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Director: Fernando Emilio Valladares Fuente

Email: fernando.valladares@upr.edu.cu

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Original article

Relationship between cortical activation and moods in judo high performance female athletes

Relación entre la activación cortical y los estados de ánimo en judocas de alto rendimiento

Relação entre ativação cortical e estados de humor em jogadores de judô de alto desempenho

Anelin Dayris Rodríguez Olivera^{1*}  <https://orcid.org/0000-0002-8584-3693>

Marisol de la Caridad Suárez Rodríguez¹  <https://orcid.org/0000-0002-7371-7876>

Magda Anoceto Mesa²  <https://orcid.org/0000-0002-7216-0121>

¹Institute of Sports Medicine. Cuba.

²University of Physical Culture and Sports Sciences "Manuel Fajardo". La Habana, Cuba

*Corresponding author: anelinpsicologa@gmail.com

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ABSTRACT

The evaluation of cortical e activation, an indicator of central fatigue, constitutes a demanded procedure for the psychological control of training in high-performance athletes in Cuba. However, most of the studies carried out do not address the relationship between this variable and moods, although the impact that the latero have on the performance of the athlete, on their health status, among other variables, has been demonstrated. The incipient knowledge in this regard has limited the performance of more comprehensive psychopedagogical interventions during the psychological control of training. The present work aimed to verify the relationship between the level of cortical activation and moods. The sample consisted of 10 judokas from the Cuban women's national judo team. Cortical activation was measured during six training sessions using the Flicker, before and after the loads were delivered. Moods were assessed before beginning each training session with the Interactive Moods Profile. Data were processed using Student's T for related samples, Pearson's and Spearman's correlation coefficient, frequency distributions, and descriptive statistics. The main results showed that in the moods variable, vigor prevails, which evaluation was high before starting the training sessions, the presence of fatigue was also evidenced, while the level of cortical activation showed the expected behavior that produced a significant increase in the same after load, confirming a very weak correlation between both variables.

Keywords: Cortical activation; High performance; Moods; Judo female athletes.

RESUMEN

La evaluación de la activación cortical e, indicador de fatiga central, constituye un demandado proceder del control psicológico del entrenamiento en deportistas de alto rendimiento en Cuba. Sin embargo, la mayoría de los estudios realizados no abordan la relación entre esta variable y los estados de ánimo, aunque se ha demostrado el impacto que poseen estos últimos en el rendimiento del deportista, en su estado de salud, entre otras variables. El incipiente conocimiento al respecto ha limitado la realización de intervenciones psicopedagógicas más integrales durante el control psicológico del entrenamiento. El presente trabajo tuvo como objetivo comprobar la relación entre el nivel de activación cortical y los estados de ánimo. La muestra estuvo compuesta por diez judocas del equipo nacional de judo femenino de Cuba. La activación cortical fue medida durante seis sesiones de entrenamiento mediante el uso del Flicker, antes y después de suministradas las cargas. Los estados de ánimo fueron evaluados antes de comenzar cada sesión de entrenamiento con el Perfil Interactivo de Estados de Ánimo. Se procesaron los datos mediante la T de Student para muestras relacionadas, el coeficiente de correlación de Pearson y Spearman, distribuciones de frecuencias y estadígrafos descriptivos. Los principales resultados arrojaron que en la variable estados de ánimos prevalece el vigor cuya evaluación fue alta antes de iniciar las sesiones de entrenamiento, también se evidenció presencia de fatiga, mientras que el nivel de activación cortical mostró el comportamiento esperado que produjo un aumento significativo de la misma poscarga, constatándose una correlación muy débil entre ambas variables.

Palabras clave: Activación cortical; Alto rendimiento; Estados de ánimo; Judocas.



RESUMO

A avaliação da ativação cortical e, um indicador de fadiga central, constitui um procedimento exigido no controle psicológico do treinamento de atletas de alto rendimento em Cuba. Entretanto, a maioria dos estudos realizados não aborda a relação entre esta variável e o humor, embora o impacto deste último no desempenho e estado de saúde do atleta, entre outras variáveis, tenha sido demonstrado. O conhecimento incipiente a este respeito tem limitado a implementação de intervenções desde psicopedagogias mais abrangentes durante o controle psicológico do treinamento. O objetivo do presente estudo era testar a relação entre o nível de ativação cortical e os estados de humor. A amostra consistiu de 10 judocas da equipe nacional feminina de judô de Cuba. A ativação cortical foi medida durante seis sessões de treinamento usando o Flicker, antes e depois que as cargas foram administradas. Os estados de humor foram avaliados antes do início de cada sessão de treinamento com o Perfil de humor interativo. Os dados foram processados usando o teste t de Student para amostras relacionadas, o coeficiente de correlação de Pearson e Spearman, distribuições de frequência e estatísticas descritivas. Os principais resultados mostraram que no variável humor prevaleceu o vigor, cuja avaliação foi alta antes de iniciar as sessões de treinamento, a presença de fadiga também foi evidenciada, enquanto o nível de ativação cortical mostrou o comportamento esperado que produziu um aumento significativo na mesma pós-carga, mostrando uma correlação muito fraca entre as duas variáveis.

Palavras-chave: Ativação cortical; Alto desempenho; estados de humor; Jogadores de judô.

INTRODUCTION

The evaluation of the level of cortical activation has become a demanded procedure within the psychological control of sports training in high-performance athletes in Cuba. The level of cortical activation is nothing more than the degree of excitement that exists in the cerebral cortex, which is an objective indicator of the behavior of the psychological response to central fatigue, [Suárez, \(2020\)](#).

Central fatigue is a process associated with specific functional alterations of the central nervous system (CNS), of which the athlete is not always aware, [Suárez and Rielo, \(2019\)](#), but can affect their performance and state of physical and mental health. The assessment of the behavior of the level of cortical activation allows knowing the incidence that the loads have on the CNS, knowledge necessary to assess the progress of the process of psychophysical assimilation of the work carried out and to make the pertinent corrections to the process of planning and dosage of the loads of training, on the way to the search for sports form, [Suárez and Rielo, \(2019\)](#).

Several researches in the field of sport have addressed the study of the behavior of the level of cortical activation, in certain stages of training [Martínez and Suárez, \(2013\)](#) before different load stimuli [Clemente, \(2017\)](#); [Clemente and Diaz, \(2019\)](#); [Suarez and Rielo, \(2019\)](#); [Suarez, \(2020\)](#); [Montoya and López, \(2021\)](#) and longitudinally throughout several cycles of preparation [Suárez, Martínez and Mesa, \(2017\)](#); in sports such as judo, cycling, soccer, marathon, artistic gymnastics and athletics, in which a significant increase in postload cortical activation has been shown as the expected effect.



It has also been confirmed that the level of cortical activation decreases as the sports preparation process progresses, as an indicator of an adequate progress of the process of psychophysical assimilation of the work carried out, [Suárez et al., \(2017\)](#); that the pre- and post-load values of the cortical activation level have a similar behavior in relation to their homogeneity and that there is a strong, positive and significant correlation between them [Martínez and Suárez, \(2013\)](#); [Suarez et al., \(2017\)](#); [Suarez and Rielo, \(2019\)](#). The results obtained in these reserches on the behavior of cortical activation before planned training loads have allowed the realization of interventions of a psychopedagogical nature, aimed at favoring the process of assimilation and adaptation to said loads, after it has been shown that variations produced in this variable have been the product of the loads supplied.

However, the existing studies have dispensed with verifying, what other variables could be related to the behavior of cortical activation?, constituting an insufficiently explored question the behavior of cortical activation in relation to other psychological responses, among which are the moods, which has limited the scope of the psychopedagogical interventions carried out.

Moods are a type of affective experience of low intensity in its manifestation, but relatively stable and with a certain duration, which nuance personality and can organize or disorganize behavior, [Castañeda et al., \(2018\)](#). The evaluation of the athlete's moods before receiving the training loads allows knowing their level of readiness for the activity. An athlete with a low level of task readiness does not properly prepare the body during the warm-up and does not work hard enough to meet the demands of training, which may result in injury, interpersonal problems as a result of moodiness, or, which can be more serious, the abandonment of the activity.

Several researches have focused on the study of moods in different sports and populations that practice physical activity, [Chacón et al., \(2017\)](#); [Hernández et al., \(2018\)](#); [Gallardo, et al., \(2019\)](#); [Sánchez et al., \(2017\)](#); [Reynoso et al., \(2021\)](#); [Shimokawa, \(2021\)](#), proving that they can favor or hinder the athlete's performance very easily and influence the behavior of other psychological variables. However, there are no studies that are able to specify its relationship with variables such as the level of cortical activation.

Hence, this research aims to verify the relationship between the behavior of the level of cortical activation and moods. The results obtained from the theoretical point of view will provide a better understanding of the psychological responses to training loads, specifically the nature of the behavior of the cortical activation level, an objective variable and its interrelation with other subjective variables.

From a practical point of view, it constitutes a reference for specialists who work in the process of preparing high-performance athletes for the analysis and interpretation of data from the psychological control of training, particularly with respect to the variables studied in their interrelation , as well as for the conformation of the methodology that can characterize the realization of this procedure.

To carry out the research, some instruments and theoretical-practical positions were taken into account that, due to their importance in the application of the relevant methodology, deserve to be highlighted in this section ([Zatsiorski, 1989](#); [Martínez, 2011](#); [Martínez and Suárez, 2013](#); [Barrios, 2015](#); [Suárez et al., 2017](#); [Suárez and Rielo, 2019](#); [Suárez, 2020](#); [Montoya and López, 2021](#)).



MATERIALS AND METHODS

The research was carried out on a sample of ten athletes from the national women's judo team of Cuba, whose ages ranged between 17 and 33 years for an average of 23 years of age, belonging to the seven competition modalities of this sport, distributed as follows: 48 kg (1), 52 kg (1), 57 kg (2), 63 kg (1), 70 kg (2), 78 kg (1) and +78 kg (2) judo female athletes respectively.

The study was developed during the accumulation period of a training structure that responds to a periodization known as ATR (accumulation-transformation-realization system), in which the judo female athletes studied during six training sessions were given the measurements of the level of cortical activation before and after the loads supplied and the moods before each session.

The loads supplied were characterized by the performance of tashi-waza and ne-waza work, which were conceived from a plan previously designed by the Technical Collective of the Women's National Judo Team, reviewed and approved by the Technical Department of the Institute. National Sports, Physical Education and Recreation of Cuba.

A total of 116 cortical activation level measurements were made (58 preload measurements and 58 post load measurements), using a direct or objective method, and 58 measurements (preload) of mood states, through the use of an indirect or subjective method.

To measure the level of cortical activation, the Flicker or fatigtest was used, an instrument that has been widely used for central fatigue studies. An apparatus designed to measure the critical frequency of ocular fusion was also used; direct indicator of the level of cortical activation that offers a numerical measure of it on a continuous scale, between the values of 10 a 60 hertz. The critical frequency of ocular fusion is the capacity of the eye to fuse images on the retina. It is a personalized value that has an individual character. A Cuban Flicker prototype was used, designed in the laboratories of the Cuban Transportation Research Institute, widely used in research on the subject carried out by Cuban specialists inside and outside of Cuba.

In this test, the athlete is exposed to light applied on a regular basis, which slowly changes its frequency. The descending variant was used within this method in which the stimulus initially appears with a high frequency, so that the light is observed as a fixed stimulus and when its frequency slowly decreases, the moment arrives when it is observed blinking.

When this is perceived by the athlete, the individual ocular fusion critical frequency value is being determined, which was estimated after three trials for each athlete studied, a procedure that has become a widely used standard in the context of sport. Mood states were measured with the Interactive Profile of Moods in Sport (Pied), designed and validated in high-performance Cuban athletes.

This *test* is a field test aimed at evaluating six moods in normal conditions of sports preparation. With a view to characterizing their moods, the selected criteria will be the following:



On a scale from 0 to 4 (where: 0=not at all/1=a little/ 2=moderate/3=quite a bit and 4=very much), the factors, dimensions or states of mind illustrated below are established:

- T: Restless / Anxious / Restless.
- D: Discouraged / Sad / Alone.
- H: Annoyed / Furious / Short-tempered.
- V: Active / Cheerful / Full of energy.
- F: Exhausted / Tired / Fatigued.
- C: Insecure / Disoriented Unable to concentrate.

These questions are alternately introduced: How restless, anxious, uneasy, do you feel right now? and the answer was requested.

Once the answers were recorded, a mood profile of the subject was obtained, which indicates the moods that characterized her to face the training.

For its interpretation, the following standards were used (Table 1).

Table 1. - Rules of interpretation of the Pied

FACTORS	UNDER	NORMAL	HIGH
Tension-Anxiety (T)	0	1- 2	3-4
Depression-Melancholia (D)	0	1- 2	3-4
Hostility - Wrath (H)	0	1- 2	3-4
Vigor - Activity (V)	0-1		4
Fatigue - Inertia (F)	0	1- 2	3-4
Confusion - Perplexity (C)	0	1- 2	3-4

Source: Taken from Development of an instrument to assess moods in high-performance athletes. Doctoral Thesis in Physical Culture Sciences Neighborhoods, (2011).

Difficulty is considered to exist in a state when the score is high, except for Vigor. The latter is considered difficult when the score is low or is below the other factors.

The factors with difficulties found in the quantitative indicators were subjected to qualitative analysis through a brief interview carried out immediately after the application of the *test*, with the aim of increasing and deepening the level of information in relation to the factor measured.

The factors, dimensions or moods evaluated consist of:

- TensionAnxiety (T): Sensation of somatic tension; perception of psychomotor activity.
- Depression-Melancholy (D): Sadness and depressed mood; emotional isolation, feelings of personal inadequacy.



- Hostility Anger (H): Feeling of disgust and dissatisfaction; feelings of hostility towards something or someone.
- Vigor Activity (V): Feeling of joy, animation and energy.
- Fatigue Inertia (F): Wear or loss of energy; inertia.
- Confusion Perplexity (C): Cognitive difficulties, confusion and disorientation.

For the statistical processing of the data, a file was created with all the values of the pre- and post-load measurements of cortical activation and the values of the pre-load measurements of mood states, for which the SPSS Software for Windows (version 20.0).

The difference in means of the values of the pre- and post-load measurements made it possible to analyze the behavior of the levels of cortical activation after the applied training load, in relation to the magnitude of their values.

To determine the relationship between the pre- and post-load values of the cortical activation level, the Pearson linear correlation coefficient (r) was used, which measures the strength of the linear relationship between the pre- and post-load measurements, which is assessed considering the absolute value of the correlation coefficient. This is between 0 and 1.

It is interpreted as follows:

- An absolute value of 0 indicates that there is no linear relationship.
- From .09 to .19 the correlation is very weak.
- From .20 to .49 the correlation is weak.
- From .5 to .69 the correlation is medium.
- From .70 to .99 the correlation is strong.
- An absolute value of 1 indicates that the relationship is functional.

In the interpretation of the statistical significance of the correlation coefficient, the following decision rule is used: reject H_0 if the value obtained from the significance p is less than the level of significance used ($\alpha = .01$). If H_0 is rejected with a level of .01, then the correlation between the preload and after load values differs significantly from zero, indicating that whenever changes occur in the magnitudes of the preload values of the measured indicators, it is to be expected that changes in the magnitudes of the after load measurement values occur.

In estimating the relationship between the behavior of the cortical activation level and moods, the Spearman correlation coefficient was used, which makes it possible to establish relationships between variables of a different nature (continues as is the case of cortical and ordinal activation level variable, as is the mood variable).



RESULTS AND DISCUSSION

The study carried out showed, as shown in Table 2, that the level of cortical activation with which the judo female athletes face the applied load is lower than the level that manifests itself at the end of the work, confirming that there was an increase in cortical activation after load corresponding to a value of 1.48 htz; which turned out to be significant ($p=.0000<.05$) (Table 2).

Table 2. - Results of the comparison of the level of cortical activation before and after load

Cortical activation level	Mean	Number of measurements	Typical deviation	standard error of the mean	T	P
Before	31.60 htz	58	3.66	0.483	-	.0000
After	33.08 htz	58	3.71	0.487	5,529	

It was confirmed that after the loads supplied with tashi-waza and ne-waza, there is an increase in the level of cortical activation, which corresponds to the expected effect.

The results of the Student's T-Test for related samples, applied since the normality of the differences in the results before and after the level of cortical activation was not rejected (Kolmogorov-Smirnov goodness-of-fit test , $n= 58$, $p= 0.2000 > 0.05$), also show that the increase that occurred in the level of cortical activation after the training load was significant, which indicates that it is due to causes motivated by the training load and not by chance or by the make up of the population studied.

Results that are consistent with those described by [Suárez et al., \(2017\)](#), in studies carried out on high-performance judo female athletes. [Suárez and Rielo \(2019\)](#) in judokas of the men's team; [Suárez \(2020\)](#) in artistic gymnastics and [Montoya and López \(2021\)](#) in athletics arrived at the same conclusion

The results obtained reinforce the criteria held by authors such as [Martínez \(2011\)](#); [Martinez and Suarez \(2013\)](#); [Suarez et al., \(2017\)](#); [Suárez and Rielo \(2019\)](#), who consider that the increase in the level of cortical activation, after the execution of the planned training loads, has become the expected effect, indicating that an adequate assimilation of the work done is taking place and that, therefore, a decrease or no variation can be considered as a symptom that there is some difficulty in the adaptation process, indicating the presence of levels of central fatigue, which can cause damage to health and affect sports performance.

The behavior of cortical activation, after the applied training loads, found in this research, then differs from what has been found in other studies that have shown a decrease or no variation, as well as in research related to workloads in which the decrease in the level of cortical activation has been declared as the expected effect according to the reference of [Suárez and Rielo \(2019\)](#).



As for the difference between the results obtained in this work compared to studies developed in the labor sphere, they could be explained from the difference that exists between the characteristics of sports activity and work. In the field of sport, several researchers [Martínez, \(2011\)](#); [Suarez et al., \(2017\)](#); [Suárez and Rielo, \(2019\)](#) consider that the decrease in postload cortical activation should be an object of attention by the coach.

The aforementioned authors refer that said behavior could be indicating the presence of a state of inhibition that manifests itself to protect the CNS when the excitation reached exceeds tolerance levels, which constitutes an index of the presence of a level of central fatigue which could be unfavorable for sports performance.

These inhibitions can be produced by very fatiguing workloads or by excessively intense or prolonged stimulation, which exceeds the individual load acceptance threshold of the trained athlete.

In the same way, the non-variation is considered as a strange but possible effect, which should be seen as the effect of the influence of supplied workloads that do not produce a significant action on the central levels, understandable when the loads do not reach the level of individual development or when there has been a high strengthening of the defense mechanisms to loads at the central level, derived from the sports training itself in the adaptation process.

It was also corroborated, as shown in Table 2, that the values of the pre- and post-load measurements of the level of cortical activation had a similar behavior in relation to their dispersion with respect to their means. However, it can be seen that the standard deviation of the values of the preload measurements is slightly lower, indicating that the values of the level of cortical activation before receiving the load show a slightly smaller dispersion in relation to their means, than those recorded under normal conditions. afterload.

The tendency to present a slightly smaller deviation in the preload values speaks in favor of the fact that these generally have a slightly more homogeneous behavior, which constitutes an expression of the stable character that cortical activation levels must have in the basal state, without the influence of workloads.

These results support the criteria of authors such as [Martínez \(2011\)](#); [Suárez et al., \(2017\)](#) who believe that any variation in the magnitude of the preload values should be taken into account by coaches and be considered as a symptom of an inadequate state of psycho physiological aptitude to face the planned workload, revealing the existence of poor recovery or the presence of disturbing processes of adequate recovery, which offer diagnostic elements of the athlete's inability to face, with quality, the planned training.

As stated before, despite this slight difference between the homogeneity of the pre- and postload measurements, in general what is observed is the existence of a similar behavior in terms of their homogeneity, which constitutes a reflection of the consistency with that are manifested, at the CNS level, the effects of the sustained application of planned training loads.



Similar results were found by [Martínez and Suárez \(2013\)](#); [Suárez et al., \(2017\)](#) unlike those obtained by [Suárez and Rielo \(2019\)](#), the latter in which their authors presuppose the existence of difficulties in the recovery process in the athletes studied.

Pearson's linear correlation coefficient (r) and its significance test revealed that, between the values of the preload and afterload measurements, there is a positive, strong and significant correlation. An r value of .847, which is between .69 and .99 and a calculated significance in its significance test less than the adopted α value of .01 ($p = .0000 < \alpha = .01$), so they confirm it. Therefore, an increase or decrease in the postload values is related to a similar behavior in the preload values. Results that are similar to those obtained by [Suárez et al., \(2017\)](#).

In summary, the level of cortical activation showed a behavior characterized by a significant increase in the same afterload, a similar homogeneity in its pre and postload values and a strong, positive and significant correlation between them. Results that correspond to those obtained by most of the research carried out in the field of high-performance sports, [Martínez and Suárez, \(2013\)](#); [Suarez et al., \(2017\)](#); [Suarez and Rielo, \(2019\)](#); [Suarez, \(2020\)](#); [Montoya and López, \(2021\)](#) and that has gradually become the expected effect.

Regarding the moods that characterize the judo female athletes before receiving the training loads, as shown in table 3, all the states have a minimum value of 0; on the other hand, the maximum moves between values 1 and 4. The moods that reach the highest values and correspondingly move with a larger range amplitude are those that reflect the sensations of depression-melancholy, hostility-anger, vigor-energy and sensations of fatigue-tiredness (Table 3).

The lowest values and those that move in smaller ranges are obtained in the states of tension-anxiety and confusion-perplexity.

Table 3. - Values of the median, mode, range, minimum and maximum in mood states

	T	D	H	v	F	C
Measurements	58	58	58	58	58	58
Median	0	0	0	2	1	0
Mode	0	0	0	3	1	0
Range	2	3	3	4	3	1
Minimum	0	0	0	0	0	0
Maximum	2	3	3	4	3	1

The value 0 predominates in all moods except in vigor and fatigue, reaching a value of 3 in vigor and 1 in fatigue. Next, figure 1 allows graphically visualizing what was previously exposed (Figure 1).



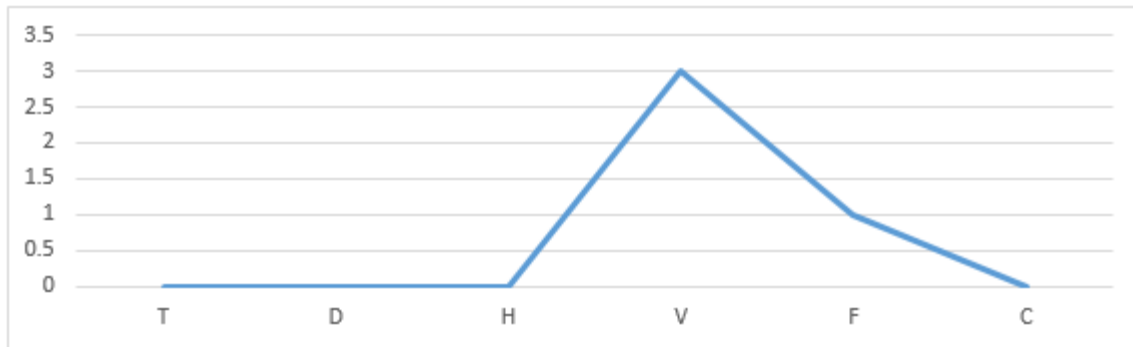


Fig. 1. - Characteristic preload mood profile of the studied sample

Similar results are provided by the estimation of the median (Table 3), in which vigor and fatigue are the only two moods in which median values other than 0 appear.

Corresponding to the above data, Table 4 shows that the highest percentage of assessments of all mood states receives a value of 0. Except in vigor and fatigue, in which they obtain a value of 3 and 1 respectively (Table 4).

Table 4. - Behavior of the Interactive Mood Profile (Pied) in the study sample

Moods	VALUES OBTAINED (n= 58 measurements)									
	0		1		2		3		4	
	Freq.	%	Freq.	%	Freq.	%	Freq.	%	Freq.	%
T	48	82.8	8	13.8	2	3.4	0	0.0	0	0.0
D	44	75.9	11	19.0	1	1.7	2	3.4	0	0.0
H	48	82.8	8	13.8	0	0.0	2	3.4	0	0.0
v	2	3.4	14	24.1	18	31.0	22	37.9	2	3.4
F	16	27.6	24	41.4	12	20.7	6	10.3	0	0.0
C	57	98.3	one	1.7	0	0.0	0	0.0	0	0.0

The following figure 2 enables a graphic visualization of the previously expressed idea (Figure 2).



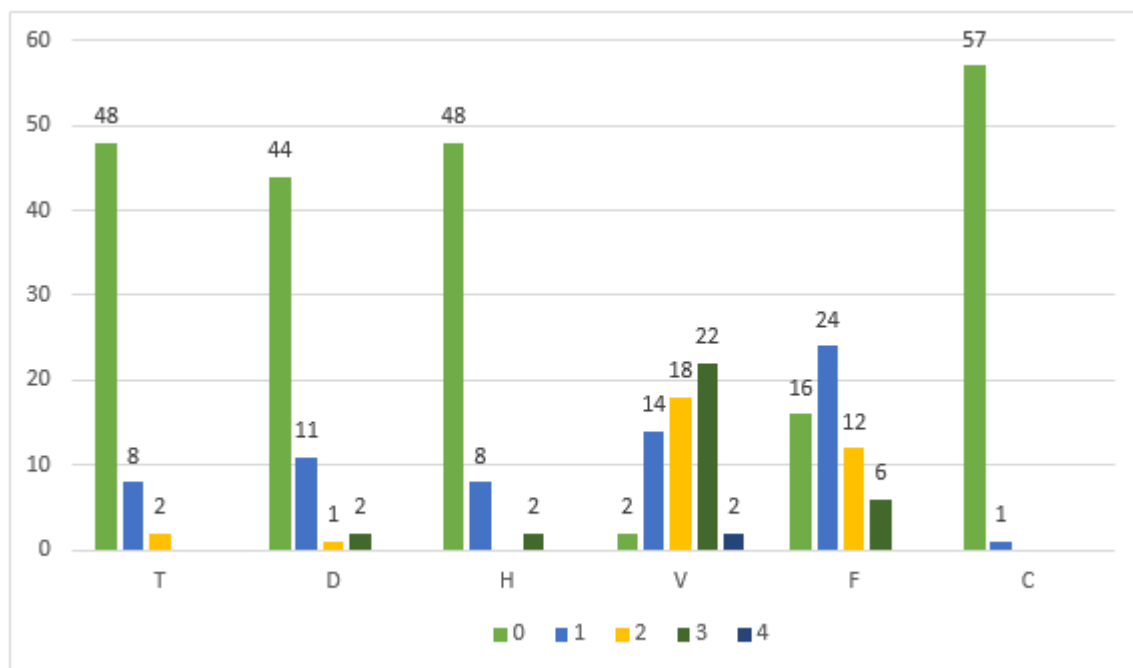


Fig. 2. - Frequency of appearance of values in each mood

Before receiving the training loads, it was found that experiences of the moods studied did not appear, assuming in all cases values of 0 (low score) or they appear to some extent, assuming values between 1 and 4, which indicate the presence in some cases of the experience of a little confusion-perplexity (value 1-normal score), or of a moderate sensation of tension-anxiety (value 2-normal score), or of feeling quite depressed-melancholic, with feelings of hostility, anger; with a feeling of fatigue (value 3-high score), or feeling very vigorous-energy (value 4-high score).

Moods depression-melancholy, hostility-anger, vigor-energy and feelings of fatigue-tiredness appeared to some extent before receiving the training loads. However, what prevailed the most was the absence before receiving the load of all the moods studied, except in the vigor that predominates the feeling of feeling quite vigorous before starting training and fatigue in which the presence of a little feeling of fatigue or tiredness.

A more specific analysis refers that in the case of vigor, half of the assessments reached values that present an absence or moderate presence of this mood; on the contrary, the other half reached higher values that show the perception of enough or a lot of vigor before starting the training.

On the other hand, regarding the experience of fatigue, half of the evaluations reached values that reflect an absence or a perception of a little tiredness before starting the training. The other half reached higher values that indicate the perception of feeling moderately or quite tired, without the experience of being very tired before starting the training.



In summary, the profile obtained is a favorable profile for sports performance, according to the studies carried out by *Rica et al., (2019)*, and *Falces et al., (2020)*. The results obtained reflect that vigor remains higher than the rest of the variables, which speaks of the predominance of a disposition to face the training load. These studies also reflect that tension is another of the factors that can rise in competitive situations, which in this case was not evidenced in judokas because they were training conditions.

The presence of a perception of fatigue also appears, although to a lesser extent, in values considered normal. It should be noted that the work period in which these samples were taken corresponds to an accumulation mesocycle belonging to the first ATR designed for the training macro, a stage where the loads are characterized by a high volume of work, which could directly affect the fatigue experience.

Particularly, in relation to the experimentation of fatigue, some studies carried out by *Suárez et al., (2017)* have confirmed that there does not necessarily have to be a directly proportional relationship between perceived fatigue and the existence of diagnosed central fatigue, based on the behavior of cortical activation. Both answers can have a different behavior.

In this case, it was found that, even when experiences of fatigue appeared before starting the session, in this study they were perceived as few, which is interpreted as normal, cortical activation maintained the expected effect. Regarding the correlation between the Pied and Flicker results (Table 5), it was found in the studied sample that these results correlate very weakly ($.09 < r < .19$). In other words, the study revealed a weak relationship between the variables level of cortical activation and moods.

Of the correlations obtained, only a medium correlation ($.05 < r < .69$) was confirmed between the moods Depression-Melancholy (D) and Hostility-Anger (H). Therefore, the changes in one of these states of mind could have some level of correspondence with changes in the other state of mind (Table 5).

Table 5. - Correlation between the results of the Pied and the Flicker (Spearman's correlation coefficients) (n=58)

	Flicker	T	D	H	v	F	C
Flicker	1.00	0.126	0.121	0.170	0.068	0.187	0.036
T		1.00	-0.110	-0.052	-0.050	0.128	0.277 *
D			1.00	0.637 **	-0.391 **	0.074	-0.074
H				1.00	-0.393 **	-0.092	-0.060
v					1.00	-0.059	0.133
F						1.00	-0.008
C							1.00

** . The correlation is significant at the 0.01 level (bilateral).
 * . The correlation is significant at the 0.05 level (bilateral).

Even though this line of research requires further study and research designs that include post-load measurements of moods, the design of this study is not considered, an idea such as the one shared by Martínez (2020) in which he alludes to Authors who consider that central fatigue can exist despite full motivation of the subject, find common points



with the results obtained in this research, in which a strong relationship between the variables level of cortical activation, objective indicator of the central fatigue and moods.

CONCLUSIONS

Finally, the study reaches the following conclusions:

In the research developed, it was shown that the correlation between the level of cortical activation before loads of tashi-waza and ne-waza, during a period of ATR, in the sample of judo female athletes studied, and moods, is weak.

The moods depression-melancholia, hostility-cholera, vigor-energy and the sensations of fatigue-tiredness appeared to some extent before receiving the training loads, even though what prevailed the most was the absence of all moods studied, except in vigor, where the feeling of quite vigorous before starting training and fatigue in which the presence of a little feeling of fatigue or tiredness prevailed.

The level of cortical activation showed the expected behavior. It was characterized by a significant increase in its post-load values, a similar homogeneity in its pre- and post-load values and a strong, positive and significant correlation between them, which have been considered as indicators of adequate assimilation and adaptation to loads of training.

The results allow verifying the relative independence that can exist between both variables and in relation to it the importance that it has for the specialists that work in the process of preparing the athletes, to take into account the evaluation of the same during the psychological control of the training sports, since they may have different behaviors and be causing certain effects on the performance and health status of the athlete. Always clarifying that this last aspect was not the object of study of the investigation, so its scope, in this particular case, does not allow such a conclusion to be asserted.

Depending on the results achieved, it can also be deduced the need for integration in the model of psychological control of sports training, the use of objective and subjective methods of measuring the psychological response to training loads, since both can throw different results and their combination enables a more comprehensive and comprehensive psychodiagnosis and, as a consequence, a more comprehensive psychopedagogical intervention.

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The authors have participated in the writing of the work and analysis of the documents.



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