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A QUALITATIVE STUDY TO EVALUATE EFFECT OF SLEEP QUALITY ON HANDGRIP STRENGTH AND COGNITION.

Physiology

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ABSTRACT

Background: It is often seen that college students struggle to get enough sleep whether it is due to studies or their lifestyle. This affects their sleep habits, making it overwhelmingly negative. This inconsistent sleep patterns, lack of efficient sleep, late bed times and other sleep related problems negatively affect quality of life.
Objective: In this we tried to report the effect of sleep quality on student's cognitive performance and handgrip strength.
Methods: 73 healthy female students were assessed using the Pittsburgh Sleep Quality Index (PSQI). On basis of PSQI out of 73 students, there were 29 good sleepers and 44 poor sleepers. Their hand grip strength and visual reaction time was measured. Statistical analysis was performed using R software (v. 3.2.5). P value was considered to be significant at ($p<0.05$).
Results: On the basis of data analysis, it was found that good sleepers have significantly higher cognitive functions than poor sleepers. Their hand grip strength was not found significant in comparison with good and poor sleepers.
Conclusion: We may conclude that, quality of sleep does have positive correlation with cognitive changes.

KEYWORDS

Cognition, Strength, Sleep Quality, Reaction Time

Introduction

Beginning a college life is a dream of every school student. As they won't have to get up early in the morning, bunking lectures, roaming around late in the night. In a simple term it is a carefree and reckless style of living for some. Few students take it as a new life to make their career in the field of their choice and to pursue their dreams they have to leave home and stay in hostel. They live away from family for a specific time period with change in lifestyle different from their home environment. In this way they learn to live independently and somehow learn how to compromise and adjust with their new home and inmates [1]. Hostel life makes them face few difficulties and hurdles such as changes in eating and sleeping habits. And if these habits are disturbed than it might even affect mental and social wellness.

Getting enough quantity with good quality of sleep at night time, can help to ensure our psychological wellness, physical wellbeing, personal satisfaction, safety and normal functioning of all the system of the body; including the immune system. In humans, the metabolic activity of the brain decreases significantly after 24 hours of sustained wakefulness. In children and youngsters, sleep also helps in overall growth and development, as release of growth hormone and increased production & breakdown of proteins takes place mainly during deep sleep. Sleep deprivation hinders physical and mental development, which might adversely influence focus, performance, behavior, emotional well-being. In a recent meta-analysis, both short and long sleep duration are found to be critical indicators of all-reason of mortality, including cardiovascular and non- cardiovascular death [2]. Poor sleep quality (e.g. trouble falling asleep, staying asleep or fragmentation) has itself been related to higher risk of diseases [3].

Sleep is crucial for organisms to adjust to their surroundings and accordingly it is essential for the development and survival. It is characterized behaviorally as a physiological condition of rapidly reversible state of immobility, connected with characteristic posture, decreased motor actions and expanded threshold for external tactile stimulation [4].

Reaction time (RT) in simple words is a time taken by the individual to respond to the stimulus. RT task that includes visual reaction time can be used to test higher cognitive functioning among individuals [5]. For individuals concentration also we can go for RT task [5]. Whereas concentration is main factor for good results, while distraction from task may affect your results [6]. It has been stated that an individual who is deprived of sleep for longer duration, less likely to perform well and with consistent in a cognitive task such as RT task [7].

People deprived of sleep often tend to chronic fatigue [8]. Sleep deprived also result in work place injuries and poor mental health [9]. There are cohort studies also on large scale which established relationship between sleep deprivation and mortality [10]. This allows us to see whether there is any effect of sleep quality on muscle strength.

In this study we focused on understanding the link between sleep, muscle strength (handgrip) and visual reaction time (VRT). The purpose is to investigate the cross-sectional association between sleep quality and its effects on healthy individual by means of three parameters, the Pittsburgh Sleep Quality Index for evaluation of subjective sleep duration and quality [11], and handgrip strength using standard adjustable handgrip dynamometer and VRT using on-line reaction time [12].

Material and Methods

Subject Selection

73 healthy female participants (university students) from medical college were included into this study by cross-sectional design. Exclusion criteria for the study were any history of smoking or alcoholic habits, any orthopedic or neurologic diseases and respiratory diseases. A written consent was taken from all participants before commencement of the study. All the participants were assessed clinically through history taking and detailed clinical examination before the study. The study protocol was approved by the Institutional Ethical Committee on the use of Human as an Experimental Subjects and experiment conforms to the principles outlined by the Declaration of Helsinki protocol, 1964.

Experimental Design

Sleep quality was assessed using the Pittsburgh Sleep Quality Index (PSQI). It differentiates "good" from "poor" sleep quality by measurement of seven areas (components): subjective quality of sleep, latency of sleep, duration of sleep, efficiency of habitual sleep, disturbances in sleep, medications use for sleep, and dysfunction during daytime in the previous month. Grip strength was measured in the position; seated on chair with back support and arm rest, shoulder abducted, elbow 90 degree flexed, forearm and wrist in mid- position [13]. Hold the dynamometer by dominant hand. Instructor gave the instructions to squeeze around dynamometer as much as one can. Instructor was to stand in front of dentist to read the amount of force. We took handgrip measurements in kg unit as the subject squeeze around it. Visual reaction time (VRT) task included a set of traffic lights, when the light turned green the participant must hit a button to record their reaction time and must complete the task five times. After demonstrating the procedure, subjects were asked to respond to visual stimuli by pressing the response key with the index finger of their

dominant hand and five consecutive readings of stimulus were recorded. Average of the five recordings was taken as the visual response time of the subject.

Data Analysis

Statistical analysis was performed using R software (v. 3.2.5). All data are presented as mean ± standard deviation (SD) values. On the basis of sleep quality, individuals were divided in two groups: Good Sleepers and Poor Sleepers. Shapiro-Wilk test was used to check the normal distribution of the data. For comparison among the groups, t test was used to compare the normally distributed parameters and Wilcoxon test was used for parameters which are not normally distributed. $P<0.05$ was considered statistically significant.

Results

A total of 73 individuals were recruited in the study. These subjects provided sufficient sleep information on sleep duration & quality (with PSQI). Participants were categorized according to their sleep quality into two groups. Further, visual reaction time and handgrip strength were assessed to all the subjects.

The distribution of selected demographic parameters of the volunteers according to sleep duration along with quality is presented in Table 1. All the groups had similar characteristics in terms of age, height, weight and BMI.

Table 1: Baseline Demographic data of individuals characterized on the basis of sleep quality

Sr. No.	Parameters	Good Sleepers(N= 29)	Poor Sleepers (N= 44)	P-value
1	Age (in years)	19.07±0.96	19±0.91	0.6758
2	Height (cm)	159.47±3.94	158.07±4.94	0.1842
3	Weight (kg)	56.88±7.84	55.82±6.84	0.3039
4	BMI (kg/m^2)	22.34±2.72	22.34±2.52	0.9927

Values expressed in Mean±S.D; cm, centimeters; Kg, Kilogram; m=meters

Sleep quality, defined as a PSQI score i.e. Good Sleepers contain good quality with scores 3.14±0.99 and Poor sleepers had 7.45±2.57 score which shows the poor quality of sleep (Table 2). The mean sleep duration (S.D) in Good and Poor sleepers was 6.6±0.76 & 5.67±0.93 respectively.

Table 2: Comparison of PSQI parameters among two groups

Sr. No.	Parameters	Good Sleepers(N= 29)	Poor Sleepers (N= 44)	P-value
1	Total sleep Time (Hours)	6.6±0.76	5.67±0.93	2.97E-05
2	Global PSQI score	3.14±0.99	7.45±2.57	4.26E-13

Values expressed in Mean±S.D.

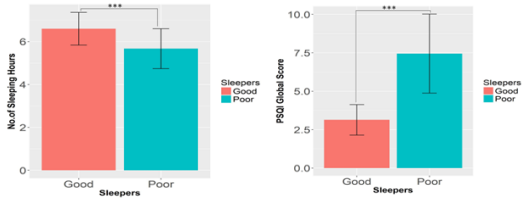


Figure 1: Total Sleep Time and Global PSQI score in Good and Poor Sleepers. *** p-value < 0.0001

Table 3 indicates that the Visual Reaction Time in Good Sleepers was low as compared to Poor Sleepers and showed statistically significant difference in between groups. There were no significant difference in Good and Poor Sleepers w.r.t. Handgrip Strength.

Table 3: Comparison of Visual Reaction Time and Handgrip Strength among two groups

Sr. No.	Parameters	Good Sleepers(N= 29)	Poor Sleepers (N= 44)	P -value
1	Visual Reaction Time (msec)	0.5±0.33	0.92±0.72	0.00793
2	Handgrip strength (Kg)	12.9±3.93	12.85±3.84	0.9594

Values expressed in Mean±S.D.; msec, millisecond; Kg, Kilograms

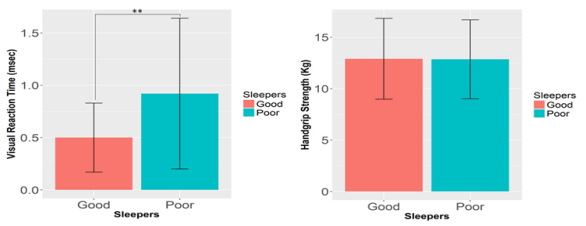


Figure 2: Figure 1: Visual Reaction Time and Handgrip Strength in Good and Poor Sleepers. ** p-value < 0.001

Discussion

In the present study, sleep quality was checked in 1st year female students of dental college using PSQI questionnaire and were divided into two groups (good and poor sleepers). Additional to this their visual reaction time and hand grip strength was measured using red-green online reaction time and handgrip dynamometer. Visual reaction time is used to test cognition and handgrip dynamometer is used to check muscle strength.

As now a day's young generation does not emphasize much on importance of sleep. It is been overlooked by them as how sleep build their body strong and healthy. Studying hard without sleeping day and night will wear out body energy and does not help you in getting good results. If you won't sleep, recovery won't be possible. Slow wave sleep, the time when you are in deep sleep, is the time when your important hormones that control metabolism and muscle growth are secreted [14]. It is also been seen that most pronounced physiological changes occur in brain during sleep [15]. Our study didn't show significant effect of sleep quality on muscle strength as the quality of sleep we checked may be affected only for one month as per PSQI questionnaire. And as per the process of aging their current age comprises of maximum of physical activity and after 30th decade there is decrease in muscle mass and strength is seen [16,17]. In a study it has been seen loss of peripheral muscle strength due quality of sleep but in patients of Chronic obstructive pulmonary disorders (COPD) [18]. Also they are young healthy adults and to look for decrease in muscle strength in a month is difficult.

Visual reaction time showed significant difference in between the two groups i.e. good and poor sleepers. Poor sleepers have significantly increased visual reaction time than good quality of sleepers. When there is lack of sleep or not sufficient sleep, we feel sleepy, physically drained and unfocused. Sleep proven to be important for sustaining normal function and complex cognitive process. Cognition involving human is a complex process focusing on various aspects like sensory, visual and emotional perception. And without some degree of physical alertness and attention it is difficult to engage in complex cognitive process. It is been observed that if continuous wakefulness pushed beyond 16 hours, individuals start showing slow reaction time and poor psychomotor vigilance [19]. Lim and Dinges, 2008 also noted worsening of reaction time during the psychomotor vigilance task (PVT) [20].

Conclusion

The present study revealed that loss of sleep or poor quality of sleep has major impact on prolongation of visual reaction time among 1st year students of dental college. The most important goal of these findings was to bring awareness that lack of sleep is a major health problem that needs to be addressed by every organization. It appears to have both global and specific effects on cognitive changes involving human brain.

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