EUROPEAN ACADEMIC RESEARCH
Vol. X, Issue 3/ June 2022

Impact Factor: 3.4546 (UIF)
DRJI Value: 5.9 (B+)

ISSN 2286-4822
www.euacademic.org

Motor Coordination and Balance do not Present a Relationship with Sportive Performance in Professional Shooters Athletes

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Abstract

Problem statement: *Balance, fine and global motor coordination are basic skills part of the range of valences to be developed during the basic phase of athlete training. In this sense, it is plausible to assume that sports shooting athletes can benefit from the development of oculus-manual coordination, the coordination of large muscle groups and dynamic and stative balance for better performance, however, this premise was not explored suggesting the need for this definition since, objectively, training should be performance-oriented.*

Approach: *Eleven athletes of both sexes, shooting sports team Rondônia's shooting Sports, and one day of the official competition of the Rondônia's Sports Shooting Championship, were submitted to the tests of dynamic and static balance and global and fine motor coordination of the Psychomotor Evaluation Battery of Vitor da Fonseca. The results were correlated with the performance achieved on a day of official competition through Pearson's correlation with a significance level of 5%.*

Objective: *To verify the possible correlation between global and fine coordination, dynamic and static balance with the performance of elite athletes in shooting sports.*

Results: *Fine motor coordination tests show that the group has an average of 2.87 ± 0.73; the overall motor coordination presented an average of 1.36 ± 0.82; static*

balance with an average of 3.01 ± 0.81; dynamic balance with an average of 2.9 ± 0.51. When comparing performance in the shooting test, Pearson's correlation showed no correlation with global motor coordination (-0.02), a mean inverse correlation with fine motor coordination (-0.41), low correlation with static balance (0.12) and dynamic balance (0.33) during an official competition of this modality in Rondônia.

Conclusions: *The results suggest that higher levels of motor coordination and balance are not related to a better performance in sports shooting, which deconstructs the hypothesis initially formulated. Therefore, the performance of the sports shot is not correlated with the motor valences studied here.*

Keywords: Global motor ordering. Fine motor coordination. Dynamic balance. Static balance. Shooting sports. Correlation

INTRODUCTION

Neuromotricity is the integration between the motive and mental functions under the effect of the operationalization of the nervous system and that is structured from existing relationships between motricity, mind and biofunctional effectiveness of the individual who exercises[1]. In the current conception of neurological sciences, it is observed that it is difficult, or almost impossible to define the origins of motor, neuromotor and perceptual-motor functions of other purely intellectual functions and affectivity. Therefore, it can be affirmed that neuromotor development as opposed to the duality between psyche and body[2].

Different authors state that the frontal lobe presents competencies that apply to motricity actions primarily[3] although it participates in general learning structuring and with broad functions in cognitive tasks[4]. Its main role continues to be the involvement from the most preliminary stages of the movement such as preparation, preparation and planning until its execution, itself which, in terms of driving actions, plays the main role in terms of command and coordination of global and fine motor coordination tasks[5] evidencing an inseparable between motricity and cognition.

Among the driving skills of motricity development, global motor coordination, one of the most difficult motor qualities to be developed, is the

[1] it (Fonseca, 2014, 2008)
[2] (Fonseca, 2014, 2008, 2010)
[3] (Karni et al., 1998; Koch et al., 2006; Lee, 2006; Pedemonte & Velluti, 2005),
[4] (Hon, 2006)
[5] (Chung et al., 2011)

ability that a subject possesses to harmoniously control large muscle groups, while fine motor coordination, the most hierarchical and that depends on the organization of all other driving valences, is referred to as the ability to control small muscle groups with high skill and precision[6] and, in a preliminary analysis, they can contribute fundamentally to the accuracy of tasks involving large and small groups, such as shooting, a fundamental issue explored here. In particular, the coordination of the oculus-manual, since the integration between eye and hand, may have a significant role in the accuracy of the sports shot, which makes up the alternative hypothesis of this study.

Furthermore, the control of the trunk and lower limbs provided by dynamic and static balance can prevent the trunk from presenting variations and pendulum movements such as, may interfere with the ability to keep the carbine stable, consequently impairing the aim, which constitutes the second hypothesis of the present study. There is in the literature regarding motor development and motor learning a peculiar tendency to relate coordination as a whole and balance in general with different sports skills[7]. This view emerges from an understanding that demonstrates that people who have better control of their motricity tend to present better sports performance in tests of high psychomotor demands, including some that require a high level of precision to achieve success when performing[8].

On the other hand, primarily physical functions are fundamental for the sports performance of inexperienced athletes, or with a physical preparation still in development, differently from what should happen to physically well-developed athletes, where the ballast for the development of better physical levels is difficult and sometimes ineffective[9] which contradicts the central hypothesis of this study, facts that are opposed to the hypothesis previously formulated. Therefore, the goal here is to see the possible correlation between global and fine coordination, dynamic and static balance with the performance of elite athletes in shooting sports.

[6] (Fonseca, 2014, 2008, 2010)
[7] (Chen et al., 2017)
[8] them (Chen et al., 2017; Vestberg et al., 2012)
[9] Lebeau et al., "Quiet Eye and Performance in Sport: A Meta-Analysis."

METHODOLOGY

Search Type

The research is of the ex-post-facto type (existing phenomenon) correlational and quantitative since it seeks to identify existing phenomena, correlate, quantify and qualify[10].

Participant and ethics of the study

The group consisted of eleven shooting athletes from the Rondônia's team volunteers of both sexes with a mean age of 30.62 $\pm$ 5.79 years. The researcher conveniently selected the group due to the facilitation of their access to the athletes, which was done by personal invitation on the day of the realization of one of the stages of the Brazilian Shooting Championship being held at the Tennis Club of Porto Velho. In addition to the personal invitation, all participants had to sign a free and informed participation term according to the standards established for research with human beings. All volunteers gave their consent to participate in this study. The method was approved by the ethics and research council under CAAE number: 44907715.2.0000.5653 on 07/27/201.

Data collection instruments

The competition in which the research subjects were requested to participate is structured by official regulation that defines all items that must be attended in a competition of this level and type. In his organization, the said race develops in a passage of competitors by four targets with a score from 1 to 10. Each participant could make up to five shots at each target. To proceed with the race, the competitor positioned himself seven meters away from the targets and should perform all the actions of shots within a time limit of ten minutes. All the rules regarding the sports shooting test with pressure rifle were followed by the official coordinating team of the race. In comparative analyses of the relationship between performance in the shooting task versus the skills of the group of variables of coordination and balance, the effective score was obtained by the sum of the points on all targets.

Vitor da Fonseca BPM Test Battery for coordination and balance

Effectively about the Psychomotor Battery tests, the classification of the athletes was made on a scale of the Battery itself with a nominal score of

[10] them (Marconi & Lakatos, 2011)

scores between 1 and 4, being the first value representing a very poor score, the score of 2 points, a bad classification, when obtaining 3 points the given classification was good and, when 4 points, a rating considered excellent.

After completing the shooting competition, the athletes had 1 hour of rest and were then invited to perform the coordination and balance tests chosen from the Psychomotor Battery of Vitor da Fonseca (1995).

For this reason, some items/tests of the first and third blocks of this Battery were used, all usually used in a variety of studies in this line. For the motor coordination assessment, the items of global and fine motor coordination were used, these being the oculus-manual coordination tests consisting of throwing tennis balls inside a box or basket of 30 x 30cm at 4m. Thus, specifically for this test, the subject was instructed to be standing with parallel feet and then perform eight throws with the hand preferably, being asked to act in the way that best suits him.

The other item was oculus-pedal coordination which requires the action of kicking tennis balls between the feet of a chair. This action occurred in eight repetitions, and the performer kept his feet apart at a 33 cm distance between them and with the chair placed at 4 meters. The objective of him/her was to try to make the ball pass between the feet of the chair, worth the same points if they hit occurred at any distance of passage of the ball between the feet of the chair. In both tests, the number of correct answers was verified to calculate the score of the test performers, and for both items, the first attempt served only as an experience to accustom the subjects to the task. That is, not being added to the verification of their final score in the tests.

To quantify the fine motor coordination, the tests performed were manual dynamic coordination, pencil scoring on a piece of paper and a cross marking test. The manual dynamic coordination test consists of completely docking and undocking twenty clips (common clips used in sheets of paper), within two minutes and without needing them. The runtime of each item/test has been timed to set the score on the item. The subjects who were able to perform the fittings of all the clips in less than two minutes obtained a score of four, between 2 and 3 minutes, the score was three points, between 3 and 4 minutes the two-point score and, above four minutes, a score with a value of one was given.

The points test consisted of making points, with the use of a pen inside the squares of a checkered paper. In this item also the number of points, exclusively within the squares, defined the score of each participant, considering that to be valid such points should be perfect and well to the centre of the squares of the sheet. The proof of crosses followed the same

criteria as the proof of the points, therefore not being able to be, the "X" marked, leaking the checkerboard drawn on the test sheet. The time stipulated in both tests was 20 seconds. The values of the scores for the pencil scoring test were four points for those who achieved the perfect marking of the point in above 40 squared, between 30 and 40 checkered the score three, between 20 and 30 of these, score two and in the execution of less than 20 correct marks of the point, the score given was one. In the cross-crossing scoring test (X), the subject who reached twenty-five crosses or more in the stipulated time (20 seconds) scored four, between 20 and 25 seconds, three, between 15 and 20 seconds, two and, less than 15 seconds, score one. For the nominal classification of the subjects, we used the scale of the battery itself, which designates values from 1 to 4, and a score of one was obtained for a "very poor" performance, a score of 2 for "poor" performance, score 3 for a "good" performance and score 4 for an "excellent" performance.

State Analysis

The data associated with the coordination and balance tests obtained from high-level athletes in this modality were statistically analyzed about the mean scores of the shot test using mean and standard deviation. The power of the experiment was determined using the online calculator available at https://www.stat.ubc.ca/~rollin/stats/ssize/n2.html. After the Kolmogorov-Smirnoff Test, the Kolmogorov-Smirnoff Test was used to verify normality and Pearson's correlation was used with a significance of 5% through the Graph Ped Prism 5.0 program.

RESULTS

The motor variables present performance from below average to above the average

The shooting tests showed that the study participants performed well, very good or optimal in the shooting tests they participated in compared to the performance of other national shooting teams (data not shown). The main results of the present study showed that the volunteer group presents adequate fine motor coordination (2.87 ± 0.73) and overall, below average (1.36 ± 0.82), good dynamic balance (2.9 ± 0.51) and static (3.01 ± 0.81) (Figure 1).

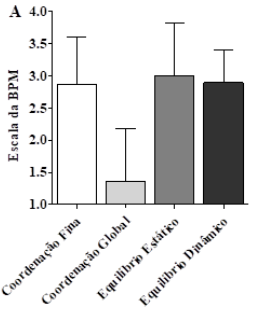

Figure 1: Motor Performance. The volunteers (n=11) were submitted to tests of fine motor coordination, global motor coordination, dynamic balance, and static balance of Vitor da Fonseca's Psychomotor Battery. The performance data in an official race of the Rondônia's shooting championship and motor tests were obtained on an official competition day. The data displayed here is from the mean standard deviation.

Motor coordination and balance have little or no correlation with performance in sports shooting with a carbine.

Pearson's correlation showed no correlation for overall motor coordination (-0.02), mean inverse correlation for fine motor coordination (-0.41), low correlation with static balance (0.12), dynamic (0.33) and performance score in shooting in an official competition.

	Shooting Fine Motor Coordination	Shooting Global Motor Coordination
n (pairs) =	11	11
r (Pearson) =	-0.0197	-0.4122
Power 0.05 =	0.0458	0.3425
	Static Balance	Dynamic Balance
n (pairs) =	11	11
r (Pearson) =	0,1225	0,4153
Power 0.05 =	0,0322	0,3648

Table 1: Pearson correlation. The volunteers (n=11) were submitted to tests of fine motor coordination, global motor coordination, dynamic balance and static balance of Vitor da Fonseca's Psychomotor Battery. The performance data in an official race of the Rondônia's shooting championship and motor tests were obtained on an official competition day and Pearson's correlation was performed to determine the possible relationship between the variables of interest with a significance of 5%.

DISCUSSION

If we know, the present study is the pioneer to investigate motor coordination and balance with performance in sports shooting. This aimed to see the

possible correlation between global and fine coordination, dynamic and static balance with the performance of elite athletes in shooting sports. The main data show that the studied group presents low overall motor coordination, optimal levels of fine motor coordination, and static and dynamic balance. However, when testing the hypothesis that sports shooting athletes would have a positive correlation between the driving skills and the performance in the chosen test, Pearson's test did not show a correlation between the variables studied here, although, for fine and global motor coordination, they were found a correlation (p= 0.458 and 0.0322 respectively) although weak and even negative.

The literature suggests that basic motor valences should provide support to sports skills, which should reflect on the performance of tests that require a high degree of motive structuring[11]. However, here the hypothesis formulated was not confirmed, because there was no correlation between sports performance and the driving skills investigated. This at first is a finding that goes against the scientific bases previously postulated that infer on the subject, because, for example, the finger that triggers the trigger (fine motricity) assumes fundamental importance in the sports motor gesture since an inadequate technique can cause deviations in the weapon to one side, decreasing the accuracy of the shot[12]. On the other hand, the control of the balance of the trunk could decrease the accuracy and coordination of the upper limbs can also influence the accuracy of the shot, both scientific premises that were deconstructed by our results[13].

In another way, sport improves motor coordination and, on the contrary, motor coordination is associated with improved sports ability[14]. In addition to the fact that different sports need balance to perform their motor gestures successfully[15]. Thus, it seems correct to affirm that according to the data found in the literature, motor skills have a positive correlation with sports performance[16] was not true for the shooting in the correlation between motor coordination and balance of the group of athletes studied.

It has been demonstrated that elite athletes involved in activities involving complex motor skills, such as combat sports, performed better in basic motor skills than individuals not involved in sports as complex as

[11] (Kantak & Winstein, 2012)
[12] (Noordstar et al., 2017)
[13] (Han et al., 2015; Paillard, 2019)
[14] (Gül & Çelik, 2021)
[15] (Yarim et al., 2020)
[16] (Cyrino et al., 2002),a fact that

running, or when comparing themselves to individuals with little experience in such activities[17]. This research area provides theoretical support to postulate that athletes with high basic motor skills demonstrate better spatial skills than those with low basic motor skills. However, the conclusions in this area have not yet been consolidated since other critical factors still need to be better explored[18].

([19]), which demonstrated a positive relationship between dynamic balance and football performance.[20] demonstrated that perception, anticipatory skills, and reaction time are fundamental for performance in sports, a fact later corroborated by Santos et al. (2014). Another study demonstrated that the development of executive functions can be a key point in sports performance. If taken together, these data indicate that there is a neural component implicated in the performance of different sports among elite athletes [21].

The variants associated with motor coordination and balance showed no significant correlation with the best performance of athletes in the execution of the sports shot with pressure carbine. Although efficiency in the motor valences investigated and efficiency in sports shooting were revealed, they do not coincide. These results suggest that a reliable performance in this sport does not present greater dependence on motor coordination and balance. This perspective opens space to think about which variables should be considered most, for example, when training athletes in this modality.

The present investigation postulated the hypothesis that there could be a correlation between motor coordination and/or balance with performance in shooting sports because the ability to control the motricity of the trunk, large and small muscle groups involved in the handling of pressure carbines could influence performance in this sport could be a key component of the performance of athletes[22], however, the physical components quantified here did not influence the athletic performance of the investigated group.

Among the limitations of this study are the reduced number of athletes, although, being athletes of an individual sport modality, the n of 11 subjects was sufficient for an experiment power of 80%, which is the recommended value. Secondly, more motor coordination evaluates should

[17] (Chen et al., 2017; Moreau, 2012; Noordstar et al., 2017; Santos et al., 2014)
[18] (Moreau, 2012)
[19] Rouissi et al. (2017
[20] Nuri et al. (2013)
[21] Verburgh, Scherder, Van Lange, & Oosterlaan (2014)
[22] (Chen et al., 2017; Noordstar et al., 2017)

have been admitted for a more comprehensive overall assessment. Another limitation was the impossibility of a control group of athletes with initial levels of physical development, which could help explain the data. Finally, the day of the competition is a day of stress for the athlete, which can influence the results.

What does this article add to the literature and what are its practical applications? Here it was demonstrated that the driving skills of professional sports shooting athletes are adequate or of good level, but the most intriguing was that these skills did not correlate with the performance of the sports shot. In practice, this suggests that it would not be producing a specific coordination and balance training to improve performance, at least not at the time the athletes were. It is a note point that the athletes observed here, possibly, were at the peak of their physical condition, which opens more space for technical and specific training, seeming to be the best strategy for maintaining and improving athletic performance. That said, the data from this study demonstrate that basic driving skills training should not be a priority when at the athlete's competitive moment because it does not provide performance advantages.

CONCLUSIONS

The data of the present study suggest that there is no correlation between motor coordination and balance as performance in sports shooting in that of the volunteer group studied. It is suggested that these findings should be due to the level of physical development that the athlete exhibited at that time, however, this statement is only a conjecture. Thus, it is suggested that mental, cognitive, and executive functions be investigated about their correlation with shooting performance to determine the influences of these important variables on athletic performance.

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