



## Original

### **Auxiliary means for the rehabilitation of the bronchial asthma in children of 8 to 12 years** **Medios auxiliares para la rehabilitación del asma bronquial en niños de 8 a 12 años**

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#### **Abstract**

The bronchial asthma is the commonest chronic illness in pediatric ages and the principal cause of hospital confinement in Cuba. The physical exercise applied to the asthmatic one is understood inside the means that compose the therapeutic strategy designed for the same ones, combining in a harmonious and personalized form with the rest of the therapeutic methods, however, the insufficient use of the auxiliary means, restrict the correct rehabilitation of the asthma in children, that is why it is proposed to elaborate a set of auxiliary means to favor the rehabilitation of the asthma in children of 8 to 12 years of Báguanos's municipality. For the logic of investigation methods of the theoretic level, empiric and within this the techniques of consent were utilized. The proposed means fulfills a series of basic characteristics in agreement with the pupils' possibilities, with the limits of the environment and with the marked objectives in the programming, as a result six means were made. Evaluated of very appropriate for specialists in the nominal group, since it offers possibilities of application, possess practical sense, adaptability, certainty and profitability-duration. The application of the statistical methods, verified that difference exists among the measurements in the studied cases that allows affirming the positive effect of the employed means to favor the rehabilitation of the bronchial asthma in children.

**Key words:** bronchial asthma; auxiliary means; rehabilitation; children

## **Resumen**

El asma bronquial es la enfermedad crónica más común en edades pediátricas y la principal causa de ingreso hospitalario en Cuba. El ejercicio físico aplicado al asmático está comprendido dentro de los medios que componen la estrategia terapéutica diseñada para los mismos, combinándose de forma armoniosa y personalizada con los demás métodos terapéuticos, sin embargo, el insuficiente empleo de los medios auxiliares, limita la correcta rehabilitación del asma bronquial en niños, por lo que se propone elaborar un conjunto de medios auxiliares para favorecer la rehabilitación del asma bronquial en niños de 8 a 12 años del municipio de Báguanos. Para la lógica de la investigación se utilizaron métodos del nivel teórico, empírico y dentro de este las técnicas de consenso. Los medios propuestos cumplen con una serie de características básicas acorde con las posibilidades de los alumnos, con los límites del entorno y con los objetivos marcados en la programación, como resultado se confeccionaron seis medios. Evaluados de muy adecuados por especialistas en el grupo nominal, dado que ofrece posibilidades de aplicación, poseen sentido práctico, adaptabilidad, seguridad y rentabilidad-duración. La aplicación de los métodos estadísticos, constató que existe diferencia entre las mediciones en los casos estudiados lo que permite afirmar el efecto positivo de los medios empleados para favorecer la rehabilitación del asma bronquial en niños.

**Palabras clave:** asma bronquial; medios auxiliares; rehabilitación; niños

## **Introduction**

Respiratory diseases, including smoking, are along with cardiovascular diseases, the most prevalent in the world and those that cause greater mortality and morbidity (Cedeño, Algas, Reyes & Gonzalez, 2016), among them is bronchial asthma considered by Alvarez (2014), as a chronic inflammatory disorder of the airways, this inflammation produces recurrent episodes of wheezing, dyspnea, chest tightness and coughing, particularly at night or early in the morning.

Studies show prevalence in the United States and Northern European countries of 5%; Western Europe and Mediterranean countries of 1-4%; Australia and New Zealand of 6.8-9.7%. Meanwhile, in Latin America the figure varies from 5.7 to 16.5 % (Vega, 2011).

Researches in Cuba states that Bronchial Asthma is a serious health problem, since it affects 10% of the population. It is the most common chronic disease in pediatric ages, affecting 12%, being within the noncommunicable diseases, the main cause of hospital admission in Cuba. According to the Health Statistical Yearbook (2018), it ranks seventh in mortality and is one of

the top 35 causes of death with 296 deaths and a rate of 2.6 per 100,000 inhabitants, affecting both sexes equally.

In Holguín, the prevalence of bronchial asthma according to age group and sex in 2017 behaved as follows, between the ages of 5 to 9 years records a rate of 123.9 per 1 000 inhabitants of sex and age, and between 10 and 14 years this rate behaved at 160.2 per 1 000 inhabitants.

Since no curative treatment is currently available, despite advances in pharmacological treatment, the fundamental objective is to control it. Physical exercise applied to asthmatic patients is included within the means that make up the strategy designed for them, combining it in a harmonious and personalized way with the other therapeutic methods which are: immunotherapy, pharmacotherapy, supportive psychotherapy, environmental control and education about the disease (Díaz & Ponce, 2006; Cartas, 2010).

The scientific studies carried out by Barbosa (2010); Sánchez (2010); Cartas (2010); Vizueta (2012) on an international scale and Negrin (2004); Arias (2010); Torres (2011); Vega (2011); Vera (2012); Espinosa (2014); Quintana (2019) and Santiesteban (2020) in the Cuban context, have demonstrated that physical rehabilitation through different physical exercises in land and water, traditional Chinese gymnastics and games are effective in decreasing the number and severity of asthma crises. However, these researches focus their attention on physical exercises as fundamental therapeutic means and limit the use of auxiliary means within their proposals.

In accordance with the above, the authors questioned how to favor the rehabilitation of bronchial asthma in children from 8 to 12 years old in the municipality of Báguanos and proposed as objective: to elaborate a set of auxiliary means to favor the rehabilitation of bronchial asthma in children from 8 to 12 years old in the municipality of Báguanos.

## **Methodology**

The research has a prospective, pre-experimental and quantitative character in a sample conformed by 46 children with bronchial asthma from 8 to 12 years old from the municipality of Báguanos selected in a random way (raffle technique) and that represent 31.5% of the population of children with bronchial asthma from 8 to 12 years old. The sample was formed by school children of both sexes, with  $x = 10.04 \pm 1,619$  years to which were determined the respiratory frequency, apnea in inspiration, apnea in expiration, forced vital capacity and evaluation test of asthma control (National Committee of Pneumonology, 2016), the time period between both tests is six months.

The inferential statistical analysis used the calculation of the median of the differences between pre-test and post-test with the Wilcoxon Test of the signed ranges for related samples, and the descriptive statistics with mean, standard deviation, maximum and minimum. The data were processed using the IBM SPSS Statistic -20 statistical package.

The research was carried out following the standards of the Ethics Committee, where all participants gave their informed consent, according to the principles of the Declaration of Helsinki (2008).

Table 1

*Characteristics of the sample according to Asthma classification*

Diagnostic classification	Number of cases	Percentage
Flashing	11	23,91 %
Persistent mild	29	63.04%
Persistent moderate	6	13,04%
Severe persistent	--	--

Source: Own elaboration

**Results**

Several authors have based their research on the use of aids for different diseases and their use in physical education and sport. From these authors is assumed the classification, requirements for their preparation and basic characteristics, such is the case of Auxiliary aids with recyclable materials to improve coordination in children (Barén, 2016); Educational intervention on alternative means for respiratory rehabilitation (Cedeño et al., 2016); Resources and materials in Physical Education (Trujillo, 2010); and, Auxiliary equipment for rehabilitation of patients with knee injuries (Estrada, Vilchis, Gutiérrez, Arellano & Borja, 2013).

The aids to promote the rehabilitation of bronchial asthma in children from 8 to 12 years, must meet a number of basic characteristics according to the possibilities of our students, the limits of the environment and the objectives set in our programming. These characteristics are, according to Blández (1995).

1. Maximum practicality: it means that they must be useful to develop, efficiently, the different objectives and contents that appear in the program for asthmatics.
2. Adaptability: the materials that we build must be easily adaptable to the spatial, temporal, physical and human context from which they will be applied.
3. Safety: the construction of the material shall be carried out in the conviction that it will not represent an evident danger to the users of the material.

4. Profitability - duration: it will be one of the fundamental characteristics of the built material, since it is usually low cost in terms of maintenance and long lasting.
5. Functionality: refers to the degree of relationship between the motor need to be covered and the possibilities of action offered by that material.
6. Polyvalence: it is about considering how many different groups of activities the material it is want to build covers.

The set of auxiliary means was made up of the following:

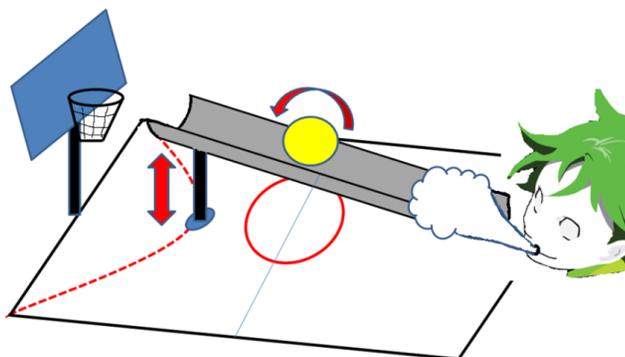


Figure 1. Auxiliary means "Basketball - Cyclone" source: own elaboration.

1- Game name: Basketball - Cyclone.

Objective: Its purpose is to develop the ventilatory-thoracic dynamics in patients with this pathology, emphasizing the processes of inspiration and expiration. It provides theoretical aspects related to the sport of basketball.

Function: placing the ball in the channel, then breathe in through the nose and then breathe out through the mouth trying to bring the ball through the channel to the hoop.

Materials used: cardboard, colored pencils or watercolor, glue, deodorant ball, thread and colored papers.

Variants: It is recommended as a variant to change the position of the players, increasing and decreasing the distance and the inclination of the channel. The medium can be used for teaching theoretical aspects of the sport of basketball.

Value. 10 pesos.

Recommendations: It is recommended to cover the board with nylon, and if possible to make the channel with PVC tube for its longer duration and conservation.

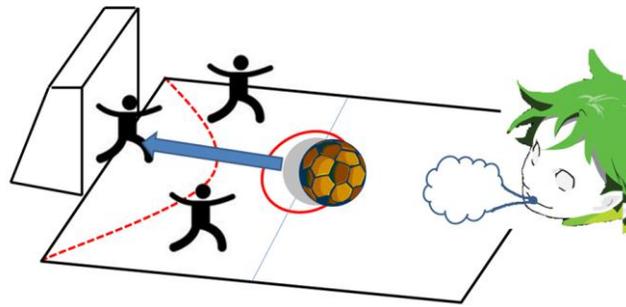


Figure II. "Soccer - Cyclone" auxiliary means source: own elaboration.

2- Game name: Football - Cyclone.

Objective: Its purpose is to develop the ventilatory-thoracic dynamics in patients with this pathology, emphasizing the processes of inspiration and expiration. It provides theoretical aspects related to the sport of soccer.

Function: placing the ball at the opposite end of the goal, then breathe in through the nose and then breathe out through the mouth trying to place the ball inside the goal.

Materials used: cardboard, colored pencils or watercolor, glue, deodorant ball, thread and colored papers.

Variants: It is recommended as a variant to change the position of the players, increasing and decreasing the distance of the ball and the inclination of the field. You can increase the number of players in the field or the presence of a goalkeeper. It is possible to use the medium for teaching theoretical aspects of the sport of soccer.

Value. 10 pesos.

Recommendations: It is recommended to cover the board with nylon, for a longer duration and conservation.

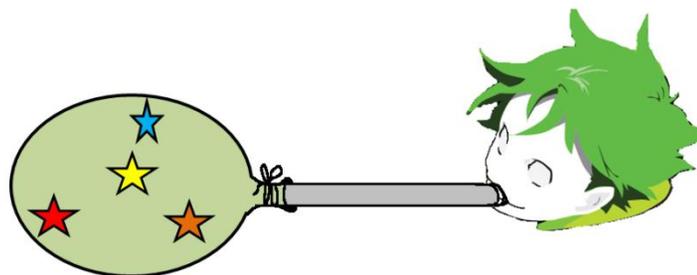


Figure III. "Matías Pérez" auxiliary means source: own elaboration.

3- Game name: Matías Pérez

Objective: It aims to carry out therapeutic and prophylactic exercise in patients with disorders and diseases of the respiratory system. It improves the processes of inspiration and expiration. As well as developing the muscles involved in breathing.

Function: It consists of taking the air strongly through the nose and expelling it through the mouth in the form of a blow. The same as the previous one, but lengthening the exhalation in a count of 5, 7, 10 times alternately.

-like the previous one, but when you breathe in you hold the air for a count of 5 beats, and perform exhalations in 5, 7 and 10 beats.

Materials used: cardboard, balloon, watercolor, glue, thread and colored paper.

Variants: It is recommended as a variant to change the dimension of the balloon, perform the exercise from the sitting and standing position

Value: 10 pesos.

Recommendations: Make thick nylon nozzles to avoid any type of infection.

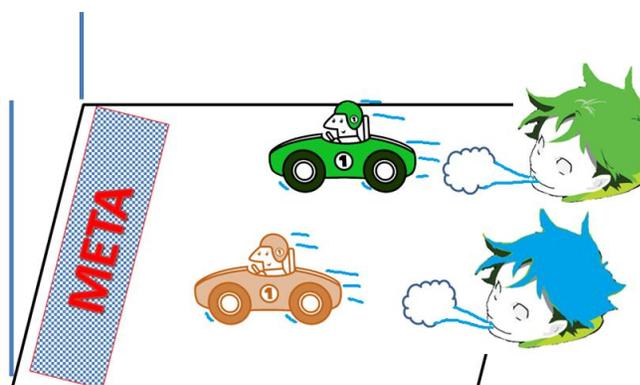


Figure IV. Auxiliary means "Bronchus car Races". Source: Own elaboration.

4- Game name: Bronchus car Races

Objective: Its purpose is to develop the ventilatory-thoracic dynamics in patients with this pathology, emphasizing the processes of inspiration and expiration.

Function: It consists of placing the cars on the starting line on a smooth surface (tables, stretchers or simply a wooden board), taking the air strongly through the nose and expelling it through the mouth in the form of a blow by pushing the cars towards the goal.

Materials used: cardboard, colored pencils or watercolor, glue, piece of polyfoam, colored paper and (tables, stretchers or simply a wooden board).

Variants: It is recommended as a variant to change the position of the players, increasing and decreasing the distance of the carts and the inclination of the ground.

Value. 5 pesos.

Recommendations: The surface must be clean to avoid possible allergies.

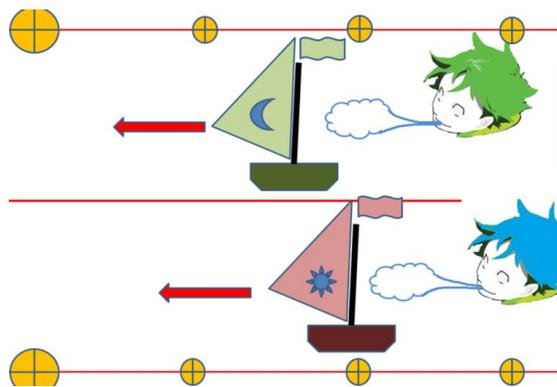


Figure V. "Full sail" auxiliary means. Source: Own elaboration.

5- Game name: Full sail

Objective: Its purpose is to develop the ventilatory-thoracic dynamics in patients with this pathology, emphasizing the processes of inspiration and expiration.

Function: It consists of placing the boats on the starting line on a smooth surface (tables, stretchers or simply a wooden board), taking the air strongly through the nose and expelling it through the mouth in the form of a blow by pushing the boats towards the goal.

Materials used: cardboard, colored pencils or watercolor, glue, buttons, pieces of polyfoam, thread and colored paper.

Variants: It is recommended as a variant to change the position of the players, increasing and decreasing the distance of the boat and the inclination of the ground.

Value: 10 pesos.

Recommendations: The surface must be clean to avoid possible allergies.

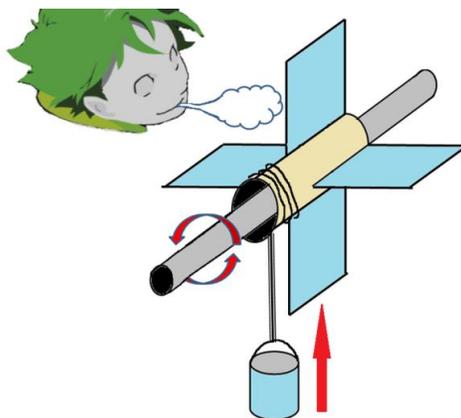


Figure VI. "The mill " auxiliary means source: own elaboration.

6- Game name: The mill

Objective: Its purpose is to develop the ventilatory-thoracic dynamics in patients with this pathology, emphasizing the processes of inspiration and expiration.

Function: The bucket is unrolled and the mill is taken with both hands, then the air is taken strongly by the nose and expelled through the mouth in the form of a blow by turning the blades of the mill and thus rolling the rope and making the bucket rise.

Materials used: cardboard, toilet paper tube, 35 cm of PVC tube, colored pencils or watercolor, glue, plastic medicine knob, thread and colored papers.

Variants: It is recommended as a variant to increase the weight of the bucket or the distance from the rope.

Value: 15 pesos.

Recommendations: Make the medium with 5 or more blades.

### **Analysis and discussion**

With the purpose of evaluating, enriching and/or perfecting the set of auxiliary means to favor the rehabilitation of bronchial asthma in children from 8 to 12 years old in the municipality of Báguanos for its application in this context and its generalization in others, it was submitted to the criteria of the specialists through a nominal group as an empirical method.

The results obtained through the application of the method allowed to state that the elaboration and proposal for the implementation of the auxiliary means to favor the rehabilitation of bronchial asthma in children from 8 to 12 is pertinent, given that:

- It offers possibilities of application, because its content takes into account the particularities of the context.
- They have a practical sense as they make it possible to achieve the different objectives and contents that appear in the Program for Asthmatics.
- It has adaptability since the materials used are easily adaptable to the spatial, temporal, physical and human context from which they are to be applied.
- The media are safe as they do not represent an obvious danger to the users of them.
- Profitability - duration the materials built are low cost in terms of maintenance and durable.
- They present low polyvalence due to the fact that the groups of different activities covered by the material in its generality are for respiratory rehabilitation.
- The means favor the process of physical rehabilitation of the patients, being of easy use and suitable to the main elements that compose the physical exercises.

The results obtained after six months of implementation of the aids coincide with that proposed by (Zenteno et al., 2010) the adequate training of the inspiratory muscles, increases their strength and resistance in patients who are carriers of chronic respiratory diseases. In addition, the dysfunction of the respiratory muscles has repercussions on the clinical evolution, the

sensation of dyspnea and the quality of life. Therefore, a training protocol for the respiratory muscles is suggested.

According to Ramos (2015), Pediatric Specialist, the normal value for the respiratory rate (FR) ranges from 15 to 20 repetitions per minute (rpm) for children over 8 years old. This parameter shows a decrease in the average (FR1=18.74±2.34 rpm and FR2=17.26±1.46rpm) in the second measurement being positive. The minimum value is maintained in both measurements, but not the maximum, which drops from 25rpm in the first to 20 rpm in the second. These values are similar to those obtained by Espinosa (2014), where she obtains a decrease in the breathing frequency by 3 times per minute but with higher maximum values (28 rpm), by means of statistical processing (table 2), it was determined that  $\alpha = 0.000$ , as  $\leq$  is more than  $\alpha = (0.05)$ , so it can be stated that there are significant differences between the first and second measurement, this responds to the level of adaptation of the respiratory system of asthmatic children to physical activities, when these are adjusted to their needs and possibilities. On the other hand, Arias (2010) determines the average in 17.1rpm without experiencing any difference between the initial and final measurement. Quintana (2019) and Santiesteban (2020) observe in both measurements that they are within the normal parameters (15 to 20 rpm).

The parameters of lung function tests have a great individual variability and depend on the anthropometric characteristics of the individuals (sex, age, height, weight and race). To evaluate the results, were used prediction equations close to the selected population, among them, the reference values of Casan (1983), for children (range 6-20 years).

The sample had an average age=10,04±1,619 years; the height=136,33cm. With a slight increase in the second of 0.24 cm, with a standard deviation=12.732 cm (minimum=109 cm and maximum=162 cm. The initial body weight was 44.03±9.18Kg, with a slight final increase of 45.07±9.18Kg, normal in the growth stage and very little difference because of the short period between measurements.

For spirometry, values below the 5th percentile are considered to be below the expected range (below the LIN). The 80% of the FVC due is close to the 5th percentile. In the first measurement 78.26% of the sample was below the LIN, for a mean=1.374±0.352 L. with a minimum=0.750 L and a maximum=2.110L. In the second measurement there was an increase of the mean=1.868±2.458L, the minimum=0.900 L and the maximum=2.300L. 80.43% of the sample was located above the LIN and the remaining cases, although still below the 5th percentile, a slight increase was observed=0.142 L, close to the LIN this is due to the increase in body weight and the little increase in height. Similar reports were found by Espinosa (2014) with an average of 1,900 L. and somewhat lower in Arias' work (2010) with values in the second measurement of

1,460 L. By means of statistical processing (table 2), it was determined that  $\alpha 0 = 0,000$ , since  $\leq (0.05)$ , so it can be stated that there are significant differences between the first and second measurements. In a general sense, the results shown allow to verify the good functioning of this indicator, which is very favorable for rehabilitation. Besides, it shows the strengthening of the muscles involved in breathing, by achieving a higher pressure when expelling the air contained in the lungs.

Table 2.

*Summary of hypothesis contrasts of the Forced Vital Capacity (FVC) and respiratory rate tests*

Test	Null hypothesis	Try	Meaning	Decision
FVC1 and FVC2 FR1 and FR2	The median of the differences between pre-test and post-test equals 0.	Wilcoxon Test of Signed Ranges for Related Samples	,000 ,000	Reject the null hypothesis

Source: IBM SPSS Statistic Viewer. Significance level 0.05

In the indicator of inspiratory apnea there is a difference of +3.8 seconds, with a final average of  $17.8 \pm 0.842$  seconds while in the expiratory apnea it was +2.3 seconds and  $10.5 \pm 0.361$  seconds, with  $\alpha 0 = 0.000$ , aspects that demonstrate the possibility of children to stop breathing after executing these two moments of pulmonary ventilation. Equivalent results were obtained by Arias (2010), Espinosa (2014), Quintana (2019) and Santiesteban (2020)

The stability of the respiratory indicators in children with bronchial asthma is determinant. By achieving this balance, they will be able to assume the demands offered by school, family and society, with a stable health condition, to participate systematically in Physical Education classes and to fulfill the teaching tasks of the other subjects that are part of the curriculum. (Espinosa, 2014).

Table 3.

*Results of the application of the Asthma Control Test (ACT) National Pneumology Committee (2016)*

In the last 4 weeks, how long has your asthma kept you from doing everything you wanted to do at work, school or home?	Always		Almost always		Sometimes		Rarely		Never	
	1st	2nd	1st	2nd	1st	2nd	1st	2nd	1st	2nd
	--	--	7	1	22	12	13	12	4	21
During the last 4 weeks, how often have you been short	More than once a day		Once a day		3 to 6 times per week		1 or 2 times per week		Never	

of breath?	1st	2nd	1st	2nd	1st	2nd	1st	2nd	1st	2nd
	1	--	16	7	14	6	12	11	3	22
During the last 4 weeks, how often did your asthma symptoms (wheezing or whistling in your chest, coughing, shortness of breath or chest tightness, pain) wake you up during the night or earlier than usual in the morning?	4 or more nights per week		2 to 3 nights per week		Once a week		Once or twice		Never	
	1st	2nd	1st	2nd	1st	2nd	1st	2nd	1st	2nd
	3	--	13	3	25	18	5	8	--	17
During the last 4 weeks, how often have you used your rescue inhaler or nebulizer medication (such as salbutamol)?	3 or more times a day		1 to 2 times a day		2 to 3 times per week		Once a week or less		Never	
	1st	2nd	1st	2nd	1st	2nd	1st	2nd	1st	2nd
	3	--	11	3	15	14	14	11	3	18
How would you rate your asthma control over the past 4 weeks?	Nothing controlled		Poorly controlled		Somewhat controlled		Well controlled		Fully controlled	
	1st	2nd	1st	2nd	1st	2nd	1st	2nd	1st	2nd
	1	--	11	5	18	8	12	23	4	10

Source: Own elaboration

For the analysis of the ACT, the scores of the 5 items are added up: maximum of 25 points, minimum of 5 points. Controlled asthma:  $\geq 20$  points. Uncontrolled asthma:  $\leq 19$  points. In the initial result it shows an average of 15,21 points that classifies the sample as uncontrolled asthma, individually 69,56% of the evaluated ones obtained results lower than 19, while the remaining proportion was higher or equal to 20 points. In the final check the average reached 19,82 points, 4,61 more than the first one. Individually, 76.08 % of those evaluated obtained results equal to or higher than 20 points, while the remaining percentage remained below 19 points. This last group, although it did not pass to the category of controlled Asthma, increased the points in more than 3 units denoting a slight improvement in this aspect. In this regard, authors such as Quintana (2019) and Santiesteban (2020) obtained higher percentages than those of this study, but it should be noted that the sample used did not exceed 15 subjects.

## Conclusions

The results obtained allows to reach the following conclusions:

In the criteria of the scientific community regarding the process of physical rehabilitation of bronchial asthma in children, there is a unity of opinion that physical exercises are effective in reducing the number and severity of asthma attacks. However, these researches focus all their attention on physical exercises as fundamental therapeutic means and limit the use of auxiliary means within their proposals.

In the development of the set of auxiliary aids to promote the rehabilitation of bronchial asthma in children from 8 to 12 years are based on the basic characteristics, according to the possibilities of the students, the limits of the environment and the objectives set.

The set of auxiliary aids to promote the rehabilitation of bronchial asthma in children from 8 to 12 was evaluated as being very suitable by the specialists in the nominal group offering possibilities of application, possessing practicality, adaptability, safety and cost-effectiveness-duration.

The results obtained during the assessment showed its feasibility by reducing asthma attacks and especially a positive response in physical performance by increasing the time of apnea in inspiration and expiration and other parameters evaluated.

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