Original article

Association between Oxygen Saturation level, Cognitive Function, and the Academic Performance of Medical Students, Jouf University

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Abstract

Background and Aims:
Many factors have an impact on academic performance, cognitive function one of the most important factor which affect the academic performance, cognitive means conscious mental activity as thinking, remembering, learning or using language. The objective of the study was to assess association between the oxygen saturation level, cognitive function and academic performance of medical students.

Methods:
descriptive cross-sectional study conducted between October 2016 to April 2017. Simple random sampling of 88 medical students were included in the study. A self-administrated questionnaire including factors affect the oxygen saturation levels, measurement of the oxygen saturation by pulse oximeter, and digital span test which include forward and backward test. The data from this research were analyzed using mean descriptive and inferential statistical tests, standard deviation, and t-test and ANOVA with a significance

الملخص

خلفية :
هناك العديد من العوامل التي تؤثر على الأداء الأكاديمي لطلاب كلية الطب البشري، منها الوظيفة المعرفية ومستوي تشبع الاكسجينبالدم. الوظيفة المعرفية تعني النشاط العقلي الواعي مثل التفكير او التذكر التعلم او استخدام اللغة

الهدف :
تقييم الارتباط بين مستوى تشبع الدم بالأكسجين، الوظيفة المعرفية والأداء الأكاديمي لطلاب الطب البشري بجامعة الجوف بالمملكة العربية السعودية.

طريقة البحث :
دراسة مقطعية اجريت في الفترة ما بين أكتوبر٢٠١٦ الى أبريل٢٠١٧، تمثلت عينه الدراسة والتي تم أخذها بطريقة عشوائية من ٨٨ طالب وطالبة من طلاب كلية الطب بجامعة الجوف، باستخدام استبيان صمم من قبل الباحثين، يبحث في العوامل المؤثرة على مستويات تشبع الدم بالأكسجين. تم قياس تشبع الاكسجين بمقياس التأكسج الذي يقيس نسبة الهيموغلوبين المؤكسج في الدم في الأوعية النابضة، وخاصة الشعيرات الدموية للإصبع. تم تقييم الوظيفة المعرفية للطلاب باستخدام اختبار الامتداد الرقمي الذي يشمل الاختبار الامامي والخلفي، تم تحليل البيانات باستخدام الاختبارات

level of $p < 0.05$.

Results:

Results showed that academic performance of the students had the highest correlation with the cognitive functions ($p < .05$). Mean± SD of cognitive function test in male and female was (14.46±3.14, 16.75±3.22 respectively), there is statistically significance difference between male and female students ($p = .002$).

Conclusion:

Results of the study concluded that the O2 saturation level are within normal range for sample population. There is a difference between male and female students in cognitive function scores; better for female students. O2 saturation level and cognitive function have a good impact on the academic performance. Also, there is no association between the cognitive function scores and the academic performance.

Keywords:

Medical students, Cognitive function, O2 saturation, Academic performance, Jouf.

الاحصائية الوصفية والاستنتاجية، الانحراف المعياري واختبار -تي - وأنوفا مع مستوى دلاله ($p < 0.05$).

اظهرت النتائج أن الأداء الأكاديمي للطلاب كان له أعلى ارتباط مع الوظائف المعرفية ($p < 0.05$).

الخلاصة :

خلصت الدراسة الى ان مستوى تشبع الدم بالأوكسجين ضمن المعدل الطبيعي للعينة المستهدفة. كان هناك فرق بين الطلاب والطالبات في درجات الوظيفة المعرفية، أفضل لصالح للطالبات، مستوى تشبع الدم بالأوكسجين والوظيفة المعرفية لها تأثير جيد على الأداء الأكاديمي. لا يوجد ارتباط بين درجات الوظيفة المعرفية والأداء الأكاديمي.

كلمات مفتاحية :

طلاب الطب، الوظيفة المعرفية، تشبع الدم بالأوكسجين، الأداء الأكاديمي، الجوف

Introduction

Education is a facility of training and learning to improve knowledge and develop skills. The ultimate purpose of medical education is to empower an individual to be an excellent physician and thus responsible for the country's social and economic development. [1]. So, the quality of students' performance now remains at top priority for educators. It is meant for making a difference locally and nationally. Defining and measuring the educational quality is not a simple issue. The complexity of the educational process still increasing. The increasing complexity is due to many reasons like change the value of the attribute which associated with academic performance. Medical student academic performance measurement has received significant attention. Academic performance is a skill that students obtain from school, college, and university through the time spent in the classroom, the lab, or the library [2]. Also, it is challenging aspects of academic literature Science, student performance is affected due to social, economic, psychological, physiological,

environmental factors. These factors that have a strong impact on the student performance. They different from country to country and from student to students [3]. In the Kingdom of Saudi Arabia, the weather is favorable especially in the inner area such as Sakaka in Al-Jouf region, where the dryness, soil, storms and the intensity of the heat in the summer, which matched the intensity of the cold in the winter. These results in silicon dust suspended in the air, causing subsidized the citizens of silicosis, which reduces the efficiency of the respiratory system to extract atmospheric oxygen[4]. Because of that we suppose there is an effect of these changes of weather and less oxygen extraction on the cognitive structure which responsible for the learning. Cognitive function refers to mental abilities used to engage in several aspects of daily life [5] Oxygen is an essential component required for normal brain function, the brain is the most metabolically active organ in the human body, and accounts for up to 30% of basal energy consumption [6]. Moss et al, confirm the relationship between oxygen administration and the memory formation in healthy young adults. The results approve that the O2 administration significantly enhances cognitive achievement more that seen in the control group. The subjects who received O2 had faster reaction times and recalled more words than the control group[7]. Physical activity shows an important role in determining the academic achievement. In which simple physical activity such as walking for 20 minutes before academic exam will improved the cognitive control and resulted in better academic scores between the students [8]. In 2013, Chandra P et al, emphasized the important of the regular exercise on the cognitive function and their positive impact on the academic performance through assess the academic performance and the physical fitness in relation to daily physical activity levels, this study also assess the association of physical fitness and academic achievement with age, the net result of this study revealed that the amounts of regular physical activity must be incorporated in lifestyle of all adolescents in order to appear its positive effects on cognitive functions, physical fitness and academic performance [9]. Alternative hypothesis is students' daily habits can affect the O2 saturation level that may affect their cognitive function and therefore their academic performance. At the end of this study we expect to find a relationship between the oxygen saturation level and student performance, and cognitive function.

The objectives of the study were to assess cognitive function of medical students, measure O2 saturation, determine academ-

ic performance, to determine the relation between the oxygen saturation and cognitive function, cognitive function and academic performance, oxygen saturation level and academic performance of medical students and to determine the difference between male and female students regarding, cognitive function test, O2, and academic performance in the selected block.

Methodology

This was a cross-sectional study. Study was approved by Jouf university Ethics Committee and the subjects were recruited in the study after obtaining the verbal consent. This study included 88 second and third-year MBBS students of both sex in a medical college, Jouf University along the Endocrine & reproductive block 2nd year and Gastrointestinal block 3rd year. We excluded any male or female students with a history of head trauma, epilepsy, encephalitis, cerebrovascular diseases, any central nervous system diseases or mental disorders students with asthma, bronchitis, or other respiratory diseases, narcolepsy or day time hypersomnia, anemia, hypotension, and heart disease.

Data were Collected by a self-administered Questionnaire: The questions were done in Closed Format " Dichotomous Questions", designed by the researchers. The questionnaire consists of 2 parts. First part designed for demographic data like age, year, course. Second part designed to ask about the student's study habits medical condition, risk factors (smoking, lung and heart disease), and medication.

- Pulse oximetry to measure the oxygen saturation
- Measure the weight and height to calculate BMI
- Cognitive tests: (Digital Span Test) There are two variants of the test, forward digit span (FDS) and backward digit span (BDS). In FDS, the digits are repeated in the order of their presentation, while in BDS they must be repeated in the reverse order. The largest number of digits that a person can repeat without error is his or her forward or backward digit span. It is well-established that the black-white gap is substantially larger on BDS than FSD. [10,11]

Procedure:

During 2016-2017, researchers distributed the questionnaire to the 2nd and 3rd year medical students male and female and measured the O2 saturation level from the 3rd week to the 9th week of the gastrointestinal and endocrine and reproductive blocks, before the time of PBL, Objective structured practical exam (OSPE), End of

block exam (EOB). Then cognitive function was done to assess the students' short memory through the Digital Span Test, which consisted of forward and backward part. Forward test composed of 8 items and each item have A and B part while the backward test composed of 7items and each item have A and B part. After giving clear instructions to the participant about how to do it. The test discontinuous only when the participant has failed in both trials of the same span length
(e.g., 5a and 5 b).

Data were analyzed using SPSS 21 software Independent t –test to was done the association between the O2 saturation and cognitive function, O2 and scores of the final block grade, cognitive function test and scores of the final block grade. In addition, we used the chi- Square test for the all remaining assertion we found in our research.

The percentage of satisfaction of all students was calculated by combining frequency of levels of satisfaction (satisfied and very satisfied) for each item in the questionnaire. Differences between pre-clinical and clinical phase and between male and females' students were calculated. Inferential statistics using independent samples t-test and ANOVA were used to compare the difference between the satisfaction and challenges scores by phase of study and gender. $P < .05$ was considered statistically significant.

Results

Out of 100 questionnaires were distributed, 88 were completed and return, the response rate was 88%. 48 (54.5 %) male and 40 (45.5%) female 38 (43.2%) from second year and 50 (56.8 %) from third year. Mean age of students was 21.7±2 years.

Table (1) Shows range, minimum, maximum and means± SD for O2saturation, cognitive function and academic performance (96.38±1.997, 15.50 ± 3.36, 76.25± 15.72 respectively)

Figure 1 show students' scores of cognitive function test, the range of score from 8-23. Mean± SD was 15.50±3.36. Majority of students scored 15, while there was 1

Table 1: Range, mean, minimum, maximum and standard deviation of study sample O2 saturation level, Cognitive function test and academic achievement

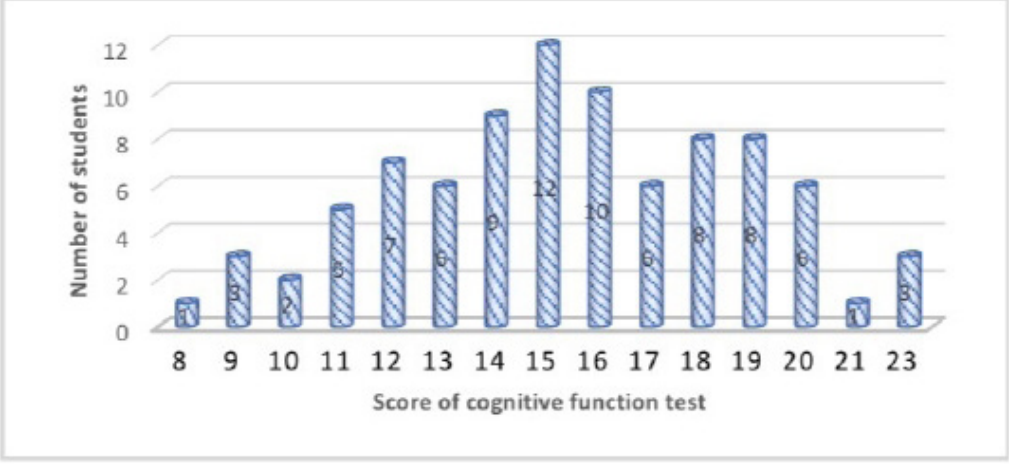
	O2 Saturation level	Cognitive Function	Academic Performance 100
Range	10.6	15.00	70.00
Minimum	88	8	29
Maximum	98	23	99
Mean	96.38	15.50	76.25
Std. Deviation	1.997	3.36	15.72

student take lowest score and two students take highest score.8 students from the third year who scored 15 while 4 students from second year. Mean± SD of cognitive test in male was 14.46±3.14 while in female 16.75±3.22.

Table 2 show the significant association between the O2 and academic performance, O2 and Cognitive Function, while there wasn't association between the Cognitive Function and academic performance.

Table 2 show the significant association between the O2 and academic performance, O2 and Cognitive Function, while there wasn't association between the Cognitive

Figure (1) Frequancy of distribution of cognitive function test among students



Function and academic performance.

Table 3 show the significant difference between male and female regarding O2 saturation, cognitive functions and academic performance.

Table 2: Mean± SD and the association between the O2 and academic performance, O2 and Cognitive Function, Cognitive Function and academic performance.

	Mean ±SD	P-value
O2 saturation level	96.38± 1.997	042*
Academic performance	76.25±15.72	
O2 saturation level	96.38± 1.997	.002 *
Cognitive function test	15.50±3.36	
Cognitive function test	15.50±3.36	.087
Academic performance	76.25±15.72	

Discussion

Defining and measuring the educational quality is not a simple issue. The complexity of the educational process still increasing. The increasing complexity is due to many reasons like change the value of the attribute which associated with academic performance. The main premise of this study focuses on the association between

Table 3: Comparing mean and standard deviation for the O2, cognitive Function, Academic performance to the male and female students

	Female **Mean± SD**	Male **Mean± SD**	**P- Value**
O2	99.27± 0.62	95.32± 2.52	.000*
Cognitive Function	14.46± 3.14	16.75± 3.22	.002*
Academic performance	70.67± 16.54	82.95± 11.17	.001*

the oxygen saturation level, cognitive function and the academic performance of the medical students. The brain activity consumes 20-30% of the energy usage for the total body; it requires approximately 200 liters of oxygen per day for normal functioning. a decrease of arterial oxygen partial pressure (PO2) can alter brain function such as attention and memory [6]. In the current study we hypothesized that the dusty weather in Sakaka Al Jouf northern area of Kingdom of Saudi Arabia may affect the O2 saturation level that may affect students' cognitive function and academic performance. Study results found that O2 saturation level for study sample was with normal level. Our study results found there was a significant association between the O2 saturation and academic performance (p=.042). In addition, significant association between cognitive function and the O2 saturation (p = 0.002) Results of the present study correspond with the study of Ho-Jun Seo et al 2007 they studied the effect of Oxygen Inhalation on Cognitive Function and found that administration of 35% oxygen to healthy young adults significantly improves verbal learning ability and affects physiological functions of the brain [6]. The normal physiological state the cognitive structure is the main part responsible for the whole learning and memory process and this part will affect by many factors maybe direct or indirect and at the end the academic performance will be effect, From this background there is an association between them, because O2 supply the whole structure in the brain include the most important part of the learning which is the hippocampus. Our result was in consistent with other research, in 2018 Lauren O et al, the effect of aerobic exercise on the cognitive structure was assessed. Generally, the aerobic exercise refers to the exercise that increase the maximum oxygen uptake enhance through the efficiency of aerobic energy producing systems and they found a positive impact on the cognitive structure [12]. Also, in 2008 Phillip D et al, the correlation of high levels of aerobic fitness with greater academic performance and IQ scores was approved [13]. The results are in contrary to a study conducted by Jan Anderson et al, 2002 they reported that inhalation of oxygen did not affect cognitive functioning[14]. Many researches promote the effect of the aerobic exercise and increase the oxygen intake had a strong positive impact on the enhance the hippocampus structure and the cognitive function, these researches support our hypothesis. Numerous studies have confirmed the authenticity of the relationship between cognitive functions and academic performance. Our results are in contrary a study conducted by Abd Khodaei and Ghaffari

(2011), they investigated the students' use of study skills and learning, and its relationship with their academic status , it was concluded that there is a direct and significant relationship between study skills and learning, and the average score of university, which is the index of academic performance [15] they found no association between the cognitive function and academic performance, also another research conducted by BooJari S et al, 2015 they found that Significant correlations were seen between attention (CAS) and academic performance and the other side between planning, simultaneous, successive functioning and academic performance P value of 0.05 and 0.01 respectively [16]. Results shows differences between male and their counterpart's cognitive function main score better for female student. We suggest this association may through indirect way such as we discussed before, the effect of physical exercise on the cognitive function, also the diet, the normal hemoglobin and good cerebral blood flow. Each of these factors has its own mechanism to enhance the all aspect of the cognitive function. In the whole researches there were definite difference between male and female in the academic performance as well as the cognitive functions, that' s what approved by Pontifex MB, et al in 2009 [8]. At the end of this study, there are many factors may affect this academic performance [17] and we can't neglect the importance of any one of them. However, each one of these factors may have a strong association with the academic performance in some research while in others research there wasn't any association.

Conclusion

Results of the study concluded that the O2 saturation level are within normal range for sample population. There is a difference between male and female students in cognitive function scores; better for female students. O2 saturation level and cognitive function have a good impact on the academic performance. Also, there is no association between the cognitive function scores and the academic performance. To improve students' academic performance, we need to improve the ventilation in the classes. Give a Health education message on the importance of physical exercise Moreover, further studies should be planned from different medical and non-medical institutions in order to gain a better insight into the matter, Also, assess different study skills like textbook reading, note taking, concentration, test preparation and time management.

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