**Association of Poor Sleep Quality with Ischemic Heart Disease**

**Abstract**

Sleep is a topic of current discourse in medical science. The twenty-first century lifestyle has contributed to changes in the pattern of human behavior manifold. Sleep cycle disruption, reduced sleep hours and decreased sleep quality is one of the most affected aspects and reality of the modern world. Multiple studies have already established that insomnia is a significant cause of mortality increment but discrepancies persist. Insomnia may not be a direct cause of mortality but a secondary etiological factor, giving rise to morbid disorders including cardiovascular changes. This is a nested case-control study that establishes a relationship between the quality of sleep quantified in PSQI scale and the risk of development of ischemic heart diseases. The study recruited patients in experimental and control groups and found the relationship to be statistically significant with p<0.001, OR = 5.76 at Ci 95% with 4.392 Z-score. The correlation between low sleep quality on PSQI and development of ischemic heart disease was found to have AR 60.97%

**Keywords**

Sleep quality, Ischemic heart disease, PSQI, Insomnia, Cardiovascular diseases

**Introduction**

The twenty first century life-style has contributed to change in pattern of human behavior manifold. Sleep cycle disruption, reduced sleep hours and decreased sleep quality is one of the most affected aspects and reality of the modern world. In medical science, much attention to quality of sleep has not been paid. Multiple studies have already established that insomnia is a significant cause of mortality increment but discrepancies persist. Insomnia may not be a direct cause of mortality but a secondary etiological factor, giving rise to morbid disorders including cardiovascular changes, chronic depression and neoplastic changes in few cases1. In a longitudinal study it shown that in the studied population group, mortality rate in men was 21 percent and in women 5 percent due to insomnia2. Classically in the discourse of psychiatry and sleep medicine, the duration of sleep in given the utmost priority, but prospective cohort study has shown sleep regularity and sleep pattern as a more valuable predictor of mortality probability than sleep duration3. Blunt blood pressure dipping is a widely accepted predictor of adverse cardiovascular events. Poor sleep quality and lowered decline in sleep period sympathetic nervous system activity blunted blood pressure dipping is directly related4. A meta-analysis regression data from a cross-sectional study has shown that both lower and higher duration of sleep is related to adverse cardiovascular outcomes, establishing a U-shaped relationship between habitual sleep duration and arterial hypertension5. The concurrent theme of research in modern medical science thus has to be steered more towards assessment of sleep quality. Cross-sectional study has already demonstrated the relationship between sleep quality and heart rate variability (HRV). Poor sleep quality complimented with greater daytime activity results into lowered very-low frequency (VLF) of HRV6. Studies have also demonstrated rennin-angiotensin aldosterone system to be a regulatory factor of VLF7. Furthermore, studies have shown obstructive sleep apnea (OSA) to be linked with nocturnal activation of rennin-angiotensin aldosterone system8. Considering such contributing factors and factors of mutual associations, it was a clinical necessity to investigate into the effect of sleep quality on the ischemic heart diseases (IHD). This is a nested case-control study carried out at the department of cardiology at the City Clinic Hospital No. 31 named after G.M Savelyova, Moscow, Russian Federation. The aim of the study is to investigate and establish a correlation between sleep quality and risk of ischemic heart diseases.

**Methodology:**

The study was conducted in a clinical setup. Patients hospitalized in the cardiology department of City Clinic Hospital No. 31, Moscow with a recent history of ischemic heart disease not exceeding seven days were recruited. Recruited patients were diagnosed with ST-segment elevation myocardial infarction (STEMI), non ST-segment elevation myocardial infarction (NSTEMI), stable angina and unstable angina. The clinical data of these patients including complex blood analysis, instrumental investigations and anamnesis were compared with patients without history of IHD in control group. A total of 122 patients (N=122) were assessed in this study. In order to conduct a case control study, the patients were divided into two equal groups; 61 patients having recent history of IHD were grouped and tagged ‘P-IHD’ and the control group of 61 consisted of patients without any history of IHD and was tagged ‘N-IHD’. Among both the groups, equal distribution of age and sex was done. For the purpose of statistical analysis STATSOFT software was used9.

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| --- | --- | --- |
| Groups | Sex | Age (years) |
| P-IHD | 36 male (59%) | 69.3±11.58 | 67.6±11.31 |
| 25 female (41%) | 71.76±11.7 |
| N-IHD (control group) | 36 male (59%) | 69.4±6.33 | 65.8±4.88 |
| 25 female (41%) | 74.4±4.46 |

 **Table No. 1**: Age and sex distribution of both the participant groups

For the purpose of assessment of sleep quality, the Pittsburgh sleep quality index (PSQI) was used as it has time and again been proven to be most sensitive with 89.6% accuracy and most specific with 86.5% accuracy tool for the purpose10. The PSQI system comprises of a self-reported questionnaire with nineteen items in order to assess seven sleep components and quantify quality of sleep during past one month11. The seven components of PSQI include sleep quality, sleep onset latency, sleep duration, sleep efficiency, sleep disturbances, use of sleeping medications, and daytime dysfunction. Each of the seven sleep components in the questionnaire derives are score from 0 to 3 points and a summed additive result of all the components ranging from 0 to 21 points with 0 indicating no difficulty and the sleep quality decreases with increasing points. A PSQI score greater than or equal to 5 points indicates poor sleep quality and it deteriorates with increasing points12,13.

**Results**

The results obtained were significant from the point of view of both theoretical and clinical medicine. In the P-IHD group 67% of the recruited patients were having a poor sleep quality with greater than or equal to 5 points on PSQI scale. On assessment, the correlation between poor sleep quality and ischemic heart disease was found to be statistically significant with probability value less than 0.0001 (p<0.05), Odd’s ratio (OR) 5.76 at a confidence interval (Ci) of 95% with Z-score 4.392 on performing linear logistic regression. It was further noted than recruited patients in P-IHD with recent history of IHD in past seven days from the time of assessment of sleep quality had 2 points more on PSQI scale than the recruited patients in N-IHD groups.



**Fig No. 1:** Box and whisker plot demonstrating PSQI score and IHD (— Median; ☐25%-75% of interquartile range; I wishker; ⊞ extremity; o outliers)

For deeper understanding of the investigated correlation, extent of risk was assessed using statistical methods as well in groups P-IHD and N-IHD.

|  |  |  |  |
| --- | --- | --- | --- |
|  | Participants with a score ≥ 5 points on PSQI scale  | Participants with a score 0-4 points on PSQI scale | Total participants (N) |
| P-IHD | 41 | 20 | 61 |
| N-IHD | 16 | 45 | 61 |
| Totals | 57 | 65 | 122 |

**Table No. 2:** Distribution of participants in P-IHD and N-IHD groups as per points score on PSQI scale.

On the comparing the data it was found that the attributable risk (AR) was at 0.409, relative risk (RR) was at 2.562 and attributable risk percentage was at 60.97 for the development of Obstructive sleep apnea in patients of ischemic heart disease. Additionally, in the P-IHD group relationship graph using linear regression was plotted (y=0.052x + 3.346; R2= 0.032).

**Fig No.2**: PSQI score distribution in P-IHD group in linear regression model.

Thus the conducted case control study puts forward a statistically significant correlation between sleep quality and ischemic heart disease and establishes poor sleep quality as a risk factor of IHD.

**Discussion**

The relationship between ischemic heart disease and sleep quality is a relatively less studied and less discussed arena of medicine. This article puts forward an essential clinical case control study, where correlation between ischemic heart diseases and poor sleep quality was demonstrated. Conversely such relation is true as well, as per results obtained by *Bin Zhang et.al* in a cohort study setup in a bigger population in rural China, where high PSQI scores in participants was related with congenital heart diseases (CHD) and it was a prevalent phenomenon among short sleepers and those with poor sleep quality14. It has been demonstrated that high PSQI scores and analogically poor sleep quality is one of the factors of pathogenesis of cardio-vascular diseases15. In this study, 67% of participants in P-IHD group had poor sleep quality and high score on PSQI scale was statistically correlated with development of IHD (p<0.0001; OR=5.76; Z-score=4.39;Ci 95%). On comparison of data from the experimental P-IHD and control group N-IHD it was found that AR of development of IHD in patients with poor sleep quality was 60.97%. There are multiple probable mechanism of such output result. Sleep deprivation reduces decreases inspiratory motor output and thus alters inspiratory motor endurance. This results into decreased Vagal tone during inspiratory endurance tasks in humans and increases heart rate16. Insomnia is directly related to increased arterial stiffness and atherosclerosis of carotid artery17, predisposing to ischemic changes in cardiomyocytes. From the point of view of neuro-endocrinology, it must be appreciated that the hypothalamic-pituitary-adrenal axis, linked to circadian rhythm, a principal mediator of neuro-endocrine stress response system plays an important role in the development and progression of cardiometabolic diseases18. Sleep deprivation or poor quality results into significant hormonal imbalance with morning cortisol level decreasing by 30% and increasing by 40% in the afternoon approximately19 and same fate is received by catecholamines as well20. All such factors are known to be associated with increased incidences of coronary artery diseases21. In 2022, the ‘Life’s simple 7’ constituting important parameters of cardiovascular health was rectified to ‘Life’s simple 8’ by the American Heart Association by including sleep as an important parameters22. Insomnia has been also found to be associated with hypertension, increasing progressively with age23. Multiple sleep latency test based study has demonstrated physiological hyperarousal, contributing to development of hypertension and other co-morbid condition24. The hyperarousal can also result into sympathetic hyperactivity, resulting into ischemic changes in heart25.

**Conclusion**

Sleep deprivation and poor sleep quality, quantified on the scale PSQI is a risk factor of development of ischemic heart diseases. The case-control study puts forward statistically significant data to demonstrate the same. The modern day lifestyle has exposed individuals to sleep deprivation which is predisposing more and more healthy individuals to development of IHDs. It is necessary of the era to understand the importance of quality sleep from the point of view of medical science and conducted massive population study on the same. A common social and medical consensus has to be reached in this regard, to reshape work-life balance and reduce ischemic diseases.

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1.

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