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Effectiveness of a Cardiovascular Rehabilitation Program for Hypertensive Patients at Kurhotel Escambray

Efectividad de un programa de rehabilitación cardiovascular en pacientes hipertensos del Kurhotel Escambray

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Abstract:

Introduction: High blood pressure is the leading cardiovascular risk factor in Cuba, with a high morbidity burden within the Revolutionary Armed Forces. Cardiovascular rehabilitation programs have demonstrated efficacy. However, there is limited evidence regarding their effectiveness in inpatient settings among military populations. Objective: To determine the effectiveness of a cardiovascular rehabilitation program in hypertensive patients at Kurhotel Escambray. Method: A prospective, longitudinal analytical observational study was conducted in 455 hypertensive patients admitted to Kurhotel Escambray between 2012 and 2024. Patients were stratified by cardiovascular risk and performed supervised exercise for 21 days. Variations in systolic and diastolic blood pressure, heart rate, adverse events, and adherence were evaluated. Favorable outcome was defined as the absence of disabling adverse events and improvement or stable values in at least two hemodynamic indicators. Effectiveness was calculated as the percentage of indicators with a positive response ≥ 75%. Results: Of the participants, 65.7% were male, with a median age corresponding to middle adulthood. Adherence was achieved in 89.2% of patients, completing more than six sessions. Systolic blood pressure improved or remained stable in 83.3%, diastolic blood pressure in 85.7%, absence of adverse events in 96.7%, and heart rate in 50.1%. Favorable outcome was observed in 80.9% of patients. Four out of five indicators were positive, with an overall effectiveness of 80%. Conclusions: The cardiovascular rehabilitation program at Kurhotel Escambray is effective and safe in hypertensive patients, with a high rate of favorable outcomes. Heart rate did not reach the effectiveness threshold, suggesting the need for longer maintenance interventions.

Keywords: arterial hypertension; cardiovascular rehabilitation; effectiveness; physical exercise; military personnel

Resumen:

Introducción: La hipertensión arterial es el principal factor de riesgo cardiovascular en Cuba, con elevada morbilidad en las Fuerzas Armadas Revolucionarias. Los programas de rehabilitación cardiovascular han demostrado eficacia, pero existe poca evidencia sobre su efectividad en régimen de internamiento en población militar. Objetivo: determinar la efectividad de un programa de rehabilitación cardiovascular en pacientes hipertensos del Kurhotel Escambray. Método: Estudio observacional analítico longitudinal prospectivo en 455 pacientes hipertensos ingresados en el Kurhotel Escambray entre 2012 y 2024. Estratificados por riesgo cardiovascular, realizaron ejercicios supervisados durante 21 días. Se evaluaron variaciones de presión arterial sistólica, diastólica y frecuencia cardiaca, eventos adversos y adherencia. La evolución favorable se definió como ausencia de eventos adversos invalidantes y mejoría o estabilidad en al menos dos indicadores hemodinámicos. La efectividad se calculó como porcentaje de indicadores con respuesta positiva ≥ 75 %. Resultados: El 65,7 % fue de hombres de mediana de edad. El 89,2 % tuvo adherencia al completar más de 6 sesiones. La presión arterial sistólica mejoró o se estabilizó en 83,3 %, la diastólica en 85,7 %, la ausencia de eventos adversos en 96,7 % y la frecuencia cardiaca en 50,1 %. La evolución fue favorable en 80,9 %. Cuatro de cinco indicadores fueron positivos, con efectividad en 80 %. Conclusiones: El programa de rehabilitación cardiovascular del Kurhotel Escambray es efectivo y seguro en pacientes hipertensos, con alta respuesta favorable. La frecuencia cardiaca no alcanzó el umbral de efectividad, lo que sugiere la necesidad de intervenciones de mantenimiento más prolongadas.

Palabras Clave: *hipertensión arterial; rehabilitación cardiovascular; efectividad; ejercicio físico; personal militar.*

Introduction

High blood pressure is the leading risk factor for cardiovascular morbidity and mortality in Cuba. According to the Third National Survey of Risk Factors, 31.9% of Cubans over 15 years of age suffer from this condition, representing 2.6 million people; after the age of 60, prevalence exceeds 60%.[1] Adequate blood pressure control remains a challenge for the health care system, as fewer than half of treated patients achieve the recommended targets.[2]

The military population is not exempt from this reality. It is exposed to high physical demands and occupational stressors that increase cardiovascular risk.[3,4] International studies report high blood pressure prevalence ranging from 15% to 68% in military populations.[5-8]

In this context, non-pharmacological interventions, particularly supervised exercise programs, play a key role in maintaining personnel operational readiness.

Cardiovascular rehabilitation has been shown to be effective in the management of high blood pressure. A recent meta-analysis confirms that resistance training improves endothelial function and reduces blood pressure in patients with cardiovascular disease,[9] while aerobic exercise significantly decreases both systolic and diastolic blood pressure in hypertensive adults.[10]

Comparative studies indicate that combined aerobic and resistance training produces more favorable effects on autonomic nervous system regulation,[11] and that all exercise modalities (aerobic, resistance, combined, and isometric) reduce systolic and diastolic blood pressure;[12] these findings support the effectiveness of exercise-based programs across populations in which they are implemented.

However, most evidence derives from outpatient settings and long-term programs; there is limited information on the effectiveness of short, intensive inpatient programs, such as the one implemented at Kurhotel Escambray.

The evaluation of intervention effectiveness in the cardiovascular field is a priority to optimize resources and improve clinical outcomes, as demonstrated by studies assessing concrete results in specific populations, such as the effectiveness of therapeutic alternatives for the surgical management of post–cardiac surgery mediastinitis.[13]

Kurhotel Escambray, a healthcare center affiliated with the Army, has implemented a cardiovascular rehabilitation program for hypertensive patients for more than 35 years. It is based on a 21-day stay, supervised exercise sessions, and a multidisciplinary approach that includes health education and lifestyle modification. The controlled environment and the homogeneity of the patient population provide a unique opportunity to evaluate the effectiveness of this intervention within the context of Cuban military healthcare.

The objective of the present study was to determine the effectiveness of the cardiovascular rehabilitation program in hypertensive patients at Kurhotel Escambray.

Method

An observational, analytical, and prospective longitudinal study was conducted at Kurhotel Escambray, in Sancti Spiritus Province, Cuba, during the period from January 2012 to December 2024. The years 2021 and 2022 were excluded due to the interruption of activities caused by the COVID-19 pandemic.

Population and Sample

The study population consisted of 989 hypertensive patients admitted for cardiovascular rehabilitation, who met the established criteria of Kurhotel Escambray according to the regulations for prophylactic and sanatorium treatments. A total of 455 patients were selected based on the following inclusion criteria: diagnosis of high blood pressure with prior control, absence of arrhythmias, compensated chronic diseases, absence of acute infections, hemoglobin ≥10 g/L, agreement to participate, and absence of neuromuscular or orthopedic conditions that could prevent physical exercise. Exclusion criteria included voluntary withdrawal, noncompliance with the program, occurrence of severe adverse events, decompensation of underlying chronic diseases, or inability to collect data.

Cardiovascular rehabilitation program intervention

All patients followed the protocol established at Kurhotel Escambray. Prior to initiation, patients were evaluated by the cardiology department and stratified according to cardiovascular risk into three groups (low, moderate, and high), which determined their assignment to exercise regimens 3, 2, and 1, respectively.[14,15] Each regimen consisted of 60-minute daily sessions, Monday through Friday, for 21 days. The sessions included a warm-up phase, a main exercise phase consisting of squats, abdominal exercises, and stationary cycling with progressively increasing intensity. Exercise intensity was individualized using the training heart rate calculated with the Karvonen formula.[15]

Variables and Effectiveness Indicators

Sociodemographic variables (age, sex) and clinical variables (degree of high blood pressure, presence of complications, toxic habits) were re-

corded.

The main outcome variables were:

1. Occurrence of disabling adverse events: defined as life-threatening events or those preventing continuation of the program, such as acute heart failure, severe arrhythmias, hypertensive response to exercise (systolic blood pressure ≥ 180 mmHg and/or diastolic blood pressure ≥ 110 mmHg), stroke, and severe musculoskeletal injuries.
2. Hemodynamic indicators: variations in systolic blood pressure, diastolic blood pressure, and heart rate, calculated as the difference between the final measurement (third minute of recovery after the last session) and baseline values, using the following criteria and cut-off points:
   - Systolic blood pressure variations: marked improvement (decrease ≥ 5 mmHg), slight improvement (decrease ≥ 1 and < 5 mmHg), stable values, mild increase (increase ≥ 1 and < 5 mmHg), significant increase (increase ≥ 5 mmHg).
   - Diastolic blood pressure variations: marked improvement (decrease ≥ 3 mmHg), slight improvement (decrease ≥ 1 and < 3 mmHg), stable values, significant increase (increase ≥ 3 mmHg).
   - Heart rate variations: marked improvement (decrease ≥ 5 bpm), slight improvement (decrease ≥ 1 and < 5 bpm), stable values, mild increase (increase ≥ 1 and < 5 bpm), significant increase (increase ≥ 5 bpm).

A favorable outcome was defined as the absence of disabling adverse events and the presence of at least two of the three hemodynamic indicators showing marked improvement, slight improvement, or stable values. Otherwise, the outcome was considered unfavorable.

To evaluate program effectiveness, the following formula was used:[16]

$$\text{Effectiveness}(\%) = \frac{\textit{Positive indicators} \times 100}{\textit{Total number of indicators}}$$

A positive indicator was defined as the condition in which the proportion of patients showing improvement (marked or slight) or stable values in the variable exceeded 75%, except for adverse events, for which positivity was defined as their occurrence in less than 25% of patients. An overall effectiveness threshold of ≥ 75% was established to consider the program effective.

Statistical Analysis

Data were analyzed using the R programming language. Qualitative variables were summarized using absolute frequencies and percentages; quantitative variables were described using measures of central tendency (median) and dispersion (interquartile range). Contingency tables were constructed for result presentation.

Ethical Considerations

The study was conducted in accordance with the principles of the Declaration of Helsinki.[17] All participants provided informed consent. Data confidentiality was ensured through coding, and established care protocols were respected.

Results

Of the 455 patients included in the study, 65.7% were male. The median age was 49 years, with an interquartile range of 42 to 56 years. Most patients (81.5%) had grade 1 hypertension. Metabolic syndrome was present in 114 patients (25.1%), and obesity in 29.5%. Regarding toxic habits, 42.6% reported alcohol consumption and 26.2% were smokers. All these variables are shown in **table 1**.

Adherence to the program was reflected in the high attendance rate at rehabilitation sessions: A total of 406 patients (89.2%) completed more than six sessions, while only 49 patients (10.8%) attended six sessions or fewer and were therefore considered non-adherent. This high level of adherence reflects the acceptance of the program within the residential setting and the patients' motivation, as shown in **table 2**.

Table 3 shows the changes in systolic blood pressure, diastolic blood pressure, and heart rate at the end of the program. Systolic blood pressure demonstrated marked improvement and stable values in 83.3% of patients. Diastolic blood pressure, in turn, showed marked improvement and stable values in 85.7% of patients. For both

Table 1. Distribution of patients according to clinical and demographic variables

Variables		n (%)
Age (years); median ± IQR		34,4 ± 8,9
Sex	male	299 (65,7)
	female	156 (34,3)
High blood pressure	Grade 1	371 (81,5)
	Grade 2	73 (16,0)
	Grade 3	11 (2,5)
Metabolic syndrome		114 (25,1)
Obesity		134 (29,5)
Alcohol consumption		194 (42,6)
Smoking status		119 (26,2)

IQR: Interquartile Range. Source: Individual medical records

variables, the percentage values were consistent with a favorable outcome indicator. In contrast, heart rate showed improvement (marked or slight) or stable values in only 50.1% of patients and therefore did not meet the criteria for a favorable outcome indicator.

Adverse events were recorded in 15 of the 455 patients evaluated at the beginning of the intervention, representing an incidence of 3.3%; all were mild and transient. Therefore, 96.7% of the patients remained free of adverse events during the program, which was also considered an indicator of a favorable outcome. No major cardiovascular events occurred, as shown in table 4.

Applying the established criterion for favorable outcomes, 368 patients (80.9%) achieved a favorable outcome at the end of the program, while 87 patients (19.1%) did not, as shown in figure 1.

Table 5 summarizes the effectiveness calculation by indicator. Systolic blood pressure, diastolic blood pressure, and absence of adverse events exceeded the 75% threshold and were therefore considered positive indicators. Heart rate did not reach this cut-off value. With four of five indicators being positive, the overall effectiveness of the program was 80%; therefore, it exceeded the pre-established criterion of 75% to be considered effective.

Discussion

The results of this study show that the cardiovascular rehabilitation program at Kurhotel Escambray is effective and safe for the treatment

Table 2. Distribution of hypertensive patients according to the number of sessions attended in the Cardiovascular Rehabilitation Program

Number of sessions	n (%)
≤ 6	49 (10,8)
> 6	406 (89,2)
Total	455 (100)

Source: Individual medical records

Table 3. Variations in systolic blood pressure, diastolic blood pressure, and heart rate at the end of the program

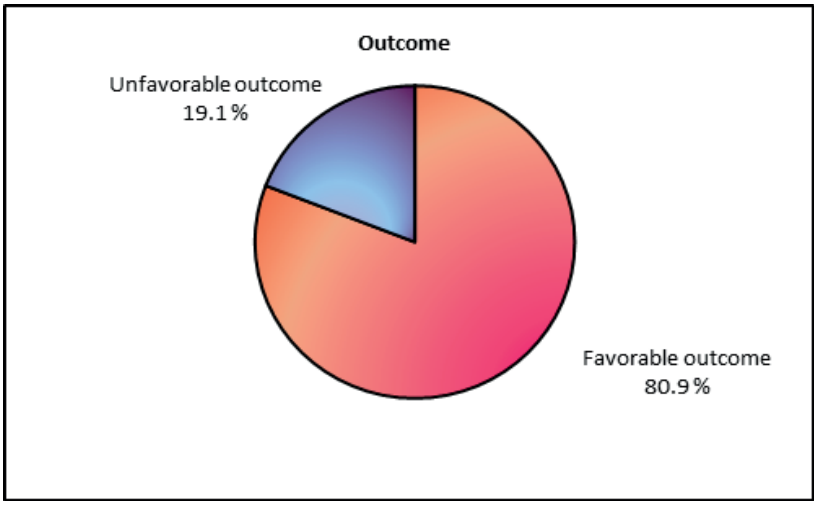
Hemodynamic variable changes	SBP n (%)	DBP n (%)	HR n (%)
Significant increase	75 (16,5)	65 (14,3)	164 (36,0)
Mild increase	1 (0,22)	0 (0,0)	63 (13,9)
Stable values	102 (22,4)	152 (33,4)	98 (21,5)
Slight improvement	0 (0,0)	0 (0,0)	40 (8,8)
Marked improvement	277 (60,9)	238 (52,3)	90 (19,8)

SBP: systolic blood pressure, DBP: diastolic blood pressure, HR: heart rate.
Source: Individual medical records

Table 4. Presence of adverse events and patient outcomes

Variable N=455	n (%)
Presence of adverse events	15 (3,3)
Absence of adverse events	440 (96,7)

Source: Individual medical records



Criteria for favorable outcome: when the patient did not present disabling adverse events and at least two of the three hemodynamic indicators showed marked improvement, slight improvement, or stable values.
Source: Authors' own elaboration

Figure 1. Patient outcomes at the end of the program according to the criteria established for the study

Table 5. Effectiveness by indicator and overall effectiveness of the cardiovascular rehabilitation program

Indicador	Effectiveness indicators: Patients with improvement or stable values n (%)	Effectiveness indicators: Patients with increase n (%)	Positive indicator
	Hemodynamic		
SBP	379 (83,3)	76 (16,7)	Yes
DBP	390 (85,7)	75 (14,3)	Yes
HR	228 (50,1)	227 (49,9)	No
	Disabling Adverse Events		
Absence of Adverse Events	440 (96,7)	15 (3,3)	Yes
	Program Outcome		
Favorable outcome	368 (80,9)	87 (19,1)	Yes
	Effectiveness		
Efectiveness (%) = (Positive indicators×100)/ (Total number of indicators)		Efectiveness (%) = (4×100)/(5)	80 %

SBP: systolic blood pressure, DBP: diastolic blood pressure, HR: heart rate. Source: Individual medical records

of hypertensive patients, with an overall effectiveness of 80% and a favorable outcome rate of 80.9%. These figures are at the upper range of those reported in the scientific literature for similar interventions.[18-21] Rauch and colleagues,[19] in an analysis of cardiovascular rehabilitation programs in Europe, found clinically significant improvement rates between 70% and 80%, while studies in resistant hypertension report 71% in terms of control.[20] The residential setting, which removes logistical barriers and allows continuous supervision, may largely explain these results in the Cuban context.

Although the study population was predominantly male, current guidelines emphasize the need to adapt cardiac rehabilitation programs to the specific characteristics of women,[22] an aspect that should be considered in future research. The adherence observed in the study (89.2% of patients attending more than six sessions) is higher than that reported in traditional outpatient programs, which often do not exceed 50-60%.[23]

This finding is particularly relevant for the military population, where service demands and deployments often interfere with continuity of outpatient care.[24] High adherence is a key predictor of success and supports the relevance of maintaining and strengthening this inpatient model within Cuban military healthcare.

Regarding hemodynamic response, improvement or stable values in systolic blood pressure in 83.3% of patients and in diastolic blood pressure in 85.7% represents a relevant outcome. These results are comparable to those obtained in controlled trials of short-term exercise programs.[25] The HIT-HYPE study[26] reported reductions of 8.4/5.1 mmHg after four weeks of training, attributed to acute neurohumoral mechanisms.

The magnitude of reduction observed in the cohort, although not quantified in absolute mmHg values, translates into a reduction in cardiovascular risk, as it has been documented that each 10 mmHg reduction in systolic blood pressure is associated with a 20% decrease in major cardiovascular events.[27]

Heart rate response was more heterogeneous: only 50.1% of patients showed improvement or stable values. This behavior is expected in short-duration programs, since autonomic adaptations leading to a sustained reduction in resting heart rate require at least six to eight weeks of continuous training.[28] The initial increase observed in some patients may reflect an acute stress response to exercise or relative dehydration and should not be interpreted as therapeutic failure, but rather as a transitional phase requiring follow-up and reinforcement during the post-discharge maintenance period.

The safety profile was excellent, with an adverse event incidence of only 3.3%, all of which were mild and transient. This is lower than that reported in recent meta-analyses (17.3%)[29] and confirms that supervised cardiovascular rehabilitation in a controlled environment such as Kurhotel Escambray is a very low-risk intervention, even in intensive programs.[30]

Strict monitoring and immediate adjustment of workload minimize the likelihood of serious events and ensure patient safety throughout the process.

Limitations

This study has several limitations. First, as an observational design without a control group, it is not possible to establish a definitive causal relationship or exclude the effect of uncontrolled factors such as changes in diet or rest during the stay. Second, outcomes were assessed at the end of the 21-day program; therefore, the long-term persistence of benefits is unknown. The post-discharge maintenance phase is crucial and should be addressed in future research. Third, being conducted in a single center with predominantly military personnel, the results may not be generalizable to other healthcare settings.

Conclusion

The cardiovascular rehabilitation program at Kurhotel Escambray proved to be effective and showed a high rate of favorable outcomes in hypertensive patients. Systolic and diastolic blood pressure showed improvement or stability in most patients, whereas heart rate did not reach the established effectiveness threshold.

The safety profile of the program was excellent, with a low incidence of adverse events, all mild and transient. The high adherence observed supports the feasibility and acceptability of this inpatient intervention model in the military personnel.

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