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Experience modulates the psychophysiological response of airborne warfighters during a tactical combat parachute jump

Vicente Javier Clemente-Suárez [a,b,*], Ricardo de la Vega [c], José Juan Robles-Pérez [a,d], Mario Lautenschlaeger [d], Jesús Fernández-Lucas [e]

[a] Research Center in Applied Combat (CESCA), Toledo, Spain
[b] Department of Sport Science, European University of Madrid, Spain
[c] Department of Physical Education, Sport & Human Movement, Autonomous University of Madrid, Spain
[d] Light Forces Head Quarter of the Spanish Army, Madrid, Spain
[e] Biomedical Science School, European University of Madrid, Spain

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ABSTRACT

We aimed to analyse the effect of experience level in the psychophysiological response and specific fine motor skills of novel and expert parachute warfighters during a tactical combat parachute jump. We analysed blood oxygen saturation, heart rate, salivary cortisol, blood glucose, lactate and creatinkinase, leg strength, isometric hand-grip strength, cortical arousal, specific fine motor skills and cognitive anxiety, somatic anxiety and self-confident before and after a tactical combat parachute jump in 40 warfighters divided in two group, novel (n = 17) and expert group (n = 23). Novels presented a higher heart rate, lactate, cognitive anxiety, somatic anxiety and a lower self-confident than experts during the jump. We concluded that experience level has a direct effect on the psychophysiological response since novel paratroopers presented a higher psychophysiological response than compared to the expert ones, however this result neither affected the specific fine motor skills nor the muscle structure after a tactical combat parachute jump.

1. Introduction

The parachute jump has been used as a model to study the psychophysiological response to stress and the mechanism to cope with it, consisting a methodology to approach the psychophysiological mechanism of some pathologies as anxiety disorders (Hare et al., 2013; Cavalade et al., 2015). The parachute jump is considered as a reliable stimulus that elicits a psychophysiological response since it is a more intense stressor than traditionally laboratory stressor and is a real risk of injury and death (Yonelinas et al., 2011). Another situation that elicits a large stress response is combat, where warfighters´ have to deal with many situations that can endanger their lives. In these situations warfighters sympathetic nervous system is large activated producing an increase in cardiovascular, muscular and metabolic response, however cortical arousal, processing information and working memory decreased (Clemente-Suárez and Robles-Pérez, 2012a, 2012b; Clemente-Suárez and Robles-Pérez, 2013a, 2013b; Taverniers et al., 2010). Some research suggest that this highly stress stimulus could affect the warfighters health when it's becoming chronic, being the maintenance of a high sympathetic nervous system activation a cardiovascular risk factor (Curtis and O'Keefe, 2002). Some special units as airborne are exposed in their missions to both, the stress of the parachute jump and the stress of combat.

In line with this, the relationship between the acute stress response and the dysregulation of the hypothalamic-pituitary-adrenal axis have been extensively studied in field and laboratory situations, but the subjective anxiety perception is poor known in field studies into the military actions (Meyer et al., 2015). In the present research we consider the classical differentiation of King et al. (1976) between stress and anxiety: the stress would refer to the objective proprieties of the situation stimuli, while fear refer to the perception of a situation as threatening or dangerous, being anxiety the product of both and the perception of the warfighters (Lazarus and Folkman, 1984). The anxiety manifested in the parachute jump must be explained in terms of the relationships established between the soldiers' idiosyncratic characteristics and the situation, being the cognitive, emotional and motivational aspects, as well as the perception of the situation, crucial in the anxyogenic response manifested (Mischel, 1977).

It is known that motor and visual experience positively influences action perception (Aglioti et al., 2008) being the experience level a critical factor to develop an optimal performance in different task or employments, like medical (Scott et al., 2000), air traffic controller (Pecena et al., 2013) or sport area (Swann et al., 2012), as general

* Corresponding author at: Department of Sport Science, Calle Tajo, s/n, 28670, Villaviciosa de Odón, Madrid, Spain.
E-mail address: vctxente@yahoo.es (V.J. Clemente-Suárez).

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adaptation syndrome and habituation process theory explained (Selye, 1976). Specifically in parachute jumpers, experience level is an important factor to explain the influence of psychological stress and adrenocorticotropic hormone (ACTH) and cortisol hormones, finding in novel jumpers higher heart rate and a decrease in subjective arousal (Kowalczyk and Kura, 2012), these results being compatible with the extinction of anticipatory anxiety theory (Roth et al., 1996).

Independently of the warfighters experience, they have to deal with the same threat in the actual theatres of operations, carrying heavy equipment, and specifically the paratroopers supporting a landing before combat with these heavy equipment. This combination of psychological and physiological stress can negatively affect the muscle structure of warfighter, as previous studies found increases in muscle destruction parameter as creatinkinase (Clemente-Suárez, Robles-Pérez, & Montañez-Toledo, 2015), and fine motor skills, both important factors for paratroopers that have to handle the parachute during the deployment and after that move to the operation area using a weapon. Then, interferences in these parameters could have a direct impact on its operability and mission effectiveness. Thus, the purpose of the present study was to analyse the effect of experience level in the psychophysiological response of experienced and novel parachute warfighters during a military tactical parachute jump. It was hypothesized that novel jumpers would present a higher anxyogenic response that would increase the psychophysiological response affecting negatively their fine motor skills and muscle structure after the jump.

2. Methods

2.1. Participants

We analysed 40 male soldiers of the Spanish Army divided in two groups, the first one with 17 novel airborne warfighters (mean age: 23.2 ± 2.7 years; 23.7 BMI) with 6 parachute jumps performed in the basic parachute military training, this group was analysed during the first jump of their units, for this reason all of them only had 6 jumps of experience; The experienced group included 23 experienced airborne warfighters (mean age: 35.5 ± 5.2 years; 23.8 BMI; 76.0 ± 10.8 parachute jumps). All of them served in the Airborne Brigade *Almogáraves VI* (Paracuellos del Jarama, Madrid, Spain). We analysed the specific warfighters because there were as the unit was selected to conduct the study by the Unit officers, the researchers had not could not intervene in the participants' selection. Soldiers were equipped with standard uniforms and boots, helmet, tactical fighting load carrier, body armour, an Hk G-36 rifle and the reglementary and emergency parachutes to perform the jump. The weight carried by the paratroopers was 39.3 kg. Prior to participation, the experimental procedures were explained to all the participants, who gave their voluntary written informed consent in accordance with the Declaration of Helsinki. In addition all the procedures were approved by the Head Quarter of the Unit.

2.2. Instrumentation and study variables

Before and after the automatic parachute jump the following parameters were analysed in this order.

Blood oxygen saturation and heart rate by a pulse oximeter (PO 30 Beurer Medical).

Salivary cortisol, by the Salivette system (Sarstedt AG & Co., Numbrecht, Germany). Each participant was given a bag containing two Salivettes. For the sample collection participants were encouraged to place the Salivettes underneath their tongue without the use of their hands after chew the swabs during 60 s. Participants were then asked to then place the roll back into the plastic container using only their mouth and then to put the cap back into the external Salivette tube. Each sample was visually inspected for blood contamination and then stored–80 °C until assayed. Salivary free-cortisol concentration in saliva was determined in the laboratory following standard procedures (Hogue et al., 2013). The sample previous to the jump was obtained at 08:30 and post jump sample between 12:30 and 13:30.

Blood glucose concentration by the analysis of 5 μl of capillary finger blood using a portable analyser (One Touch Basic, LifeScan Inc. Madrid).

Blood lactate concentration taking a sample of 5 μl capillary blood from a finger of subjects and analysed with the Lactate Pro Arkay, Inc. system (Kyoto, Japan).

Blood creatinkinase concentrations taking a sample of 32 μl capillary blood from a finger and analysed using the Reflotron Plus system, (Roche Diagnostics S.L. Sant Cugat del Vallès, Barcelona).

Lower body muscular strength manifestation by means of a vertical jump test. We used the Sensorize FreePowerJump system (SANRO Electromedicina, Madrid. Spain) which recorded flight time (s) and jump height (cm) to evaluate three vertical types of jump. Soldiers performed 2 Squat Jump (SJ), 2 Contramovement Jump (CMJ) and 2 Abalakov jump (ABK) as previous research conducted in soldiers (Clemente-Suárez and Robles-Pérez, 2013a). We chose the best intent of each type of jumps.

Isometric handgrip strength by a grip dynamometer (Takei Kiki Koyo, Japan).

Cortical arousal trough the Critical Flicker Fusion Threshold (CFFT) in a viewing chamber (Lafayette Instrument Flicker Fusion Control Unit Model 12,021) following the procedures conducted in previous studies (Clemente-Suárez and Robles-Pérez, 2013a). An increase in CFFT suggests an increase in cortical arousal and information process, by contrast, when the values fall below the baseline, it suggests a reduction in the efficiency to process information and fatigue of central nervous system (Saito, 1992).

Specific fine motor skills, by the time of reloading a 15 bullet of 9 mm calibre into a *Beretta* pistol magazine.

State anxiety was assessed using the CSAI-2R self-evaluation questionnaire(Cox et al., 2003), consisting of 5 cognitive anxiety (CA), 7 somatic anxiety (SA) and 5 self-confidence (SC) questions. The response scale evaluated the intensity of each symptom on a scale of 1 (not at all) to 4 (very much). Higher scores on cognitive and somatic anxiety subscales indicated a higher level of anxiety, whereas higher scores on the self-confidence subscale indicated a higher level of self-confidence.

2.3. Procedure

Basal sample of all the study variables were taken at 08:30 in the Torrejon Airbase of the Spanish Air Force. After the basal sample, each group went to be equipped and then boarded to a Hercules T-21 airplane of the Spanish Air Force to perform the tactical combat parachute jump. Soldiers performed a low altitude combat parachute jump at 500 m of altitude and the parachute automatically opened after living the airplane. Novel soldiers jumped prior to novel, and after landing them, experienced jumped in a lapse time inferior of 15 min. After landing soldiers were regrouped by operative units as a real tactical parachute jump and then went to the field laboratory placed in the landing area to conduct the post samples tests, it occurred between 12:30 and 13:30 after 15–20 min of landing.

2.4. Statistical analysis

Data were analysed using the Statistical Package for the Social Sciences (SPSS) version 21 (SPSS Inc., Chicago, Ill., USA). Means and SDs were calculated using traditional statistical techniques. Normality was tested with the Kolmogorov-Smirnov test. A one factor ANOVA for intergroup comparisons and a Student's *t*-test for intragroup comparisons since variables presented a parametric distribution were conducted. The Effect Size was tested by Cohen's d. The significance level was set at $p < 0.05$.