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Ruvakubusa Emmanuel
Ph.D., Shanghai University of
Sports, Shanghai, China

Zhang Jian
Ph.D., Shanghai University of
Sports, Shanghai, China

Ngayimbasha Adrien
Ph.D., Institut d'Education
Physique et des Sports,
Université du Burundi,
Bujumbura, Burundi

Correspondence
Ruvakubusa Emmanuel
Ph.D., Shanghai University of
Sports, Shanghai, China

Pre-competition psychophysiological stress evolution in novice karate competitors

Ruvakubusa Emmanuel, Zhang Jian and Ngayimbasha Adrien

Abstract

In martial art competition like karate, there are many challenging situations which can induce psychophysiological changes such as competitive anxiety. The current study was aimed to assess the pre-competition evolution tendency of physiological and psychological indicators of anxiety and the pre-competition state of self-confidence in novice international karate competitors. Sixteen male karate competitors participated to the present study.

Two combined methods have been used in the current study data collection: test method for the collection and analyzing of salivary cortisol and questionnaire method in the assessment of psychological indicators of stress.

The study results showed an increasing tendency of cortisol concentration time after time as the competition approach (at 8 a.m. Was 21.03 ± 0.9 nmol/l⁻¹; 23.2 ± 1.8 nmol/l⁻¹ 90 min and 23.8 ± 1.3 nmol/l⁻¹ one hour before the start of the competition). Significance statistical differences have been established. On psychological stress indicators, obtained data showed that our subjects had higher mean scores in cognitive anxiety (21.76) and somatic anxiety (19.46) subscales.

Novice karate competitors experience increased psychological and physiological stresses which potentially reduce their competitive capability.

Keywords: Novice karate competitors, psychophysiology stress, evolution, pre-competition

Introduction

Competition is a challenging situation, which usually stimulates intense responses from participants. Challenging situation can be different from discipline to another. In martial art like karate, there are many situations that can be perceived as challenging, threatening or even harmful. With the attacks and assault of the count-part athlete, it is difficult to excavate as the area of competition is small and limited. Also karate involves intermittent, high-intensity efforts interspersed with periods of low-intensity activity during which active and passive recovery periods occur, thus inducing physical demand and competitive anxiety. Competitive anxiety is a complex psychological phenomenon; it appears to be composed of some common basic elements. One component of this competitive anxiety is cognitive anxiety which is characterized by athletes' negative concerns about performance and disrupted attention (Mieczyslaw *et al.* 2011) [1]. Another component of competitive anxiety is somatic anxiety. It is characterized by several physiological symptoms such as excessive perspiration and tremor of limbs. Psychological stress might play an important role during karate competition as it requires steadiness, precision, motivation and motor control for effective quick attack or excavate the adverse attack. Previous studies results affirmed that age and experience of an athlete plays an important role in influencing the onset of cognitive and somatic anxiety. Krane and Williams (1994) [2] found that more experienced players had a much lower level of cognitive and somatic anxiety than less experienced athletes. In his review papers, Jones (1991, 1995) concluded that both the intensity and direction of anxiety symptoms are important determinants of performance in sports. Intensity and direction also interact with other psychological factors such as motivation, attitudes and expectations, as illustrated, for example, by Jones and Hanton (1996) [5].

In the field of martial arts, several researches oriented on athlete's psychological state during and prior to competition have been conducted. Most of them assessed evolution of some component of psychology such, task oriented, emotion oriented, avoidance oriented,

distraction and social diversion (Mytskan *et al.* 2006; Filaire *et al.* 2001) [6]. Obtained publications on psychophysiological responses to martial art practice showed that the endocrine points of view have been ignored by researchers. However, the Hypothalamic-Pituitary-Adrenocortical axis is activated during competition and even during pre-competition period. The cortisol is hormone released from this axis, and its production is dependent on the athlete psychological state of the organism (Deborah *et al.* 2008) [8]. Specifically, literature suggests that the Hypothalamic- Pituitary-Adrenocortical axis activation, with the release of cortisol, is particularly reflective of the affective component of the individual's experience (Franken-haeuser, 1986; 1991) [9, 10]. The increases in cortisol can be expected in anticipation of stressful stimulation (Gaab *et al.*, 2005; Lovallo *et al.*, 1990) [11, 12]. This is especially relevant in situations inducing ego-involvement, novelty, unpredictability and uncontrollability (al'Absi and Lovallo, 1993; Levine and Weiner, 1989) [12, 13], leading to negative affective states (Buchanan *et al.*, 1999; Lovallo *et al.*, 1990) [11]. As a novice karate competitor may not have sufficient technic skills, he may experiences upgraded psychological and even somatic anxiety as the competition time approach.

The aim of the present study is to evaluate the evolution tendency of some psychophysiological components, namely cortisol as physiological indicator of anxiety and psychological anxiety and somatic anxiety and self-confidence before competition started.

Materials and Method

Subjects

Participant to the study was national karate team members participating in East Africa competition held in Burundi on June 2018. It was the first time for these athletes to participate in a competition at regional and international level. Only male athletes took part to the present study. The purpose was explained thoroughly to every athlete and a signed informed consent form, approved by the local Medical Ethics Committee, was obtained from each individual in order to take part in the investigation. They were informed that all data collected in this study were to be kept confidential and that the coaching staff would not be given access to these data. Sixteen male karate competitors (23.2±1.4 years; 175.3±2.2 cm; 72.3± 2.5 kg) entered the experimentation after informed consent. Their mean period of practicing this sport was 8 ± 2.3 years. All participants to the present study were at 1Dan black belt technical level. These athletes trained 3 times a week and were all in good physical health.

Testing protocol

In order to facilitate the salivary collection, a medical room was installed inside the competition hall. All recruited athletes were invited to the medical room of the stadium for three sessions for salivary collection. All testing were carried out the day of competition, but before the start of competition. Selected athletes to participate to this study were instructed to abstain from alcohol consumption, nicotine and caffeine for 12 h before the start of the competition. To avoid the effect of circadian rhythm and food intake variation on hormonal secretion, participant to the study provided three samples of saliva at 8 a.m. before breakfast, 90 min before the competition start and 60 min before the competition start. All competition games were scheduled to begin at 12 p.m. After the last saliva sample correction, each participant was asked to complete a questionnaire identified to rate their emotions prior to the competition start.

Cortisol hormone assay

At each session, participant to the study salivated into tubes (Salivette, Sarstedt, Germany) and within five minutes typically produced volumes of 5-10 ml, sufficient for subsequent preparation for radioimmunoassay. Samples were stored in a freezer at - 30°C until assay. They were then analyzed at the same time by radioimmunoassay to evaluate cortisol concentrations using the method developed by Lac *et al.* (1993). Briefly, steroids were extracted with aliquots with 10 vol. of diethyl-ether, dry extracts were dissolved in a phosphate buffer and an immunoassay performed (Sensitivity: 15 pg, accuracy: 10.5%, intraassay reproducibility: 6.1%). All samples were tested in the same series to avoid assay variations.

Assessment of psychological indicators of stress

In collecting information about our participant states of psychological stress before competition started, we used two different instruments:

- **Competitive State Anxiety Inventory - 2 (CSAI):** This questionnaire tool help to evaluate our subject's level of anxiety. This second version of **CSAI** has 27 questions which evaluate three subscales of cognitive anxiety, somatic anxiety and self-confidence with Likert scale (1: null to 4: very much).

Therefore, the scores of subjects ranged from 36 to 9 and high score indicates a higher level in each subscale. The validity of this questionnaire was confirmed by professors and the reliability was measured by Alpha Cronbach ($\alpha=0.89$). Also, internal reliability of this questionnaire was reported by Peter *et al.* (2004) as 85.75, 0.0 and 0.83 respectively.

- **The Spielberger State-Trait Anger Expression:** This questionnaire instrument has been used to evaluate the anger level of our subject's. This questionnaire is constituted by 44 questions which investigate anger in the form of three subscales of emotional state of anger (state anger), trait anger (personality anxiety) and expression of anger in a 4-point Likert scale (1: never, 2: sometimes, 3: more often, 4: always). Validity of this questionnaire was confirmed by professors and its reliability was measured by Alpha Cronbach ($\alpha=0.86$). Also, Ruiz (2004) reported internal reliability of this questionnaire as $r = 0.84$.

Statistical analysis

Two kinds of results from the present study have been analyzed: hormonal (cortisol) and psychological indicators of anxiety prior to competition. For cortisol as physiological indicator, we used ANOVA for variance analysis. To the second kind of results (psychological indicators of stress), only descriptive statistics (mean value and standard deviation) have been applied to this results.

Results

According to the outcomes of the present study, the cortisol concentrations during the three stages of measurements showed an increased concentration tendency as the competition time approach. The cortisol level measured at 8 a.m. was 21.03 ±0.9 nmol/l⁻¹; 23.2± 1.8 nmol/l⁻¹ 90 min before the competition start and 23.8± 1.3 nmol/l⁻¹one hour before the start of the competition.

Analyzing the statistical differences between cortisol concentrations at different time of measurements, significantly higher differences have been obtained, with respective $P < .05$ at 8 a.m. the day of the competition

compared to 90min before competition; $P < .001$ an hour and half before the completion compared to 90min before competition and $P < .001$ one hour before the competition start when we establish comparison between cortisol concentration at the first stage of measurement to the end stage of measurement. Statistical results are presented in below table.

Table 1: Means and Standard Deviation of Cortisol concentration at 3 stages measurements before competition

Cortisol(nmol/l ⁻¹)	Mean	SD	P
8a.m.	21.03	0.9	.001
90 min before start	23.2	1.8	.001
60min before start	23.8	1.3	

To the psychological indicators of stress, the results of data analysis showed that our subjects had higher mean scores in cognitive anxiety (21.76) and somatic anxiety (19.46) subscales. This means that our study participant athletes presented a higher indicator for cognitive and somatic anxiety level. But, according to the present study results our athlete competitor presented a higher mean score in the self-confidence (22.57) just one hour before the competition start. Statistical data are presented in table 2.

Table 2: Means scores of competitive anxiety subscales before competition

Subscales	Mean	Standard deviation
Cognitive anxiety	21.76	2.21
Somatic anxiety	19.46	1.37
Self-confidence	22.57	2.55

Come to our participants behaviors towards anger, the present research statistics have showed higher trait behavior towards anger (trait anxiety). See in below table obtained traits of anxiety.

Table 3: Means scores of subscales of anger expression level in our study participant

Subscales	Mean	Standard deviation
State anxiety (acute)	16.42	2.13
Trait anxiety (chronic)	17.39	1.64
Anger expression	13.67	2.22

Discussion

Two kinds of results have been discussed throughout the present study commentary and discussion. Psychological indicators of anxiety were the first to be commented and then hormonal/physiological indicators evolution has been discussed. Obtained statistical results on psychological indicators of cognitive and somatic anxiety have showed that our subjects presented higher scores of anxiety. Research on pre-competition anxiety and anger on volleyball player indicated that pre-competition anxiety and high anger levels have no positive effect on performance player in Volleyball (Esfahani and colleague 2010). Same as in Volleyball, we can affirm that the rise of psychological indicators of anxiety and anger level before competition has no positive effect on performance in karate competitors. As affirmed by Peares (2007) sport activity level (professional or amateur), type of sport (individual or group-based) as well as activity history and experience are important factors influencing pre-competition anxiety. As it was the first time for our participants to compete at regional competition level, this increased level of anger and anxiety can be explained by our participant novelty in high level competition. Gualberto

(2008) believes that those athletes who experience higher levels of competitive anxiety would experience early burnout in their sport field and this factor causes stress due to expressing bad performance by the athlete. He believes that as the athlete has the ability to control the conditions causing anger and anxiety, they could use this additional energy to delay exhaustion, to attempt more to achieve those goals considered by the coach, to increase their awareness level and correct concentration. Craft (2003) identified personal traits of athletes (type A, B) and the rate of personal emotion control as the most important factors influencing pre-competition anxiety and believes that these factors greatly create competitive anxiety. But Roys has nuanced this affirmation of negative effect of anxiety and anger of competition outcomes. He confirmed the positive effects of anger on the performance of professional karate players, he also reported that anxiety and anger levels are related to personal traits of athlete. When the athletes find the source of anger inside them, they can control stress and anxiety using proper strategies such as positive self-talk, deep breath and imagination of excellent performance. But, when the source of anger is external (audience and sensitivity of competition), the athletes must use and apply their experience, otherwise the possibility of achieving success would decrease. Roy's research results reported the existence of a relationship between performance level and control of negative excitements, tension and anger in top athletes compared to other athletes. Jones (2002), in his study compared professional athletes' psychological anxiety to amateur's one. He reported that professional athletes due to high self-confidence and experience compared to amateur ones, enjoy different mental and cognitive skills in order to display excellent performance, but amateur ones use mental skills and imagination just to decrease their anxiety before competition and to feel relaxed. Shinke R. and Costa (2001) who investigated the causes of failure in athletes and reasons of weak performance in important competitions reported that lack of experience in these competitions and lack of concentration and sufficient self-confidence are of the most important factors which decrease performance and create unusual behaviors and states in athletes.

As we see that before completion, athlete's novice athletes cognitive and somatic anxiety level increase, and also its anger level rise up the normal level and according to different study result's this psychological situation negatively impact on athlete's performance capability, it is important to know how to cope with anxiety and anger before and even during competition. Different factors such as increasing the experience of athletes in different tournaments, teaching to insist on more activities or adversely decreasing the activities and energy economics in different conditions would increase their efficacy and performance. Based on a research, Jones (1995) reported that exercising mental skills and using them during competition is the most applicable strategy for controlling factors that cause failure in athletes' performance. His research showed that the athletes, who have the ability to control their tension before competition and to deal with stressful conditions, would have higher success in achieving the goals considered and maintained by the coach. Therefore, the goal of the coach and trainers would be to develop in their athlete's different positive mental skills which would generate positive effects on athlete's performance by decreasing athlete's anxiety and anger before, during and even after competition.

Come to physiological/hormonal indicators of anxiety, the present study results have showed that at different time before

competition, the mean score of cortisol increased time after time. This indicator was assessed 8 a.m. before the competition start, one hour and half before the competition and one hour before the competition started. Obtained results at different times showed significant difference. In other words, as the competition starting time approach, the salivary concentration significantly increase. This increased cortisol concentration showed by the present study results before competition was also found by Hoffman *et al.* (2002). In his study, Hoffman and al 2002, observed that cortisol concentration during the pre-competition period, was greater than its baseline values. The existence of anticipatory cortisol response prior to competition has been recognized for some time (Eubank *et al.*, 1997; Filaire *et al.*, 2001a; Filaire *et al.*, 2007; Passelergue and Lac, 1999; Salvador *et al.*, 2003; Suay *et al.*, 1999) [7, 27, 28, 31, 36]. Moreover, it has long been established that cortisol is increased in an intensity-dependent manner in response to an exercise stimulus (Few, 1974) [33]. This rise of salivary cortisol prior to competition found in the present study is in agreement with many other studies results. In fact, Mao *et al.* 2002 [34] demonstrated that prior to rugby game competition, the salivary cortisol increase. The same situations of salivary cortisol rise prior to wrestling game have been observed by Kraemer *et al.*, 2001. Salvador *et al.*, 2003 [35, 31, 36] have also observed a salivary cortisol rise prior to judo game competition; and before weight lifting competition (Passelergue *et al.*, 1995) [37].

Research results have indicated that moderate elevation in the hormone help individuals to deal with challenge in three ways that may apply to competition (Kivlinghan *et al.* 2005) [38]. First, it marshals resources needed for physical activity (for example moving blood from extremities to large muscles); second it positively affects memory, learning and emotions that are important in performing effectively; third cortisol serves a homeostatic function by regulating other stress sensitive system. However, in the current study, since the salivary cortisol was observed a long time before the competition start, we can affirm that this was because of psychological stress than competition energy need. This means that psychological stress acts on the hypo-physico-pituitary adrenal axis which in return releases the cortisol hormone in blood and in salivary.

Conclusion

Novice karate competitors experience increased cognitive and somatic anxiety which reduce their performance capability. Moreover, some physiological stress indicators such “cortisol” rise significantly as the competition time approach. All this psychological stressful states can potentially decrease athlete’s mental and athletic skills, and as consequence athlete’s performance capability become negatively influenced. The competition outcomes are also negatively influenced by psychophysiological stress. Then in their training program, the coach must well equip players of necessary skills to cope with these stressful situations. The coach must be able to appreciate psychological stress accompanying competition and, he should construct training program environments simulating similar psychophysiological responses.

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