Orginal Research: A Correlation of Quality of sleep with Physical fitness, Balance, and Attention among young adults

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Abstract
Problem: Adequate sleep is utmost necessary and important for normal physical growth and emotional stability.30% of adults suffer from sleep issues as estimated by The National Commission on Sleep Disorders Research estimates. So, the aim of the study was to find relationship between sleep quality, physical fitness, attention, and balance among young adults.**Approach**: A cross-sectional study of 130 young adults with age group of 18 to 24 was conducted at various colleges and individuals responded to Pittsburgh sleep quality index for quality of sleep, Trial making test for attention and performed Flamingo test for balance and Queens College step test physical fitness. **Finding**: Spearman correlation co-efficient was used for analysis which showed that the quality of sleep had a correlation with attention and balance with p value <0.01 but not with physical fitness. **Conclusion**: Sleep quality affects the balance and attention of the young adults and thus sleep quality should be a part of physiotherapy assessment and rehabilitation and young adults should be made aware about the importance of quality of sleep and its effects.
Key words: 1.Attention, 2.Physical fitness, 3.Sleep quality, 4.balance, 5.young adult

Introduction

Sleep disorder is an emerging public health problem. If there is any deficiency in either quality or quantity of sleep it is considered as a sleep disorder. Despite the overwhelming consensus that both sufficient sleep and adequate exercise are pivotal in maintaining health, these behaviours are often deprioritized within the typical current lifestyle. For example, the Centers for Disease Control and Prevention estimated that sleep of nearly one-third of adults is less than the recommended seven hours per night which is needed to maintain optimal health. A larger sleep deficit is also observed in teenagers: roughly two-thirds of high-school students, who are advised to sleep eight to ten hours, sleep less than eight hours during working days in school .[1)]

It is estimated that globally 25%–30% of adults suffer with at least one of the sleep disorders. According to The International Classification of Diseases-10 sleep disorders are classified into six symptoms based on major categories, namely insomnia, hypersomnia, sleep-related breathing disorders, parasomnia, circadian rhythm sleep disorders and sleep-related movement disorders.[2]

Sleep disorder over short duration leads to difficulty in concentration, flawed judgement, poor memory, psychological stress and deficient problem-solving skills. Due to this condition in the long run it leads to the development of various non-communicable diseases such as hypertension, diabetes mellitus, cardiovascular diseases, kidney disease and suicidal tendencies. Despite of adverse effects of sleep disorders on health, there is a lack of advocacy for prioritizing sleep disorders as an emerging public health problem in developing countries.[2] Recently, a study by Cocca, Liukkonen, Mayorga-Vega & Viciana-Ramírezet.al, revealed that great attention has been put in promoting physical activity and physical fitness, in order to improve sleep quality. The population group of young adults, compared with children and adolescents, generally does not meet the recommendations for physical activity and fitness levels which could potentially lead to sleep consequences.[3] Furthermore sleep disturbances were also found to cause emotional disturbances and behavioural problems.

Physical fitness is the ability to achieve certain performance standards of physical activity and it's the outcome of habitual physical activity or exercise. Higher level of physical fitness delays all-cause mortality primarily due to lowered rates of cardiovascular diseases . According to **A.J.Y.LEE et.al,** Evaluating the physical fitness among young adults and late adolescents is relevant because low levels of physical fitness may underlie the potential of several health problems in the later adulthood. A recent study by **M**

Guszkowska et.al , also demonstrated that physical fitness may also be important resource helping students to cope with stress.
Balance is a fundamental skill required for human being to perform most of our daily-life activities. Balance is a complex integration of the central nervous system with the visual, the vestibular, the proprioceptive and the musculoskeletal systems. In normal standing, balance of a person is achieved by constantly reconfiguring ground reaction forces under the feet to counteract the sway of the body. Acute sleep deprivation affects posture control during quiet standing (known as static balance).[5] According to the study by **Rébecca Robillard et.al**, sleep pressure has a destabilizing effect on postural control independently of circadian factors, therefore suggesting that sleep debt may be a significant risk factor for falls.[6]

Attention is an essential cognitive process for various performance tasks. According to Rafal and Posner model, modified by Valdez et al. , attention is defined by four components: 1 - tonic alertness, which is the ability to respond to the environment at any time; 2 - phasic alertness, which is the ability to respond to a stimulus after an alert signal; 3 - selective attention, which allows the individual to respond to a specific stimulus while ignoring others; and 4 -vigilance (sustained attention), which is the ability to maintain attention for a period of time. the use of electronic media at night may promote suppression of melatonin secretion and a delay in circadian rhythms caused by blue light emission from these electronics devices, as well as an increase on physiological arousal caused by its use, causing more excitatory stimuli to the central nervous system at night. This causes alteration in attention and study by**Haraszti RÁ,** sleep irregularity was associated with lower cognitive performance and academic achievement in high school students[23] and negatively correlated with academic performance in undergraduates.[7]

So from the above literature, there becomes a strong need to find out whether the quality of sleep has any direct relationship with all the components or not and thus the aim of the study is to find the correlation of quality of sleep with attention , balance and physical fitness in young adults.

Methodology

The study was an observational cross-sectional study conducted in 2023. Data of 130 young healthy adults with the age group of 18years to 24 years were collected from the various colleges in and around Rajkot. The sample size was calculated using SAMPLE SIZE V2 calculator software. Both male (69) and female (61) were included. Subjects who had any recent injuries, neurological disorders, musculoskeletal disorders, chronic illness or any head injuries. [8] The subjects were explained in detail about the procedure, purpose of the study and thereafter written consent were signed by the subjects. The ethical clearance was given by Saurashtra university ethical board.

Quality of sleep: The subjects filled up the The **Pittsburgh Sleep Quality Index** (**PSQI**) for quality of sleep. Itwas a self-report questionnaire and consisted of 19 individual items, creating 7 components that produce one global score, and takes 5–10 minutes to complete. The component scores consisted of subjective sleep quality, sleep latency (i.e., how long it takes to fall asleep), sleep duration, habitual sleep efficiency (i.e., the percentage of time in bed that one is asleep), sleep disturbances, use of sleeping medication, and daytime dysfunction.

Each item was weighted on a 0–3 interval scale. The global PSQI score was then calculated by adding the seven component scores, providing an overall score ranging from 0 to 21, where lower scores denoted a healthier sleep quality.Traditionally, the items from the PSQI had been summed to create a total score to measure overall sleep quality. The scale has a good content and construct validity and adequate test-retest reliability Conbrochas alpha greater than or equal to 0.7.

Physical fitness: Queens college step test was used to measure the aerobic fitness. The test procedures were explained to the subjects. The subject had to step up and down on the platform at a rate of 22 steps per minute for females and at 24 steps per minute for males. The subjects had to step using a four-step cadence, 'up-up-down-down' for 3 minutes. The subjects stopped immediately on completion of the test, and the heart beats were counted for 15 seconds from 5-20 seconds of recovery. Then the 15 second readings had to be multiplied by 4 which gave the beats per minute (bpm) value to be used in the calculation.

An estimation of VO_{2max} was calculated from the test results, using this formula (McArdle et al.,1972). A rating was determined using the VO_{2max} norms.

men: VO_{2max}(ml/kg/min) = 111.33 - (0.42 x heart rate (bpm))

women: VO_{2max}(ml/kg/min) = 65.81 - (0.1847 x heart rate (bpm))

Test re-test reliability for recovery heart rate was excellent r = 0.92 and validity between recovery heart rate and VO_{2max} was also good r = -0.75.[9]

Attention: Executive functions of the subjects were assessed using Trial making test. The Trail Making Test (TMT) has two parts and the times taken to complete each part were used to measure central executive functioning. In Part A (TMT-A), the subjects had to draw a line to connect consecutive numbers, from 1 to 25. In Part B (TMT-B), the subjects had to connect numbers and letters in an alternating progressive sequence, 1 to A, A to 2, 2 to B, and so on. Thus, to measure central executive functioning, the difference in time taken to complete TMT-B, which stresses central executive processes of task-set inhibition, cognitive flexibility, and the ability to maintain a response set, and the time to complete TMT-A, which has little executive input, was calculated.[10] Retest reliability of TMT-A was between 0.76 and 0.89 and TMT-B was 0.86 to 0.94.[11]

Balance: Flamingo balance test was used to measure balance of the subjects. The detailed procedure of how to perform it was first explained to the subjects. Prior to the test a warm up session was given. it included mild jogging. Than the subjects had to stand on the beam with shoes removed. Subjects had to Keep balance by holding the instructor's hand. While balancing on the preferred leg, the free leg was flexed at the knee and the foot of this leg was held close to the buttocks. As the instructor let's go the time duration was noted and each time the person loses balance (either by falling off the beam or letting go of the foot being held) the stop watch was stopped. Again, the subjects had to Start over, and timing until they lose balance was noted. the number of falls in 60 seconds of balancing were counted. If the number of falls were more than 15 falls in the first 30 seconds, the test was terminated and a score of zero was given.

Stastical tests

The statistical analysis was done using SPSS software version 26. The normality of the data was checked using Kolmogrov-Smirnov and data did follow the normal distribution, so Spearman Corelation coefficient was used to find the correlation of physical fitness , attention, balance and quality of sleep.

Results

The results were derived from data of 130 subjects. The mean and standard deviation of variables are given in table 1.1. The results suggest that the quality of sleep had a correlation with attention and balance with $p<0.01$ and so altered sleep affects attention and balance of young adults as shown in graph 1.1, 1.2 respectively . Vo2max did not correlate quality of sleep as shown in graph 1.3 and so the quality of sleep does not affect the physical fitness directly in the young adults.

Discussion

The study aimed to find the correlation of quality of sleep, attention, physical fitness, and balance in young adults and the results suggested that there is a correlation of quality of sleep with attention and balance and not with physical fitness. Adolescents undergo several physiological and behavioural changes with puberty onset and One of them ischanges observed in the sleep-wake cycle pattern, which is manifested by a phase delay, when bedtime and wake up time occurs later. This variation that occurs in sleep-wake cycle occurs as a consequence of modifications in the mechanisms that regulate sleep and in the psychosocial context.[12] Tonic alertness is the responsiveness to the environment at any time and is related to the ascending reticular activating system which may be linked to the homeostatic component of sleep. Thus, deprivation of sleep and poor quality can interfere with this component of attention.[13] Phasic alertness is the ability to respond to a stimulus after a warning signal, while selective attention allows the individual to respond to a specific stimulus while ignoring others, and sustained attention is the ability to maintain attention for a period of time.[14] All of these components are related to the prefrontal cortex , an area that is also negatively affected by sleep deprivation and sleep quality. Poor sleep quality was associated more strongly with a negative effect in cognition than sleep loss.[15] According to ivan**esaú pinto vargaset**.al, sleep deprivation deteriorates the sustained attention when it is required for the adults to maintain that for longer period of time which supports the result of our study that . [16] According to **Fernanda Mayara Crispim Diogo** et.al, the High school adolescents have worse sleep quality and poorer performance on the cognitive task that evaluated attention as compared to young adults . Though the results are not in support of our study but yet it says that quality of sleep do affects attention.[7]

During quiet standing, human balance is achieved by constantly reconfiguring ground reaction forces under the feet to counteract the sway of the body. According to **Luis Montesinos,et.al** , changes in sleep quality and pattern over consecutive days may affect balance and The results of the present study also showed that quality of sleep affects the balance of the young adults .[5] The neural mechanism behind this can be explained as both vigilant attention and the visual system are affected by sleep deprivation. Both have also been found to play an important role in postural control and thus affects the balance of an individual.[17]**Guilherme Silva Umemura**1, et,al, also suggested that sleep conditions of a subject should be considered for several days prior to balance control tests. This balance control relies on visual, proprioceptive and vestibular information. While vision is the most important, the removal of any of them compromises balance. In this respect, sleep deprivation affects the metabolism of the thalamus, cerebellum and basal ganglia, affecting sensory integration and motor coordination, and, therefore balance. This would explain the more marked balance performance decrease under Sleep deprivation when eyes are closed.[18]

As discussed above the quality of sleep affects the cognition , attention in particular of the young adults and according to **Beibei Shi**et.al, different modalities of acute exercise influence cognitive flexibility in high- and low-aerobic fitness young adults differently. So majorly, the results provide new evidence that aerobic fitness and exercise modalities together modulate the effects of acute exercise on cognitive flexibility in young adults. College students who are doing exercise are advised to take their fitness level into account when choosing the type of exercise that is most time-efficient and maximizes cognitive ability.[19] So it can be concluded that quality of sleep alters the cognition and cognition is improved with improved physical fitness. Thus, indirectly the quality of sleep may be affecting the physical fitness of an individual but there is no direct correlation of quality of sleep with physical fitness in young adults.

There are some limitations in the study that balance as a whole is considered here for the measurement. The gender specific variations in the attention and balance of girls and boys are not considered here as in the young adult age group there may be various hormonal changes in the male and female which might affect the sleep regulation system of the body.

So, the future studies can focus on whether the quality of sleep affects static and dynamic balance in the same way or is there any difference. Also gender specific measurements can be done whether there is any specific gender effects of quality of sleep on the above factors.

Conclusion

Thus, it can be concluded from the results of the study that quality of sleep affects the balance and attention of the young adults but do not directly affect the physical fitness of the young adults. Thus, the burdensome of the current scenario of increased stress level, improper food habits and unscheduled work cycle of the adults leads to sleep disorders and thus impair their attention and thus ultimately performance.

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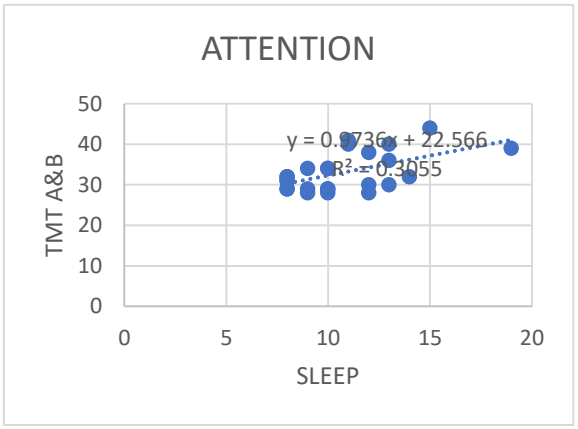
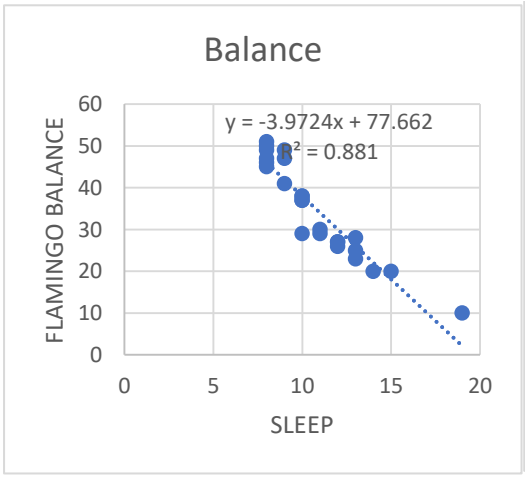
Variable	Mean	Standard Deviation
Age	21.9	2.3
Vo2max	61.93	13.76
Trial Making Test	32.5	7.30
Pittsburgh sleep quality index	11.18	2.49
Flamingo balance test	33.03	10.76

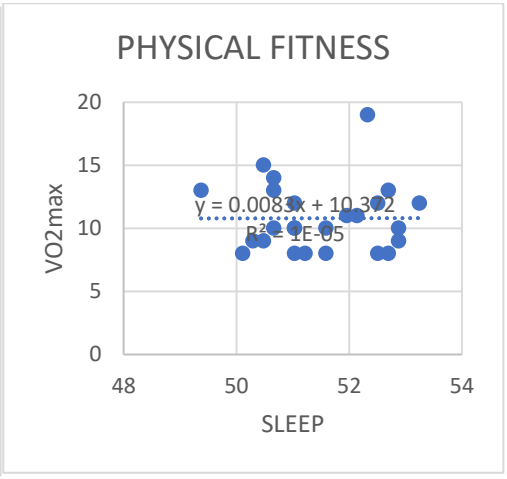
Table 1.1



Graph 1.1



Graph 1.2



Graph 1.3