RESEARCH ARTICLE

TIME OF SLEEP AND MEMORY STRENGTH AMONG SAUDI PEOPLE: EXPLORATORY STUDY.

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Manuscript Info	Abstract
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People in Saudi Arabia and the Gulf region are known for their preference of evening mingling and late-night trips, which may have negative effects on health. In this study, the main objectives were estimating the prevalence of daytime sleeping, and exploring the effect of sleep timing on memory strength. Whereas the specific objectives were assessment of the strength of memory of participants, and comparing the memory test scores between those who sleep at daytime and those who sleep at night. Online Google form was posted from July – December 2018. It was consisted of three parts, and 10-item Rasch modeled memory self-efficacy scale was used to evaluate the memory strength. It was found that daytime sleepers were males more than females, older and married more than night sleepers. As will, daytime sleepers were less educated, less economic status, and had more family history of Alzheimer's disease than night sleepers. Also, it was found that the prevailed reason among daytime sleepers was mainly due to work, followed by preferring night time. Furthermore, feeling lazy was more among people who sleep at night. These differences between the two groups were significant at 95% confidence interval. Moreover, it was found that score of memory test was higher amid night sleepers; nonetheless, the prevalence ratio between low versus med/high memory levels, among daytime and night sleepers was less than one. So it can be concluded that time of sleep does not associate with memory strength.

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Introduction:-
The sleep–wake cycle, is driven by a circadian timing system which is influenced by factors such as school and work schedules, physiological function and other factors. A study of healthy persons showed that sleepiness may have a significant adverse influence on general health and quality of life. (Abdulghani et al, 2012)

Sleep plays an important role in the consolidation of memory. This most clearly shown in adults for both procedural memory (i.e. skills and procedures) and affirmative memory (e.g. recall of facts). (Potkin & Bunney, 2012) Sleep cycle consists of rapid eye movement (REM) and non-rapid eye movement (NREM). 20–25% of total sleep each night for REM sleep, in which dreaming occurs, that is important for consolidating emotions, memories and stress. Also, it is important for learning, arousing the brain regions used in learning and developing new skills. While NREM sleep occupies 75–80% of total sleep per night. In this phase, growth and tissue repair occurs, also energy is

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restored and hormones are released. (Morselli et al, 2010) The National Sleep Foundation recommended that, for healthy people with normal sleep, 8 to 10 hours was considered appropriate for teenagers, 7 to 9 hours appropriate for young adults and adults, and 7 to 8 hours of sleep was enough for old people. However, sufficient sleep duration vary from person to person. (Hirshkowitz et al, 2015) Adequate sleep is important for a healthy lifestyle, and can affect vital body systems. Also, may affect mind, weight and more. (Mograss, 2008) According to several epidemiological studies, the risk of all-cause mortality occurs among people was with long duration of sleep ($\geq$8 hours sleep daily) and short durations of sleep (<7 hours sleep daily). (Ahmed et al, 2017; Lauderdale et al, 2008) A study showed that the long sleepers, failed to show significant recall of the old/studied items. Correlation Coefficient revealed a significant negative correlation between accuracy and sleep duration in the short sleepers. While long and average sleepers showed a positive correlation between the two variables. (Mograss et al, 2010)

Also differences in sleep pattern among healthy adults had been investigated. (Mograss et al, 2010) Moreover, an important parameter involved in how to sleep well is the time of going to sleep. An interesting theory said that from sunrise to sunset, positive frequencies are moving in the atmosphere. After sunset, distressing frequencies start moving in the atmosphere. (Gupta, 2015) Population-based studies found that 1 in 5 adults suffers from daytime sleepiness, but there is a lack of consistency in how daytime sleepiness was defined, measured, and interpreted, which may affect the medical management of the disorder. For example, many measures of sleepiness based on sleep tendency and falling asleep tend to overlook patients with insomnia and sleepiness. Daytime sleepiness, or difficulty in sustaining a desired level of wakefulness, is oftentimes viewed by the general population as a common experience and predictable consequence of insufficient sleep. Yet, daytime sleepiness can have a serious impact on health, safety, and quality of life. (Young, 2004)

In this current study, prevalence of daytime Saudi sleepers was explored and effect of daytime sleeping on memory strength was investigated.

1.2 Objectives
Therefore, the main objectives of this study were estimating the prevalence of daytime sleeping, and exploring the effect of sleep timing on memory strength. Whereas the specific objectives were evaluation of the strength of memory of participants and comparing the memory test scores between those who sleep at daytime and those who sleep at night.

Methodology:-
2.1 Eligibility
Eligible persons for this study were Saudi people who lived in Saudi Arabia, and aged 19-53 years old.

2.2 Memory Scale
10-item Rasch modeled memory self-efficacy scale was used to evaluate the memory strength. The original scale was in English, but it was translated into Arabic language. The Arabic scale was used before in case-control study in Jordan in 2018, to evaluate the memory strength of participants. (Al-Ajlouni, 2019)

2.3 Data Collection
The online Google form was posted from July – December 2018. The used questionnaire was consisted of three parts. The first part was about the demographic characteristics, the second part was about sleeping, while the third part was about memory strength. The latter had a test consisted of 10 questions.

Results:-
The sample of the current study was consisted of 516 participants. However 18 participants were excluded for honesty issue and contradiction answers. 63.86 % of the sample was females, while 36.14% were males. Moreover, 61.90 % of the daytime sleepers were males, while 72.58% of night sleepers were females; additionally, 43.37% of the participants were 31-40 years old, followed by 37.35% were 25-30 years old; and 78.11% of them were more than secondary education while 4.82% of them had primary education. Also, 63.86% of the participants were married followed by 31.33% were singles; and according to self-evaluation of economic status of the participants, it was found that 55.42% of the sample had good economic status followed by 30.32 % were "very good", while 2.41% of them had bad or not good economic status.

Table 1:-Distribution of sleep time of Saudi people, in 2018

Sleeping time		F	%	Total percent	
Morning	(Dawn-midday)	102	20.48	25.30 %	Daytime
Noon	(After midday- Asr prayer)	6	1.20		
After noon	(After Asr prayer-Sunset)	18	3.61		
Early night	(After sunset-Isha prayer)	6	1.20	74.70 %	Night
Night	(After Isha prayer-midnight)	84	16.87		
After midnight	(After 12 am – Fajir prayer)	282	56.63		
Total		498	100.00		

With respect to sleep time, as shown in above table 1, it was found that 56.63 % of the participants went to sleep after midnight, followed by sleeping at morning then night, 20.48% and 16.87% respectively. In general, those who sleep at daytime found to be 25.3%. The reason of sleep in such time was mainly due to work followed by love night time, 76.19 % and 19.05% respectively. Furthermore, percent of daytime sleepers was more among males (61.90%) than females (38.10%). On the other side, percent of night sleepers was more among females (72.58%) than males. The differences were significant at 95% confidence interval. The computed chi-square statistic was 48.4969 and the p-value was < 0.00001.

Among age groups it was found that 52.38% of daytime sleepers were 31-40 years old, while 41.94% of night sleepers were 25-30 years old followed by 31-40 years old (40.32%). At 95% confidence interval, the differences between daytime and night sleepers were significant. The chi-square statistic was 31.6566 and the p-value was < 0.00001.

Regarding level of education, three quarters of the participants were "higher than secondary" education. However, "more than secondary level" was 61.90% among daytime sleepers versus 80.65% of night sleepers. Also, 6.45% of night sleepers had primary education. These differences were significant at 95% confidence interval. The computed chi-square statistic was 18.0729 and the p-value was 0.000021.

For marital status, 80.95% of the daytime sleepers were married versus 59.68% of night sleepers were married. On the other side, 19.05% of daytime sleepers were single versus 35.48% of night sleepers were single. These differences were significant at p-value 0.0006, and the chi-square statistic 11.82. The confidence interval was 95%. Further, among daytime sleepers, 66.67% had good economic status, followed by those who had very good economic status (14.3%); nevertheless few had excellent status (4.8%). While among night sleepers, 51.6% had good economic status, then very good status (35.5%), whilst 8.1% of them had excellent status. These differences were significant at p-value < 0.00001, and the chi-square statistic 36.2. The confidence interval was 95%.

Table 2:-Distribution of period of sleeping hours of Saudi people in 2018

Average duration of Sleeping	Sample		Daytime		Night	
	F	%	F	%	F	%
Less Than 5 Hours (short period)	42	8.43	12	9.52	30	8.06
5- 7 Hours	264	53.01	72	57.14	192	51.61
More Than 7 Hours (long period)	192	38.55	42	33.33	150	40.32
Total	498	100.00	126	100.00	372	100.00

In regard to sleeping duration, as shown in the table above, it was found that (53.01%) of the participants sleep "5-7 hours", while 8.43% sleep short period (less than 5 hours). The differences between morning people (i.e. sleep at daytime) and night people (i.e. sleep at night) was examined. It was found that with 95% confidence interval, the chi-square statistic was 5.5563 and p-value was 0.062153. Therefore, the differences were not significant.

For Laziness from time to time, it was found more among morning people while much laziness was more among people who sleep at night, 80.95% and 20.97% respectively. The differences were significant with 95% confidence interval. The chi-square statistic was 18.7616, and the p-value was 0.000084.

Regarding family history of Alzheimer's disease, the majority of the sample did not have family history of Alzheimer disease. On the other hand, 21.69% of the sample had family history. Alzheimer's family disease history

was more among daytime sleepers (23.81 %) than among night sleepers (20.97 %). The differences were significant with 95% confidence interval, in which the chi-square statistic was 15.0998 and the p-value was 0.000526.

With respect to assessment of memory strength of the participants, it was found that the average scores of all ten questions of daytime sleepers were lower than of night sleepers except for memorizing faces and directions (see table 3 below). As well, the average of total scores of all the ten questions of memory test among daytime sleepers was lower than among night sleepers. However, chi-square was 0.531669 and the P-value was 0.99996. Therefore, with a 95% confidence interval, the differences were not significant. Surprisingly that when the scores of memory strength were categorized into low, medium and high (as in table 4 below), it was found that those with low memory constituted 4.76% of daytime sleepers versus 11.29% of night sleepers. On the far side, for those with high memory scores constituted 38.10% of daytime sleeping versus 35.48% of night sleeping participants. The chi-square statistic was 4.6058 and the p-value was 0.099969. The differences were not significant at $p < .05$. However, when re-categorized the participants into low memory and med/high memory the differences became significant at p-value 0.031864 and chi-square statistic 4.6058.

Table 3:-Distribution of average scores of 10-memory test questions among Saudi people, 2018

10-memory test	Daytime	Night
A1. Overall assessment of your memory status?	4.35	4.89
A2-1. Problems with names?	4.05	4.61
A2-2. Problems with faces?	5.96	4.91
A2-3. Problems with where you put your key or likewise?	3.61	4.50
A2-4. Problems in directions?	5.49	5.32
A2-5. Problems with remembering what are you doing?	4.57	5.34
A3-1. Remembering the paragraph before your last reading paragraph?	4.31	5.21
A3-2. Remember the sentence before your last reading sentence?	3.75	5.46
A4-1. Remember things happened before 1-5 years left?	4.67	5.34
A4-2. Remember things happened before 6-10 years left?	3.69	4.60
Total scores	**44.44**	**50.19**

Table 4:-Distribution of memory test score categories among daytime and night sleeping time, among Saudi people

Memory scores	Daytime		Night	
	F	%	F	%
Low (total score is less than 30)	6	4.76	42	11.29
Medium (total score is 30-50)	72	57.14	198	53.23
High (Total score is more than 50)	48	38.10	132	35.48
Total	126	100.00	372	100.00

At last, it was found that prevalence of low memory strength was lower in those with the exposure to daytime sleeping (see table 5 below). Along, the prevalence ratio between the latter categories (i.e. low, med/high) among daytime and night sleepers was (6/126) / (42/372) = 0.422.

Table 5:-Prevalence of low memory among Saudi sleepers at daytime and night, 2018

	Low	Med/high	Total
Daytime	6	120	126
Night	42	330	372
Total	48	450	498
Prevalence ratio = (6/126)/(42/372)= 0.42176871			

Discussion:-
The study sample consisted of 498 participants, about two third of them were females. According to Saudi General Authority for Statistics, in 2017, Saudi citizens consisted of 50.94% males versus 49.06% females. (GASTAT, 2017) These percentages compared to percentages of this study were non identical, because generally online sample

is not representing all Saudi citizens. Also, more than three quarters of the sample were "more than secondary" educated. This is consistent with the fact that the literacy rate is 98 % among persons between 15 and 24 years of age, (Fanack, 2018) and only 13.4% of Saudis in 2017 were without educational qualifications. (GASTAT, 2017) For marital status, more than of two third of the sample were married, and 45.8% of the sample were less than 31 years old. This is consistent with Population Characteristics of Survey 2017, which found that 97.01% of Saudis got married between 15-30 years old. The highest percent of marriage was at age 20 (11.086%) followed by almost similar percentage at age 21 and age 17, 10.835% and 10.331% respectively.

For economic status, Self-evaluation was used. This was a good method to avoid non-response or false information from some participants because income is not only sensitive issue, but also does not take into account if it is enough with respect to family size and financial commitments. It was found that more than half of the sample had good economic status. According to the Saudi labor market bulletin of the second quarter of 2018, the average monthly wage of Saudi workers in the four sectors (public, private, non-profit organizations, international and regional agencies) and other sectors was (10.238) SAR. This was measured based on estimating the average wages of both males and females Saudi workers in the above mentioned four sectors, in addition to the wages of workers in other sectors which were taken from the field survey that GASTAT conducted quarterly by asking households about their monthly wages. It should be taken into consideration that these salaries differ from the salaries registered in the administrative records, where the monthly salary may not include any related allowances or bonuses. However, the average salary of Saudis (males and females) who work in these sectors registered (11.198 SAR) in the public sector, (7.339 SAR) in the private sector, (4.750 SAR) at non- profit organizations, and (16.257 SAR) in other international and regional agencies and sectors. As for the difference between figures issued by GASTAT and the figures issued by other entities such as GOSI (i.e. General Organization for Social Insurance), the figures issued by GOSI represent the basic salary average registered by the employer. They do not include allowances, compensations, or bonuses. (GASTAT, 2019) it is worth to note that in 2011, the unemployment rate in KSA was officially 10.5 % and the rate among women was 29.6 %. However, in 2012, the Central Department of Statistics and Information released a survey on unemployment among Saudis over 15 years old: it was found to be generally 12.2%, with 6.6% among men and 34% among women. Also, they found that the service sector employed the highest proportion of Saudis, at 28%, and the lowest proportions (less than 5%) were found in managerial positions, clerical work, agriculture, fishing, and industry. (Fanack, 2018)

Regarding to the family history of Alzheimer's disease among Saudi community, there are no official statistics on the spread of Alzheimer's disease, but specialists estimated that there are at least 50 thousand patients in the KSA, most of them are women. (MOH, 2013) When the Saudi population is 20,271,058 –as in the year 2013- (GLMM, 2015) this implies that the prevalence of Alzheimer's disease would be at least 2 – 3 per 1000 persons. This estimation is lower than the prevalence of the disease in USA. In the year 2018, 5.8 million had Alzheimer's disease (out of 327.2 million populations in USA). (Alzheimer's Association, 2019; BrightFoucus, 2019) This implies that the prevalence of Alzheimer's would be 17 – 18 per 1000 persons. Moreover, the estimated prevalence of Alzheimer's disease in KSA is much less than that found in the current study (21.69%). This could be due to misunderstanding of the definition of Alzheimer's disease. Some people call any old person who suffers from degradation of memory as "Alzheimer's patient". Participants assumed theoretically that they are Alzheimer's cases but may not be clinically confirmed; or maybe they got confused between Alzheimer's disease and dementia. Alzheimer's disease and dementia are two terms that are often used interchangeably as many persons believe that dementia means Alzheimer's. (Graff-Radford, 2018) A Saudi cross-sectional study consisted of 171 Saudi patients with age 67 ± 6 years, found that the prevalence of cognitive impairment was 45% and the prevalence of dementia was 6.4%. (Alkhunizan, 2018) This implies that if the population of age 60 or more were 1,333,615 (as in the year 2017 in KSA), then 85,351.36 of them would have dementia (i.e. 6.4%). Therefore, based on finding of Alkhunizan's study, prevalence of dementia would be 4 per 1000 of Saudi population.

Furthermore, this current study found more than half of the participants sleep 5-7 hours on average and sleep after midnight. This is consistent with a study conducted by the research center at King Fahd Medical City which revealed that 41% of Saudis suffer from sleep disorder. Participants were on average 34 years old and 55 % of them were women, who suffered sleep disorders more than men. Their marital status and educational level did not have any effect on their sleep disorder. King Fahd Medical City study found that more than half of the participants sleep less than six hours every day, and most of them sleep late at night. Also, found that non-workers had more sleep disorders than working people (Al-Tanayyur, 2016). Likewise, a Saudi study found that one-third (33.8%) reported short sleep duration of less than 7 hours/night, and was more prevalent in females. (Mograss, 2008) Besides, a 2015-

report from the app Sleep Cycle placed Saudi Arabia second – after Japan – in the list of the world's five worst countries for average sleeping hours. According to the (Sleep Cycle) report findings, short sleep duration was more prevalent among females. (Khaishgi, 2019) Anyhow, sleep requirements fluctuate slightly from person to person, most healthy adults need between 7 to 9 hours of sleep per night to function at their best. But not only gaining enough each night, but also gaining good-quality sleep. (Taylor, 2017; Smith & Segal, 2018) There's no ubiquitous definition for sleep quality. Nonetheless, it may be defined as how long it takes to fall asleep, how often wake up during the night, or how rested person feel day after. (Taylor, 2017) There is a big unlikeness between the amount of sleep hours and the amount need to function optimally. Nevertheless, it is known that both good quality sleep and adequate amount of sleep are important in order to have better cognitive performance and avoid health problems and psychiatric disorders. (Giri et al, 2013)

As well, this current study found males sleep at daytime more than females. This is comply with findings of cross-sectional survey of 1035 high school students, ages 14 to 23 years, in Jeddah city, revealed that students slept an average of 7.0 hours on school nights, and around 1 in 10 students stayed up all night and slept after returning from school on weeknights. This pattern was more prevalent among boys than girls and students with lower GPAs. (Merdad et al, 2014) The common reasons for the delayed sleep usually studying; get along with friends, late night TV watching, and video games internet. Studies reported that watching television lately reduced not only the total sleep time, but also delayed bed time and therefore difficulty in waking up. (Mishra et al, 2017) Moreover, the Köppen climate classification classified the climate in Saudi-Arabia as BWh climate (i.e. a dry desert climate). With the exception of the province of Asir on the western coast, Saudi Arabia characterized by extreme heat during the day and very low annual rainfall. The average summer temperature is about 45° C, but may reach up to 54° C. (Peel et al, 2007). As a result, many shops and private enterprises open after 2 or 4 p.m. consequence, workers at those places can wake up late.

For insomnia at this study, the prevalence among daytime sleepers was low (4.76%). It is generally believed that 10% to 15% of the adult population suffers from chronic insomnia, and an additional 25% to 35% have transient or occasional insomnia. Prevalence estimation varies because of inconsistent definitions and diagnostic criteria of insomnia. (Doghramji, 2006)

In regard to the scores of "10-item Rasch modeled memory self-efficacy scale", it was found that scores were lower among daytime sleepers for all questions except for remembering faces and place directions (i.e. QA2-2, QA2-4), but this difference was not statistically significant. Also, it was found that differences were significant between low memory levels versus mid / high level. These findings supported by a case-control study applied in Jordan in which cases were 98 participants sleep at daytime (i.e. from sunrise to sunset; while controls were 120 participants sleep at night (i.e. after sunset till the dawn). It was found that the average scores of each of all ten questions for cases were lower than the average scores of the controls. Along, the average of total scores of all questions of memory test among the cases was lower than the average total scores among the controls. Yet, the differences were not significant. But when the scores of memory strength were categorized into low, medium and high, the differences of memory strength categories among cases and controls turned to significant. (Al-Ajlouni, 2019)

At last, the aim of computing prevalence ratio (PR) was to measure the association of time of sleep and strength of memory by quantifying the relationship between sleep timing and low memory. So, based on the computed PR (i.e. 0.4 –in table 5-), it can be concluded that time of sleep does not associate to memory strength. This is comply with a cross-sectional study in Morocco which was conducted on 457 medical students from the Faculty of Medicine and Pharmacy, aimed to determine the quality of sleep and excessive daytime sleepiness, respectively. It was found that daytime sleepiness was not statistically associated with academic performance. (El Hangouche et al, 2018) Other study found that irregular sleep and light exposure patterns among college students were associated with delayed circadian cycles and lower academic performance. (Phillips et al, 2017)

Daytime sleeping may affect the mood as shown in a study published in Springer's Cognitive Therapy and Research Journal which found that "night" people who went to bed later had more negative thoughts than "morning" people who went to bed earlier**.** (Faith, 2019) Another study revealed that Japanese workers who went to bed later showed more depressive symptoms than those who went to bed earlier; other study found that "morning" people may avoid mental illness. (Faith, 2019) light exposure in the morning has been reported to be effective for depressed patients and seasonal affective disorder. (Kohyama, 2007) Anyway, Harvard researchers found that not staying up late or

sleeping in is not the problem, but irregular sleep patterns are. Irregular sleep patterns were associated with poorer performance and productivity. (Faith, 2019)

Conclusion:-
In general, one quarter of the participants sleep at daytime, mainly due to work followed by fond of night time. Scores of memory test were lower among daytime sleepers for all questions except for remembering faces and place directions, but this difference was not statistically significant. Nonetheless, differences were significant between low memory categories versus mid / high category. However, computed Prevalence Ratio was less than one, therefore, it can be concluded that time of sleep does not associate with memory strength.

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Conflicts Of Interest
The author declares no conflict of interest. Financial disclosure: none.

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