Journal of Physiotherapy and Rehabilitation

Research Article A SCITECHNOL JOURNAL

Cognitive Abilities between Soccer and Age-Matched Non Soccer Adolescent Males in Enugu, South East Nigeria

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Received date: 14 July, 2020, Manuscript No. JPTR-20-15513;

Editor assigned date: 16 July, 2020, PreQC No. JPTR-20-15513 (PQ);

Reviewed date: 30 July, 2020, QC No. JPTR-20-15513;

Revised date: 08 February, 2023, Manuscript No. JPTR-20-15513 (R);

Published date: 15 February, 2023, DOI: 10.4172/Jptr.1000114

Abstract

Background: Cognitive function refers to the ability of an individual to understand, take part and work towards his external and internal impulses in his environment. They are responsible for successful performance of most activities of daily living. Cognitive function has been reported to be enhanced by both aerobic and anaerobic exercises. Soccer players are required to anticipate and react continuously in a changing, unpredictable situation in the field. This work aims to compare the cognitive functions of soccer and non-soccer adolescent males.

Method: 50 adolescent males (25 soccer and 25 non-soccer athletes) were conveniently selected from government secondary school, Enugu in Nigeria. Their cognitive functions were assessed using two manual test batteries; Trial Making Test (TMT) and Stroop Colour-Word Test (SCWT).

Results: Football players took less time in completion of the TMT, part A and B with a p value of <0.001. For the stroop colour card, word card and colour-word card, the players also completed the task faster than the non-athletes. Commutation of the SCWT showed no significant difference between the athletes and non-athletes.

Conclusion: Optimal participation of players requires better understanding of their environment, they need to have awareness of the position of their team players and react to unexpected movements. Aerobic exercises such as football may have a positive correlation with cognitive function. Soccer games may improve neurocognitive abilities and are recommended for cognitive development in adolescents.

Keywords: Cognition; Soccer players; Non-soccer players; Trial making test; Stroop colour-word interference test; Aerobic exercise; Cognitive abilities

Description

Cognitive functions refer to the ability of an individual to take part, understand and work towards his external and internal impulses in his environment [1]. These functions also encompasses the executive functions which looks at how one plan and execute his daily activities, concentrate on the details of the task at hand and perform different skills coincidentally [2]. Cognitive functions are essential for the optimal performance of day-day life activities [3]. For instance, auto drivers with high cognitive abilities may predict and survive dangerous situations better than their counterparts with lower cognitive abilities. Similarly, other life situations require adequate cognitive functions for efficient performances [4].

Disorders in cognitive functions can result as complications of various health conditions, including Schizophrenia, dementias, stroke, and developmental disabilities. Age has been regarded as the primary risk factor for cognitive functions. Other myriad of factors can be considered to be a risk factor; and these includes family background, level of education, smoking and drinking habits, mental stress, nutritional aspects and sedentary lifestyle [5].

Several approaches have been identified as a means of improving cognitive abilities. Amongst the numerous approaches, physical and mental based activities are the most commonly utilized by physiotherapists [6]. Several studies have reported positive relationships between aerobic capability and effective performance of cognitive tasks while others have reported a negative relationship between sedentary lifestyle and neurocognitive functioning. Although the entire mechanisms are unclear, sedentary lifestyle has been associated with high inflammation risk, disturbed insulin regulation, and high level of triglycerides [7].

Other patterns of physical activity has been associated with optimum neurocognitive functioning. It has been found that table tennis players used self-talk to concentrate and contain their emotions. During different part of the match, players were asked to describe the emotions they are feeling. Athletes who won more points during the match were observed to be among those that self-reported that they managed their emotions well. A group of adult and junior volley ball players and their respective age-matched control groups were administered a comprehensive cognitive abilities test. Cognitive ability of athletes was revealed to be higher than the non-athletes [8].

A study recruited individuals who were not athletes and engaged them in a 10-month training program in either wrestling or running. At onset, all participants had a comparable score on the mental rotation task. At the end of the program, the wrestling group produced higher scores than the running group. The pre-test score of the runners were not significantly different from the post-test [9]. Another study revealed that football players showed a higher reaction time and anticipation skills than non-athletes [10].

To further contribute to the existing knowledge, this study was designed to compare neurocognitive abilities between soccer and non-soccer athletes in Nigeria.

Materials and Methods

Fifty (50) adolescent males (25 soccer athletes and 25 non-soccer athletes) who were enlisted from a secondary school in Enugu, Nigeria participated in this cross sectional observational study. Exclusion criteria included students who are engaged in other sports other than football games and those with known mental, cognitive and psychological disorders. Participants were screened for their eligibility subsequent to volunteering for the study [11].

Approval to conduct the study was obtained from health research and ethics committee of the university of Nigeria teaching hospital Ituku/Ozalla Enugu and participants' written informed consents were obtained prior to their participation in the study. Information regarding age, weight, height, and body mass index were recorded. Two test batteries were used to assess neurocognitive functions and they included trial making test (part A and part B) and stroop colour-word interference test [12].

The TMT (part A and B) consists of 25 circles spread over a sheet of paper. In part A, the circles are randomly numbered 1-25, participants were instructed to link up the numbers by drawing lines to connect the numbers in an ascending order. Part B consists of both numbers (1-13) and letters (A-L). As seen in part A, participants are instructed to link up both numbers and letters alternatively in an ascending order by drawing lines to connect them. Participants are expected to perform these actions without lifting the pencil from the paper once the participants have begun connecting the numbers and/or letters. The time spent on each task was ascertained and recorded [13].

The stroop color and word interference test consisted of three cards (A, B, and C). Card A which referred to as the colour card contains 100 patches from five different colours written on it, card B which is known as the word card contains the same colour as in card A; but printed in black and white. Card C which is referred to as the colour word card contains printed names of colours but printed in an ink that is conflicting to the colour word. The cards are placed on the table at the eye level of the participants, who will be in the sitting position. Participants are told of what is expected of them before they commence. the researcher says; GO at the beginning of each card with the stop watch started simultaneously. The researcher notifies the participants once an overt error is made by tapping the card with a pencil [14].

The ability to inhibit cognitive interference as proposed by Stroop can be measured using the formula: Total time(s)+ ((2 × mean time per word) × number of uncorrected errors). However, in the current study, the formula that will be adopted for calculating SCWT were formulated by Thurstone in a more recent study of the stroop test. Formula: SCWT CARD A/SCWT CARD C. where, the total time is the time scored for card A divided by the time scored for card C [15].

Data were analyzed with the SPSS software version 20.0 for data analysis (SPSS Inc., Chicago, IL). Descriptive statistics of mean and standard deviation, inferential statistics of independent t-test was used to compare mean values between groups at a significant level of 0.05 [16].

Results

The study results revealed that soccer athletes performed significantly ($p<0.05$) better than non-athletes in TMT part A and B tests. These shows that soccer athletes completed the task faster than the non-soccer athletes revealing a high cognitive function in them compared to their counterparts [17]. Similarly, the results of the stroop colour card, stroop word card, and stroop colour-word card tests showed that the soccer athletes significantly ($p<0.05$) demonstrated better neurocognitive abilities, as compared to the non-soccer athletes (Table 1).

Variable	Athlete (n=25)	Non-athlete (n=25)
Age (years)	16.64 ± 1.55	16.72 ± 1.46
Weight (kg)	60.52 ± 9.084	60.72 ± 8.78
Height (m)	1.70 ± 0.082	1.74 ± 0.103
BMI (kg/m^2)	20.28 ± 2.26	19.76 ± 2.03
*Note: BMI-Body Mass Index		

Table 1: Descriptive statistics of participants socio-demographic characteristics.

Furthermore, commutation of Stroop Colour-Word Interference (SCWI) test reveals no significant difference between soccer athletes and non-soccer athletes, p=0.364 (Table 2).

Variable	Athlete	Non-athlete	t-value	p-value
TMT A (sec)	21.08 ± 8.15	47.76 ± 21.30	-5.85	0.000*
TMT B (sec)	45.00 ± 19.29	93.92 ± 33.30	-6.35	0.000*
SCC (sec)	51.48 ± 10.50	72.64 ± 15.63	-5.62	0.000*
SWC (sec)	55.24 ± 11.94	76.32 ± 17.09	-5.06	0.000*
SCWC (sec)	120.50 ± 27.90	162.80 ± 44.54	-4.02	0.000*
Total SCWI (sec)	0.69 ± 1.22	0.46 ± 0.10	0.917	0.36
Note: TMT A=Trial Making Test part A, TMT B= Trial Making Test part B, SCC= Stroop Colour Card, SWC=Stroop Word Card, SCWC=Stroop Colour-Word Card.				
* indicates significance at $p<0.05$				

Table 2: Comparisons of neurocognitive abilities of athletes and non-athletes.

Discussion

This study compared the neurocognitive abilities of soccer athletes and age matched non-soccer athlete adolescent males in Nigeria. The study reported a better performance of the neurocognitive tests among the soccer athletes, as compared to the non-soccer athletes. This implied that the soccer athletes had better speed of processing, task switching, mental flexibility, visual attention, visual search speed, scanning, selective attention and cognitive interference inhibition abilities than the non-athletes. From the results obtained from the study, it can be inferred that in a dynamic sports environment like soccer, the payers are being trained with the visual stimuli during practice. These players focus more on the visual inputs like watching out when to receive a pass from their team mates, finding out the different positions their team mates are, to know how to coordinate the ball well [18]. Therefore, a good understanding of the position and postural direction of the opposite players as well as the direction of the ball is necessary for better performance. The capacity of players to have this skill requires better speedy reaction time, visual attention and task switching time during game. Within the short time needed to act before being taken down by an opponent, players are trained to acquire good processing speed within the shortest possible time and also trained to deliver effectively and efficiently within the time frame [19].

The result of this study is in concordance with a previous study regarding reaction time and anticipation skills. A study comparison between soccer players was performed. The results showed that athletes have better reaction time and anticipation skills than non-athletes. In a football environment, players are faced with so many distracting stimuli; these stimuli can come from different sounds and noise made by the fans. It can come from the opponents and can equally come from team mates. These players are trained to inhibit these irrelevant sounds and focus on the particular goal set before them. The results showed that soccer athlete has more cognitive interference inhibition abilities more than non-athletes. This is in concordance with a previous study regarding the neurocognitive functioning of professional and amateur football players with non-athletes. The results revealed that variance in inhibition, short term memory; working memory and lapses of attention were attributed to number of time spent in sports, with better performance allocated to the number of time spent in sports. Outdoor play was also positively associated with working memory. In contrary, negative association was observed in time spent on the computer with inhibition.

Recognized limitations to this work include that self-report was used as measures of physical activity of soccer athletes and non-soccer athletes. Despite this limitation, self-report measure has been regarded to provide valid measures of time spent in sedentary behavior, unlike other measures like pedometers and accelerometers that are able to ascertain the different activities. The second limitation was the inability to examine differences in the non-athlete group by activity.

Conclusion

Aerobic exercises play a role in the enhancement of cognitive functions. The results from the current study suggest that aerobic exercises are vital in the development and enhancement of cognitive functions among adolescent and should be included in the curriculum. Football players can better apprehend and interpret the environment as compared to the non-athletes. Therefore we recommend that schools should make football games and other sports as part of the school curriculum to encourage participation of students and an improvement in cognitive abilities.

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