Advances in Bioresearch
Adv. Biores., Vol 14 (6) November 2023: 56-64
©2023 Society of Education, India
Print ISSN 0976-4585; Online ISSN 2277-1573
Journal's URL:http://www.soeagra.com/abr.html
CODEN: ABRDC3
DOI: 10.15515/abr.0976-4585.14.6.5664

Advances in Bioresearch

ORIGINAL ARTICLE

The Nexus of Sleep, Diet, and Musculoskeletal Disorders in IT Professionals Working on Day and Night Shifts: An Empirical Study

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ABSTRACT
IT professionals who work with computer terminals and keyboards during different shifts experiences disrupted sleep, varied food intake pattern, and wide spectrum of musculoskeletal diseases. The study aimed of this study was to examine if there were variations in sleep quality, nutrition, and musculoskeletal disorder between computer professionals working day and night shifts. The quality of the sleep was measured using Pittsburgh Sleep Quality Index (PSQI), the diet quality was accessed using healthy eating index (HEI), and musculoskeletal discomfort in IT professionals was evaluated Cornell Musculoskeletal Discomfort questionnaire (CMDQ) was used to evaluate the musculoskeletal discomfort in IT Professionals. Correlation between PSQI and HEI score was positive, moderate and significant in day shift IT professionals however there was negative, moderate and significant correlation in nightshift IT professionals. There was strong, negative and nonsignificant correlation between the sleep quality and musculoskeletal disorders in day shift IT professional while in nightshift IT professionals there was significantly stronger and negative correlation. In addition, a weak significant positive correlation was found between diet quality and musculoskeletal discomfort both in the dayshift and nightshift IT professionals. Better sleep quality in day shift IT professionals seems to be balanced with health food intake, however, the nightshift IT professionals seems to consume more unhealthy diet with poor sleep quality. Sleep quality and diet quality affects both the day and nightshift IT professionals resulting in significant musculoskeletal disorders.

Keywords: *Sleep Quality, Diet Quality, Musculoskeletal disorders, IT professionals, day shift, night shift.*

Received 24.07.2023 Revised 01.10.2023 Accepted 23.11.2023

How to cite this article:
Ankita Sharma, Moattar Raza Rizvi. The Nexus of Sleep, Diet, And Musculoskeletal Disorders in IT Professionals Working on Day and Night Shifts: An Empirical Study. Adv. Biores., Vol 14 (6) November 2023: 56-64.

INTRODUCTION

Information and communication technology(ICT), a broad information exchange system, has been growing for over a century and rapidly accelerating in development.[1] Information technology (IT) now powers various sectors such as agriculture, healthcare, defense, education, weather forecasting, and more. India has been a pioneer in the digital world with a major IT industry.[2] Excessive computer use can cause sleep deprivation, musculoskeletal problems, and poor diet quality. Flexible working hours in IT jobs may lead to over dedication and sleep deficiency, which have been linked to higher health risks due to extended work duration and decreased sleep.[3, 4] Poor sleep quality can cause a sleeping disorder called insomnia and can decrease the quality of life (QOL).[5] Work profile in IT sector can be viable and exhausting with night shifts and high workloads. Professionals may also be exposed to computer screens for extended periods, affecting their sleep quality due to factors such as screen resolution, brightness, contrast, refreshing rates, glare, working distance, and angle of sight.[6, 7] The outcomes of lack of sleep and drowsiness have been noted as the main medical condition in our advanced society among shift workers. These outcomes shows a hike in mortality, morbidity, mishaps and mistakes,

leaves from work, decline in profitability, and weakening of personal and business bonding.[8] Shift workers regularly experience sleep problems, but they are usually misdiagnosed.[9] The quality of sleep is a crucial clinical aspect for maintaining the physical fitness of individuals. Inadequate sleep patterns can serve as a notable indication of various sleep disorders and other medical conditions, and may even have a direct impact on mortality rates. [10] Shift workers are a wide reaching category that normally work in desk bounded place for a long time in a day and in this manner, they have an expanded chances for the adverse consequences of an inactive way of life.[11] These people stay in a sitting desk bounded position for about two-thirds of their working time.[12] In addition, extended periods of time, time limitations, and an absence of social space all increment the chance of diminished active work.[13] Work-Related Musculo-Skeletal Disorders (WRMSDs) are general in IT workers. Utilizing some unacceptable seat or simply sitting inappropriately before a PC for long duration can lead to weaknesses like stiffness, headache, lower, and upper spinal pain. Muscles and tendons can get swollen because of long duration of sitting.[14, 15] Carpal tunnel syndrome is a typical case of over worked injury related to working on computers.[16] The increased utilization of video display terminals (VDTs) in modern office environments has raised concerns regarding potential health risks associated with their usage.[17] The WRMSDs explains a huge scope of inflammatory and degenerative diseases situations that bring about ache and functional disability influencing the neck, shoulders, elbows, wrists, and hands.[18] Shift workers deals with the changing hours of the day (morning, evening and night shift) or work at consistent hours of the day outside the regular all day (lasting nightshift). Nightshift work particularly brings sleeplessness and may lead to circadian interruption with injurious metabolic and cardiovascular effects.[19] Night workers tend to consume a different diet than day workers, with a higher frequency of snacking during work hours. Individuals who work non-traditional hours are more susceptible to the onset of health issues, potentially due to atypical or inadequate eating habits.[20] Previous studies have linked altered sleep and eating patterns to musculoskeletal disorders in workers, but have not explored the correlation with day-night shift changes. This study aims to evaluate the sleep quality, dietary habits, and musculoskeletal disorders of IT professionals on day or night shifts, and investigate the correlation between shift type and these factors.

MATERIAL AND METHODS

Study design, setting, and participants

A Correlational study was done after obtaining the data through survey method. Convenience sampling technique was used in this study for data collection.

Sample size calculation

The effective sample size was calculated using G*Power 3.1.9.4. A priori independent t-test suggested that an effective sample size of 128 was necessary to obtain a statistical power of 80% for detecting the training effect size(0.50) at the 0.05 level of significance. Total 128 participants were included in this study, out of which 64 were from dayshift and 64 from nightshift.

Inclusion and Exclusion Criteria

IT professionals of either sex with age 22-35 years, working since past 6 months for at least 6 hours or more per day, and in the same shift either day or night for last 6 months were included in the present study.

IT professionals suffering from chronic illness except occupational related, who underwent major surgery, or being part-time workers, having visual problems or post-traumatic stiff joint, fixed deformity and those having weakness and paralysis of limbs were excluded from present study.

Procedure

Consent from every participant was taken after informing the participant about the purpose, method and risk assessment of the study. The quality of the sleep was measured using Pittsburgh Sleep Quality Index (PSQI), the diet quality was accessed using healthy eating index (HEI), and musculoskeletal discomfort in IT professionals was evaluated Cornell Musculoskeletal Discomfort questionnaire (CMDQ) was used to evaluate the musculoskeletal discomfort in IT Professionals.

Pittsburgh Sleep Quality Index (PSQI)

PSQI is a self-reported questionnaire used to assess the quality of sleep-in individuals. The PSQI takes into account various factors related to sleep quality, such as sleep duration, sleep disturbances, sleep latency (time taken to fall asleep), sleep efficiency, sleep medication use, and daytime dysfunction. Each component is rated on a 0-3 scale, with higher scores indicating poorer sleep quality. The component scores are summed to produce a global score ranging from 0-21. Several research groups have evaluated the clinical and psychometric properties of the PSQI.[21]

Buysse DJ, Reynolds CF, Monk TH, et al. The Pittsburgh Sleep

Quality Index: a new instrument for psychiatric practice and research. Psychiatry Res 1989;28:193-213
Buysse DJ, Reynolds CF, Monk TH, et al. The Pittsburgh Sleep Quality Index: a new instrument for psychiatric practice and research. Psychiatry Res 1989;28:193-213
Buysse DJ, Reynolds CF, Monk TH, et al. The Pittsburgh Sleep Quality Index: a new instrument for psychiatric practice and research. Psychiatry Res 1989;28:193-213

Healthy Eating Index-2015

HEI-2015 is a scoring system used to evaluate the overall quality of an individual's diet based on the guidelines.[22] The HEI assigns scores to different components of a person's diet, including fruits, vegetables, whole grains, dairy, protein foods, added sugars, saturated fats, and sodium. Each component is evaluated based on specific criteria, such as the recommended intake levels and the proportion of total calories it should contribute to the diet. The scores for each component are then summed to obtain an overall HEI score, which ranges from 0 to 100. It uses the One-Day 24-Hour Recall Method to evaluate diet quality based on nutrient intake and healthy eating patterns.

Cornell Musculoskeletal Discomfort Questionnaire

CMDQ assesses musculoskeletal discomfort in different body regions with 10 specific items each addressing a specific body region (neck, shoulders, lower back, knees) and asking respondents to rate the severity and frequency of discomfort they have experienced in that region over the past month. Respondents rate the severity and frequency of discomfort over the past month and identify the duration and type of activity that triggers discomfort. The CMDQ is a valid measure to identify individuals at risk of musculoskeletal disorders and evaluate ergonomic interventions to prevent injuries. It's used in different occupational groups.[23, 24]

Statistical analysis

The statistical analyses were conducted using IBM SPSS for Windows version 25.0. Descriptive statistics are encompassed in statistical analyses. Pearson correlation analysis was employed to establish the relationships between PSQI and HEI, PSQI and CMDQ, and HEI and CMDQ. Values below 0.3 were deemed insignificant, while those falling between 0.3 and less than 0.5 were classified as low. Values ranging from 0.5 to 0.7 were categorised as moderate, and values exceeding 0.7 were deemed highly correlated.[25] All reported p values were two-tailed, $p<0.05$ was considered as significant.

RESULTS

The demographics of the participants are shown in Table 1. The table compares dayshift and nightshift workers in terms of age, BMI, sex, marital status, and working experience. The only significant difference found was in BMI, with nightshift workers having a higher average BMI than dayshift workers. There is also a significant difference in working experience, with more nightshift workers having less than 5 years of experience and more dayshift workers having 6-10 years of experience. No significant differences were found in age, sex, or marital status.

Sleep Quality

Average Global Score (PSQI) of IT Professionals working in different shifts was evaluated. In nightshift IT Professionals, Average Global Score (PSQI) was significantly higher (6.96 ±3.12) as compared to the day shift professionals (5.70 ±3.23). Mean Values of different components in different shifts are shown in the table 2. Night shift IT professionals had higher scores in subjective sleep quality, sleep latency, sleep disturbances, and daytime dysfunction. Day shift IT professionals had a higher total score for sleep duration. The difference in habitual sleep efficiency and use of sleeping medication between the two groups was not statistically significant.

Diet Quality

Diet quality as measured through the HEI score was found to be significantly higher for night shift IT professionals (73.9/100) as compared to the day shift professionals (66.8/100). Dietary adequacy in HEI-2015 as determined by nine components and moderation or limited consumption as determined by remaining four components are tabulated for day and night shift IT professionals in Figure 1. There was no significant difference in the dietary adequacy of healthy eating index between the day (41.2/60) and night shift (42.8/60) IT professionals. However, the score for moderation or limited consumption component of healthy eating index was significantly higher in night shift (31/40) as compared to the day shift (25.6/40) IT professionals (Table 3). Component score of HEI index for day and night shift IT professionals is represented in table 3. In adequacy component of HEI, fruits, grains and fats intake was significantly higher in day shift IT professionals. The dairy component was found to be significantly

higher in night shift IT professionals. There was no significant difference between the vegetables and protein foods intake between the day and night shift IT professionals. In limited consumption or moderation component of HEI both sodium component and empty calories (added sugar and saturated fat component) intake was higher in night shift IT professionals. There was no significant difference in the refined grains component between day and night shift IT professionals.

Musculoskeletal Discomfort Score

The overall musculoskeletal discomfort score in IT professionals in day shift IT professionals (34.9±6.94) was significantly ($p<0.01$) lower as compared to the night shift IT professionals (21.9±9.17). Table 4 shows the musculoskeletal discomfort (MSD) scores experienced in different parts of the body by the day and night shift IT professionals . The results revealed that there was significantly higher MSD scores for neck, right shoulder, right upper arm, lower back, right forearm, wrist, hips/buttocks, right thigh and right lower leg in night shift IT professionals as compared to the day shift. However, there was no significant difference in MSD score of left shoulder, upper back, left forearm, left thigh, right and left knee and left lower leg.

Correlation between Sleep Quality, Diet Quality and Musculoskeletal Discomfort

The association between diet quality and Sleep Global Score indicated a moderate positive and nonsignificant correlation ($r=0.51$, $p=0.315$) in day shift workers as compared to significant, moderate and negative correlation in night shift IT professionals ($r = -0.55$, $p<0.043$). A strong, negative and nonsignificant correlation ($r= -0.70$, $p=0.051$) was found between sleep quality and musculoskeletal disorders in day shift IT professionals. On the other hand, in the night shift IT professionals there was significant strong and negative correlation ($r = -0.77$, $p<0.035$) between sleep and musculoskeletal disorder. In addition, there was mild and significant correlation between the diet quality and musculoskeletal disorder amongst both day ($r = 0.41$, $p<0.041$) and night shift ($r = 0.47$, $p<0.038$) IT professionals (Table 5).

Table 1: Demographic characteristics amongst the dayshift and nightshift IT workers

Characteristics	Total (n = 128)	Dayshift (n = 64)	Nightshift (n = 64)	p value
Age (Year)	25.6±2.8	25.63±3.2	24.1±2.7	0.645
BMI	24.2±3.8	23.8±3.1	24.9±2.9	0.043*
Sex				0.531
Male	58 (55%)	28 (54%)	30 (57%)	
Female	49 (47%)	26 (50%)	23 (43%)	
Marital Status				0.056
Single	43 (41%)	24 (46%)	19 (36%)	
Married	62 (59%)	29 (54%)	33 (64%)	
Working Experience				0.041*
0-5 Years	55 (52%)	22 (42%)	33 (62%)	
6-10 Years	41 (39%)	24 (46%)	17 (32%)	
>10 Years	9 (8.5%)	6 (12%)	3 (6%)	
Data are presented as mean ± standard deviation values (independent sample t-test); *p < 0.05				

Table 2: Average Scores of all Components in Different Shifts and Total Population

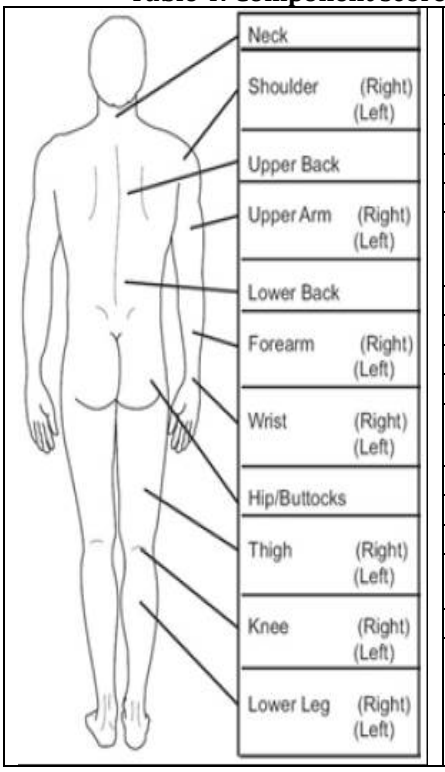
PSQI Components	Average Day Shift Global Score	Average Night Shift Global Score	P value
Subjective Sleep Quality	0.87 ±0.68	1.25 ±0.75	0.041
Sleep latency	1.17 ±0.91	1.31 ±0.97	0.036
Sleep duration	1.08 ±0.29	0.79 ±0.85	0.002
Habitual Sleep efficiency	0.47 ±0.73	0.75 ±1.22	0.091
Sleep disturbances	0.73 ±0.41	0.97 ±0.51	0.004
Use of sleeping medication	0.29 ±0.59	0.47 ±0.98	0.621
Daytime Dysfunction	1.09 ±0.98	1.42 ±1.08	0.026

Data are presented as Mean±Standard deviation values; PSQI: Pittsburgh Sleep Quality Index.

Table 3: Component scores in different shifts and total population

	Construct	Dietary intake	Average day shift diet score	Average night shift diet score	p value
Adequacy (60/100)	Fruits (10)	Total Fruit component	3.96±1.44	3.27±2.17	0.021
		Whole fruit component	3.63±1.69	3.21±2.31	0.044
	Vegetables (10)	Total Vegetable component	2.88±0.82	3.15±0.76	0.424
		Greens and Beans component	3.76±2.03	4.04±1.44	0.513
	Grains (10)	Whole grain component	6.82 ±1.33	6.08 ±1.66	0.039
	Dairy (10)	Dairy component	6.69 ±1.79	8.45 ±1.57	0.021
	Protein Foods (10)	Total Protein Food Component	3.96±0.42	4.02±0.45	0.621
		Seafood and Plant Protein Component	3.27±1.72	2.90±1.84	0.417
	Fats (10)	Fatty Acid Ratio Component	6.24 ±1.26	7.74 ±0.95	0.028
Moderation (40/100)	Refined Grains (10)	Refined Grains Component	7.83 ±2.58	7.88 ±3.27	0.564
	Sodium (10)	Sodium Component	7.08 ±1.95	8.37 ±1.72	0.032
	Empty Calories (20)	Added Sugar Component	5.46 ±3.14	7.41 ±3.34	0.017
		Saturated Fat Component	5.22 ±1.30	7.37 ±1.21	0.008

Table 4: Component scores of different shifts and total population



	Average Day Shift MSD Score	Average Night Shift MSD Score	p-value
Neck	2.65 ±0.60	3.20 ±0.82	0.042
Right shoulder	0.85 ±0.02	1.62 ±0.01	0.016
Left shoulder	1.42 ±0.58	2.12 ±0.63	0.035
Upper back	2.34 ±0.52	2.87 ±0.76	0.512
Right upper arm	1.17±0.26	2.5 ±0.75	0.043
Lower back	2.49±0.95	4.25 ±0.76	0.041
Right forearm	1.1 ±0.11	2.58 ±0.90	0.481
Left forearm	0.95±0.08	1.12 ±0.68	0.289
Wrist	0.9±0.29	2.25 ±0.64	0.034
Hips/buttocks	1.2 ±0.45	2.25 ±0.64	0.043
Right thigh	1.52 ±0.73	2.5 ±0.53	0.038
Left thigh	1.2 ±0.34	1.54 ±0.99	0.431
Right knee	0.92±0.13	1.5 ±0.91	0.610
Left knee	1.2±0.45	1.41 ±0.88	0.213
Right lower leg	1.1±.25	2 ±0.34	0.437
Left lower leg	0.9±0.94	1.12 ±0.94	0.725

Table 5 Correlation of different variables between day and night shift IT Professionals

Correlation between	Day shift IT Professionals	Night shift IT Professionals
Sleep Quality and Diet Quality	0.51 (p = 0.0315)	-0.55 (p = 0.043)
Sleep Quality and Musculoskeletal Discomfort	-0.70 (p = 0.051)	-0.77 (p = 0.035)
Diet Quality and Musculoskeletal Discomfort	0.41 (p = 0.041)	0.47 (p = 0.038)

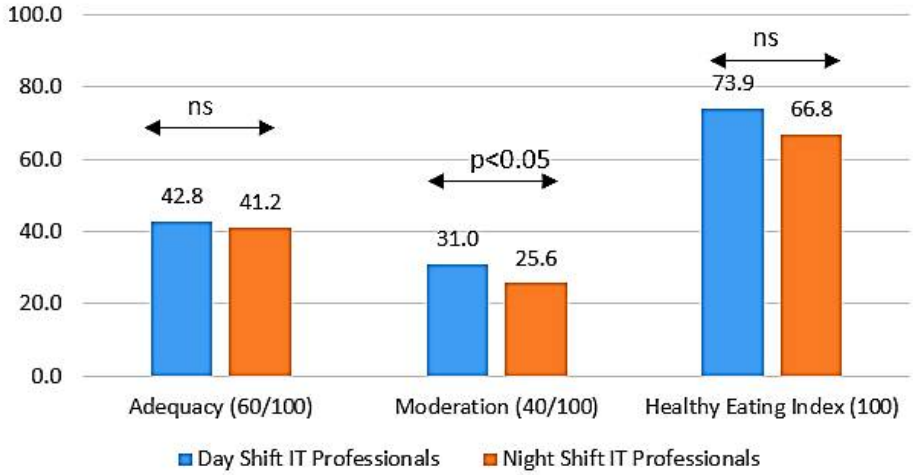


Figure 1: Diet quality as measured through Healthy Eating Index score in day and night shift IT Professionals.

DISCUSSION

Health and fitness is a necessary part for working life and lifestyle. Good health of IT Professionals are equally important for economic and productive growth of any Company, Bureau, Forum and for Nation also.[26] The physical well-being of IT professionals, particularly in terms of comfort, is significantly influenced by their sleep and dietary habits [27]. Poor sleep quality and poor diet quality is responsible for musculoskeletal discomfort [15]. In this study, we tried to find out the effect on sleep quality and diet quality in different shifts and influence of diet and sleep on musculoskeletal problems in different shifts of work. Nightshift IT professionals have a higher BMI compared to their dayshift counterparts, likely due to disrupted eating patterns and sleep. This increases the risk of various health issues such as cardiovascular disease, sleep apnea, reproductive issues, and musculoskeletal problems. Cheng et al. provide support for this assertion by emphasizing the association between working night shifts and a heightened susceptibility to metabolic syndrome. This may be due to the impact of disrupted sleep patterns on metabolism and hormone regulation, leading to weight gain.[28] Sleep disturbances are a common occurrence among individuals who work night shifts, primarily due to the disruption of the natural circadian rhythm. The study reveals that night shift IT professionals exhibit significantly higher levels of PSQI components, including sleep quality, latency, disturbances, and daytime dysfunction, in comparison to their day shift counterparts. Arendt and Rajaratnam discuss the negative health consequences of shift work and sleep deprivation on individuals who work outside traditional daytime hours, emphasizing the impact on sleep and overall well-being.[29] Akerstedt and Wright also found out the significant impact of shift work on sleep and fatigue, and the potential for this to leading to shift work disorder.[30] Diet quality as measured through the HEI score was found to be significantly lower for night shift IT professionals as compared to the day shift professionals although there was no significant difference in the dietary adequacy of healthy eating index between the day and night shift of IT professionals. A prior investigation investigated the impact of occupational stress, dietary patterns, and physical exercise on the well-being of IT experts in India. The results indicated a significant correlation between stress and suboptimal dietary habits in this population. The study found that IT professionals who experienced elevated levels of work-related stress exhibited a reduced consumption of fruits and vegetables, while concurrently demonstrating an increased consumption of fried and fatty foods.[31] According to a study conducted by de Rijk, individuals who worked night shifts exhibited a correlation with inferior dietary quality. The findings indicate that individuals who work the night shift tend to consume fewer fruits and vegetables, while consuming a greater amount of energy-dense foods (such as snacks, sugar-sweetened beverages, and processed foods), and lower overall dietary quality scores the finding goes in line with the findings of this study where the night shift professionals were found to be taking the higher amount of diary components, added sugar and saturated fats as compared to the day shift professionals [27]. Day shift IT professionals had a significantly higher average musculoskeletal discomfort score than night shift workers. Night shift IT professionals had higher MSD scores in regions such as the neck, right shoulder, right upper arm, lower back, right forearm, wrist, hips/buttocks, right thigh, and right lower leg compared to day shift workers. A previous study reported a negative impact of night-shift work on the musculoskeletal health of female nurses in Japan.[32] Musculoskeletal discomfort in night-shift workers can result from various factors, including the work environment, tasks, and

disruption of circadian rhythm. According to Soares et al., healthcare workers on night shifts experienced higher musculoskeletal discomfort rates in areas like the neck, shoulders, and lower back. Those who worked longer hours and had more frequent night shifts experienced greater intensity of discomfort.[15] Poor sleep quality is significantly correlated with musculoskeletal disorders in night shift IT professionals. This may be due to the body not having enough time to repair and regenerate tissues that are damaged during daily activities. Chronic inflammation, associated with several musculoskeletal disorders, can result from this. The study conducted by Almhdawi et al. revealed a significant correlation between inadequate sleep quality and musculoskeletal discomfort in nursing personnel. The study found that nursing personnel exhibiting suboptimal sleep quality experienced a greater incidence of musculoskeletal discomfort in comparison to their counterparts who reported satisfactory sleep quality.[33] The study revealed a correlation, ranging from mild to significant, between the quality of diet and musculoskeletal disorders among IT professionals working both day and night shifts. Insufficient consumption of specific nutrients and overconsumption of others, resulting in poor diet quality, have been linked to an elevated likelihood of musculoskeletal conditions, such as osteoporosis, osteoarthritis, and rheumatoid arthritis. According to a study, there exists a positive correlation between the consumption of a diet that is rich in sugar and saturated fat and the likelihood of developing osteoarthritis in women. The research additionally revealed that a dietary regimen abundant in fruits, vegetables, and whole grains exhibited a correlation with a reduced likelihood of developing osteoarthritis.[34] A research study has indicated that a deficient intake of vitamin D is linked to a heightened likelihood of osteoporosis development in elderly individuals. The consumption of Vitamin D is crucial for maintaining optimal bone health, and insufficient intake may result in reduced bone density and an elevated susceptibility to fractures.[35]

LIMITATIONS

The research employed a cross-sectional methodology, which gathered information at a singular instance, thereby posing challenges in establishing a causal relationship between sleep quality, diet quality, and musculoskeletal issues, ascertaining which variable preceded the others remains unclear. The research was dependent on data provided by the participants themselves, which could potentially be influenced by partiality and imprecision. The research exclusively utilised subjective metrics, such as self-reported dietary patterns and sleep quality. The utilization of objective measures, such as actigraphy or biomarkers, may yield more precise and reliable information pertaining to an individual's sleep quality and dietary patterns.

CONCLUSION

In conclusion, the available research suggests that there is a relationship between sleep quality, diet quality, and musculoskeletal problems among day and nightshift IT professionals. Poor sleep quality and unhealthy dietary habits may contribute to the development of musculoskeletal problems, with night shift workers being at greater risk due to disruptions in their circadian rhythm. It is important to promote healthy sleep and dietary habits among IT professionals, especially those working in night shifts, to reduce the risk of musculoskeletal problems. Further research is needed to better understand these relationships and to identify effective interventions for promoting healthy habits in this population.

Financial support and sponsorship

Nil.

Conflicts of interest

There are no conflicts of interest.

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