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Controlling anxiety and stress in ski-biathlon athletes using EmWave2

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Abstract

This study determines whether mental training, by applying specific techniques that influence certain psychological factors, is able to optimise performance in biathlon ski. The aim of this study is to modify dysfunctional negative emotions during competition and reduce stress and anxiety at biathlon skiing through mental training. The experimental series comprised 2 x 15 skiers from two clubs. The EmWave2 device is used, which gives bio-feedback about the physiological indicators of the body, taking into account three levels of consistency such as low LH, medium MH and high HH. These were observed as: Group I – statistically high significant differences between at least two levels ($p < 0.01$) and Group II – intense statistically significant differences between at least two levels ($p < 0.001$). The test scores show that applying mental training lowers anxiety technique issues. The statistical differences observed between the two groups were intensely significant ($p < 0.001$).

Keywords: Skiing - biathlon, stress, anxiety, cardiac rhythm, sport performance.

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1. Introduction

The aim of this study includes the following: To improve the behaviour of athletes, to modify dysfunctional negative emotions during competition and reduce stress and anxiety at biathlon skiing, through mental training. The first testing took place during 5–6 February 2015. The subjects were aged between 12 ± 6 and 17 ± 1 years, with a total of 15 athletes each in group I and group II. The mean age was 15.05 years in group I and 15.49 years in group II. The second test took place during the same month of February, but in the year 2016.

In defining the ski-biathlon concept, we found this: In Norway, the biathlon is called *skiskyting* (literally *ski shooting*), in the Encyclopedia of Sports (1990). In Norway, there are still separate contests for *skifeltskyting*, (Kalin & Barton, 2015). Nordic skiing, *World Heritage Encyclopedia*, Ski & Snowboard Australia, Michigan Tech Huskies, in sports, Types of skiing, a cross-country race at 12 km with large-calibre rifle shooting at various targets with unknown range, (Kalin & Barton, 2015).

The carrying out of physical activities in various environments – terrestrial and aquatic –through the influences they imprint on the effort made, coupled with the technological innovation of materials, can trigger positive responses of the body, with connotations on the movement ability (Badau, Ungur & Badau, 2015).

1.1. Problem statement

A basic unitary emotion emerged because of stimuli perceived as threatening (Klein, 1987; Levenson, 2003); anxiety is manifested through self-protection tendencies by avoidance and it is distinguished from the emotions due to an objective, direct challenge.

Of the multiple theories that approached this phenomenon, we believed that the most adequate one for our study, in order to interpret the objectives correctly, was the multidimensional anxiety theory. It starts from the assumption that the experimentation of anxiety takes place at a psycho-cognitive level and at a somatic-physiological level, through a wide array of manifestations, with major implications in all areas of human activity (Goldie, 2000; Jones & Cale, 1989; Klein, 1987; Martens, Vealey & Burton, 1990).

1.2. Purpose of study

The aim was to determine whether mental training, by applying specific techniques that influence certain psychological factors, is able to optimise performance in biathlon ski. The experimental series comprised 15 skiers each from two clubs: CSS Vatra – Dornei (SV) – 15-skiers control group and CSS Baia – Sprie (MM) – 15-skiers experimental group.

The general aim in conducting the research was developing a strategy that can reduce stress and anxiety competitive. We worked with athletes learning relaxation techniques, both mental and physical, Grosu (2012).

In this interval, the experimental group (15 athletes legitimised for ski-biathlon, Baia Sprie School Sports Club – group II) was subjected regularly (six times throughout the 12 months) to the EmWave2 relaxation technique in order to obtain global physiological coherence. This coherence helps to reach a positive balance between the cardiac, psycho-mental and emotional elements, where the nervous, cardiovascular, hormonal and immune systems converge towards well-being (see McCraty & Tomasino, 2006).

The control group (15 athletes legitimised for ski-biathlon, Vatra Dornei School Sports Club – group I) did not participate in this programme of constant application of the EmWave2 technique. The athletes within the control group were mentally trained and tested only in the two recorded moments (the initial phase and the final phase), with the same methods used for the experimental group. For a

short description of the timeline and the research framework of the entire research (initial study and final study), see Table 1.

Table 1. Methodological milestones (initial study and final study) and the timeline of the research

Timeline:	
February 2015 (Initial study)	
February 2016 (Final study)	From March 2015 to January 2016
Group I, control (15 subjects, CSS Vatra Dornei)	Group II (CSS Baia Sprie)
Group II, experimental (15 subjects, CSS Baia Sprie)	Mental Training Coherence Technique, applied monthly to the subjects within the experimental group
Both groups were tested with: EmWave2	
Data collection: batteries of psychological tests (questionnaires) administered to both groups and psychological-physiological measurement instruments for certain objective parameters	Data collection: EmWave2 technique for coherence
Data analysis: statistical analysis	Data analysis: observation, psychological-physiological measurements through EmWave 2 application

2. Methods

We used the device EmWave2, which is actually a bio-feedback, which give us information about physiological indicators of body: heart rate. The EmWave technology is based on the discovery consistency. Coherence is a state of synchronisation between the heart, brain and autonomic nervous systems. The system has three levels of consistency: low LH (red), medium MH (blue) and high HH (green). These three coloured lines appear under the heading 'ration consistency' above graph in the lower right of the screen. Essentially, this technique can bring rapid heart rhythm coherence. Coherence is a term used by scientists to describe a highly efficient physiological state in which the nervous system and the cardiovascular, hormonal and immune systems work together efficiently and harmoniously. With practice, the condition of consistency throughout the body can relieve stress, heal emotional trauma and exaggerated worry and fear and there is an improvement in the greater overall health.

The technology (equipment) used for measuring the psycho-physiological indicators per se (recorded using direct and specific techniques, through computer systems and devices) was the following:

- a) *The EmWave2 device*, similar to an EKG, but it helps to optimise the rhythm, in order to create physiological coherence in the entire body; it indicated three levels of coherence: low (red), average (blue), high (green). Essentially, this technique can bring the heart rate rapidly to a state of coherence (McCraty, Atkinson, Tomasino & Bradley, 2009; McCraty & Zayas, 2014). In 2010, a new version was designed (software–hardware) for the EmWave system (Desktop for PC and Mac), which monitors the heart rate and determines coherence. The EmWave2 device is a product that combines emWave Desktop and emWave Personal Stress Reliever, in order to achieve coherence, meant to mitigate general stress (for details, see the HearthMath Institute site: www.heartmath.org/research).
- b) *The data analysis and processing methods* (results by applying psychological tests – physical performance indicators; and psycho-physiological measurements – devices for calculating cardiac and mental parameters, described above) were the following: statistical indicators (descriptive

statistics concerning centrality, localisation and distribution). To test the normal distribution, Shapiro–Wilk test was used. For data with normal distribution, the t-test (student) and the calculated uneven distribution or ranks were used; non-parametric Mann–Whitney (U) tests for two unpaired samples or Wilcoxon for two paired samples were used for analysis of three or more samples.

3. Findings and Results

Using this tool, we succeed in improving the general health of athletes and optimise the performance capability by increasing the speed of learning and the power of concentration, thus achieving a higher level of emotional balance.

– A comparison of the results is obtained per group, initial indicator, and indicators at the end of the mental training programme.

The main differences that resulted after the two studies, per groups, are described below: The measurements described in the aforementioned section were conducted initially and repeated identically after a year (under similar circumstances, in the same season, for the same persons). In this interval, the experimental group was applied mental relaxation techniques, in order to obtain coherence regularly (at an interval of 2 months out of the 12 months, namely six times). The control group did not receive any mental training.

We will not insist on the data that do not indicate significant differences between the groups. In exchange, we will develop ideas based on the results suggesting remarkable differences, thus proving the efficiency of this therapeutic strategy, in order to acquire a positive state in competition in the long-term among performance athletes (mainly, the mitigation of critical stress and anxiety, as well as the higher harmonisation of psychomotor components in the sports activity specific to ski-biathlon).

ANOVA test was used for normally distributed data or the non-parametric Kruskal–Wallis test, in the case of an uneven distribution of values or rank.

Statistical analysis of test values: The EmWave2 levels taking into account the three levels of consistency were observed: In group I, there was – statistically highly significant differences between at least two levels ($p < 0.01$), while in group II, –there were intense statistically significant differences between at least two levels ($p < 0.001$).

Statistical analysis of test values: The EmWave2 levels were observed in group I – statistically highly significant differences between the levels of LH, MH ($p < 0.01$) and in group II – statistically highly significant differences between the levels of LH, MH ($p < 0.01$).

EmWave2. The statistical analysis of values in the indicators obtained for *the EmWave2 test*, between the two tests, is shown as follows.

For group I, highly statistically significant differences were recorded for score and average heart rate (HR) ($p < 0.001$). Whereas, group I was subjected to the coherence technique only at the beginning and it was only repeated one year later. During final testing (by following the inter-group comparison), these results indicate the efficiency even in the long term.

It is mostly remarkable that the coherence score increased significantly: those within the control group started from a score of 73.6 points, which almost doubled after a year (138.87 points). HR decreased visibly between the two tests in the control group, from 89 beats/minute to 72 beats/minute.

These results stand to show the increased capacity of the aforementioned technique, in terms of activating the psychological resources meant to reduce stress and to obtain global coherence.

For group II, a statistically significant difference for score (highly significant difference $p < 0.001$) and for average HR (moderately significant difference $p < 0.05$) emerged again. It entails the same

interpretation as for group I: the application of the EmWave2 technique is extremely useful in relaxation, stress reduction and coherence attainment.

Table 2. EmWave2 Test (average values in tests 1 and 2) for the studied groups and statistical significance

Group	Level	Test 1	Test 2	Statistical significance (<i>p</i>) Test 1 vs. Test 2
I	L	25.67	24.00	>0.9999
	M	25.60	26.13	0.8629
	H	48.73	49.87	0.7738
	Standard time			
	Time (sec)	314.40	314.30	EmWave2
	Score	73.60	138.87	<0.0001
	Average HR	89.07	71.87	<0.0001
	L	21.27	22.13	0.7638
	M	23.80	24.67	0.7657
II	H	54.93	53.20	0.6637
	Standard time			
	Time (sec)	314.47	314.20	EmWave2
	Score	78.87	162.60	<0.0001
	Average HR	75.53	72.67	0.0245

Whereas this comparison based on the statistical significance of the results between the groups does not indicate, at first glance, a result that differentiates them from the variable of regular application of the technique in the experimental group/non-application for one year in the control group, if we analyse the values of the score per groups, the picture changes. More precisely, in the second test, those within the experimental group have a coherence score of 162.60, whereas those within the control group have only 138.87.

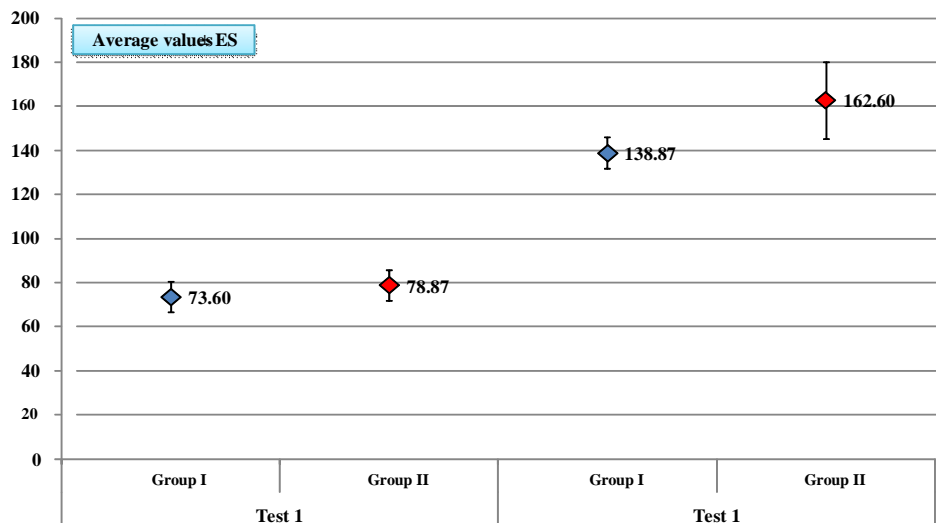


Figure 1. EmWave2 Test for the studied groups – score – tests 1 and 2

As follows, the average HR illustrates the efficiency of repeatedly applying the technique for each group, shown by the comparison of the results per groups:

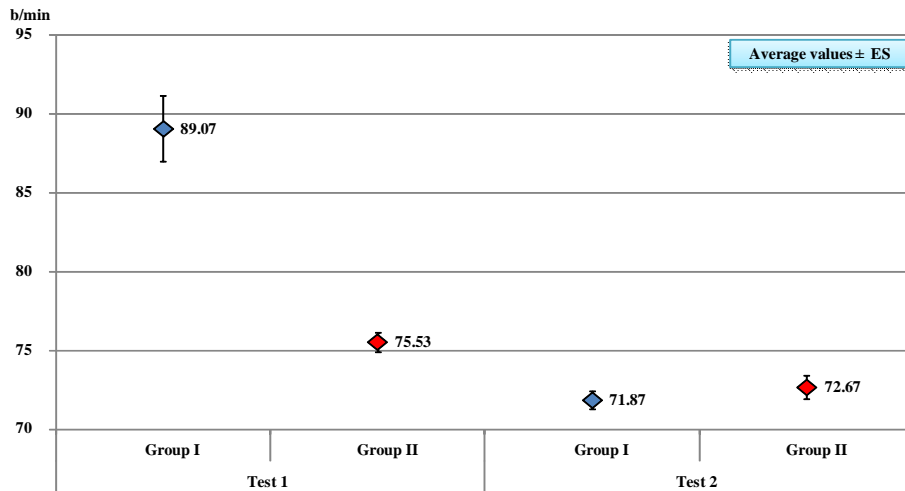


Figure 2. EmWave2 Test for the studied groups – average heart rate – tests 1 and 2

Concerning the level of coherence (low, average and high levels), too, the experimental group obtained, at the second test, a visibly higher value than the control group: 53.20 compared to 49.87. These comparisons are illustrative and they can be visualised in Figure 3.

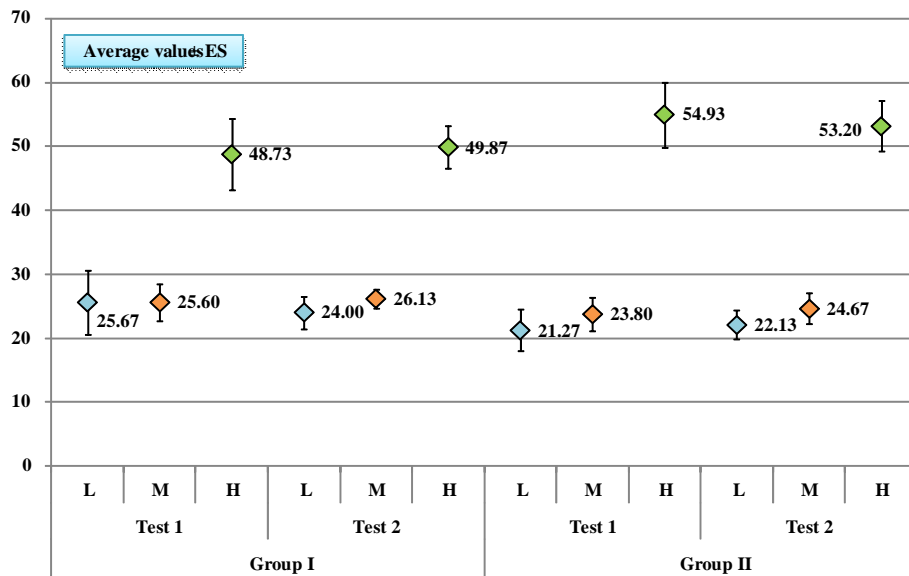


Figure 3. EmWave2 Test for the studied groups – levels (of coherence) – tests 1 and 2

4. Conclusions and Recommendations

From the comparative analysis of test scores applied to the studied groups and statistical significance, we can say that applying mental training will lead to lower anxiety technique issues. Statistical analysis of test score EmWave2 values were not observed as statistically difference between the two groups ($p > 0.05$). Statistical analysis values mean heart rate (FC average) recorded EmWave2 test, and the statistical differences observed between the two groups were intensely significant ($p < 0.001$). The statistical analysis of time values, where the EmWave2 test was conducted, were the statistically highly significant differences observed between the two groups ($p < 0.01$).

The aforementioned results have shown that the experience of pre- and post-competition anxiety has a wide array of effects on ski-biathlon athletes in terms of self-esteem, full capacity of attaining goals, dimensions of motivational persistence, psychomotor skills and global performances, and the general state of psycho-physiological balance. The technological innovation of ski shows modern features offered by both material properties and design, such as the forces and momentums transferred from the ski runners to the ski bindings and the snow resistance acting upon the ski interface on the snow, (Badau & Badau, 2015).

The most relevant differences between the groups, recorded at the two tests, were as follows.

The statistical analysis of values in the indicators obtained for *EmWave2 Test* has shown the positive effects of EmWave2 technique on coherence, even though the control group was not subjected to it regularly. Hence, the effects on the experimental group are highly significant, by comparison between the tests to the control group. In the second test, those within the experimental group have a coherence score of 162.60, whereas those within the control group have only 138.87. In addition, concerning the level of coherence, those within the experimental group obtained a significantly higher average value of high coherence compared to the control group. We thus confirm the assumptions of the multidimensional theory of anxiety (Goldie, 2000; Jones & Cale, 1989).

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