hernández Corvo Method: Flat Foot 0-34%. Normal Flat Foot 35-39%. Normal foot 40-54%. Normal foot Cavus 55-59%. Cavus Foot 60-74%. Foot Cavus strong 75-84%. Extreme Cavus Foot 85-100%.

Analysis: 32% had flat feet, 40% had normal feet, 16% had normal cavus feet and 12% had cavus feet. These results show us the prevalence of flat feet in school children, which demonstrate the importance of carrying out this type of research projects with a physiotherapeutic approach for flat feet at ages between 5 and 7 years.

Table 2: Sociodemographic data of children with flat feet

Ages	***Frequency***	***Percentage (%)***
5-6 years	7	90
7 years	1	10
Total	8	100
Gender	**Frequency**	**Percentage (%)**
Male	6	75
Female	2	25
Total	8	100

Source: Own elaboration with the research data (2024)

Analysis: In the observational form, the Sociodemographic data of the children with flat feet were collected. In the population with flat feet, males predominate with 75%, and females with 25%.

Table 3: Pre-evaluation and Post-evaluation of flat feet in schoolchildren with the Hernández Corvo Method.

Pre-assessment Flatfoot	***Mean – Standard deviation***	***Post-assessment Normal Flat Foot***	**Mean – Standard deviation**
Right foot	23 0.081	*Right foot*	33 0.029
Left foot	26 0.045	*Left foot*	34 0.027

Percentages of the Hernández Corvo Method: Flat Foot 0-34%. Normal flat foot 35-39%

Analysis: After the identification of the foot type in the schoolchildren, the children who had flat feet underwent Risser exercises at school to form the plantar arch. These results demonstrate the evolution of the plantar footprint, that is, the morphology of the foot before and after the intervention in children with flat feet. The results of the pre-evaluation and post-evaluation after the intervention with Risser exercises are evident.

Table 4: T-Student test in the study population between Pre-assessment and Post-assessment

T-Student test for means of two paired samples right foot		
	PRE RIGHT FOOT	**POST RIGHT FOOT**
Half	23,125	32,875
Degrees of freedom	7	
α	0.05	
t-statistic	-3,062	
Critical value of t (one-tailed)	1,894	
T-Student test for means of two paired samples left foot		
	PRE LEFT FOOT	**POST LEFT FOOT**
Half	25,625	33.75
Degrees of freedom	7	
α	0.05	
t-statistic	-5,051	
P(T<=t) one tail	0.000738664	
Critical value of t (one-tailed)	1,894	

Source: Own elaboration with the research data (2024)

Analysis: Null hypothesis: Risser exercises do not improve flat feet. Alternative hypothesis: Risser Exercises improve flat feet. In both cases, that is, for the plantar footprint of the right foot and left foot, the alternative hypothesis ensures that the mean of the sample in the pre-evaluation is lower than the mean of the post-evaluation sample and given that the t-statistic for the right foot is of -3.062 and the one on the left is -5.051 and these are less than -1.894. Therefore, the alternative hypothesis is accepted.

DISCUSSION

In the pre-evaluation in which the Hernández Corvo method was used, it is shown that school children aged 5-7 years presented alterations in the plantar footprint, which were 40% normal feet, 32% flat feet, 16% normal cavus foot and 12% cavus foot. These results are not similar to those mentioned by Peralta, et al. (2018) in their study with 17.97% flat feet, 27.65% normal feet; 54.38 cavus foot. But in both research projects, the percentages or values using the Hernández Corvo method demonstrate the alterations of the foot prints in schoolchildren.

In this research, according to the data collected in the observational form, flat feet predominated in males with 75%, and females with 25%. Motoche, et al. (2019) in their study found 67% of flat feet in females. With these values we see that both projects did not have similar results regarding gender with the alterations of the plantar footprint, but it is noted that in both, flat feet predominated as one of the main alterations in preschool children.

In the post-evaluation of the children who completed the physiotherapy intervention with Risser Exercises for flat feet, a favorable evolution was observed with respect to the flat feet they presented, obtaining a normal flat foot. That is, 23-26% of flat feet had a favorable evolution, which reached 33-34% of a normal flat foot. Motoche, et al. (2019) show that 67% of the patients improved after physiotherapy treatment. I applied the Hernández Corvo method with which it shows that of the 26% with flat feet they reached 35% in the plantar footprint, reaching normal flat feet according to the method. . With these results, both investigations are similar since in both they applied the Risser exercises for flat feet and in both the results were favorable for children who had flat feet.

CONCLUSIONS

Once the research process was completed, it was observed thanks to the analysis of the plantar footprint, that children aged 5 to 7 years had alterations in the plantar footprint. That is, not all of them had a normal foot. They had flat feet, cavus feet, and normal cavus feet and normal feet. These results show us the prevalence of flat feet and other types of

foot disorders in school children. This demonstrates the importance of carrying out this type of research projects with a physiotherapeutic approach at preschool ages to help in early diagnosis and for timely treatment. It aims at avoiding complications in the future of flat feet such as the biomechanical repercussions on the musculoskeletal system that, if not corrected in time, can cause repercussions on the foot, hip, knees, gait and alterations in posture.

The Hernández Corvo method is an easy and practical instrument to apply. It is accessible since it consists of taking the foot print and then making the respective measurements. It is important that it continues to be used for this type of research since it is economical for the researcher and gives a reliable result. This was useful for the pre and post evaluation of the children's footprint. It also allowed us to identify the type of foot. Children who presented flat feet had a post-evaluation with this method, after applying the Risser exercise scheme for 6 months.

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