Virtual High-Intensity Interval Training on Physical Condition of Military Personnel in Pandemic

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Abstract

The measures adopted worldwide by COVID-19 were mainly focused on social distancing. However, these measures affected the physical preparation of the members of the Ecuadorian Army. This research aimed to analyze the incidence of high intensity intervallic training in military personnel who were in confinement through a quasi-experimental study applying a virtual training plan to improve physical condition. For this purpose, VO2 max (maximum oxygen consumption that the organism can absorb), CORE resistance strength (abdominal, lumbar, pelvic and gluteal muscles) and upper body resistance strength were evaluated. The results were statistically analyzed through the Wilcoxon signed-rank test, obtaining significant differences that allowed concluding that the virtual training plan had a positive impact on the physical condition of the military personnel and that it constitutes an effective alternative for the physical preparation of members of the Army in the context that is currently being experienced due to the pandemic.

Keywords. Aerobic capacity; Physical fitness; Strength endurance; Pandemic.

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Introduction

The pandemic caused by COVID-19 brought with it not only catastrophic effects in the field of global health but also in other spheres, such as economic, social, educational, sports, and even military, due to the collateral consequences that were produced by the restrictions and control measures implemented to mitigate the proliferation of contagions in the world. (Ammar, et al., 2020; Douglas et al., 2020).

The measures adopted worldwide were mainly focused on contributing to social distancing by closing airports, restricting public transportation, and prohibiting the execution of social, cultural, sports and educational activities, among others (Douglas et al., 2020)

According to Ogonaga & Chiriboga (2020), Ecuador has become one of the countries with the highest number of COVID-19 infections and affectations in South America, despite having only 17.64 million inhabitants and having been one of the first countries in the region to have implemented the aforementioned control measures to avoid the exponential increase in the number of infected people.

Therefore, the Armed Forces of Ecuador have been forced to react adequately to solve and fulfill all the constitutional and subsidiary missions imposed by the state despite the facts caused by COVID-19. Unfortunately, however, this institution was also a victim of this pandemic, having to restrict the training and physical preparation required by the military profession to meet the competencies of the professional profile of the soldier in the cognitive, psychological and physical aspects.

Every year, the Ecuadorian Army must train its personnel to be able to comply with the promotion requirement, attending courses at the War Academy for officers and the different Schools of Arms and Services for troops in order to maintain its personnel in optimal intellectual and physical conditions, which will allow them to maintain the operability demanded by the country.

The military high command, aware of the possible consequences of the pandemic in the face-to-face modality, decided to implement virtual refresher courses, mainly affecting military physical training. In particular, this restriction has meant violating the health of uniformed members by potentially compromising physical fitness, which is positively correlated with the ability to fight infections and immunological and cardiopulmonary complications with more severe results (Ammar, Brach, et al., 2020). Putting at risk not only the operability of one of the institutions that have collaborated the most in the various logistical and operational activities during this pandemic but mainly the lives of the military who fulfill the missions throughout the length and breadth of the country.

On the other hand, it is remarkable the emergence of training methodologies today, or rather, the use of these that were used at the beginning of the century by great exponents of high performance. One of those cases is High-Intensity Interval Training (HIIT). This methodology has re-emerged as a strategy or therapeutic tool since it has been confirmed to be effective in improving physical condition and is associated with people's health (Cofré-Bolaños et al., 2016).

Therefore, denoting under multiple studies have shown that a good physical condition is related to positive perceptions of the state of health (Alonso Martínez et al., 2003) and considering HIIT (High-Intensity Interval Training) as a method that allows the Ecuadorian Army to make up for the temporary, logistical and methodological impossibility for the physical preparation of military personnel due to the restrictions of confinement in Pandemic (Haddock et al., 2016). Therefore, the objective of this research was to analyze the incidence of this training in military personnel through a quasi-experimental study applying a virtual training plan to improve physical condition.

Methods

Population

The study participants were 123 male military professionals aged between 34 and 41 years (age: 36.73 ± 1.82 years; height: 167.93 ± 5.96 cm; body weight: 74.87 ± 20.18 kg; BMI: 26.57 ± 7.41 kg/m^2), who were undergoing the advanced course from the first corporal to the second sergeant at the Army Infantry School. The sample selection criteria were: 1) Professional military personnel of the infantry weapon; 2) Military personnel between 30 and 45 years of age. Exclusion criteria were: 1) Being infected or having been infected with COVID-19; 2) Presenting any disease suggesting possible difficulty in completing the study, such as cardiovascular, pulmonary or osteomuscular diseases; and 3) Presenting any physical or mental disability.

Evaluation design

The research work was of a quasi-experimental type, transversal due to the evaluation of the physical condition of the military personnel before and after implementing the intervention plan virtually to assess the existence of significant differences. Each participant complied with the battery of physical tests according to the table corresponding to their age, regulated by the Regulations for the Physical Evaluation of the military personnel of the Armed Forces of Ecuador: two-mile test, hip flexions (Sit-ups) in 1'30", elbow flexions (Push-ups) in 1'30". In which VO2max, abdominal and upper body strength resistance were evaluated, respectively, based on the scales proposed in the regulations (COMACO, 2018).

For the two-mile test, those evaluated performed a 3,219 m run on a flat surface, completing it in the shortest possible time to allow measuring VO2 max. For the elbow flexion and extension test, the protocol of counting the number of correct repetitions executed in 1 minute and 30 seconds was applied, taking into account that when flexing, the performer must touch the back of the evaluator's hand with the chest, located horizontally under the evaluated person. Furthermore, the body during the exercise execution must remain extended entirely; that is to say, the hips must not be arched, or any other part of the body other than the hands and the tips of the toes must not rest on the floor. Furthermore, finally, in the hip flexion and extension test, the protocol of counting the number of correct repetitions executed in 1 minute and 30 seconds was applied, considering that the person evaluated is placed in the dorsal ulna position with arms crossed, palms of the hands at shoulder height, knees extended and

legs crossed. The hip flexion should be a coordinated and simultaneous movement to slightly pick up the legs while lifting the back a maximum of 30 degrees from the floor, and the elbows may have a slight separation from the body without removing the palms of the hands from shoulder height. The feet should touch and drag along the floor. If the person evaluated takes the palms of the hands off shoulder height during the push-up or takes impulse with the arms, the push-up is not counted (COMACO, 2018).

Intervention plan

An 8-week training plan was planned and executed, each week with five training sessions, 3 of which were based on the HIIT method (High-Intensity Interval Training), with training sessions of 20 to 30 minutes in 6-station circuits with self-load and overload, with an intensity between 64 - 90% of VO2 max, and 77 - 95% of HR max (Bouaziz et al., 2020; Chicharro & Vicente-Campos, 2018; Costa et al., 2018; Feito et al., 2018; Germano et al., 2019), applying the modified Borg effort scale, as a means of monitoring training intensity (Chicharro & Vicente-Campos, 2018), and two training sessions of moderate intensity through proprioceptive and coordinative exercises.

All training sessions were guided through a training plan written in a digital magazine in PDF format, and explanatory videos of the proposed circuits were elaborated to avoid erroneous execution. Furthermore, each training session was monitored through the Zoom platform, following the protocol that involved 10 minutes of warm-up, the main part that was executed between 20 to 30 minutes according to the planning and finally, between 5 to 10 minutes of activities to return to calm.

Statistical Analysis

In order to determine the appropriate statistical test to analyze the behavior of VO2 max, upper body and abdominal strength, the normality analysis was performed through the Kolmogorov-Smirnov test for a sample of the difference between the results obtained from the pre-test concerning the post-test. Since the values were lower than the significance level of 0.05, it was concluded that the distribution of the variables was different from the normal distribution. Consequently, a non-parametric statistical test, the Wilcoxon signed-rank test, had to be used for data analysis. The level of statistical significance considered for the investigation was the $p< 0.05$ and a confidence level of 95% (Presidency of the Republic, 1997) (Silvente & Hurtado, 2012).

Results

Table 1

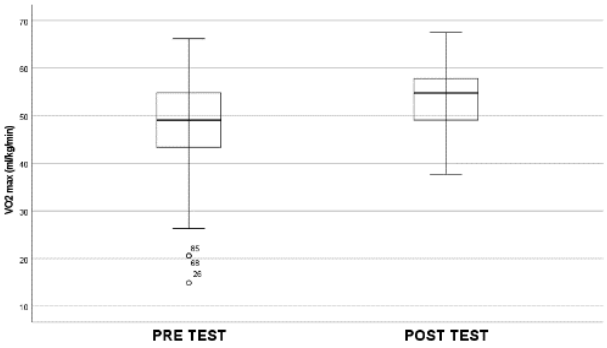
Physical fitness assessment statistics for military personnel.

		PRE-TEST VO2max (ml/kg/min)	POSTEST VO2max (ml/kg/min)	PRETEST SIT-UPS (repeticiones)	POSTEST SIT-UPS (repeticiones)	PRETEST PUSH-UPS (repeticiones)	POSTEST PUSH-UPS (repeticiones)
N	Valid	123	123	123	123	123	123
	Lost	0	0	0	0	0	0
Media			53,99	50,45	55,67	42,95	48,03
Median			54,80	52,00	55,00	43,00	48,00
Deviation			5,595	6,115	6,497	4,256	5,680
Deviation Range			29,80	35,00	33,00	28,00	33,00
Minimum			37,70	30,00	40,00	28,00	38,00
Maximum			67,50	65,00	73,00	56,00	71,00

Note: The results obtained from the battery of tests performed before and after applying the intervention plan, after training for eight weeks, with five weekly training sessions, and after applying the protocols mentioned above, are shown.

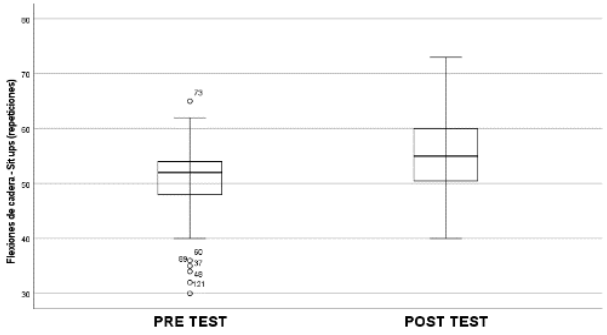
Figure 1

Box Plot of VO2max Statistics



Note: An increase of 13.93% is evidenced in terms of the group's mean value for VO2max. In addition, the deviation of VO2max for its mean decreased by 41.20%.

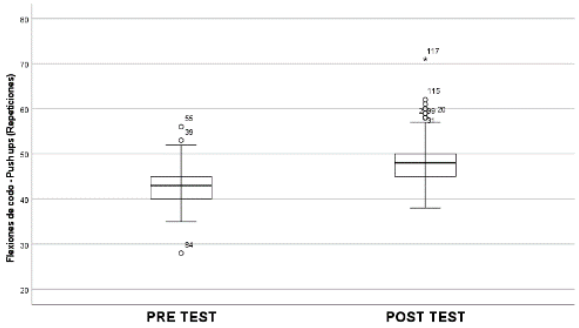
Figure 2 : *Box Diagram of Sit-ups Test Statistics*



Note: The number of repetitions performed in the abdominal flexion test shows an increase of 10.35% concerning the mean value and an increase of 6.25% of the standard deviation for the mean number of repetitions.

Figure 1

Box Plot of Push-ups Test Statistics



Note: There was an increase of 11.83% in the mean value of the number of repetitions in the elbow flexion test and an increase of 33.46% in the deviation of the value of the number of repetitions for the mean value.

Table 2

Kolmogorov-Smirnov one-sample test

		VO2 MAX	PUSH-UPS	SIT-UPS
N		123	123	123
Normal parameters[a,b]	Media	-6,6016	-5,0813	-5,22
	Deviation Deviation	6,00833	5,73256	4,197
Maximum extreme differences	Absolute	0,291	0,098	0,109
	Positive	0,136	0,098	0,099
	Negative	-0,291	-0,095	-0,109

Test statistic			0,291	0,098	0,109
Sig. asin. (bilateral)[c]			<,001	0,005	0,001
Monte Carlo (bilateral)[d]	Sig.		0,000	0,005	<,001
	99% confidence interval	Lower limit	0,000	0,004	0,000
		Upper limit	0,000	0,007	0,002

Note: The values of (VO2max p=0.000; Push-ups p=0.005; Sit-ups p=0.001) are less than the significance level 0.05; that is, there are significant differences. Therefore, the distribution of the variable is different from the normal distribution. Consequently, a non-parametric statistical test, the Wilcoxon signed-rank test, had to be used to analyze the data.

Table 3

Wilcoxon Test Ranges of the variables

		N	Average range	Sum of ranks
VO2 max POST - PRE	Negative ranges	0[a]	,00	,00
	Positive ranges	112[b]	56,50	6328,00
	Ties	11[c]		
	Total	123		
SIT-UPS POST - PRE	Negative ranges	1[a]	22,50	22,50
	Positive ranges	111[b]	56,81	6305,50
	Ties	11[c]		
	Total	123		
PUSH-UPS POST - PRE	Negative ranges	11[a]	29,59	325,50
	Positive ranges	95[b]	56,27	5345,50
	Ties	17[c]		
	Total	123		

Note: To determine the existence of significant differences, the Wilcoxon Signed Ranks Test was used, having as findings that of the 123 individuals in terms of their VO2max: 112 subjects improved, 11 subjects maintained it, and no subject had a decrease.

Regarding the values obtained in the Hip Flexion Test, it is identified that of the 123 individuals: 111 subjects improved, 11 subjects maintained their marks, and only one subject had a decrease in his post-test.

In relation to the values obtained in the elbow flexion test, it is evident that of the 123 subjects: 95 subjects improved, 11 subjects maintained their marks, and 17 subjects had a decrease in their post-test.

Table 4

Wilcoxon test statistics for the variables

	VO2 max	SIT-UPS	PUSH-UPS
	POST - PRE	POST - PRE	POST - PRE
Z	-9,222[b]	-9,131[b]	-7,920[b]
Sig. asin. (bilateral)	<,001	<,001	<,001

a. Wilcoxon signed-rank test

b. It is based on negative ranges.

Note: The values (VO2max p<0.001; Push-ups p<0.001; Sit-ups p<0.001) obtained with the Wilcoxon Signed Ranks Test, being less than the significance value of 0.05, denote significant differences, which allows us to conclude that the virtual training plan with HIIT methodology had a significant effect on the physical condition of the military personnel under study.

Discussion

The results of the study have shown that the use of virtual high-intensity intervallic training in military personnel who were in confinement due to the pandemic had a positive impact by showing a significant increase in their Vo2 max (p=0.000), upper body strength assessed through elbow flexions (p=0.005) and core strength through the assessment of hip flexions (Sit-ups p=0.001), confirming the studies conducted by several authors (Bouaziz et al., 2020; Cao et al., 2019; Chicharro & Vicente-Campos, 2018; Menz et al., 2019; Villelabeitia Jaureguizar et al., 2016; Wewege et al., 2017).where they have mentioned the effects of this training mainly in the increase of VO2max levels.

To achieve these results, we implemented an application of HIIT in health proposed by (Chicharro & Vicente-Campos, 2018) to execute moderate and vigorous physical activity for healthy adults with an intensity between 64 - 90% of VO2 max, and 77 - 95% of HR max, with an adaptation of the researcher through bodyweight exercises that involved the execution of motor actions with the intervention of several muscle groups such as burpees, jumping rope, mountain climbers, air squats, lunges with jumps, push-ups, among others; which helps to induce adaptations in the different body systems mainly in the cardiorespiratory and musculoskeletal system. (Ammar et al., 2020; MacInnis & Gibala, 2017; Menz et al., 2019; Weston et al., 2014).

Recent studies (Ammar et al., 2020; Ammar et al., 2020; De Oliveira et al., 2020) have shown that home confinement caused by the current COVID-19 strongly impacts lifestyles of people worldwide by reducing the performance of physical activity and participation in sports.

The HIIT methodology allows for optimizing training time, infrastructure and sports implementation, being more effective in improving conditional capacities (MacInnis & Gibala, 2017; Milanović et al., 2015)., becoming an effective and alternative tool for the Ecuadorian Army.

The design of the virtual training plan is innovative and easily accessible to the military population through the digital magazine Hiit Militar Virtual with a graphic and written explanation of the training sessions and videos that allow those involved to execute the exercises in a better way and under the supervision of the researcher through the zoom platform, to identify errors and correct them to avoid future injuries.

However, during the execution of the intervention plan, it was observed that some participants inaction in the training sessions due to several factors, among which we can highlight: the results of home confinement and the motivation that this type of training demands since being of high intensity and being executed autonomously, it requires certain methodological elements that allow increasing the internal state of the individual that activates and maintains an adequate behavior towards the fulfillment of the training objectives (Ammar, Brach, et al., 2020; Chaari & Golubnitschaja, 2020; De Oliveira et al., 2020; Narici et al., 2021).

Implementing the Virtual Military Hiit, needs its execution as a complementary means to develop technological means such as videos that provide more significant support to military personnel.

In addition, the interaction between individuals through these digital media allows to add the social aspect that is favorable to promote healthy lifestyle habits through physical activity; and finally, that allows unit commanders to execute monitoring of the compliance of training sessions to supervise the physical preparation of the personnel under their command.

Conclusion

The appropriate use of virtual high-intensity intervallic training improved the physical condition of the military personnel under study and was related to positive perceptions of health status.

This application of high-intensity intervallic training under a virtual modality becomes a new methodology that satisfies the need of the Ecuadorian Army to solve the problems arising with the physical preparation of military personnel who are in confinement fulfilling their advanced training courses. However, due to the COVID-19 pandemic, they have not been able to execute it normally, but at a distance.

In addition, the design of the virtual training plan through a digital magazine and explanatory videos of the training sessions favored the adequate and standardized execution by the military personnel who were part of the research.

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