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ORIGINAL ARTICLE

Study of VO_{2max} and body composition in trained soldiers of the army special operations unit

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ABSTRACT

The objective of this article was to establish comparisons between different special operations units of the army. 91 male subjects (mean ± Standard deviation; age: 33.05 ± 3.28 years; height: 1.77 ± 1.37 m; body weight 79.02 ± 1.59 kg), divided into 4 groups (mountain, diving, UEO and mobility), were evaluated through body composition and stress tests. A bioimpedance test was carried out to determine the different tissues and an incremental treadmill stress test with a gas analyser to establish the different physiological parameters. The results showed significant differences in terms of heart rate (HR) in the different thresholds (ventilatory threshold 1, ventilatory threshold 2 and maximum oxygen consumption) and in the speed reached in these ($p < .05$). On the other hand, with respect to body composition (muscle mass weight, % fat mass and fat weight), no significant differences were observed between the different groups analysed ($p > .05$).
Keywords: Performance analysis of sport, Sport medicine, Army, VO_{2max}, Body composition.

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INTRODUCTION

Physical analysis constitutes a fundamental part as the basis for sports training and performance to achieve various objectives (Dyrstad et al., 2006; Delextrat & Cohen, 2008; Courel-Ibáñez & Herrera-Gálvez, 2020). In this sense, for decades, some researchers have separated different components of physical fitness related to health and performance (Pate, 1983; Garber et al., 2011; Knapik et al., 2017; Proyer et al., 2018). Recently, in the sports field, all kinds of evaluations and tests have been included to establish parameters and aptitudes that favor an improvement in performance and, consequently, in sports success according to the characteristics and demands of the sport itself (Lidor et al., 2009; Ranković et al., 2010; Bujnovsky et al., 2019; Sarmento et al., 2014; Tabacchi et al., 2019).

There are also other areas in which tests, assessments and evaluations of physical fitness are used to establish certain requirements for access and improvement of their physical capacity, as is the case of the military (Williamson et al., 2009; J. J. Knapik et al., 2009; Knapik et al., 2017; Draicchio et al., 2020). Traditionally, physical fitness has been considered a critical element in the success of special operations because the demands of the tasks to which they are subjected require a high level of effort (McCaig & Gooderson, 1986; Friedl et al., 2000; Hoyt et al., 2006). These fitness and fitness levels are not only necessary for health, but also for specific military tasks and injury prevention (Knapik et al., 2017). The importance of evaluation and physical fitness in the military has shown, in previous operational and experimental research, how soldiers with better physical conditions and aptitudes exhibit higher levels of performance in real or simulated military tasks (J. Knapik et al., 1990; Rayson & Holliman, 2000).

In this sense, the objective of this article is to compare body composition and the different physiological variables obtained in stress tests and analyze them according to the physiological requirements and demands required by the activities in which they are specialized.

MATERIAL AND METHODS

Participants

A total of 91 subjects (mean ± Standard deviation; age: 33.05 ± 3.28 years; height: 1.77 ± 1.37 m; body weight 79.02 ± 1.59 kg) divided into 4 groups participated in the present study. These groups are made up of: 37 subjects from the mobility group, 30 mountain subjects, 11 diving subjects and 13 from the group of Special Operations Units (UOE). Military women, due to their small number of participants (n = 1), are not represented in all the operational groups analyzed. Separated by groups, Table 1 presents the characteristics of each group.

Table 1. Provide this table in WORD/EXCEL (or similar) format to sjsp@aearedo.es or at SJSP Web

It is a sample with a high level of physical condition, with a preparation and daily training program oriented to the demands of their corresponding activities. Said physical condition has been determined through factorial studies that provide construction validity for the concept of physical condition (Knapik et al., 2006). They train 20 hours a week divided into maneuvers and practices. The activities they carry out daily are determined according to the demands and preparation required by the different special operations entrusted to each of the groups (i.e., strength training, resistance, agility, dexterity).

Design

A prospective observational pilot study of a single cohort without follow-up was conducted. The study was carried out with the participation of the Technology-Based Company of the University of Alicante, Kinetic Performance.

Procedure

The control of the tests was carried out in Alicante in the year 2021. The participants were instructed to carry out the tests, which were developed under controlled environmental conditions. The tests were carried out at different times and in different months. During previous weeks, several sessions were held with the different ranges and study participants in order to report on the development of the intervention and its duration.

Measures

Anthropometry

The anthropometric study was carried out using a segmental multifrequency DSM-BIA body composition analyzer (InBody 270) and weight, fat percentage, muscle mass percentage, residual mass percentage, amount of water stored and symmetries in all body zones were obtained.

Effort test

The stress test was performed with a gas analyzer on the Technogym Excite 500 treadmill. Polar H9 heart rate bands were used for HR monitoring.

Statistic analysis

A descriptive analysis (mean and standard deviation) was used using the SPSS 25.0 program (SPSS Inc., Chicago, IL, USA). A robust ANOVA test was performed using the Brown-Forsythe and Welch tests, carrying out a posteriori (post-hoc) comparison to determine more specific significant differences between groups. The level of significance was set at $p < .05$.

RESULTS

Between the different groups of special operations compared, there are no significant differences in terms of muscle mass, fat and % of fat mass ($p > .05$). Figure 1 shows the results regarding the body composition of each of the groups. The group with the highest muscle mass (kg) is the diving group, while the group with the lowest body fat is the mountain group, but without significant differences in all the parameters analyzed ($p > .05$).

Regarding the different thresholds used (aerobic, anaerobic and maximum oxygen consumption), there are significant differences with respect to the speed reached (Km/h) in the stress tests ($p < .05$). There are also significant differences in heart rate (HR) for the aerobic and anaerobic thresholds ($p < .05$), while the same does not occur in the HR obtained at maximum oxygen consumption or VO_2max ($p > .05$). In figures 1 and 2, these data can be observed. In them, it is contrasted how there are greater differences in the anaerobic threshold according to the speed reached in the tests. On the other hand, if we analyze the HR obtained at the different thresholds, we observe a clear difference between the mountain and diving groups with respect to the UOE and mobility groups.

In the same way, the liters of oxygen per minute (L/min) were also analyzed in the tests (graph 3). In the three thresholds analyzed, significant differences are observed between the groups ($p > .05$). Also in this case, the mountain and diving groups obtained higher values than the UOE and mobility groups.

If we analyze the comparisons a posteriori (post-hoc), significant differences are observed in terms of HR at the different thresholds compared, being mainly significant between the mountain and diving groups with respect to the UOE and the mobility group ($p < .05$). At the same time, the same thing happens with the speed reached and the L/min at these thresholds in the different stress tests. However, in these parameters, the same does not occur between mobility groups and UOE, as well as, Mountain and diving ($p > .05$).

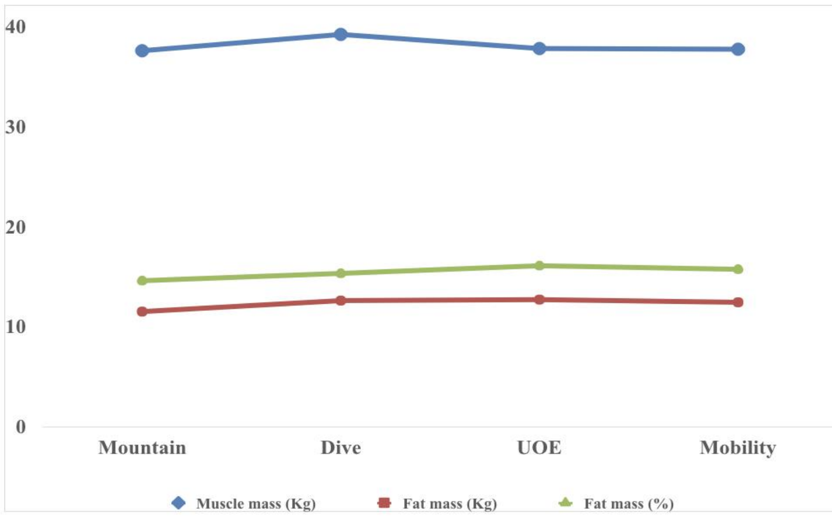

Figure 1. Body composition of the different groups analyzed ($p < .05$).

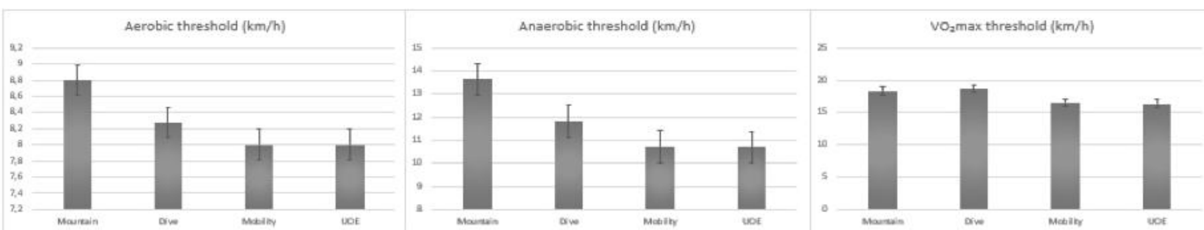

Figure 2. Thresholds established with respect to the speed reached (km/h).

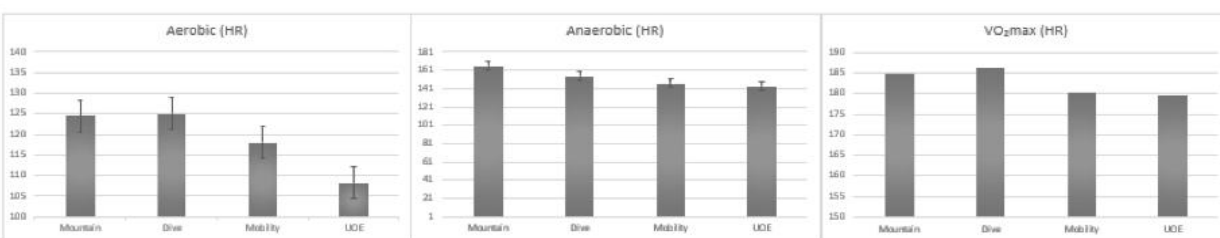

Figure 3. Heart rate reached with respect to the different thresholds analized.

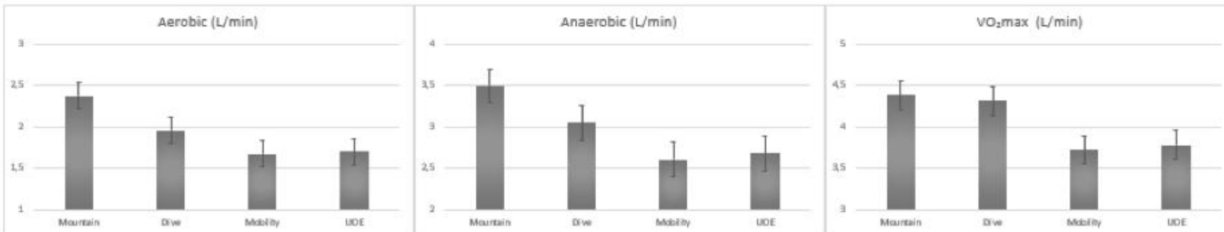

Figure 4. Liters of O_2 (expressed in L/min) reached at different thresholds analyzed.

DISCUSSION

The objective of this study was to establish the differences that exist between the different groups of special operations analyzed according to body composition and physiological parameters measured in stress tests.

Our study observed that there are significant differences in the thresholds reached (VT1, VT2 and VO_2max) with respect to the speed reached in the stress tests ($p < .05$). The same thing happened with respect to the obtained HR, but without significant differences in VO_2max. Differences were also observed between the groups in the liters of oxygen in terms of these analyzed thresholds ($p < .05$).

Despite having been reported in the literature changes in body composition in soldiers through training (Gobbo et al., 2022), and being a widely demonstrated concept, based on these data, no differences in body composition parameters were observed in our study between groups. Although there are differences in the energy demands to which each of the groups are subjected, the body composition is very similar between them. Therefore, despite being groups that carry out totally different activities, their body composition is similar. This characteristic does not occur in other areas such as sports, where there are differences according to the requirements of their respective disciplines (Fields et al., 2018; Bojan Masanovic, 2019; Reale et al., 2020) and even between different levels of the same sport (B. Masanovic et al., 2019; Gardasevic et al., 2019; Bosch et al., 2019).

If we focus on the heart rate and speed reached by the subjects according to the different thresholds analyzed, significant differences are observed between the different groups ($p < .05$). Therefore, in this case there are variations between the different groups analyzed, as occurs in different sports disciplines (Ranković et al., 2010; Souza et al., 2018). The same thing happens with the liters of oxygen assessed during stress tests.

Regarding the specific comparative analysis between the different groups, the mountain and diving groups differ significantly from the mobility and UE group, especially in VO_2max. In this sense, it has been documented in the literature that mountain activities require good physical condition (Burtscher, 2004; Burtscher & Ponchia, 2010; Burtscher, 2012). The importance of good physical fitness, respiratory capacity and body composition are important to achieve good levels of diving and freediving (Lindholm et al., 2007; Rusoke-Dierich, 2018), as well as, an optimal medical and physical examination of your cardiorespiratory capacities to carry out said activity (Weiss, 2003). Therefore, groups specialized in this type of activity must have a good preparation and significant cardiorespiratory fitness. In this sense, our study shows a strong correlation with the existing literature on this topic.

Despite the fact that prediction tests have been used for military performance (Stocker & Leo, 2020) and training oriented according to the specialty they carry out (Sucipta et al., 2018), there is no extensive literature on comparisons between different groups of operations within the military service. Therefore, future research is necessary between different specialized groups in order to guide their training according to the characteristics and demands of the activity and operations they carry out.

Finally, there are certain limitations in our study. On the one hand, the selected groups are not made up of the same number of subjects, which could affect the accuracy of the data. On the other hand, the stress tests carried out have been carried out for months, and the climatic conditions or the type of training of the subjects may vary, as well as their rest and, therefore, changes in the volume of training may have occurred.

CONCLUSION

In conclusion, our study showed that there are no significant differences regarding the body composition of the four groups analyzed, but there are between the speed and HR reached in the different thresholds analyzed. On the other hand, in the L/min observed in these thresholds, significant differences were also demonstrated in the different special operations units of the army.

AUTHOR CONTRIBUTIONS

M.T.S. and C.E.A. manuscript writing, collected the data, preparation and research design; M.A.J. critically reviewed the work, result interpretation and manuscript writing; M.J.G.G. manuscript writing and collected the data, and J.A.P.T. research design, statistical analysis and result interpretation.

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DISCLOSURE STATEMENT

This study was approved by the ethics committee.

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