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ORIGINAL SCIENTIFIC ARTICLE

REACTIVE STRESS TOLERANCE IN PREADOLESCENT SPORTS PARTICIPANTS: A COMPARISON OF SIX INDIVIDUAL NON-CONTACT SPORTS

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Authors' Contribution: A – Study design; B – Data collection; C – Statistical analysis; D – Manuscript Preparation; E – Funds Collection

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Abstract

Purpose of the study. The study's aim was to examine how reactive stress tolerance differs in preadolescence across six different non-contact sports.

Materials and Methods. Archery, cycling, shooting, swimming, track & field, and weightlifting are non-contact sports chosen for research. The study included 180 male sports cadets from the Jharkhand State Sports Promotion Society, with an age range of 11–13 years. To assess reactive stress tolerance, the determination test form S1 under the Vienna Test System was used. Sub-variables like the percentile ranks of correct, incorrect, and omitted responses, as well as the score of median reaction time, were selected for study. Comparisons were made between scores of sub-variables under the reactive stress tolerance of six selected sports disciplines. The main effect was determined using the Kruskal-Wallis test, while pairwise post-hoc comparisons were made using the Mann-Whitney U test. The significance level was set at 0.05.

Results. There were no significant differences in percentile rank of correct, incorrect, and median reaction times between selected sports. In terms of percentile rank of incorrect responses, sports like archery, shooting, and weightlifting differ significantly from swimming.

Conclusion. According to the findings, the sports in which distance is covered by producing bodily momentum are less likely to exhibit uncontrollable behaviour during athletic events.

Keywords: reactive stress tolerance, young athletes, archery, cycling, shooting, swimming, track and field, and weightlifting.

Introduction

Actual performance can only be observed in the main competition, but the factors that influence performance may be examined before the event (Chahal, Ghildyal, & Chahal, 2012). One of these factors is the information processing approach, a cognitive psychology component. The primary focus of this approach is the storage and retrieval of information from memory (Huitt, 2003).

When a sportsperson competes, they are well prepared and aware of the body movements and motor skills that they will be executing (Taneja & Zutshi, 2019). Being familiar with the training environment, the situations are known, but during competition, each timeframe brings an unknown stimulus. As a consequence of a change in the athlete's external environment, changes in the athlete's internal environment may occur (Bali, 2015), causing difficulty in performing previously learned skills (Allard & Starkes, 1991). In such situations, the behaviours observed are not under the conscious control of the athlete and can be seen in sensorimotor or action-based skills (Baumeister, 1984; Lewis & Linder, 1997), causing the athlete to perform worse than expected. The phenomenon is known as "choking under pressure" (Masters, 1992; Beilock & Carr, 2001). Pressure may be defined as any factor or combination of factors that increases the importance of performing well on a particular occasion, whereas choking refers to performance decrements under pressure circumstances (Baumeister, 1984). Despite individual effort and situational expectations for higher performance, "choking under pressure" is a figurative idiom used to describe the occurrence of lower performance (Baumeister & Showers, 1986). Choking in sports refers to a drastic drop in athletic performance under stressful circum-

stances (Mesagno & Grant, 2010). In the near term, this has a negative impact on the athlete's performance, and in the long term, it may restrict their degree of sporting success (Hill, Hanton, Matthews, & Fleming, 2010).

In all sports, athletes are trained technically and tactically so that they can make rapid decisions during competition (Nathan, 2017). During training, the circumstances and surroundings are familiar, but in competition the scenario changes, resulting in distraction through external sources that lead to debilitating anxiety and low perceived control, causing a significant drop in performance (Hill, Hanton, Matthews, & Fleming, 2010). In competition, when the conditions (environment and opponent) change, an athlete should be able to recognise the stressor, deal with it, make rapid decisions, and respond correctly to external cues in order to maximise the chances of sporting success (Williams, Hodges, North, & Barton, 2016; Patócs, Melia, Kovács, Fózer-Selmeci, Révész, & Tóth, 2016). If an athlete becomes choked in this situation, he will not be able to respond and will fail to give his best performance. Besides external factors, stress is caused by the quick processing of information in the form of visual, auditory, and audio-visual stimuli, which plays an important role in decision-making (Patócs, Melia, Kovács, Fózer-Selmeci, Révész, & Tóth, 2016). Several studies have found a connection between sports performance and psychology in terms of information processing systems, perceptual skills (Williams, A. M., 2000), multiple-choice reaction and visual perception (Doğan, 2009), competitive and organisational stressors (Hanton, Fletcher, & Coughlan, 2005), psychological skills (Cox, Zhan, & Yijun, 1996), and psychological states in competition (Doron & Martinent, 2015). However, response selection and skill execution play a major part in sporting success that cannot be comprehended only by looking at reaction time. As it is not enough to execute learned skills quickly, the basic tactical skill that an athlete must possess is the selection of the right skill at the right time (Czajkowski, 2009). No doubt, reaction speed matters, but without an appropriate reaction, the reaction speed is of no use (Johne, Poliszczuk, Poliszck, & Dabrowska-Perzyna, 2013).

In the process of making a rapid decision and quickly acting upon it, an individual has a threshold capacity to respond to constantly changing stimuli. This is influenced by individual characteristics, personality types, sports types, etc. (Nathanael, 2017). Sports psychologist states this ability as "reactive stress tolerance." Reactive stress tolerance is defined as an individual's ability to react effectively, quickly, and appropriately to a given circumstance, even in a stressful setting (Schuhfried, 2016).

The study's purpose: The aim of this study was to determine the level of reactive stress tolerance among preadolescent male athletes who actively trained and participated in six different non-contact individual sports (archery, track and field, cycling, shooting, swimming and weightlifting). To accomplish this goal, the sample was chosen from a specific academy that offers a consistent daily schedule and training regimen based on the athlete's developmental age. Female participants were excluded from the study to gain maximum control over extraneous variables like mental health change during adolescence (Fink, Patalay, Sharpe, Holley, Deighton, & Wolpert, 2015; Haugland, Wold, Stevenson, Aaroe, & Woynarowska, 2001; Jones, 2001). A minimum of two years of regularly trained sports cadets were selected for the research in order to ensure training stability.

Materials and Methods

Study participants

Selection of Subjects: A total of 180 male sports participants from the Jharkhand State Sports Promotion Society were selected for the study. 30 participants each from six different non-contact sports (archery, athletics, cycling, shooting, swimming, and weightlifting) were drawn using a stratified random sampling method. The chronological age range of participants was 11–13 years, with a minimum of 2 years of training experience.

Study organization

Variable and Test Selection: The variable chosen for the study was reactive stress tolerance. To measure its parameters, the determination test (DT) form S1 was chosen from the Vienna Test System. Sports were the independent variables, whereas different scores of reactive stress tolerance were kept as dependent variables. The test lasts approximately 6 minutes and includes sound and visual stimuli. The description of the test is presented in Table 1.

Table 1. Illustration of Determination Test

Stimuli Presented	Stimuli	Signal	Reaction	Response Key
Colour	Visual	White	Hand	Round white
		Red		Round red
		Yellow		Round yellow
		Green		Round green
		Blue		Round blue
Foot signal	Audio	Left side	Foot	Left paddle
		Right Side		Right paddle
Tone	Visual	Low 100 Hz	Hand	Rectangle Black
		High 2000 Hz		Rectangle Grey

Selection of Instrument and Scoring: Reactive stress tolerance was administered using a computer-based testing device, the Vienna test system by Schuhfried GmbH. For scoring purposes, the PR (Percentile Rank) of the correct response, the PR of the incorrect response, the PR of the omitted response, and the median reaction time were obtained.

Consent: Because the athletes were minors (under the age of 18), informed consent was obtained from the academy's administration and the athlete's in-charge. Apart from that, each subject was told about the test ahead of time and their agreement was also obtained.

Test Procedure: Test was administered between 9 AM to 5 PM. Selected athletes were well informed in advance about their test date and time. Before the beginning of each test, the computer programme offered a practise set. Once the subject acknowledged the practise set, the real test was conducted. An introspective report (feedback) was gathered at the end, and incentives were handed out.

Statistical Analysis

The Shapiro-Wilk test was employed to ensure the normality of the data. The Kruskal-Wallis test was used to compare measures of reactive stress tolerance in different sports. A pairwise comparison using the Mann-Whitney U test was used as a post-hoc test (Verma, 2016). The level of significance was preserved at p = 0.05. The profile chart was created using mean, standard deviation, minimum and maximum scores. Equation – (1) $z = \frac{X - \bar{X}}{S}$ was used to convert the minimum, maximum, and mean scores to their standard scores, where Z is the standard score, X is the score used for conversion (minimum, maximum, or average), $\bar{x}$ is the mean, and S is the standard deviation. Z values were converted into linear transformed scores using Equation – (2) $Z_1 = 50 + 10 \times Z$, where Z_1 is the linear transformed score of Z, and Z is the interest score for which linear transformation is being done.

Results

The descriptive statistics for the chosen variables are shown in Table 2. In the result, it can be observed that the mean score of weightlifting under the percentile rank of correct response, cycling under the percentile rank of incorrect response, and archery, track & field, swimming, and weightlifting under the median reaction time are nearly equal to their median. The p-values of these variables are only slightly more than 0.05. Therefore, data under PR-C, weightlifting, PR-I, shooting, and MRT, including archery, track and field, swimming, and weightlifting, are considered to be normally distributed.

Figure 1 depicts a descriptive graph of six sports for each variable. On each variable, the scores are found to be broadly distributed.

Although there are 30 samples in each sports category, many variables and sports do not follow a normal distribution. As a result, the nonparametric Kruskal-Wallis Test was employed to compare the scores of reactive stress tolerance of six distinct sports.

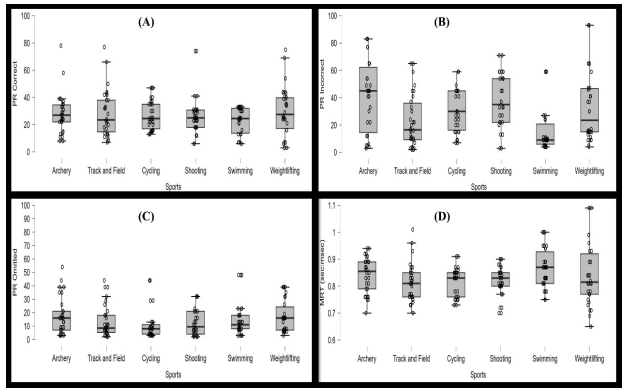

Figure 1. Data Distribution of Sports on Each Variable

Table 3 shows the result of comparative statistics by applying Kruskal-Wallis Test. The values of mean rank, degree of freedom (df), chi-square ($\chi 2$), and p-value were presented. The larger $\chi 2$ value indicates large differences between

Table 2. Descriptive Statistics

Variables	Sports	N	Mean	Median	SD	IQR	Shapiro-Wilk
PR-C	Archery	30	28	27	14.51	14.75	0.003
	Track and Filed	30	28.36	23.5	16.92	25.25	0.019
	Cycling	30	26.9	24.5	10.76	19.50	0.021
	Shooting	30	26.76	25	15.63	13.00	0.000
	Swimming	30	22.56	24.5	9.74	19.00	0.001
	Weightlifting	30	29.56	27.5	18.25	24.75	0.114^
PR-I	Archery	30	40.16	45	25.99	53.00	0.046
	Track and Filed	30	23.1	16.5	19.41	29.50	0.003
	Cycling	30	31.7	30	16.48	30.00	0.047
	Shooting	30	37.66	35	19.64	33.25	0.119^
	Swimming	30	15.86	9	16.26	19.00	0.00
	Weightlifting	30	32.66	23.5	25.17	32.50	0.002
PR-O	Archery	30	17.36	16	13.82	16.00	0.002
	Track and Filed	30	13.73	8.5	12.08	19.75	0.00
	Cycling	30	11.73	8	12.68	7.50	0.00
	Shooting	30	12.53	9.5	9.6	17.25	0.003
	Swimming	30	14.96	11	12.56	10.25	0.00
	Weightlifting	30	17.26	16	12.1	20.75	0.00
MRT	Archery	30	0.84	0.85	0.06	0.11	0.116^
	Track and Filed	30	0.81	0.81	0.07	0.09	0.204^
	Cycling	30	0.81	0.83	0.05	0.09	0.009
	Shooting	30	0.82	0.83	0.06	0.05	0.037
	Swimming	30	0.86	0.87	0.07	0.13	0.106^
	Weightlifting	30	0.84	0.82	0.11	0.17	0.065^

PR-C: Percentile Rank of Correct Response; PR-I: Percentile Rank of Incorrect Response; PR-O: Percentile Rank of Omitted Stimuli; MRT: Median Reaction Time; ^ Non-significant at 0.05

Table 3. Kruskal-Wallis Ranks Test and Variables Test Statistics

Variables	Sports	Mean Rank	df	χ2	p- value
PR-C	Archery	94.25	5	3.218	0.666
	Track and Field	91.63			
	Cycling	92.92			
	Shooting	85.7			
	Swimming	78.22			
	Weightlifting	100.28			
PR-I	Archery	109.42	5	27.478	0.000*
	Track and Field	73.85			
	Cycling	99			
	Shooting	110.93			
	Swimming	54.05			
	Weightlifting	95.75			
PR-O	Archery	101.83	5	8.496	0.131
	Track and Field	84.98			
	Cycling	72.58			
	Shooting	82.82			
	Swimming	96.48			
	Weightlifting	104.3			
MRT	Archery	100.92	5	9.364	0.095
	Track and Field	75.42			
	Cycling	81.77			
	Shooting	85.05			
	Swimming	110.53			
	Weightlifting	89.32			

PR-C: Percentile Rank of Correct Response; PR-I: Percentile Rank of Incorrect Response; PR-O: Percentile Rank of Omitted Stimuli; MRT: Median Reaction Time; * Significant at 0.05

the groups. The percentile rank for incorrect responses has a higher Chi-square value 27.478, and the calculated p-value is < 0.001. It is possible to infer that the percentile rank of incorrect responses varies across six different non-contact sports. Other factors, such as percentile rank of correct response (χ2 = 3.218, p-value = 0.666), percentile rank of omitted stimuli (χ2 = 8.496, p-value = 0.131), and median reaction time (χ2 = 9364, p-value = 0.095) do not show any significant differences. As a result, the percentile rank of correct responses, percentile rank of omitted stimuli, and median reaction time in chosen non-contact sports did not differ significantly.

Figure 2 represents the post-hoc analysis of incorrect responses and demonstrates the mean ranks and p-values of each selected sport. The Mann-Whitney U test was used for the post-hoc analysis. Only four pairs, swimming – cycling (p = 0.012), swimming – archery (p = 0.001), swimming – shooting (p < 0.001), and swimming – weightlifting (p = 0.029), displayed a significant difference.

Following Equation – (1) and (2), a profile chart (Figure 3) was created to compare selected variables of reactive stress tolerance. The minimum and maximum scores demonstrate the upper and lower limits of variables for each sport.

Discussion

The individual sports selected for the study had non-contact characteristics. According to a previous study (Piepiora,

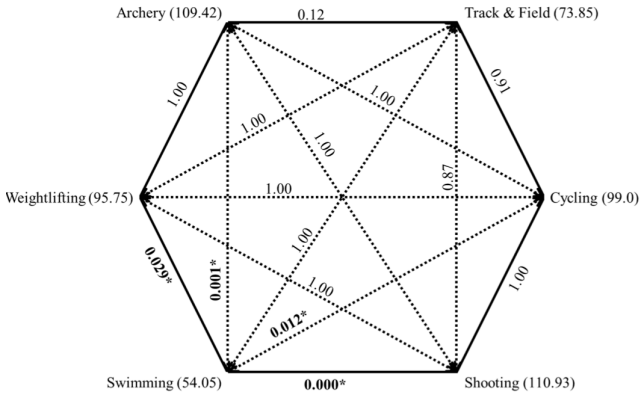

Figure 2. Post-Hoc Comparison of Percentile Ranks of Incorrect Response with (Mean Ranks) and p-values

2021; Pahan & Singh 2021), it was assumed that each parameter of reactive stress tolerance, such as the percentile rank of correct responses, the percentile rank of incorrect responses, the percentile rank of omitted stimuli, and the median reaction time for each sport, would be significantly different.

According to the findings, although there were disparities in scores under the percentile rank of correct response,

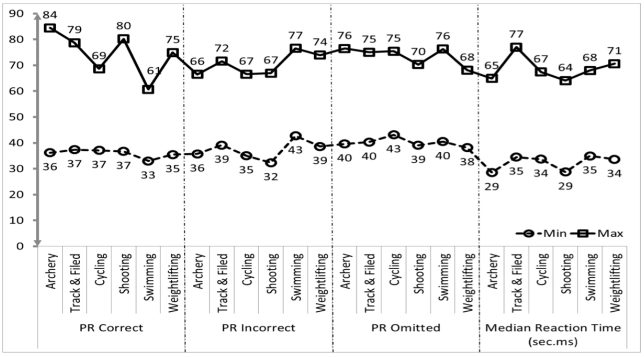

Figure 3. Profile Chart of Reactive Stress Tolerance under Different Individual Non-Contact Sports

percentile rank of omitted stimuli, and median reaction time existed, they did not approach the necessary value to be considered significant. As a result, no significant variation in these characteristics was observed. By examining the visual output of scores in Figure 1 & Table 2, it is clear that there was a wide spread of scores. This indicates that the sample used in the research was more diverse. According to the protocol for avoiding premature specialisation in sports (Committee on Sports Medicine and Fitness, 2000; Launay, 2015; Travassos, Araujo, & Davids, 2017; Buckley et al., 2017), the subject participated in a specific sport but received training appropriate to their age category (chronological, developmental, and training). The trainees were in the preliminary phase of their long-term athletic development. Their training focused more on general physical training than specific sports training. It is possible that this is why the scores under the parameters of reactive stress tolerance displayed a large variation.

According to the developmental aspect of an individual, the age range of 10-14 is categorised as an adolescence period. It is a period of transition from childhood to adulthood

(IGNOU, 2010; Allen & Waterman, 2019). During this stage, there is a rapid change in the way an adolescent perceives their environment. The changes are sudden and various biological, cognitive, and perceptual developments occur. There are some children who reach maturity early and late, while others follow their normal developmental pattern (Thompson, 2009). Individual developmental patterns may be a factor in why homogeneity in the scores was not established.

However, the percentile rank of incorrect responses was found to be statistically significant. The result of a pairwise (post-hoc) comparison revealed that mean ranks of shooting, archery, and weightlifting were statistically higher than swimming. As a result, the commitment to uncontrolled behaviour is higher in shooting, archery, and weightlifting than in swimming. The differences found may be due to the physical nature and requirement of attentional demands in each sport (Laborde, Guillén, & Mosley, 2016). The following are the justifications for acknowledging that the commitment of mistakes varies depending on the physical character of individual non-contact sports.

Nature 1: Equipment Handling vs. Free Hand: Sports like archery and shooting are target-oriented games that require good control of their sport-related equipment (bow, rifle, and pistol). Similarly, weightlifting also demands good control over the barbell and its resistance. Swimming, on the other hand, is a free-hand sport. On this premise, it is reasonable to infer that sports in which equipment is handled are more liable to commit uncontrolled movement. However, this statement is unsatisfactory since the throwing events of track and field and cycling are also sports that need good equipment control.

Nature 2: Speed Dominating vs. Static Stance: For this, it can be said that cycling, swimming, and track and field are the sports which are more speed-dominating. In throwing events of track and field, the distance is achieved by creating momentum, whereas in races, including swimming, track or cycling, momentum is required. If weightlifting is concerned, then it also requires momentum to lift the weight, and on the basis of the generation of momentum, again, it cannot be said that a difference occurred.

Nature 3: Displacement of Own Body vs. Displacement of Equipment: If we understand these individual games, then the factor that is creating the difference can be identified. The factor can be said to be displacement of the body and displacement of equipment. To achieve a desired performance in sports like throwing, jumping, or timing a race (running, swimming, and cycling), momentum is created by covering a fixed distance. Whereas, in weightlifting, archery, and shooting, the athlete does not show any displacement while performing. They have a fixed platform (weightlifting) or a shooting line (target sports) where a participant has to maintain their stance and perform. The athletes of circle throwing events (discus, hammer, and shot-put) in track and field also have a fixed diameter circle. But here they are again creating momentum by displacing their position, which is not similar to weightlifting. Therefore, it can be said that sports where momentum is created by displacing the body have fewer errors in committing behaviour.

From Table 3 and Figure 2, it can be well understood by observing the mean ranks in chronological order that in sports where less physical movement is done, there is a greater chance to choke. In shooting, the preparation of equipment at the time of competition requires less physical input, and gaining stability while shooting shows the higher mean rank. Next is archery, in which an archer has to prepare the equipment by pulling the string and extending the bow hand after placing the arrow. It requires more physical effort as compared to shooting, and hence the mean rank is nearly same but lower than shooting. Similarly, in weightlifting, the foot is placed and fixed during stance, and movement of other body parts is done to lift a weight that requires maximum strength and has a lower mean rank than in archery. Cycling, on the other hand, has a lower mean rank than weight lifting. The nature of sport is handling a cycle where movement is only done by the lower limbs while maintaining the stability of the upper body and controlling the cycle on a line. Track & Field has a lower mean score than cycling, where the jumping, running, and throwing are done, which requires controlled movement of the whole body to achieve performance. In this study, the track and field athletes were not separated and were kept under one category only. Therefore, much information cannot be stated. The swimming at the end scores very little in mean rank. In swimming, a swimmer should have the ability to float on the surface of water while making movements from both the upper and lower body parts. From this, we can understand that in sports where there is less physical demand, the occurrence of unwanted behaviour is greater. Hence, it is not a proven fact and needs further study.

Conclusion

On the basis of the current study, it can be inferred that the level of reactive stress tolerance of six individual non-contact sports only differs by the execution of uncontrolled behaviour. As there are high cognitive demands in each sport, the risk of errors or choking under pressure is greater in sports where the displacement of an athlete's position is very small. Therefore, coaches or physical educationalists who train sportsperson in shooting, archery, and weightlifting should include several kinds of cognitive training to improve the executive function of their trannies. In future research to acquire a better understanding, samples from senior or elite-level athletes may be chosen and categorised according to their personality types and training stages.

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Conflict of Interest

The author declares that there is no conflict of interest

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ТОЛЕРАНТНІСТЬ ДО РЕАКТИВНОГО СТРЕСУ У УЧАСНИКІВ ДОПІДЛІТКОВОГО СПОРТУ: ПОРІВНЯННЯ ШЕСТИ ІНДИВІДУАЛЬНИХ БЕЗКОНТАКТНИХ ВИДІВ СПОРТУ

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Авторський вклад: A – дизайн дослідження; B – збір даних; C – статаналіз; D – підготовка рукопису; E – збір коштів

Реферат. Стаття: 7 с., 3 табл., 3 рис., 38 джерел.

Мета дослідження. Метою дослідження було вивчити, як відрізняється стійкість до реактивного стресу в передпідлітковому віці в шести різних безконтактних видах спорту.

Матеріали та методи. Стрільба з лука, їзда на велосипеді, стрільба, плавання, легка атлетика та важка атлетика – це безконтактні види спорту, обрані для дослідження. У дослідженні взяли участь 180 спортивних кадетів із Державного товариства сприяння спорту Джаркханда, віком від 11 до 13 років. Для оцінки стійкості до реактивного стресу використовували форму детермінаційного тесту S1 за Віденською тестовою системою. Для дослідження були відібрані змінні, такі як процентильні ранги правильних, неправильних і пропущених відповідей, а також оцінка середнього часу реакції. Було проведено порівняння між десятками змінних у реактивній стресостійкості шести вибраних спортивних дисциплін. Основний ефект визначали за допомогою тесту Краскала-Уолліса, тоді як попарні пост-хок порівняння проводили за допомогою U-критерію Манна-Уітні. Рівень значимості був встановлений на рівні 0,05.

Результати. Не було значущих відмінностей у процентильному рейтингу правильного, неправильного та середнього часу реакції між вибраними видами спорту. За процентним рейтингом неправильних відповідей такі види спорту, як стрільба з лука, стрільба та важка атлетика, значно відрізняються від плавання.

Висновок. Згідно з висновками, види спорту, в яких відстань долається за рахунок вироблення імпульсу тіла, менш схильні до неконтрольованої поведінки під час спортивних змагань.

Ключові слова: реактивна стресостійкість, юні спортсмени, стрільба з лука, велоспорт, стрільба, плавання, легка атлетика, важка атлетика.

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