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Original article

Integrated Physical Rehabilitation With Stimulation Of Verbal Fluency In The Older Adult With Cardiopathe

Rehabilitación Física Integrada Con Estimulación De La Fluidez Verbal, En El Adulto Mayor Cardiópata

Reabilitação Física Integrada com Estimulação da Fluência Verbal em Idosos Cardíacos

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ABSTRACT

With aging, changes occur in the people different organs and their functional capacity, as they are subjected to diseases and risk factors such as dyslipidemia, obesity, stress, cognitive decline, high blood pressure and ischemic heart disease, among others. The objective of the research was to establish a group of physical exercises for the physical rehabilitation program integrated with cognitive actions for the stimulation of verbal fluency in elderly patients with heart disease in the maintenance phase, as this age group is more prone to cognitive decline. The methods used were observation, measurement, specialist criteria and monitoring of cardiovascular function by controlling vital signs. For the evaluation, the six-minute walk test, the mini-mental test and the semantic and phonological verbal fluency test were applied. The results obtained, after implementing the proposed exercises, showed a significant improvement in the subjects investigated who articulated more words, optimized the cognitive domains, attention and memory, cardiovascular function and global cognition.

Keywords: elderly with heart disease; physical exercise; verbal stimulation; physical rehabilitation

RESUMEN

Con el envejecimiento ocurren cambios en los diferentes órganos y en su capacidad funcional, pues se está sujeto a enfermedades y factores de riesgo como la dislipidemia, la obesidad, el estrés, el deterioro cognitivo, la hipertensión arterial y la cardiopatía isquémica, entre otras. El objetivo de la investigación fue establecer un grupo de ejercicios físicos para el programa de rehabilitación física integrado con acciones cognitivas para la estimulación de la fluidez verbal en el adulto mayor cardiópata en la fase de mantenimiento, al ser este grupo etario más propenso al deterioro cognitivo. Los métodos utilizados fueron la observación, la medición, el criterio de especialista y el seguimiento de la función cardiovascular mediante el control de los signos vitales. Para la evaluación se aplicaron los test de caminata de seis minutos, el minimental y el de fluidez verbal semántica y fonológica. Los resultados obtenidos, después de la implementar los ejercicios propuestos constaron

una mejoría significativa en los sujetos investigados que articularon más palabras, optimizaron los dominios cognitivos, la atención y la memoria, la función cardiovascular y la cognición global.

Palabras clave: adulto mayor cardiópata; ejercicio físico; estimulación verbal; rehabilitación física

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RESUMO

Com o envelhecimento, ocorrem alterações nos diferentes órgãos e na sua capacidade funcional, pois estamos sujeitos a doenças e fatores de risco como dislipidemia, obesidade, estresse, deterioração cognitiva, hipertensão arterial e cardiopatia isquêmica, entre outros. O objetivo da pesquisa foi estabelecer um grupo de exercícios físicos para o programa de reabilitação física integrados a ações cognitivas para estimulação da fluência verbal em idosos cardiopatas em fase de manutenção, visto que essa faixa etária é mais propensa à deterioração cognitiva. . Os métodos utilizados foram observação, medição, julgamento especializado e monitorização da função cardiovascular através da monitorização dos sinais vitais. Para avaliação foram aplicados o teste de caminhada de seis minutos, o miniteste mental e a prova de fluência verbal semântica e fonológica. Os resultados obtidos, após a implementação dos exercícios propostos, mostraram melhora significativa nos sujeitos investigados que articularam mais palavras, otimizaram domínios cognitivos, atenção e memória, função cardiovascular e cognição global.

Palavras-chave: idoso com cardiopatia; exercício físico; estimulação verbal; reabilitação física

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INTRODUCTION

Population aging has had an unprecedented increase in the history of humanity and Cuba is not exempt from this process; currently, there are more than two million older adults and they constitute 22.3% of the population, it is estimated that between 2025 and 2030, this age

group will represent more than 30%, according to the National Office of Information and Statistics of Cuba (ONEI, 2023).

An older adult is defined as any person over sixty years of age and is characterized by changes that occur in different organs and systems and affect functional capacity; in addition to diseases such as dyslipidemia, obesity, stress, cognitive decline, high blood pressure and ischemic heart disease, among others.

The acute myocardial infarction (AMI) is a major health problem, and although it can occur at any age, the most prone people are those who have suffered a cardiovascular event and older adults. This disease is one of the most serious manifestations of ischemic heart disease and people who have presented this type of heart disease are called heart patients. Among the main sequelae of AMI are the decrease in the functional capacity of the subject with a high incidence in the cerebral cortex that promotes cognitive deterioration or vascular dementia (Jhoansen, et al., 2023).

In relation to recent studies that have investigated the behavior of the relationship between ischemic heart disease and cognitive function in the elderly, it has been revealed that there is a close correlation between the heart and the brain; this has shown that cardiovascular diseases (CVD) not only affect the heart, but also the brain, particularly cognitive functions (Jhoansen , et al., 2023).

Elderly people with heart disease are prone to suffer a decline in cognitive processes such as memory, orientation, visuospatial ability, calculation, constructive skills, abstract thinking, judgment, reasoning and language. This last cognitive domain is a complex function, and one of the processes with the most transformations with aging (Lastre , 2019). The cognitive process of language requires the implementation of mechanisms of access to the lexicon and cognitive abilities such as the verbal fluency (VF) skill, which is a task of the executive function and encompasses semantic verbal fluency (SVF) and phonemic verbal fluency (FVF), according to Marino et al. (2012).

On the one hand, SVF is the ability to generate words by following a command and is considered a complex cognitive task, involving mnemonic processes (working memory and semantic memory) and executive processes; on the other hand, FVF consists of the ability to create, produce, express, relate words and know their meaning to provoke spontaneously fluid language, without excessive pauses that reflect difficulties in accessing the lexicon (Marino et al., 2012; Lastre , 2019).

The linguistic abilities that are most affected in older adults with heart disease are those that require adequate preservation of the lexical access and retrieval processes. One of the most frequent problems of lexical access is revealed in the **denominative deficit** in the ability of verbal fluency, from difficulties in starting the dialogue, finding the right word, **rambling, slowness, unfinished sentences, use of superficial phrases and words** (Lastre, 2019).

Accordingly, care for the elderly by the different states, government managers and health authorities has been a priority task, in order to provide a dignified and safe old age. Likewise, different actions have been indicated, such as active aging (Barrientos, et al., 2021).

Physical activity has distinguished itself as one of the main non-pharmacological treatments put into practice. This name has been adopted by the World Health Organization (WHO), with the intention of mitigating the negative impact caused by chronic non-communicable diseases in older adults (Noa, et al., 2021).

The treatment prescribed to patients with heart disease is cardiovascular rehabilitation, which is carried out in the Comprehensive Cardiac Rehabilitation Program, which includes three phases: hospitalization, convalescence, and maintenance. In Cuba, in the first two phases, patients receive comprehensive care provided by a multidisciplinary team. In the last phase, therapeutic areas of physical culture must be incorporated to continue their rehabilitation for life.

In cardiac rehabilitation programs, physical activity during the maintenance phase is used as the main action. According to the research carried out by Núñez and Belinson (2018), well-dosed physical exercise helps to improve vital signs at rest and during activity, favors

the maximum physical load achieved and tolerated, improves cardiovascular functional capacity, reduces risk factors, mortality and the probability of coronary events.

In relation to attention to cognitive processes in older adults, it is essential to guarantee cognitive stimulation that integrates a set of techniques and actions aimed at reinforcing epistemic domains based on neuronal neuroplasticity processes. Among the research that addresses the topic, Lastre (2019) stands out, who applied a cognitive stimulation program to enhance language, and obtained as a finding the improvement in verbal and semantic fluency, and in other cognitive processes evaluated.

From the area of knowledge of physical activity, cognitive stimulation has also been used, but intentionally, supported by the comprehensive physical educational model that has been considered as a general method of education. This type of stimulation is used as pedagogical material related to human movement in all its forms and is characterized by constituting a philosophy of education, based on the preceding models, it is based on the cognitive paradigm of divided attention, where physical exercise is intentionally combined with cognitive actions of the general culture that the individual has, supported by the cognitive paradigm of divided attention and the processes of neuronal neuroplasticity , to achieve the stimulation of physical and mental functions, for preventive and therapeutic purposes (Barrientos et al., 2021).

There have been several authors who assert the viability of cognitive stimulation through physical activity, among them Barrientos (2013) conducted research with two groups of hypertensive older adults, to whom he applied a methodological procedure for stimulating short-term memory with cognitive tasks that favored group communication based on the general culture of the sample, thereby improving the attention process and short-term memory.

Likewise, Reigal and Hernández (2014) analyzed the effect of a cognitive-motor program on executive function in a sample of older people when compared to another exclusive physical activity program, and found findings such as improved motor skills, inhibitory control, and cognitive flexibility. Similar effects were found by Barrientos et al. (2021) with a

methodology for stimulating memory and executive function in older adults, through physical activity with two groups that improved cognitive processes (memory, attention, verbal fluency, inhibition, among others).

Based on the above, it is essential to pay attention to cognitive processes in elderly people with heart disease during the physical rehabilitation process, and this process is implemented to offer comprehensive care during the maintenance phase. In this way , cognitive, cardiovascular and physical damage that can occur due to illness and aging is prevented.

The theoretical references cited constitute important background for research; however, in Cuba there are insufficient studies on cognitive stimulation in elderly people with heart disease through physical rehabilitation, hence the need to reverse this process. Consequently, it is established as a problematic situation that elderly people with heart disease are prone to cognitive alterations in the ability of verbal fluency; however, there are insufficient activities that are oriented to address this process through physical rehabilitation during the maintenance phase.

The scientific problem to be solved is how to contribute to the attention of the verbal fluency skill in the elderly person with heart disease during the maintenance phase in the physical rehabilitation process. In order to respond to the scientific problem raised, the objective is to establish a group of physical exercises of the physical rehabilitation program integrated with cognitive actions for the stimulation of verbal fluency in the elderly person with heart disease in the maintenance phase, because this age group is more prone to cognitive deterioration, and in the methodological indications of the cardiovascular rehabilitation program, attention to cognition is not mentioned.

MATERIALS AND METHODS

To develop the research, a prospective longitudinal study was conducted over a period of five months (September 2019 to January 2020), with a pre-experimental design, qualitative-quantitative nature and minimal control, at the Physical Activity and Health Center (CAFS),

of the University of Physical Culture and Sports Sciences (UCCFD) "Manuel Fajardo", in Havana, Cuba. The sample was intentionally selected and consisted of 20 older adults diagnosed with ischemic heart disease (acute myocardial infarction). Of these, 18 were female (90%) and two were male (10%). The average age was 68 years. The cultural level of the sample consisted of 10 from the primary level, which represented 50% and five from the secondary and university levels, for 0.25%, respectively.

The sample was selected according to the following inclusion criteria: having given informed consent to participate in the research; having a low-risk stratification for ischemic heart disease, according to the results of the ergometric test; having controlled risk factors for the disease; having a preserved cognitive and auditory state; and being in the maintenance phase.

The study was carried out by a research group made up of five professionals, three of them specialists in therapeutic physical culture, a psychologist and a neuropsychologist; all trained to carry out the different evaluations. The interpretation of the results was carried out as a team. The most commonly used methods in the research, at the theoretical level, were the historical-logical method that allowed the study of antecedents related to the subject being investigated; the inductive-deductive method that made it possible to determine the differences between the general and particular characteristics; and the analytical-synthetic method that facilitated the analysis and summary of the most important aspects of the consulted bibliography.

At the empirical level, the survey was conducted with patients and specialists to find out the state of care of the object of study, as well as the selection of activities to be implemented with the cardiac rehabilitation program. The cognitive and practical dimensions were taken into account.

Observation of 48 cardiovascular rehabilitation classes at the CAFS, to learn the facts about the state of attention of the object of study; as well as the behavior of the symptoms in patients during the cardiac rehabilitation process, in the implementation of the exercises of

the cardiovascular rehabilitation program integrated with cognitive actions for the stimulation of verbal fluency.

Through a documentary review, the contents of comprehensive cardiac rehabilitation were assessed to verify the situation related to the stimulation of cognitive processes. In the definition of the dimensions, two are declared: physical and cognitive. Cognitive actions are defined, according to Barrientos et al. (2021), as the different actions and tasks of a cognitive nature, developed from the contents of different sciences, which are combined with physical exercise to simultaneously stimulate cognition, in order to improve the physical and mental capacity of the individual.

Regarding the measurement, three tests were applied:

The 6-minute walk test determined the maximum oxygen consumption (VO2max.), from the formula recommended by Núñez and Belison (2018), the average training pulse of the sample was (103.3 ± 10 ppm) it was obtained from the Karvonen formula : PE P% (Fc . max. - Fc . Rep.) * 0.6 to 0.8 + Fc Rep.

The Mini-Mental Test was implemented to evaluate global cognitive function. This instrument was validated in Cuba, for adults, by Barrientos et al. (2021) .

The verbal, phonological and semantic fluency test was used to assess the quality of communication using an instrument that evaluated word production and semantics (category to be evoked, name of animals). The validation carried out for Latin American countries was used due to its value in content.

The statistical techniques used were the arithmetic mean for the descriptive analysis of the statistical results. Wilcoxon test for dependent samples, in order to compare the existence of differences between the moments of the measurements, the levels of 0.10, 0.05 and 0.01 showed the degrees of significance of little significant, significant and very significant, respectively, and the software used was SPSS 20.0.0 of 2011.

RESULTS AND DISCUSSION

The results of the factual diagnosis, observation, measurement, survey and documentary review were processed using the method of methodological triangulation, which demonstrated:

The risk factors that had the greatest impact on the sample were obesity and high blood pressure, the latter representing 100%; however, it was controlled and constituted an inclusion criterion, as was the assessment of cognition in the diagnosis, which reached 100% in the reserved cognitive status category.

The documentary review was first carried out on the Therapeutic Physical Culture Program, intended for the areas of physical culture; it includes all the programs for physical rehabilitation of different diseases and among them the cardiovascular rehabilitation object of study. It was found that the evaluation of global cognition was not oriented in the rehabilitation of the heart patient, nor were physical exercises integrated with the stimulation of verbal fluency applied. The indications related to the planning of physical exercise for cardiovascular rehabilitation in polyclinics and hospitals were also reviewed and it was found that cognitive actions are not oriented for the stimulation of verbal fluency in heart patients integrated with physical rehabilitation exercises.

Regarding the response in the survey on group communication behavior, 95% of the sample responded that it is poor, due to the little interaction in rehabilitation classes, an aspect so important for the development of this process.

Regarding the results of the observation carried out on five professionals in physical rehabilitation classes for heart patients, it was found that 100% did not integrate physical exercises for cardiovascular rehabilitation with cognitive actions to stimulate verbal fluency.

In the survey applied to professionals in the question related to the mastery of the characteristics of cognitive processes, 70% responded with little mastery and only 30% claimed mastery. of the characteristics of cognitive processes.

Figure 1. *Coincident answers of the survey of heart patients and professionals about the verbal fluency stimulation*

Figure 1 shows the results of questions five and six of the survey conducted with heart patients and professionals, respectively, on whether it is appropriate to perform verbal fluency stimulation on heart patients during physical rehabilitation, and 100% answered affirmatively. It was concluded that the results of the diagnosis related to the stimulation of verbal fluency in heart patients through physical rehabilitation were insufficient.

Table 1 shows the physical rehabilitation program and for its implementation, physical exercises were integrated with cognitive actions to stimulate verbal fluency, according to the methodology of Barrientos et al. (2021), which includes four stages: familiarization, reinforcement, consolidation and evaluation. Its objective was to stimulate cognitive processes, with emphasis on the memory and executive function domains, and was based on neuroscience, neuroplasticity processes, bioadaptation, neuropsychology, pedagogical sciences, the comprehensive physical educational model and the cognitive paradigm of divided attention.

The application frequency was three times a week for a total of 60 hours, of which 25 hours were devoted to cognitive stimulation, which represented 41.6%. The proposal was assessed as pertinent by the specialists, because the exercises were adequately dosed, the stages declared for their implementation and the specific methods, procedures and indicators for the integration of the exercises with the stimulation of verbal fluency.

The exercises were applied in the morning in a covered gymnasium with all the conditions to carry out cardiovascular physical rehabilitation activities, and means such as cards, slides

and a blackboard were created. Before starting the rehabilitation, vital signs, heart rate and blood pressure were taken, and this procedure was repeated at the three moments of patient care (main, initial, final part). Likewise, verbal, practical, heuristic conversations, joint elaboration, explanation and demonstration methods, among others, were applied.

Accordingly, the methodological indications were used, as well as evaluation indicators for the transition from one stage to the other according to Barrientos (2021). In the first stage, the sample was evaluated and verbal fluency was stimulated in the patients, without integrating with physical rehabilitation exercises, from the guidelines of psychological and neuropsychological stimulation. In the second stage, cognitive actions were integrated with cardiovascular rehabilitation exercises, as indicated in the methodological guidelines, moving from easy to difficult and from simple to complex and as a fundamental principle, the practitioner had to have motor control of the activity he performed.

In the third stage, the exercises became more complex according to the characteristics of the practitioners; in addition, the heart rate was monitored before and after each exercise, the general observation of the heart patient in his/her mode of action in the process of physical rehabilitation was carried out, and emphasis was placed on the comprehensive stimulation of all cognitive processes. The evaluation of the procedure was carried out from the physical (cardiovascular functional capacity) and cognitive points of view.

Table 1. *Physical exercises of the physical rehabilitation program integrated with cognitive actions for the stimulation of verbal fluency in elderly people with heart disease in the maintenance phase.*

Aim	Cognitive actions integrated with physical exercises	Methodological remarks
Work on physical exercises for joint mobility and aerobic endurance through walking, dancing, step, and on machines, integrated with cognitive actions to stimulate verbal fluency.	1. Recall the days of the week and the months of the year and at the same time perform joint mobility exercises as indicated by the teacher (flexing and extending arms and bending legs). 2. Produce words with the letter chosen by the practitioners, while going up and down step.	-Taking, monitoring and controlling vital signs. -Correcting posture. -Gradual progressive increase in physical load. -It starts with simple actions that later become more complex.

	2. Name objects that are presented on a sheet and at the same time, walk on a rolling mat.	

Figure 2 shows the results obtained by the sample in the walking test, where they managed to improve the average distance traveled by a difference of 75 meters, from the pretest to the posttest. Statistically, the results are very significant for $P < 0.005$, which revealed a tolerance to physical exercise and an improvement in cardiovascular functional capacity. The results are homologous to those obtained in the research by Araya et al. (2021); Núñez and Belison (2018).

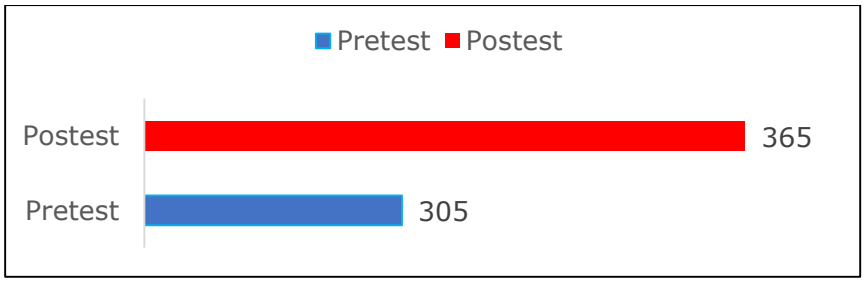

***Fig. 2**. Distance covered in meters in the six-minute test*

In the monitoring of heart rate during the exercises with machines during the five-month period, as shown in Figure 3, it can be seen that in the first month, it oscillated in the ranges of (114 to 116 bpm) because the physical exercise was not integrated with the cognitive actions for the stimulation of verbal fluency, which indicated that the sample was already adapted to the physical load of the cardiac rehabilitation program. In the second month, the average heart rate had a tendency to increase (118 to 120 bpm), because the physical exercises were integrated with cognitive actions for the stimulation of verbal fluency. In the third month, there was a slight tendency for the heart rate to decrease until reaching the fifth month, with ranges similar to the first month; which indicated that the sample was adapting to the physical load and the type of activity.

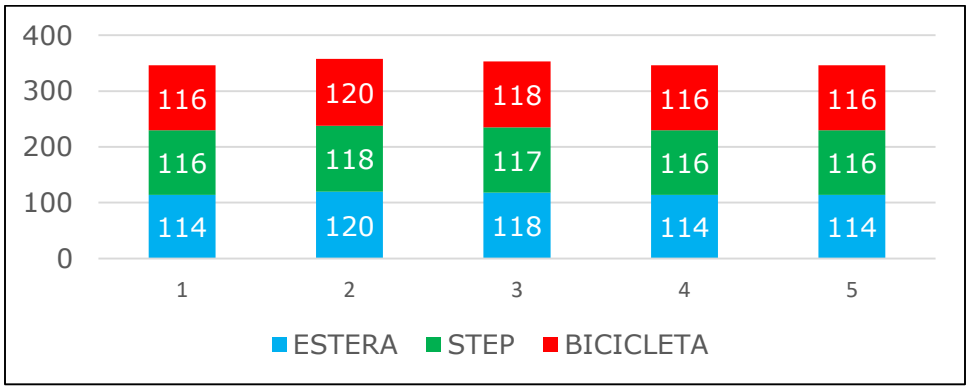

***Figure 3**. Heart rate behavior in aerobic exercise integrated with verbal fluency stimulation.*

Table 2 shows the results obtained by the sample in the consumption of Vo2 Max, from the six-minute walk test. It can be observed that in the pretest the patients achieved a Vo2 Max, relative to eight points corresponding to functional class III; and in the posttest they improved four points for a group average of 12. The sample remained in the same functional class, but improved significantly in Vo2max consumption. Similar findings were obtained in the research by Araya et al. (2021); Núñez and Belison (2018).

***Table 2.** Result of VO2max consumption, in the sample.*

VO2max Pretest	Functional class	VO2max Posttest	Functional class	Significance
8	**III**	**12**	**III**	**Significant P=0.05**

Figure 4 presents the results of the evaluation of phonological verbal fluency. The sample in the pretest managed to produce few words at the three educational levels (8, 12 and 13), respectively; however, in the posttest the number of words produced improved until gaining (4, 4 and 5) words at the three educational levels, after receiving cardiac rehabilitation with integrated physical exercises for VF stimulation, it improved very significantly P=0.001.

The results revealed the achievement of a more organized phonological fluency, through the processing and manipulation of lexical - semantic information, attention control and performance monitoring; likewise, it was observed that the educational level influenced the

production of words. These results are analogous to those achieved by Lastre (2019); Reygal and Hernández (2014); Salazar et al. (2020), through cognitive stimulation in older adults from the psychological context.

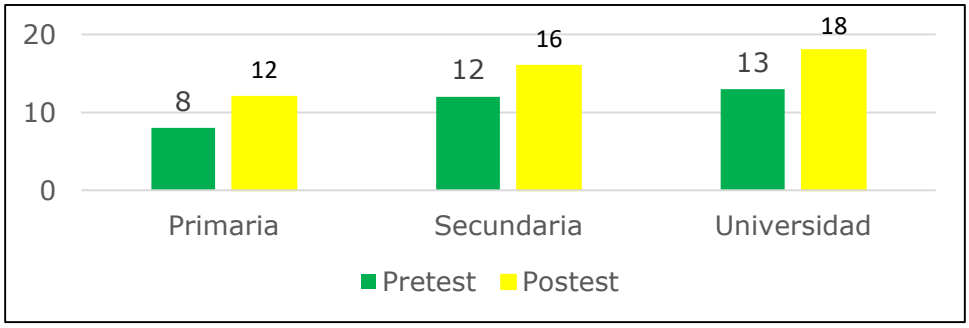

***Figure 4**. Behavior of the phonological verbal fluency variable*

The results of the semantic fluency test (Figure 5) showed a production of 11 to 12 categories on average, in the pretest; however, in the posttest a higher average of semantic categories was used in the three educational levels with very significant results P = 0.005, since physical rehabilitation integrated with cognitive actions for the stimulation of verbal fluency was applied. Similar results were those of Salazar et al. (2020) when evaluating the effects of cognitive stimulation in older adults from the psychological context, and are similar to those achieved by Barrientos et al. (2021).

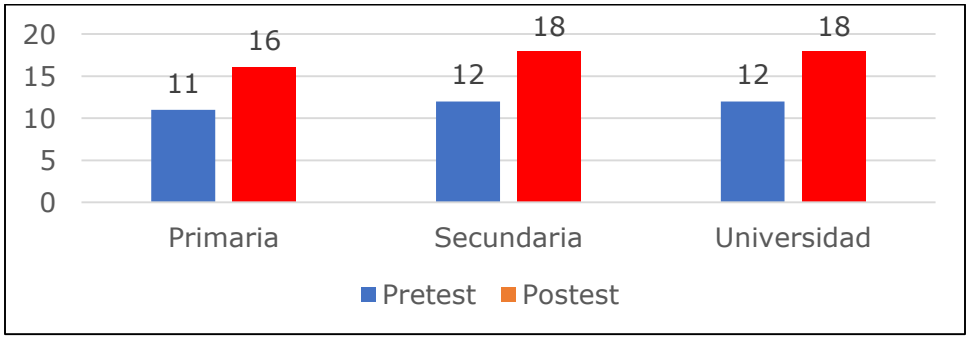

***Figure 5.** Semantic fluency behavior.*

The results of the evaluation of global cognition with the Mini-Mental Test are shown in Table 3. In the first measurement, the average score was 27, and in the post-test, the average

score was higher. The improvement obtained in global cognition was based on the stimulation of verbal fluency as a complex cognitive skill that activates the mechanisms for lexical access and involved cognitive functions such as the capacity for controlled and programmed verbal production and the elimination of irrelevant responses, through the intervention of processes such as attention, working memory, flexibility, information processing speed, initiative, and production monitoring (Barrientos, et al., 2021 ; Calatayu, et al., 2020; Lara, et al., 2019).

Table 3. *Result of the evaluation of global cognition in the sample.*

Variable	Pretest	Posttest	Difference	Significance
Global Cognition	**27**	**29**	**3**	**Very Significant p=0.001**

In the presented work the effect of the implementation of physical exercises of the physical rehabilitation program integrated with cognitive actions for the stimulation of VF in elderly cardiac patients in the maintenance phase is appreciated. This topic has been little studied in the context of physical activity; however, the results obtained in the variables physical exercises, functional class and V02max are analogous to those of Araya et al. (2021); Núñez and Belison (2018) although in these investigations only cardiovascular functional capacity was considered.

It is noteworthy that in this research, heart rate was monitored during the phenomenological act of performing physical exercises integrated with the stimulation of verbal fluency, and a trend towards increased heart rate was found in the mean values of the sample. This physiological response reveals that when a subject performs two activities at the same time, a greater physical effort is required to trigger the circulatory readaptation phenomena in the body and, therefore, a greater consumption of oxygen to satisfy motor and cognitive needs. The results are supported from a neurophysiological point of view by the research of Marino et al. (2012), who evaluated the functional hemodynamic response in the brain through a phonological verbal fluency test and obtained, as an effect, the

activation of the superior prefrontal cortex , associated with components of the executive function.

In this order of ideas, it is emphasized that this research differs from previous ones in that the physical exercises of the physical rehabilitation program were implemented with the stimulation of the verbal fluency skill in the elderly heart patient during the maintenance phase and in the control and monitoring of the heart rate during this activity.

With the application of the physical rehabilitation program integrated with cognitive actions for VF stimulation in elderly people with heart disease in the maintenance phase, benefits such as the optimization of word production and semantic categories were achieved; likewise, gains in global cognition were demonstrated with significant results that agree with the results of Barrientos et al. (2013), (2021); Lara et al. (2019); Reigal and Hernández (2014).

CONCLUSIONS

With the implementation of physical exercises of the physical rehabilitation program integrated with cognitive actions for the stimulation of verbal fluency in elderly heart patients in the maintenance phase, the importance of attention to the cognitive process of language in elderly heart patients in the context of physical activity was demonstrated, in order to contribute to preventing cognitive damage that can occur with age and illness. The sample significantly improved verbal fluency, cardiovascular functional capacity, and global cognition, in favor of an improvement in the physical and mental functionality of elderly heart patients.

The research showed benefits in cardiovascular and cognitive functional capacity, although it is considered that there were limitations and it is suggested that in future research two groups be used for the study, one control and one experimental, and that other cognitive processes be treated intentionally.

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Conflict of interest statement:

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Author's contribution:

The author is responsible for writing the work and analyzing the documents.