European Journal of Molecular & Clinical Medicine

ISSN 2515-8260 Volume 9, Issue 7, 2022

ORIGINAL RESEARCH

Impact of SARS-CoV-2 pandemic on Sleep Quality

Akanksha Togra[1], Sudhir Pawar[1], Jaisen Lokhande[1], Zarrin Ansari[1] Sanjay Kumar[2]

1: Lokmanya Tilak Municipal Medical College and General Hospital, Maharashtra University of Health Sciences, Sion Mumbai, India
2: Marshfield Medical Center, Weston & University of Wisconsin- Department of Medicine, WI, USA

Corresponding Author:
Dr. Akanksha Togra, MD 3rd Year, Lokmanya Tilak Municipal Medical College and General Hospital, Maharashtra University of Health Sciences, Sion Mumbai, India,
Email: akankshatogra97@gmail.com,

ABSTRACT
The coronavirus disease 2019 (COVID-19) pandemic has led to considerable stress and anxiety, adversely affecting the quality of the sleep. A study was conducted to evaluate if the COVID-19 pandemic had any effects(s) on the sleeping pattern and on overall sleep quality. Study was conducted as a cross sectional, questionnaire-based survey in Indian population on an online platform utilising Pittsburgh Sleep Quality Index (PSQI) to assess pattern and quality of sleep before and during the pandemic. The survey questionnaire was conducted during pandemic; hence the data collected for "before pandemic" duration was retrospective. A total of 1615 participants' responses were received of which there were 756 female and 859 male participants. The mean PSQI score (global) before the pandemic was 4.68 ± 2.98 while that during the pandemic is 6.02 ± 3.62 indicating a significant change in the sleep quality. The proportion of poor sleepers also increased dramatically from 26.1% pre-covid to 49.3% during covid. Both sleep deprivation and poor-quality of sleep are well-known to produce significant mood disturbances and to lower the immunity. Thus, it can be extrapolated that those individuals who developed significant sleep disturbances during COVID-19 are likely to be at a greater risk for negative health consequences even if they did not develop active COVID-19 infection. As sleep is vital for both mental and physical health of the human body, adequate measures should be taken at an individual level as well as at the community level to maintain quality of the sleep during pandemic or other disasters like war that trigger considerable stress.
Keywords: COVID-19, Pittsburgh Sleep Quality Index, Sleep disturbances, Sleep quality, Mental health Sleep deprivation

INTRODUCTION

The novel coronavirus disease 2019 (COVID-19) pandemic has produced considerable stress and anxiety globally in terms of health, employment, and financial hardships *(1, 2)*. Grief, isolation, loss of income and fear during the pandemic had triggered mental health conditions as well as had worsened the existing chronic mental health illnesses. The imposition of lockdown, followed by restrictions in travel and even going out of house for day-to-day activities led to a huge change in the daily life pattern of human lives. Fear of infection along with an overall sense of uncertainty dismantled the normal fabric of life to a very large extent.

Globally, sleep disturbances emerged as one of the major concerns during this time period. Healthy sleep is vital in building resistance in human body to cope up against the stress related situations. However, in this pandemic, sleep, per se, was observed to have been affected for both working classes such as healthcare workers and the enforcers of law-police force as well as for the general population. International surveys since the rise of COVID-19 have shown very high rates of insomnia (34–36%), anxiety (45%) and depressive symptoms (50%), among the healthcare workers especially prominent among those directly involved with COVID-19 patients (*3*). Data from the general population also indicates that insomnia and poor sleep quality have been the widespread complaints during this

pandemic, with rates similar to those associated with other major calamities and natural disasters such as earthquakes, floods, or wildfires *(4).*

Sleep quality more than sleep quantity, is very well known to play a more important role in stress reactivity *(5, 6, 7)*. Prolonged stress levels have been correlated with hypothalamic–pituitary–adrenal (HPA) axis excess hyperactivity, decreased sleep duration, as well as reduced REM sleep, further leading to inferior sleep quality, impaired memory, poor mood management, to accumulation of fatigue, drowsiness & increased anxiety *(8, 9, 10)*.

Healthy sleep is majorly defined by three parameters: Timing(s) of Sleep, Adequate Sleep duration and Quality of Sleep. The human 'sleep-wake' schedule is regulated by many factors including several social and environmental timekeepers which includes our daily routines such as waking up at a fixed time with a set-alarm, showing up at work every day at the same time, eating, exercising, and engaging in social and leisure activities at relatively fixed times throughout the day *(7)*. Under the confinement conditions, several of these time signals get altered due to fewer constraints to perform these activities at fixed times. Even when the earlier imposed strict lockdown and travel restrictions were lifted, there was a complete change in lifestyle due to factors such as confinement to home most of the time, constant sanitisation of hands, continuous wearing of masks and maintaining social distancing in public places.

The usual preparatory measures for a biological threat or a pandemic include prompt quarantine, potential treatment options including repurposing of the drugs, developing new vaccines for covid- 19 treatments and other immediate measures taken to enhance the immunity *(11, 12)*. However, no actions to prevent acute effects on health caused due to prolonged quarantine and social isolation and its subsequent outcome, are usually not taken into account. Healthy sleep and circadian rhythms also serve as a protective strategy against infectious diseases (*13*, *14*). It is, hence, crucial to understand the extent of the impact of pandemic on sleep so that interventions can be developed and established to help people address.

Studies to assess sleep quality have been conducted in various countries including Italy and China. However, the data available on sleep quality in Indian population is limited. The present study was conducted during COVID-19 lockdown period to collect data of population in Indian subcontinent on sleep and its various components so as to assess if there is an impact of pandemic on the overall quality of sleep.

MATERIALS AND METHODS:

This study was performed as a cross sectional, questionnaire-based survey to assess sleep pattern and sleep quality in Indian population during the COVID-19 pandemic as compared to before the pandemic. It was conducted through an online questionnaire having nineteen multiple choice question-based items, pertaining to various indices related to sleep quality and sleep patterns. Data on sleep quality before COVID-19 was collected based on participants' memory. The questionnaire was circulated through an online link on various social media platforms like WhatsApp, Facebook, and Gmail.

Institutional Ethics Committee approval was taken before starting the study. Participants completed the online survey, after reading the online consent form and agreeing to participate in the survey. The population variables for comparisons were gender, age groups, working or non-working status.

Responses received on Google forms were saved in a Google spreadsheet in designated Google drive. Response Forms were extracted and saved individually as well to help maintain all the records. The data collected in Google Forms was exported to Microsoft excel and analysed using PASW (Predictive Analytics Software) Statistics 18.0, also known as Sstatistical Package for the Social Sciences software (SPSS) 18.0.

The total planned duration of the study from data collection to data assessment was six months. The time frame from data collection to data assessment was targeted for 9-12 months. All the records submitted during lockdown between 13th October 2020 to 31st October 2020 were taken into consideration. This was a period of COVID-19 lockdown.

Study Participants

Participants of both genders who could understand English content of the questionnaire form were invited to participate voluntarily by sending them the questionnaire online. They were informed that

the form would take approximately 10-15 minutes to be filled and one person could fill the form only once. Participants were requested to fill it to the best of their knowledge and their memory. Their consent for participation was taken at the beginning of the Form. The participants were also requested to forward the survey to their personal or social media contacts.
The key objectives of the study were to assess sleep quality during the COVID-19 pandemic and comparison with pre-covid sleep quality. The secondary objectives were to compare if there are any differences in the sleep quality in the following population groups: (a) Different working Groups, (b) Males and Females, (c) Different age groups.
Individual responses which were incomplete and where consent was not given were excluded from the analysis.

Questionnaire
The questionnaire was based on the Pittsburgh Sleep Quality Index (PSQI) which is a commonly used method for assessment of quality of sleep. The survey questionnaire was conducted during pandemic; hence the data collected for "before pandemic" duration was retrospective.

PSQI is a self-rated questionnaire which contains nineteen elements of the questionnaire grouped into seven component scores, each weighted equally on a scale of 0 to 3. The seven components were: (i) Subjective sleep quality, (ii) Sleep latency, (iii) Sleep duration, (iv) Habitual sleep efficiency, (v) Sleep disturbance, (vi) Use of sleep medication and (vii) Daytime dysfunction. The sum of scores for these seven components yields one global score (*15*). Each item is scored zero to three and the sum allows for a subjective sleep quality score. A cut off score of more/greater than 5 distinguishes 'poor sleepers' from 'good sleepers' (≤5).

From the data collected, mean PSQI scores before and during the pandemic were calculated. A comparison of the average scores of the two-time frames (before and during the pandemic) and number of participants with poor sleep quality were carried out using 'Wilcoxon Signed rank test' for the global PSQI scores of the study participants. A comparison of the "participants with poor sleep quality between the two-time frames (before and during the pandemic) was also carried out using McNemar Test. This was beneficial for tracking down the subgroups that has poorer sleep quality during the pandemic which could better help relate to the cause for this change.

RESULTS
Study population
A total of 1647 subjects participated in the study. Thirty-two (32) participants were not included in the analysis as consent was not received. Of the remaining 1615 analysed, there were 756 females and 859 males. The participants were aged from 13 years to 80 years with the mean age of 36.08 ± 12.51 years (mean age of females = 33.70 ± 12.18 years; mean age of males = 38.17 ± 12.42 years). The responders were arbitrarily grouped in 3 age groups, i.e. those between 13 to 35 years, 36 to 60 years and more than 60 years. The working class for the participants were categorised as (i) Salaried Workers (883), (ii) Home makers (81), (iii) Students (399) and (iv) Other occupations (252). Of the 1615 study population, 86 responders had tested positive for COVID-19. The characteristics of study participants are presented in Table-1.

Table 1: Characteristics of Study Participants

Variable	**Statistics**	
Age (years)	Mean	36.08
(N=1615)	SD	12.51
	Minimum	13.0
	Maximum	80.0
	Range	67.0
	Category	*n (%)*
Gender	Male	859 (53.19)
	Female	756 (46.81)

Variable	Statistics	
Work Status	Salaried Worker	883 (54.6)
	Home Maker	81 (5.0).
	Student	399 (24.7)
	Other	252 (15.6)
Age groups (years)	13 – 35	824 (50.9)
	36 – 60	756 (49.7)
	60+	35 (2.2)
COVID-19 test	Positive	86
	Negative/ Not Tested	1529

The Mean PSQI (global) during the pandemic is 6.02 ± 3.62. Global PSQI score > 5 indicates poor sleep quality. Further, PSQI score was above 5 in all age groups and males and females as presented in the figure 1 below.

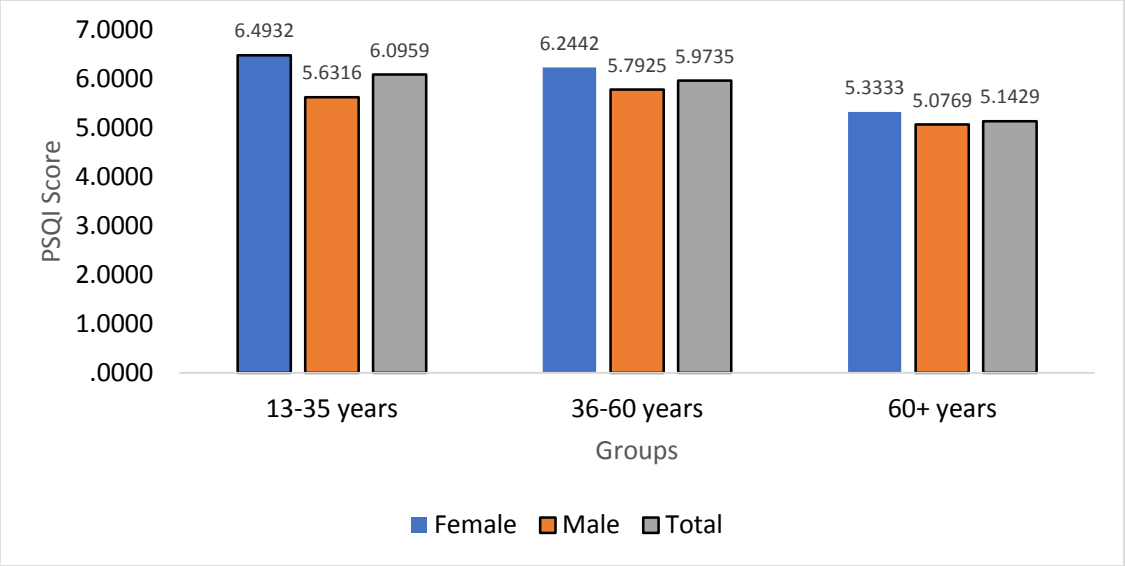

Figure 1: Global PSQI Score during pandemic across the three age group categories, segregated for Males and Females

There is significant difference in number of participants with poor sleep quality during pandemic compared to before pandemic. Out of 1615 ,791(49.2%) people were having poor sleep quality (PSQI score > 5) during pandemic whereas this number was before pandemic 522 (32.3%). Overall, there was 51.33% increase in the number of participants suffering poor sleep quality during pandemic compared to pre-pandemic. Similarly, there was increase of 60.94% increase in male population and 43.94% increase in poor sleep quality percentage in the female population (Table 2).

Table 2: Percent change in number of participants with "poor sleep quality" during pandemic compared to before pandemic: overall, male and female groups

Gender	Before Pandemic (Poor sleep quality) N (%)	During Pandemic (Poor sleep quality) N (%)	% Change in poor sleep quality
Overall	522 (32.3)	791(48.9)	51.53%
Male	233 (27.1)	375 (43.7)	60.94%
Female	289 (38.2)	416 (55.5)	43.94%

On assessment of mean scores, it was found that the Mean PSQI (global) in overall population before the pandemic was 4.68 ± 2.98 while this was during the pandemic 6.02 ± 3.62 (Table 3). Statistical analyses indicate significant change in the mean PSQI score indicating overall worsening of sleep

quality, similarly highly significant change was observed in number of participants with poor sleep quality.

Statistics	Before Pandemic	During Pandemic.	P-value
N	1615	1615	
Mean	4.68	6.02	
SD	2.98	3.62	
Median	4	5	<0.000
Minimum	0	0	
Maximum	21	20	
Poor Sleep Quality	522(32.3)	794(49.2)	<0.000

Table 3: Analysis of sleep quality "before pandemic" and after pandemic in overall population

Further analysis was done in gender subgroups. In male population, the mean PSQI before the pandemic was 4.34 ± 2.72 while that during the pandemic is 5.70 ± 3.51. While in females, the mean PSQI was increased from 5.06 ± 3.21 before pandemic to 6.38 ± 3.71 during the pandemic. In both subgroups difference was highly significant both for mean PSQI score and number of participants with poor sleep quality.

Table 4: Quality of sleep before and during pandemic in male and female sub-groups

Gender	Statistics	Global PSQI score		P-value
		Before Pandemic.	During Pandemic.	
Female	N	756	756	<0.000
	Mean	5.06	6.38	
	SD	3.21	3.71 4	
	Median	6	6	
	Minimum	0	0	
	Maximum	21	20	
	Poor sleep Quality (Score>5)	289(38.2)	414(54.8)	0.001
Male	N	859	859	<0.000
	Mean	4.34	5.70	
	SD	2.72 4	3.71	
	Median	5	5	
	Minimum	0	0	
	Maximum	16	19	
	Poor sleep Quality (Score>5)	233(27.1)	380(43.7)	<0.000

Statistical analyses confirmed significant change in the mean PSQI score indicating in both male and female, similarly highly significant change was observed in number of participants with poor sleep quality in both genders.

On assessment of sleep quality in different subgroups of work status, i.e., salaried workers, home makers, students and other than these 3 groups, number of participants with poor sleep quality were increased during pandemic compared to pre-pandemic time, refer table-5 below. The difference was statistically significant in all except home makers. In home maker group, there was increase in the number of subjects with increased from before pandemic to during pandemic (29 vs 44), however sample size, number of participants, in this group was lowest. Details on data are captured in table 5 below.

Table-5. Percent change in number of participants with "poor sleep quality" during pandemic compared to before pandemic in work status subgroups

Working Class	**Before Pandemic (Poor sleep quality) N**	**During Pandemic (Poor sleep quality) N**	**% Change**
Salaried	237	419	76.79%
Homemaker	29	45	55.14%
Student	175	205	17.14%
Other	81	122	50.62%
Overall	522	791	51.53%

The mean PSQI scores before and during the pandemic were compared 4 work-based groups. There was increase in the mean PSQI score in all the groups and increase was statistically significant.

Table 6: Quality of sleep before and during pandemic in different working groups

Work status		**Before Pandemic**	**During Pandemic**	**P value**
Salaried worker	N	883	883	<0.000
	Mean	4.32	5.93	
	SD	2.80	3.62	
	Median	4	5	
	Minimum	0	0	
	Maximum	17	18	
	Poor sleep Quality (Score>5)	237(26.8)	424(48.0)	<0.000
Home Maker	N	81	81	<0.00
	Mean	5.22	6.51	
	SD	3.68	3.75	
	Median	4	6	
	Minimum	0	0	
	Maximum	21	20	
	Poor sleep Quality (Score>5)	29(35.8)	44(54.3)	0.37
Student	N	399	399	<0.000
	Mean	6.10	5.41	
	SD	3.49	3.05	

Work status		Before Pandemic	During Pandemic	P value
	Median	5	6	
	Minimum	0	0	
	Maximum	16	16	
	Poor sleep Quality (Score>5)	175(43.9)	205(51.4)	0.029
Other	N	252	252	
	Mean	6.04	4.61	
	SD	3.78	3.03	<0.000
	Median	4	5	
	Minimum	0	0	
	Maximum	20	17	
	Poor sleep Quality (Score>5)	81(32.1)	121(48.0)	0.001

On assessment of sleep quality in different age groups, i.e., 18-35 year, 35-60 and > 60 age group, number of participants with poor sleep quality were increased during pandemic compared to pre-pandemic time, refer table-6 below. The difference was statistically significant in age groups 18-35 and 35-60. In age > 60 age group, there was increase in the number of subjects with increased from before pandemic to during pandemic (31.4 vs 51.4), however sample size, number of participants, in this group was lowest and p value was more than 0.5, details on data are captured in table 7 below.

The mean PSQI scores before and during the pandemic were compared 3 age-based groups. There was increase in the mean PSQI score in all the groups and increase was statistically significant, details on data are captured in table 8 below.

Table-7: Percent change in number of participants with "poor sleep quality" during pandemic compared to before pandemic in different age groups

Age (years)	Before Pandemic (Poor sleep quality) N	During Pandemic (Poor sleep quality) N	% Change
18-35	334	423	26.65%
36-60	177	349	97.65%
>60	11	19	72.73%
Overall	522	791	51.53%

Table 8: Quality of sleep before and during pandemic in different age groups

Age (in Years)	Statistics	Before Pandemic.	During Pandemic.	P-value
18-35	N	824	824	
	Mean	5.16	6.10	
	SD	3.05	3.51	
	Median	5	6	<0.000
	Minimum	0	17	
	Maximum	0	18	
	Poor Sleep Quality (Score>5)	334(40.5)	420(51.0)	0.001

36-60	N (%)	756	756	<0.000
	Mean	4.18	5.97	
	SD	2.85	3.77	
	Median	4	5	
	Minimum	0	21	
	Maximum	0	20	
	Poor Sleep Quality (Score>5)	177(23.4)	356(47.1)	<0.000
>60	N (%)	35	35	0.008
	Mean	4.17	5.14	
	SD	2.13	2.68	
	Median	4	6	
	Minimum	1	9	
	Maximum	1	10	
	Poor Sleep Quality (Score>5)	11(31.4)	18(51.4)	0.366

The sleep timings, going to bed & waking up, were also observed to have changed when assessed between before and after pandemic, as presented below (Table 9). On average, bedtime was delayed by ~14 min and participants on average woke up about 40 min later than usual.

Table 9: Sleep timing before and during pandemic

Timing	**Before**	**During**	**Change**
Going to Bed	11:47 pm	12:01 am	Delay of 14 mins
Waking up	7.03am	7.43 am	Delay of 40 mins

The overall mean score (±SD) was 0.94 (±0.83) for subjective sleep quality, 1.29 (±1.04) for sleep latency, 1.18 (±0.77) for sleep duration, 0.77 (±1.02) for sleep efficiency, 0.85 (±0.64) for sleep disturbance, 0.20 (±0.7) use of sleeping medication and 0.79 (±0.78) for daytime dysfunction. For these PSQI domain scores, similar to other studies, sleep latency was the highest, and the use of sleeping medication was the lowest.

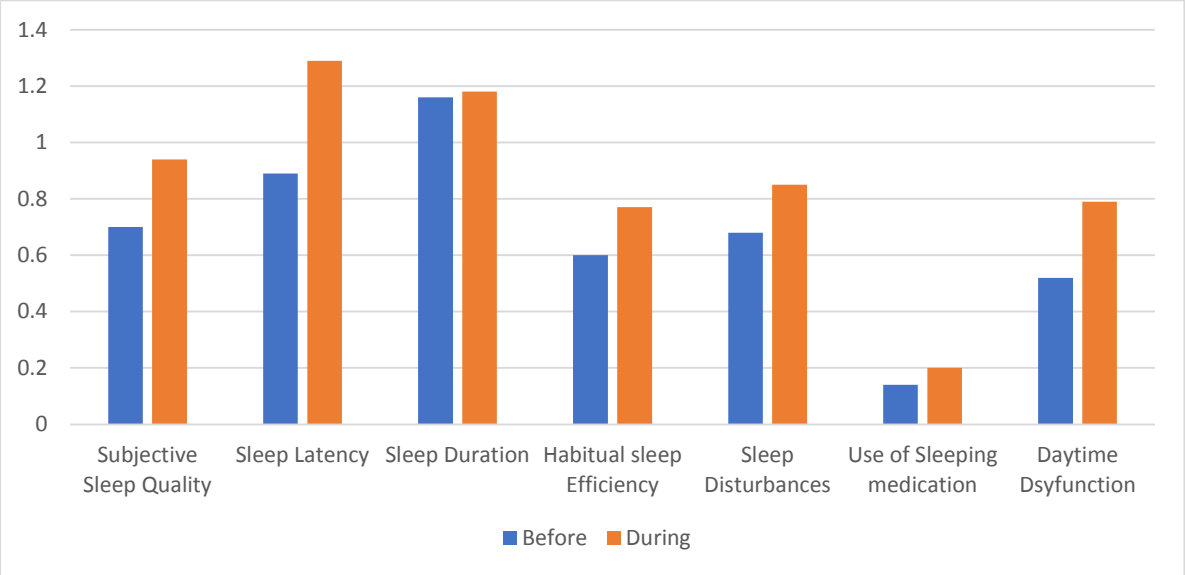

Figure-2. PSQI domain scores of sleep quality during the COVID-19 pandemic

Table 10: PSQI Domain scores before and during pandemic

Sleep Study Components	Statistics	Before Pandemic	During Pandemic.	P-value
Subjective Sleep Quality	N	1615	1615	<0.000
	Mean	0.70	0.94	
	SD	0.68	0.83	
	Median	1	1	
	Minimum	0	0	
	Maximum	3	3	
Sleep Latency	N	1615	1615	<0.000
	Mean	0.89	1.29	
	SD	0.89	1.04	
	Median	1	1	
	Minimum	0	0	
	Maximum	3	3	
Sleep Duration	N	1615	1615	0.401
	Mean	1.16	1.18	
	SD	0.64	0.77	
	Median	1	1	
	Minimum	0	0	
	Maximum	3	3	
Habitual Sleep Efficiency	N	1615	1615	<0.000
	Mean	0.60	0.77	
	SD	0.95	1.02	
	Median	0	0	
	Minimum	0	0	
	Maximum	3	3	
Sleep Disturbances	N	1615	1615	<0.000
	Mean	0.68	0.85	
	SD	0.59	0.64	
	Median	1	1	
	Minimum	0	0	
	Maximum	3	3	
Use of Sleeping Medication	N	1615	1615	<0.000
	Mean	0.14	0.20	
	SD	0.57	0.70	
	Median	0	0	
	Minimum	0	0	
	Maximum	3	3	
Daytime Dysfunction	N	1615	1615	<0.000
	Mean	0.52	0.79	
	SD	0.68	0.78	
	Median	0	1	
	Minimum	0	0	
	Maximum	3	3	

Comparison of PSQI domain scores was done before covid and during covid. All scores were increased except sleep duration (Figure-2). Increase in the mean scores of PSQI domain scores was statistically significant except in case of increase in the sleep duration, this indicates overall worsening of quality of sleep during covid compared to before Covid-19.

DISCUSSION

COVID-19 pandemic, the most significant global events of this era, has exerted a great impact over medical, psychological, and social concerns all over the world and affected numerous life domains including sleep. Studies have been conducted to assess sleep quality in different situations.

A study *(4)* conducted during the current COVID-19 pandemic in Italy, reported that sleep quality was significantly affected among the young Italians who were not having coronavirus infection, following the complete lockdown in Italy. A fraction of population that was facing an increase in sleep difficulties, also suffered from a higher level of symptoms of depression and anxiety. This can be attributed to the imposition of restrictions during this period that forced everyone to live in a feeling of alienation, and so increasing mental stress.

Another cross-sectional study from China, showed poor sleep quality and a shorter sleep duration among employees who just returned to work. Employees who were older than 24 years old, had higher education level or negative attitude towards the COVID-19 control, or had anxiety and depressive symptoms tended to have a higher risk of poor sleep quality.

In the current study, in addition to the cross-sectional survey on the sleep quality and a sleep duration, we have also collected data on sleep quality "before pandemic" based on memory and feeling using PSQI questionnaire. PSQI is the most widely used sleep health assessment tool in both clinical and non-clinical populations (*15, 16, 17*). About one-third of all studies on sleep quality use the questionnaire based PSQI as the primary tool for assessing subjective sleep quality (*18*). PSQI is established to provide a reliable and standardized measure to differentiate "good" from "poor" sleepers with the help of a simple index. Previous studies have shown good test-retest reliability for the PSQI, with correlation coefficients of 0.85 and 0.87 over a period of 2 days to a month (*19*). The performance of PSQI was studied in a sample Indian population of young adult males (*20)* and was found to be similar to polysomnography in terms internal consistency, internal homogeneity, and diagnostic characteristics. This supports the overall applicability of the PSQI in the Indian population *(17)*. Therefore, PSQI was selected as the instrument for this survey.

Our study demonstrated that the proportion of poor sleepers (i.e., PSQI > 5) was 51.5%, which was similar to the study by Cellini et al from Italy reporting poor sleepers 52.4%. Further, both these studies confirmed increase in the proportion of poor sleepers: increase from 32.3% to 51.5% in our study and 40.5% to 52.4% in the study by Cellini et al (*4*).

On assessment of sleep quality in different age groups, i.e., 18-35 year, 35-60 and > 60 age group, number of participants with poor sleep quality were increased during pandemic compared to pre-pandemic time. Subgroup 18–35-year age was closer to study population of Italian study and change in this subgroup was again found to be similar, i.e., increase from 40.5 % to 51.5% in the age group 18-35 year our study and 40.5% to 52.4% in the study by Cellini et al. (*4*)

On assessment of sleep quality in different subgroups of work status, i.e., salaried workers, home makers, students and other than these 3 groups, number of participants with poor sleep quality were increased during pandemic compared to pre-pandemic time (table-5). Subgroup student was closer to study population of Italian study and change in this subgroup was again found to be similar, i.e., increase from 43.9 % to 51.4% in the age group 18-35 year our study and 40.5% to 52.4% in the study by Cellini et al. (*4*).

Analysis of mean PSQI scores (mean score 6.02) also supported the hypothesis of increase in the poor sleep quality during pandemic. Mean PSQI score was consistently >5 in all the groups based on gender, salary status and age groups indicating poor sleep in overall and across the study population. Further, on comparing the mean PSQI scores during pandemic compared to before pandemic in the overall score population and subgroups, showed worsening of mean scores and also statistically significant. Consistent with analysis on the increase in the proportion of poor sleepers during pandemic.

These results are also similar to the recent studies published for Indian population during COVID-19 pandemic *(21, 22)* which showed an overall decrease in sleep quality during the pandemic. A study

conducted to assess the quality of sleep before and during COVID-19 pandemic among Nepalese residents under complete lockdown imposed by their government *(23)* also reported high prevalence of poor sleep quality with regards to difficulty in falling asleep, difficulty in staying asleep, satisfaction to current sleep and worrying about sleep problem. Our study also indicates that the changes in sleep pattern were apparent after the country went into lockdown/ imposition of restrictions.

The sleep timings, going to bed & waking up, were also observed to have changed. On average, bedtime was delayed by ~14 min and participants on average woke up about 40 min later than usual. Similarly in Italian study bedtime was delayed by 41 min and waking up time by 1 hour and 13 min. It can be hypothesized that due to the restrictions of movement and in overall physical activity, there was an overall lack of enthusiasm and discipline as well in daily routine to follow the fixed 'sleep-wake' schedules. There was a decreased compulsion to wake up at fixed times, and therefore, going to sleep at a particular time which was seen to translate into a decrease in total sleep time as observed in the results.

Comparison of PSQI domain scores was done before covid and during covid. All domain scores were increased except sleep duration (Figure-2). Increase in the mean scores of PSQI domain scores was statistically significant except in case of increase in the sleep duration, this indicates overall worsening of quality of sleep during covid compared to before Covid-19. For these PSQI domain scores, sleep latency was the highest, and the use of sleeping medication was the lowest.

This study also has some limitations. As the questionnaire was in English, the participants in this study included only English-speaking population. This is a limitation of this study as this study represents the impact of pandemic on a selected set of population. Study sample was a non-probability sample, which is a sample of voluntary participants and sample might not be equal in all subgroups. We have tried to address this by presenting subgroup analysis. Because the online questionnaire was a self-administered evaluation, the indicated levels of insomnia symptoms may not always be consistent with the evaluations of mental health professionals, however, sleep quality is measured by validated questionnaire which is validated. Further, before pandemic data was collected retrospectively. However, we have seen that before and during pandemic data is comparable with other studies. Overall, conclusion drawn seems to be valid.

The lockdown enforced during COVID-19 pandemic along with social restrictions was a hard psychological experience for most people as it required physical and social distancing, including being separated from family and friends, as well as the frustration resulting from the forced confinement at home. This changed lifestyle led to significant consequences on sleep and mental health. The results from this study show that there is a significant change in sleep quality during the COVID-19 pandemic than before the pandemic.

This study confirmed that people in Covid lockdown are experienced poor sleep quality, which would have an impact on well-being. There have been studies from West and East which have shown similar results. During COVID lockdown people's sleep habits are challenged by several factors like, changed lifestyle, reduced physical activity and psychological distress.

Sleep disturbances during COVID-19 could result in long-term negative health consequences. Thus, protecting sleep during this and any future pandemic is particularly important to build strength and cope more efficiently with the social confinement, distress, and ambiguity produced by this pandemic. Healthy sleep plays a crucial role for coping physically and psychologically with major life events such as the COVID-19 pandemic.

REFERENCES

1 Haleem A, Javaid M, Vaishya R. Effects of COVID-19 pandemic in daily life. *Curr Med Res Pract*. 2020;10(2):78-79.

2 https://www.who.int/news/item/05-10-2020-covid-19-disrupting-mental-health-services-in-most-countries-who-survey [5 October 2020**,** News release]

3 Zhang C, Yang L, Liu S, et al. Survey of Insomnia and Related Social Psychological Factors Among Medical Staff Involved in the 2019 Novel Coronavirus Disease Outbreak. *Front Psychiatry*. 2020; 11:306.

4 Cellini N, Canale N, Mioni G, Costa S. Changes in sleep pattern, sense of time and digital media use during COVID-19 lockdown in Italy. *J Sleep Res*. 2020 Aug; 29(4):e13074.

5 Bassett SM, Lupis SB, Gianferante D, Rohleder N, Wolf JM. Sleep quality but not sleep quantity effects on cortisol responses to acute psychosocial stress. *Stress*. 2015 Nov 2;18(6):638-44.
6 Abad VC, Guilleminault C. Diagnosis and treatment of sleep disorders: a brief review for clinicians. *Dialogues in clinical neuroscience*. 2003 Dec; 5(4):371.
7 Morin CM, Carrier J, Bastien C, Godbout R. Sleep and circadian rhythm in response to the COVID-19 pandemic. *Canadian Journal of Public Health*. 2020 Oct; 111(5):654-7.
8 Nollet M, Wisden W, Franks NP. Sleep deprivation and stress: a reciprocal relationship. *Interface focus*. 2020 Jun 6;10(3):20190092.
9 Claudino JG, Gabbett TJ, de Sá Souza H, Simim M, Fowler P, de Alcantara Borba D, Melo M, Bottino A, Loturco I, D'Almeida V, Amadio AC. Which parameters to use for sleep quality monitoring in team sport athletes? A systematic review and meta-analysis. *BMJ open sport & exercise medicine*. 2019 Feb 1;5(1).
10 Goldstein AN, Walker MP. The role of sleep in emotional brain function. *Annual review of clinical psychology*. 2014 Mar 28;10:679-708.
11 Gulia KK, Kumar VM. Importance of sleep for health and wellbeing amidst COVID-19 pandemic. *Sleep and vigilance*. 2020 Jun; 4(1):49-50.
12 Douglas PK, Douglas DB, Harrigan DC, Douglas KM. Preparing for pandemic influenza and its aftermath: mental health issues considered. *International journal of emergency mental health*. 2009 Jan 1;11(3):137.
13 Mehra R, Teodorescu M. Sleep, circadian disruption, and microbial-immune interactions: A new frontier. *Chest*. 2018 Oct 1;154(4):740-2.
14 Kelly BD. Coronavirus disease: challenges for psychiatry. *The British Journal of Psychiatry*. 2020 Jul;217(1):352-3.
15 Buysse DJ, Reynolds III CF, Monk TH, Berman SR, Kupfer DJ. The Pittsburgh Sleep Quality Index: a new instrument for psychiatric practice and research. *Psychiatry research*. 1989 May 1;28(2):193-213.
16 Kurina LM, Knutson KL, Hawkley LC, Cacioppo JT, Lauderdale DS, Ober C. Loneliness is associated with sleep fragmentation in a communal society. *Sleep*. 2011 Nov 1;34(11):1519-26.
17 Manzar MD, Moiz JA, Zannat W, Spence DW, Pandi-Perumal SR, BaHammam AS, Hussain ME. Validity of the Pittsburgh sleep quality index in Indian university students. *Oman medical journal*. 2015 May; 30(3):193.
18 Pilz LK, Keller LK, Lenssen D, Roenneberg T. Time to rethink sleep quality: PSQI scores reflect sleep quality on workdays. *Sleep*. 2018 May; 41(5):zsy029.
19 Backhaus J, Junghanns K, Broocks A, Riemann D, Hohagen F. Test–retest reliability and validity of the Pittsburgh Sleep Quality Index in primary insomnia. *Journal of psychosomatic research*. 2002 Sep 1;53(3):737-40.
20 Manzar MD, BaHammam AS, Hameed UA, Spence DW, Pandi-Perumal SR, Moscovitch A, Streiner DL. Dimensionality of the Pittsburgh Sleep Quality Index: a systematic review. *Health and quality of life outcomes*. 2018 Dec; 16(1):1-22.
21 Gupta R, Grover S, Basu A, Krishnan V, Tripathi A, Subramanyam A, Nischal A, Hussain A, Mehra A, Ambekar A, Saha G. Changes in sleep pattern and sleep quality during COVID-19 lockdown. *Indian Journal of Psychiatry*. 2020 Jul; 62(4):370.
22 Kanchan S, Bhardwaj KK , Tiwari S , Bakshi S, Vajpei P. Effect of Coronavirus Disease-2019 Pandemic on the Sleep Quality of Indian Population. *Indian J Sleep Med*, 2020;15(3):35–38.
23 Chandra A, Karki P, Prakash P, Chandra A, Khadka S. Impact of Covid-19 Pandemic on Quality of Sleep Among Nepalese Residents. 2020; 10.21203/rs.3.rs-31619/v1.
24 Reed DL, Sacco WP. Measuring sleep efficiency: what should the denominator be?. *Journal of clinical sleep medicine*. 2016 Feb 15;12(2):263-6.