

## Sleep Disturbance May Lead to a Higher Divorce Rate in General Population

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### Abstract

**Introduction:** Sleep disturbance has been associated with multiple issues like metabolic derangement, cardiovascular risk, cancer risk etc. One of the key aspects related to chronic sleep deprivation is its impact on psychological and psychiatric patho-physiologies. In current review we examine and evaluate multiple studies linking sleep derangement and psychiatric issues which further can impact the marital life extending to the level of divorce in general population.

**Methods:** In current review, critical analysis of individual studies was conducted evaluating credibility of experiments leading to a final opinion pertaining to role of Sleep disturbance leading to higher incidence of divorce in general population. Multiple original contributions were reviewed and after careful selection of the papers, current review was compiled.

**Conclusion and Way Forward:** There is limited direct evidence with respect to causal relationship between sleep disorders and divorce in general population. Current research also suggests the bi-directional association between the two rather than unidirectional. Sleep disorders and marital relationship derangement are more likely to be part of a vicious circle in which one can lead to the other. Future interventional clinical trials would be required to further substantiate causal relationship between sleep disorders and divorce in general population.

**Keywords:** Sleep Disturbance; Metabolic Derangement; Cardiovascular Risk; Cancer Risk

### Abbreviations

AHI: Apnoea-Hypopnoea Index; CRP: C Reactive Protein; DBP: Diastolic Blood Pressure; GRISS: Golombok Rust Inventory of Sexual Satisfaction; PSQI: Pittsburgh Sleep Quality Index; IPV: Intimate partner victimization; PSG: Polysomnography; REM: Rapid Eye Movement; SBP: Systolic Blood Pressure; SCID: Structured Clinical Interview for DSM-IV

### Introduction

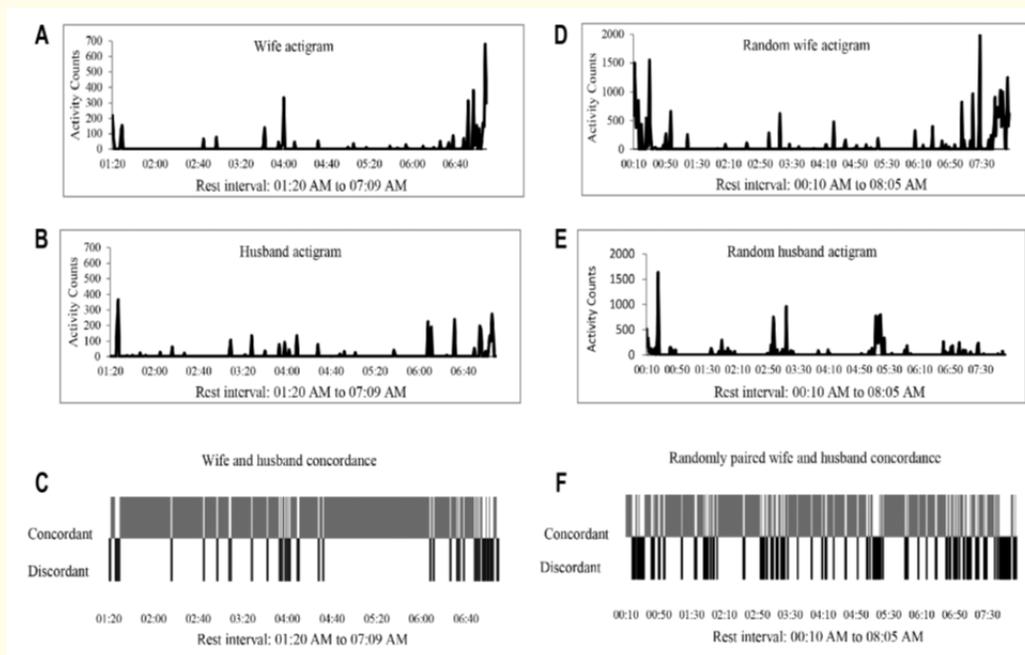
Sleep disorders have been associated with multiple pathological conditions like metabolic disorders, immunity challenges, cardiovascular disorders etc. One of the key aspects associated with sleep regulation derangement is impact on the psychological and psychiatric aspects. Psychiatric and psychological aspect can lead to behavioral concerns which can not only disturb but also marital life.

Sleep disorders can have impact on physical, mental and social health of an individual which can impact marital life. Multiple pathways of sleep disorders which can lead to divorce in general population are presented in the current review. Concept of sleep wake concordance between the couples has been investigated for association with behavior and subsequent marital satisfaction. Role of sleep derangement induced anxiety also plays some role in adversely effecting marital relationship. Similarly, mood swings secondary to sleep derangement can have impact of married relationship as well. Aggressive behavior leading to domestic violence is one of the key issues leading to divorce globally. Researchers have been working to determine the pathways responsible for Intimate partner victimization secondary to sleep disorder. One of the proposed pathway on this is aggression development secondary to continuous sleep deprivation. Related to this violent sleep behavior as found in REM sleep disorder can lead to physical attacks during sleep of which diseased person even has no clue and things end up to divorce level. Shift workers who develop sleep derangement are much more prone to psychological issues which can further impact the marital life in a negative way. Sleep apnea has also been found associated with decreased levels of testosterone levels in males. Testosterone levels are in turn responsible for overall sexual drive in males. Thus, sleep apnea may lead to poor marital relationship and lead to divorce. Current review explores multiple pathways responsible for poor marital relationship in couples secondary to sleep disorders.

**Sleep concordance and divorce**

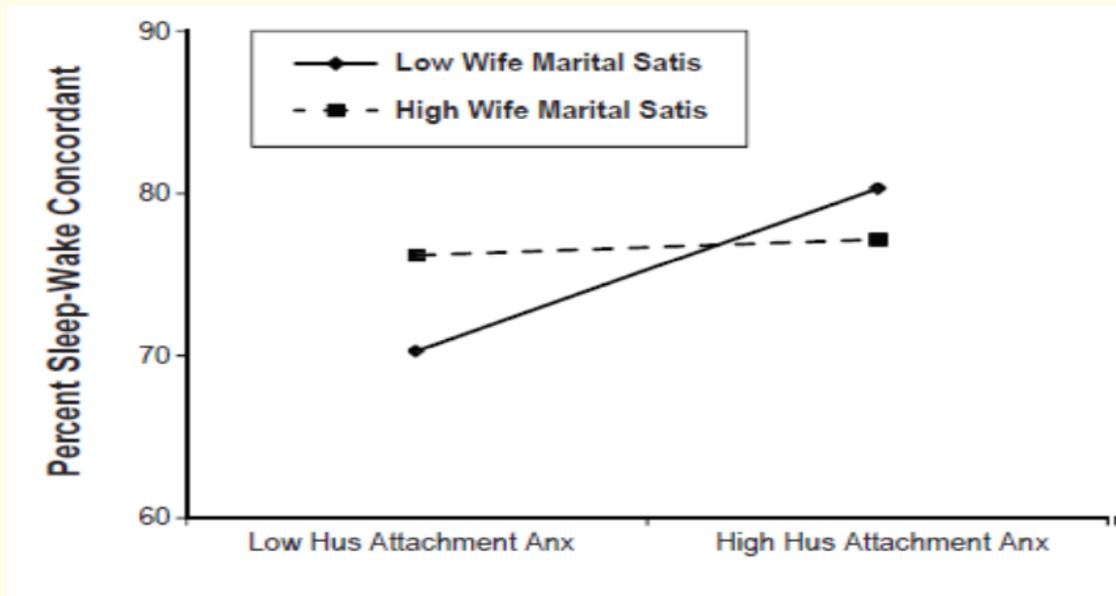
Sleep concordance in couples can be defined as time slots during night when both husband and wife were either sleeping at same time or awake. In this study, research group tried to evaluate the sleep concordance in 48 pairs of heterosexual healthy couples based on 10 days of actigraphy recordings. Overall range of concordance was found to be 53 - 88%. It was also observed that the degree of concordance in sleep was dependent on attachment and other behavioral aspects in couples.

Figure 1 indicates the actigrams of both husbands and wives in true. (A-B) and random sampling. (D-E) while C and F depicts the sleep wake concordance in respective groups. In case of true groups concordance was found to be 89% while for the random groups it was 75%.



**Figure 1:** Actigraphy epochs reflecting sleep wake concordance in true paired couples (A-B-C) and random paired couples (D-E-F) [1].

In husbands in case of anxious behavior there was increased sleep wake concordance ( $P = 0.019$ ) while in case of females' attachment style did not have any association with concordance. In females another aspect of significance was marital satisfaction in the relationship was directly proportional to sleep wake concordance ( $P < 0.001$ ) (Figure 2) [1].



**Figure 2:** In case of wives' high marital satisfaction was directly proportional to sleep wake concordance. In husbands in case of anxious behavior there was increased sleep wake concordance while in case of female's attachment style did not have any association with concordance [1].

This study was one of its kind however more robust mechanism like PSG would have been added benefit. Home based PSG would have been a better idea. More number of couples would have been enrolled to get significant results. Further studies should be undertaken including sleep disorders couples of different cultural, financial and educational backgrounds.

Gun., *et al.* [2] further investigated association of sleep wake concordance with cardiac disease using biomarkers like SBP-systolic blood pressure, DBP-diastolic blood pressure and CRP-C reactive protein in couples with no sleep disorders (men  $n = 46$  and women  $n = 46$ ) SBP, DBP and CRP were the dependent variables were recorded for 48 hours in both the groups. Percentage sleep wake concordance was calculated with actigraphy for 10 days.

It was observed that couples with higher percentage of sleep wake concordance had lower values of systolic and diastolic blood pressure in night ( $p < 0.05$ ). Further, systolic blood pressure during wake period in the day was also found to be on the lower side with higher sleep wake concordance ( $p < 0.05$ ).

Similar positive findings were observed with respect to CRP levels as well. Couples with higher sleep wake concordance had low levels of CRP ( $p < 0.05$ ).

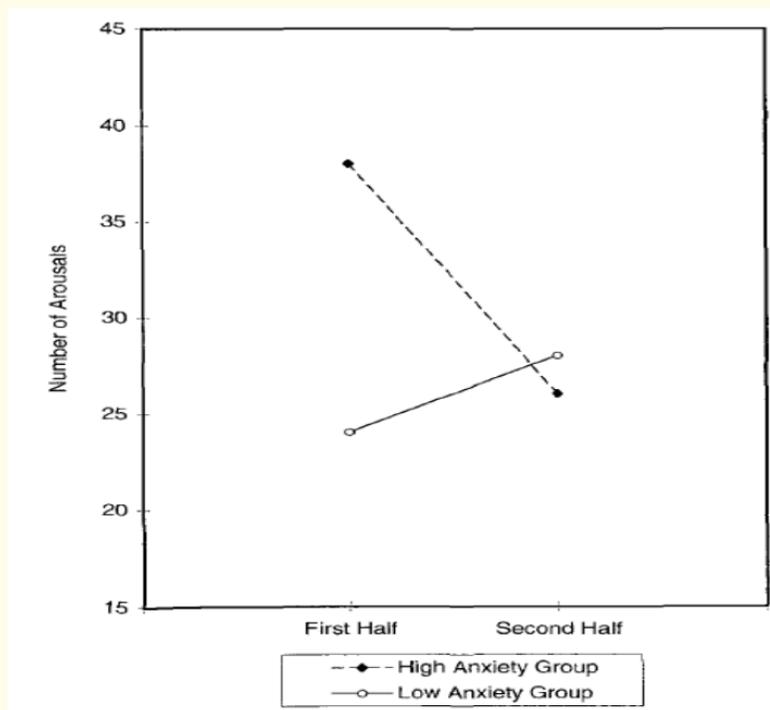
Both CRP and blood pressure are individual predictors of cardiac pathology in humans. CRP is also associated with other kinds of inflammatory disorders as well.

Current study is first of its kind to demonstrate positive association between sleep wake concordance and improvement in cardiac profile in healthy couples. CRP is responsible for inflammatory responses in humans and hence this study provides linkage with sleep disturbance and maintenance of physiological health in healthy couples. Better physiological health status can also be translated to psychological wellbeing of the couples. Thus, creating an aura of positivity and hence forth possible reduction in house hold clashes and lesser divorce rates. On the other hand, poor sleep wake concordance can have ill impact on mental and social well being of the couples leading to increased chances of household disputes.

Key limitations of this study were being a cross-sectional study there is possibility of bias. Further, couples under evaluation were healthy and had significant good relationship. Study also lacked PSG monitoring of the subjects as only actigraphy was used to investigate various sleep parameters.

### Anxiety and marital interaction

Anxiety as a disorder can be fairly linked with hyperactivity and theoretically probability of sleep derangement lies in anxiety patients. In PSG based study, association of sleep disorders and anxiety was investigated in 30 subjects (n = 15 with high levels of anxiety and n = 15 with low levels of anxiety). PSG findings reflected that group with high levels of anxiety had significant challenges in sleep: they took more time to fall asleep (P < 0.01), had significantly decreased percentage of slow wave activity (P < 0.01), microarousals were also more (Refer figure 3) (P < 0.05), decreased density of REM sleep (P < 0.05) and there were more transitions to NREM 1 stage (P < 0.01) as compared to the low anxiety group [3].



**Figure 3:** Demonstrates how anxiety can correlate with number of arousals during night sleep. X-Axis -number of arousals. Y-Axis-first and second half of the sleep period (Solid lines indicate low anxiety group (n = 15) and dotted lines indicate high anxiety (n = 15)) [3].

Current study provides strong evidence pertaining to anxiety levels have a direct relation with sleep disturbance. Disturbance in sleep is also known to cause multiple organic and psychological issues in patients. Hence, this can lead to a vicious circle in which high levels of anxiety and sleep disturbance can be both effect and cause. Anxiety can play a significant role in creating issues in happy married life as well based on behavioral aspects.

Limitation point of view, this study enrolls very smaller number of patients and higher sample size can have better impact on providing evidence. This is only one night PSG study and there was no adaption night provided to the patients which can have a biased impact.

### **Mood as a linking mechanism between sleep and married life behavior**

Yorgason, *et al.* [4] studied association of mood, its impact on sleep and henceforth marital relationship in 191 older couples based on 14 days survey. Various parameters like quality of sleep, duration of sleep in hours and feeling fresh after sleep were considered. Results indicated that positive mood can mediate alterations in couple's behavior in an optimistic manner. Good mood and better sleep have been found associated with improved marital discussions. Positive mood led to better sleep quality and vice versa and had direct benefit in marital relationship. Current study supports the concept of direct association model as it emphasizes how mood is linked to sleep and marital relationship. Hence, positive and negative moods can impact the relationship between the couples to be long lasting or of shorter duration.

Though study provided good evidence pertaining to association between mood, sleep and marital relationship, however some of the limitations need to be addressed. Duration of marriage was not being documented for all the couples and hence results may not represent actual figures. Estimating the duration of marriage prospectively would be a great idea to further validate the concept. As the format was self-reporting type, probability of bias cannot be ruled out which would have been taken care by objective measures of sleep like PSG or actigraphy. Further, study could not consider establish relationship between occupational aspects like shift workers and marital duration which would have been good idea to strengthen the evidence.

### **Sleep and self-disclosure and marital relationship**

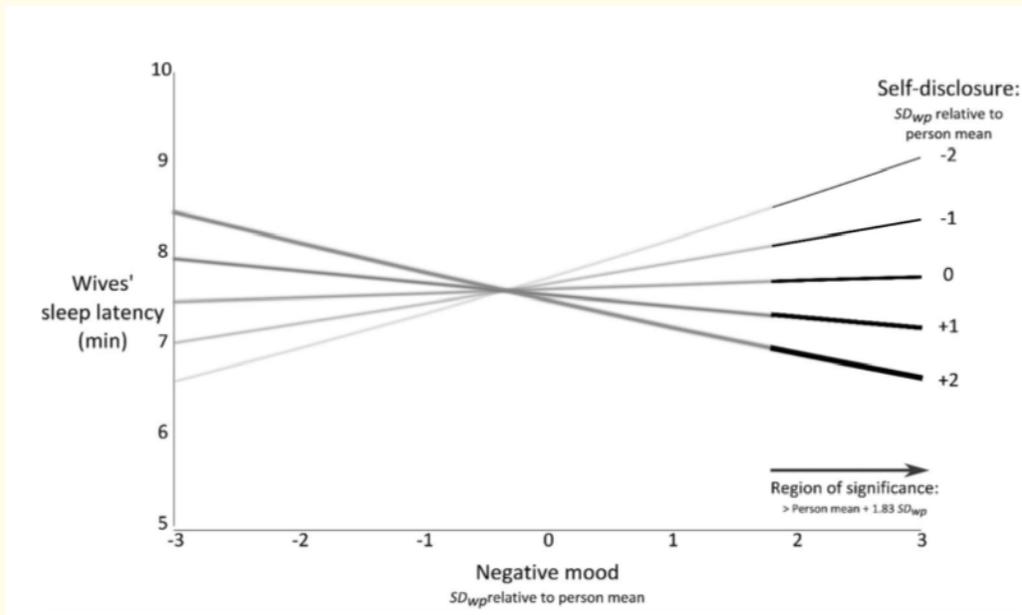
Kane, *et al.* [5] studies role of self-disclosure in couples (wives  $n = 46$  and husbands  $n = 38$ ) in sleep regulation and thus marital relationship. Subjective measures of sleep i.e. sleep diaries were used for 56 days to observe the impact of self-disclosure on sleep and relationship. Morning diaries focused on question related to sleep duration, quality etc. while evening diaries focused on self-disclosure by couples, mood variation and impact of the same in interactions between the couples. Results were promising though indicated gender based variation.

In wives self-disclosure to the partner was found to be statistically significant for: over night quality of sleep ( $P < 0.01$ ) and efficiency of sleep ( $P < 0.001$ ) (Refer figure 4). On the other hand husbands were found to have lesser number of awakenings during night if self-disclosure was made to the partner ( $P < 0.05$ ).

One of the key limitations of the study is very low sample size along with mismatch in number between the two groups. Further results of the study cannot be translated to sleep disorder population as only healthy couples were enrolled in this study. Results also indicate gender variation as wives had better response to self-disclosure as compared to husbands. Larger sample size studies need to be conducted to evaluate the concept. Finally, only subjective measures were used which adds to limitation of the study. Going forward objective methods like PSG, actigraphy and others need to be used on a much larger sample size.

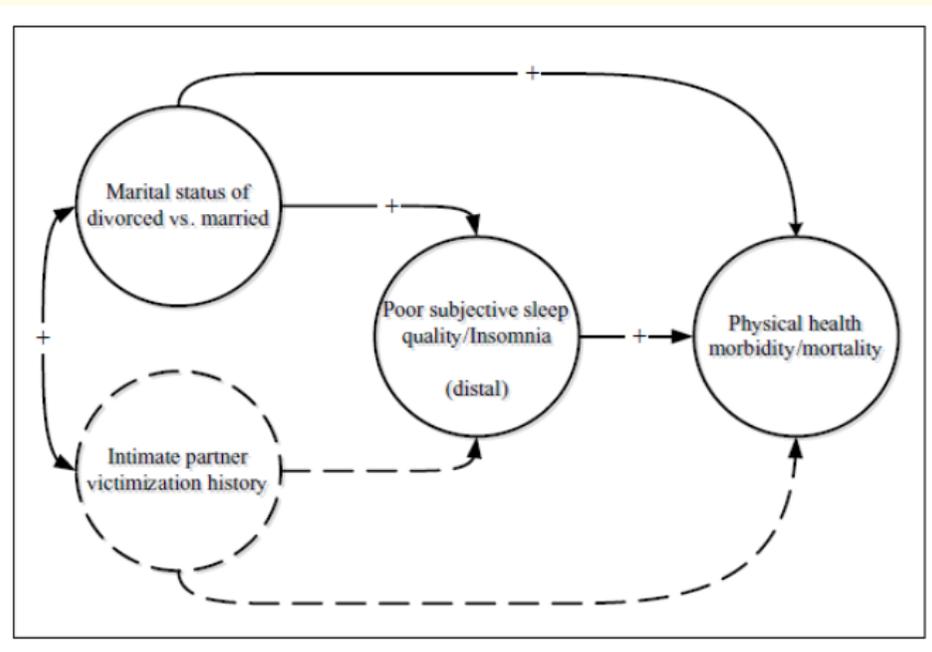
### **IPV-Intimate partner victimization, sleep quality and divorce**

IPV-Intimate partner victimization (home violence) has been associated with divorce history across the globe. In a study conducted by Newton and his team, women with history of divorce with or without intimate partner victimization ( $n = 170$ ). 61 subjects were observed in lab and 109 were assessed based on subjective measures. In this cross-sectional study subjects were assessed on lab and subjective



**Figure 4:** Demonstrates in wives how negative mood and self-disclosure can impact the sleep latency. X-Axis-indicates negative mood. Y-Axis- Wives latency in sleep (n = 46) [5].

measures of sleep quality (PSQI and psychological assessment) and other sleep parameters of last month. Group proposed hypothesis linking IPV, marriage/divorce status, sleep derangement and physical health (Refer figure 5) [6].



**Figure 5:** Hypothesis linking IPV, marriage/divorce status, sleep derangement and physical health. Dotted lines refer to the proposed hypothesis pertaining to IPV (Intimate partner victimization) and poor Sleep Quality in divorced females. Bold lines are indicative of already established relationship between divorce and health issues [6].

It was observed that the subjects having history of IPV had strong relation with poor sleep quality as well with a dose response curve type relationship ( $p < 0.01$ ). Further odds ratio (3.368 @ 95% CI,  $P < 0.02$ ) was found to be more than 3 times higher in subjects with positive history of IPV. Similarly, odds ratio (3.27 @ 95% CI,  $P < 0.01$ ) was found to be more than 3 times higher for clinical presentation with psychological symptoms in the subjects.

This is a clinically important study as it considers derangement in sleep quality based on IPV once the acute phase is over. Study also provides a dose response relationship between IPV and sleep quality and thus IPV can be considered as individual contributor to impaired sleep quality. Though study provides strong relationship between IPV and sleep quality however being a retrospective cross-sectional study it cannot be taken as a conclusive evidence. Further, study sample size should have been significantly higher to support the evidence. Another limitation should be taken into consideration is eligibility of the subjects to participate in the study was ruled out through telephonic interview however face to face interview should have been conducted for screening. Being a retrospective study also adds to the probability of recall bias.

**Sleep apnea, testosterone levels and marital status**

One of the key aspects in happy married life is physical health along with other socio-economic factors. Sexual compatibility is also another important factor of marital sustainability. There has been increased rate of divorce in case of sexual non-compatibility. Mehmet., *et al.* [7] investigated association of sleep apnea and sexual performance in males ( $n = 42$  apnea and  $n = 43$  normal controls). Assessment of Apnea and non-apnea was done basis Structured Clinical Interview for DSM-IV (SCID) and Golombok Rust Inventory of Sexual Satisfaction (GRISS). Apnea group was divided into 3 sub-groups: low (5 - 15), medium (15 - 30) and high (30) based on AHI (Apnoea-Hypopnoea Index) index. Fasting levels of FSH, LH, testosterone, prolactin and estrogen levels were tested. Results revealed that 3 sub-groups: low, medium and high did not have any difference with respect to sexual satisfaction. One of the key findings of the study was that apnea group had decreased levels of testosterone despite apnea group did not complain any compliant regarding sexual discomfort (Refer table 1).

	Apnoea Group (M ± SD)	Non-Apnoea Group (M ± SD)	Statistics
Age	40 ± 7.10	36.62 ± 9.20	t(83) = -1.88, n.s.
BMI	32.31 ± 3.85	28.34 ± 3.67	t(50) = -3.80***
<b>Hormones</b>			
FSH	4.60 ± 2.16	4.13 ± 1.95	t(83) = -1.06, n.s.
LH	3.85 ± 1.59	4.61 ± 1.61	t(83) = 2.16*
Estradiol	25.67 ± 9.96	24.80 ± 12.97	t(83) = -.34, n.s.
Prolactin	6.85 ± 2.69	6.68 ± 2.74	t(83) = -.29, n.s.
Testosterone	13.17 ± 5.34	15.80 ± 3.85	t(83) = 2.60**
*p < .05, **p < .01, ***p < .001			

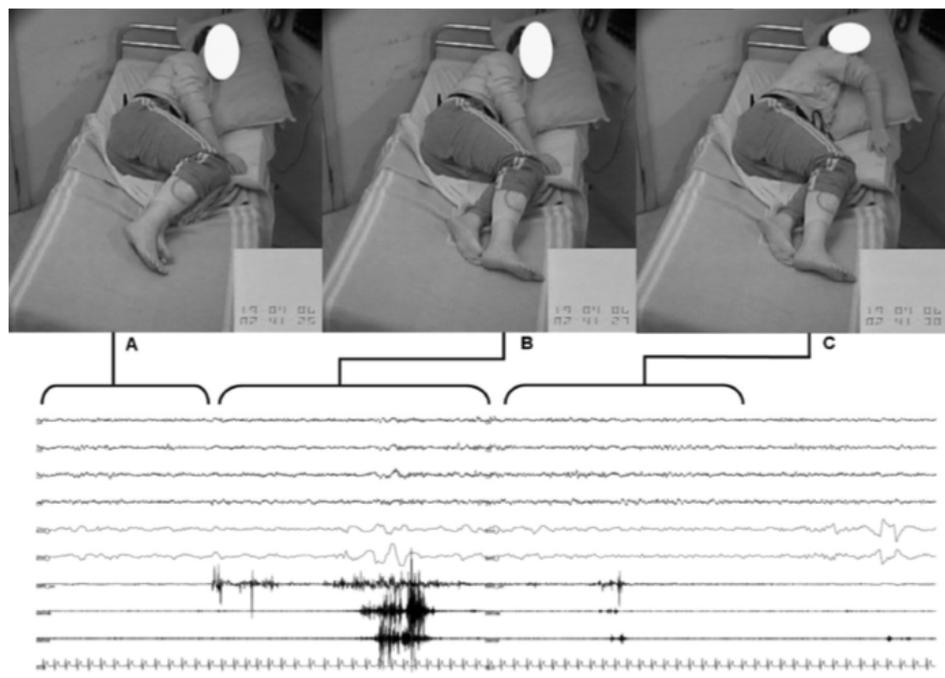
**Table 1:** Comparison between apnea and non-apnea groups: LH ( $p < 0.05$ ) and testosterone ( $p < 0.01$ ) levels were found to be statistically lower in apnea as compared to non-apnea group. BMI was found to be higher in apnea patients.

Current study provides an evidence of statistically significant reduction in the testosterone levels in apnea patients. Although apnea patients did not complain about sexual displeasure however the patients were not followed up for the same concern to predict more appropriate association. Further, it would have been instrumental to have questionnaire information on the subject matter from the better half of the males.

**Violent sleep behavior can lead to divorce**

Ingravallo., *et al.* [8] presented a case report of a patient suffering from narcolepsy with cataplexy along with REM behaviour disorder. Case history relates to post marriage challenges faced by the couple due to sleep disorder in male partner. Married at the age of 28 years this male had multiple episodes of hitting her wife in the night after 2 years of marriage and he could not recall any part of the episode.

Patient was diagnosed with narcolepsy with cataplexy along with REM sleep disorder based on PSG and video monitoring (Refer figure 6). One of the incidence patient's wife reported to emergency with injury of chest region secondary to punch and ultrasonography revealed 4 cm<sup>3</sup> of hematoma. Similar episodes kept on recurring in future till the time patient charged with assault and formal divorce suit was filed by wife. Marital status suffered due to the sleep disorder and violence episodes associated with the same. Patient was put of modafinil, clonazepam and finally on sodium oxybate.



**Figure 6:** “Nocturnal video-polysomnography (PSG) documenting an RBD episode. (A) The patient is sleeping on the left side. The PSG tracing is typical for REM sleep. (B) The patient moves the left leg forward. REM sleep is still recognizable on the EEG tracings and an increase in EMG tonic and phasic activity is recognizable on the chin and anterior tibialis muscles tracings. (C) The patient pulls the left arm forward and upward. EEG is typical of REM sleep with saw tooth activity and a brief EMG phasic activity on the chin and anterior tibialis muscles tracings (EMG from the upper limbs are not recorded). REM sleep with muscle atonia then reappears. Electroencephalography (C4, O2, C3, O1), right and left electro-oculography (EOG dx, EOG sn), chin electromyography (EMG sm), right and left tibialis anterior muscles electromyography (EMG tibr, EMG tibl), electrocardiography (ECG)” [8].

Though current case report only takes one patient assessments into account, yet it provides quite important findings. Violent REM behavior disorder and narcolepsy can really spoil the relationship between the couples and end up to court of law for both civil and criminal proceedings. In this case divorce was filed by wife and she was able to get the same quite comfortably. Current case also emphasizes how complicated can be the diagnoses in such kind of cases which can further delay treatment of the patients.

### Sleep derangement and divorce in shift workers

Different scientific groups have studied shift workers and sleep pathology related to the same in significant details. Along with different medical conditions sleep derangement in shift workers can lead to various societal challenges as well. Scientists did analyses on data (n = 3,552) received from “Families and Work Institute’s National Study of the Changing Workforce” and tried to find risk associated with sleep derangement in sleep disorders and marital satisfaction and results were quite significant and alarming.

Shift workers due to their odd hours of operation and sleep related health concerns had significantly poor family satisfaction levels. Those who had increase work related travel were associated with higher rates of divorce as well. Others had less satisfactory marriages with respect to sexual and psychological factors leading to divorces. For male shift workers who had children and duration of marriage was less than 5 years, odds ratio for divorce was found to be 6 i.e. these shift workers had 6 times higher risk of getting divorce than the shift workers with no sleep disorder. Similarly, women with same criteria had a relative risk of divorce equal to 3 as well [9,10].

Both these studies very clearly correlate risk associated with marital failure in the form of divorce and sleep disorders secondary to shift workers. Hence, sleep disturbance and other psychological parameters in shift workers can be one of the potential pathways which can explain higher rates of divorce in general population.

### Sleep issues, psychotic problems and marital life

Koyanagi, *et al.* [11] studied association between Sleep issues and corresponding psychotic problems globally over 56 countries in a cross-sectional model. Total number of participants was  $n = 261547$ . Subject data pool was taken from World Health Survey which was done by World Health Organization from the year 2002 - 2004. Composite International Diagnostic Interview (CIDI) was used in which subjects were evaluated for psychosis based on 4 questions. Only severe sleep problems occurred during last 30 days were considered. For the statistical analysis multivariable logistic regression was used and it was found that average sleep prevalence was 7.6%, China having the lowest (1.6%) and Morocco (18.6%) being the highest. In the current samples the odds ratio was found to be 2.41 (at 95% CI) for at least one symptom of psychosis and after adjusting for anxiety and depression symptoms Odd's ratio was found to be 1.59 (95% CI).

Current study provides very significant evidence pertaining to causal relationship between psychotic disorders and sleep. Though there have been differences in odds ratio in different countries however prevalence of sleep disorders has been found related to history of psychotic disease across the globe.

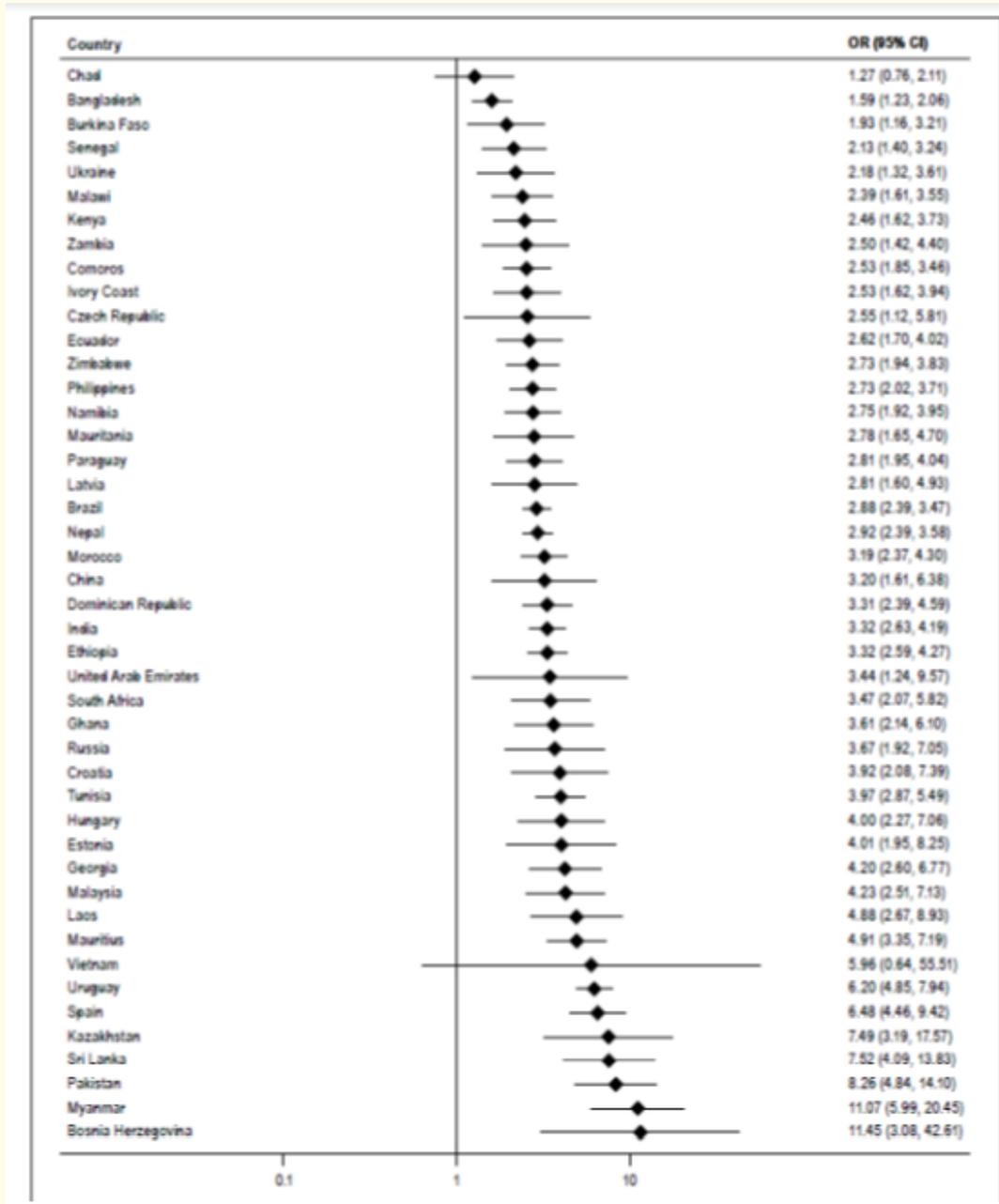
Further, psychological and mood disorders have been associated with issues in marital relationship and has a significant scope for divorce [12]. Hence we can say that sleep disorders can have higher probability of divorce across the globe.

One of the main limitations of the study was even single psychotic symptom was considered for ruling out for disorder. Ideally series of factors/symptoms and diagnostic criteria should have been used to finalize the diagnosis. Being a cross sectional study adds to probability of bias as well.

### Sleep disorders and poor marital relationship

William and his team worked on investigating role of sleep disorders leading to poor marital relationship among the 405 older couples ( $n = 810$ ) in a longitudinal setting. Assessment was based on subjective measures where subjects have to respond to in case they have felt challenge in going to sleep, have there been any concerns of arousals in the night and did they get up early in the morning. These questions were supposed to responded in ranged manner from never to often. Statistical analysis was based on multivariate models. Study results revealed that those couples who had sleep disorders had significant issues pertaining to marital satisfaction which could have impacted their married life in a longer run. Odd ratio for prevalence of unhappy marriage in case of self-sleep disorders in couples was found to be 1.12 at 95% CI. Similarly, Odd ratio for prevalence of unhappy marriage in case of partner's sleep disorder was found to be 1.15 at 95% CI [13].

This study provided good evidence regarding sleep disorders leading to marriage dissatisfaction and thus increasing the probability of separation. However, study had some drawbacks as well. Study did not provide data on individual sleep disorders as questionnaires were very generic in nature. Further, sleep disorders were not evaluated basis any objective measures like PSG and actigraphy. Only single point cross-sectional analysis was done without any follow up. For establishing a causal relationship prospective longitudinal studies would have been instrumental [14].



**Figure 7:** Demonstrates country wise Odds ratio with respect to prevalence of Sleep disorders in subjects who presented at least one symptom of psychotic symptom. Average sleep prevalence was 7.6%, China having the lowest (1.6%) and Morocco (18.6%) [11].

### Discussion

There have been multiple studies linking different possible mechanisms pertaining to sleep and marital relationship quality. Number of pathways have been proposed to evaluate causal association between sleep disorders and marital relationship concerns leading to di-

orce. These pathways include physiological, behavioral and psychological and organic pathology pathways as well. However, the concern here is direct evidence regarding the pathways leading to divorce in general population is not there. These pathways focus only indirect mechanisms by virtue of which it is difficult to rule out causal relationship between sleep disorders and divorce in general population.

Based on the research studies we can say that healthy sleep patterns can help to attain better psychological, physiological, social health which can have good impact on the marital relationship in a positive way. On the other hand sleep disorders can impact psychological health leading to anxiety, stress leading to frequent agitations, arguments and sometimes violence between the couples leading to disruption in the marriage as well. Concept of sleep wake concordance between the couples, role of sleep derangement induced anxiety, aggressive behavior leading to domestic violence, intimate partner victimization secondary to sleep disorder, shift workers are much more prone to psychological issues and sleep apnea associated decrease in testosterone levels etc. can contribute to poor marital relationship.

Similarly, research also suggest that their can be reverse causal relationship as well. Thus, making it a vicious circle in which sleep disorders can lead to challenges in martial relationship which can further contribute to sleep dysregulation. Hence, in spite of having no direct causal relationship evidence, it becomes a complex association to understand and propose way forward. There are limited studies in which clinical interventions were used to correct sleep disorders in patients with marital challenges.

### Conclusion and Way Forward

There is limited direct evidence with respect to causal relationship between sleep disorders and divorce in general population. Current research also suggests the bi-directional association between the two rather than unidirectional. Sleep disorders and marital relationship derangement are more likely to be part of a vicious circle in which one can lead to the other. Future interventional clinical trials would be required to further substantiate causal relationship between sleep disorders and divorce in general population.

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