EFFECT OF SLEEP WAKE DISORDER ON OCULAR HEALTH AND VISUAL PERFORMANCE OF NIGHT SHIFT DRIVERS

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ABSTRACT

PURPOSE: *Current study aimed to investigate the relation of sleep disturbance on ocular health and visual performance during night driving among professional night shift drivers.*

METHOD: *This was a cross-sectional study including 40 night shift male professional drivers (Age ranging from 26-55 years). After taking informed consent, data related to night driving, sleep, ocular health problems) and visual performance was collected from all these subjects by self-designed pro-forma. Visual functions were assessed.*

RESULTS: *Sleep wake disorders were not prevalent as 7 (17.5%) drivers declared disturbed sleep and 9 (22.5%) experienced it sometimes. Among ocular health problems, 12.5% drivers had ocular burning, 20% with eye redness, 10% with itching, 12.5% with watering, 30% with ocular fatigue and 40% drivers reported flashlight piercing during night driving. 17.5% drivers feel decrease of visual performance with passage of time. 2.5% drivers had occasional difficulty to recognize traffic signals and 5% reported seldom difficulty to recognize sign boards and other objects during night driving. Four (10%) drivers were involved in road crashes, three (7.5%) with normal and one (2.5%) with defective VA. There was no statistically significant correlation of sleep disturbance with ocular health and visual performance.. Ocular health problems including redness, watering ocular burning and above all fatigue were common among night drivers ($p<0.05$).*

CONCLUSION: *Sleep wake disorder is not common among night drivers and it has no statistically significant relation regarding its effects on ocular health and visual performance. However, ocular fatigue is common with frequent or occasional sleep disturbance.*

KEY WORDS: *sleep wake disorders, ocular*

INTRODUCTION

Sleep is a biotic process which is obligatory for conservation of life and optimal health.[1,2] It is an active process that is generated and modulated by neural systems located in thalamus, hypothalamus and brainstem.[3] It has a crucial role in functioning of brain and systemic physiology regarding functioning of cardio-vascular system, immune system, endocrine system and body metabolism. Normal healthy sleep refers to sufficient sleep duration, proper and regular timing without any sleep disorder. About 70 million people in USA and 45 million people in Europe have chronic sleep disorder that affects their routine functioning and health. For example, driver sleepiness is associated with 20% serious injuries resulting from car accidents.[1,4] There are about 100 sleep disorder categorizations, but they are classically exhibited in one of the three ways: an incapability to retain sleep continuity (sleep fragmentation or sleep disruption), failure to get quality sleep or insufficient amount of sleep (sleep deficiency) and incidents that occur during sleep (i.e. sleep apnea).[1]

A current study by Centers for Disease Control and Prevention (CDC) reveals that between 1985 and 2012 average sleep period reduced and the fraction of adults sleeping ≤ 6 hours per day raised. The trend signifies a near doubling in the figure of U.S adults sleeping ≤ 6 hours per day from about 38 million to 70 million.[2] Different environmental aspects e.g., occupational duties, family burdens, and communal and recreational

prospects, may lead to significant incompatibilities between the amount of sleep required and the amount of sleep obtained.[2,5]

It is suggested that disturbance in sleep is associated with disruption in circadian rhythm and even hypertension and metabolic syndrome.[6] Poor quality sleep and lack of sleep contribute to fatigue. For an adult, average sleep required is 7-8 hours per day. Lack of sufficient rest contributes to driver's weariness on the next day. If the sleep imbalance continues to occur and becomes too large, it will lead to microsleep.[7]

Fatigue and sleepiness are correlated and frequent among truck drivers. In spite of their disparate inferences with regard to diagnosis and cure, these two terms are often used reciprocally, or unified under the broad term tired, sleepy or exhausted.[8] It is claimed that fatigue (sleepiness, tiredness) is the largest noticeable and avoidable root of accidents (between 15% and 20% of all accidents).[9] There is affirmation that sleepiness is related to sensitive eye symptoms, for example, 'eye tiredness' increases before the point of no more being capable for driving in a simulator. It has been reported that difficulty to keep eyes open is common feeling by drivers who fall asleep during driving.[10] Driving performance is compromised by sleepiness and it affects decision taking, attentiveness and psychomotor performance.[11,12]

Many professions e.g., transport, healthcare involve shift work. One who works outside the normal day light hours is regarded as shift worker. It is known that shift work disturbs circadian rhythm and leads to sleep disruption.[9] One of the commonest professions in the world is driving with exclusion of being daily routine and sports for private car owners.[13] In the last two decades, there has been sharp rise in road traffic accidents in developing countries like India. RTAs (road traffic accidents) are leading cause of death from trauma and so major health problem worldwide. Truck drivers are susceptible to highway accidents because of various reasons but visual functions impairment can be one of the major causes. It has been estimated that road traffic injuries will rank as third among causes of disability –adjusted life years (DALYs) lost by 2020.[14]

It is challenging to drive at night due to various reasons such as dimness, headlight glare of oncoming traffic that makes difficult to recognize road signs, pedestrians and onrushing traffic.[15] It has been revealed that main reason behind increased pedestrian mortality rate is poor visibility at night rather than increased fatigue and alcohol.[16] For driving, one's central vision and peripheral fields must be adequate. Driving is a visually intensive task that requires mental ability, sensory ability (mainly visual) and compensatory abilities.[14] It has been found that vision contributes 95% of sensory input to brain for driving.[13,17,18] Night driving becomes more crucial for older drivers because of age related degeneration in vision. Good visual acuity, normal color vision, good stereopsis, adaptation to various levels of illumination and adequate eye coordination are mandatory for drivers to avoid road traffic accidents.[15]

Road traffic accidents occurring at night time are two to four times higher than day time and visual factors are main cause for this.[15,16] There is always some light available when driving at night, so night driving demands mesopic rather scotopic vision. Mesopic vision is a combination of photopic and scotopic vision in low but not quite dark lightning conditions. It has been reported that even in the absence of ocular diseases, mesopic vision decreases and glare sensitivity increases with advancing age. So, more drivers

are subjected to night vision difficulties, because of increasing number of elderly drivers.[19] Under mesopic light conditions of night driving, visual function is reduced and these effects are aggravated by visual impairment and increasing age. Vision and night driving is affected by light and glare from road lightning and headlights.[20]

MATERIALS AND METHODS

This cross-sectional study was conducted in the months of September to December 2020. Forty male night shift professional drivers working at Badami Bagh Bus Terminal, Lahore were included. After taking informed consent from drivers who met the inclusion and exclusion criteria, questions related to their sleep, driving, ocular health and visual performance during night driving were asked. Visual functions involving visual acuity, visual field, contrast sensitivity and color vision were also assessed using Snellen Illiterate-E chart, Confrontation method, Pelli-Robson chart and Ishihara chart respectively. All data was entered in and analyzed by Statistical Package for Social Sciences (SPSS) software (version25). Qualitative data was analyzed by using frequency and percentages. For categorical data cross tabs was used. Spearman correlation was applied to see the relationship between sleep disturbance, sleepiness and other parameters. P value ≤ 0.05 was taken as significant.

RESULTS

The results of the study showed that out of 40 male night shift professional drivers aged 41.35±7.80 years old (26 years to 55 years), 85% drivers had night driving experience >10 years (table 1) and driver age had a significant correlation with night driving experience (p=0.003) as with increasing age drivers become more experienced (table 2). 7.5% drivers sleep 3-4 hours, 27.5% sleep 4-6 hours, 37.5% sleep 6-8 hours and 27.5% sleep 8-10 hours per day. 40% drivers drive 6 hours, 20% drive 8 hours and 37.5% drive ≥10 hours at night as shown in table 1. 22.5% drivers who drove ≥10 hours reported occasional sleep during night driving (figure 1), and there was significant relation between night driving experience and night driving hours (p<0.001) given in table 2. It seems with increasing experience drivers become able to cope night driving conditions, sleep disturbance and sleep while driving and able to drive longer hours. Sleep was common among night drivers as 21 (52.5%) drivers reported sleep sometimes while night driving (table 1). 10% drivers were involved in road traffic crashes and 5% were those who occasionally sleep while driving (figure 2). And 7 (17.5%) drivers had sleep disturbance while 9 (22.5%) drivers had intermittent sleep disturbance because of night shift driving as given in table 1. Almost all drivers with sleep disturbance reported sleep during night driving (table 3). And sleep disturbance because of night shift driving was prevalent among drivers who sleep ≤8 hours per day. Disturbance in sleep was not common among drivers who sleep 10 hours per day as shown in table 3.

Among ocular health problems, 12.5% drivers had ocular burning while 17.5% drivers reported burning in eyes sometimes, 20% with eye redness and 30% had occasional redness in eyes (table 1). Eye redness was common among drivers who reported infrequent disturbance in sleep (table 3) and there was found statistically significant correlation of ocular redness with ocular burning sensation (p=0.004) as evident from (table 2). 10% with itching in eyes whereas 7.5% had intermittent ocular itching, 12.5% drivers reported watering from eyes whereas 22.5% had infrequent watering (table 1). Watering was

significant in drivers who reported sleep while night driving (p=0.030) as given in table 2. 10% drivers with occasional sleep disturbance reported infrequent watering from eyes while night driving (table 3). Ocular fatigue was more prevalent as 30% drivers responded yes while 35% drivers had ocular fatigue off and on (table 1). Out of 20% drivers with intermittent ocular fatigue, 12.5% reported sleep disturbance because of night driving (table 3) yet there was no significant relation of these. However, significant association of ocular burning sensation with ocular fatigue was found (p<0.001) as shown in (table 2). Among all of these, flashlight piercing (glare) was most common, as 40% drivers reported headlight piercing and 25% had intermittent flashlight piercing from headlamp of other vehicles while driving at night as shown in table 1. And there was not found any statistically significant correlation of sleep disturbance with any ocular health problem and visual performance. However, burning in eyes, eye fatigue, eye redness, watering from eyes and flashlight piercing (glare) were reported by drivers with occasional sleep during night driving as given in figure 1.

17.5% drivers (12.5% driving 6 hours at night) reported decrease in their visual performance with passage of time while 12.5% (5% driving 8 hours and 7.5% driving 10 hours at night) suffer this off and on during night driving (Figure 3). Out of 21 (52.5%) drivers with occasional sleep during driving, 3 (7.5%) drivers reported decreased visual performance and 3 (7.5%) drivers reported intermittent decrease of visual performance (figure 1). There was statistically significant correlation of decrease of visual performance with passage of time with night driving hours (p=0.030) and RTAs (p<0.001) while night driving (table 2). 2.5% had difficulty for traffic signals recognition and 5% reported difficulty to recognize sign boards and other objects while night driving, 4(10%) drivers were involved in road traffic accidents while driving at night, three with normal and one with defective visual acuity. 57% drivers had history of past ocular examination concerning any ocular health or visual problems, 43% drivers had never visited an eye-clinic (table 1).

Visual functions play prime contribution for safe driving particularly visual acuity. Visual functions e.g., visual acuity, visual field, contrast sensitivity and color vision were assessed using Snellen Illiterate-E chart, Confrontation method, Pelli-Robson chart and Ishihara chart respectively. It is depicted from table 1 that 8 (20%) drivers have defective visual acuity, 4 (10%) had constricted visual field and 6 (15%) drivers have mild defective contrast sensitivity. 1 driver (2.5%) was found with severe defective color vision and he was not aware of this defect (table 1). Present study showed significant association of driver age with visual acuity (p=0.022) and contrast sensitivity (p=0.012) given in table 2. Defective visual acuity and deficit contrast sensitivity were prevalent among drivers with age in 40s or older.

DISCUSSION

Sleepiness or difficulty to stay awake epitomizes a risk in many trades. There is plenty of research on transport professions such as long haul truck drivers, bus drivers, air-line pilots[21] or train drivers which involve shift work.[22] Night shift work is usually related with sleep disruption and sleep deprivation, this decreases mental or cognitive performance involving driving competencies.[23] Compromised fitness to drive raises risk of accidents for driver, travelers as well as walkers particularly in urban public transport. A study on urban drivers established that 19%

drivers fall asleep and they have to cope with sleepiness while driving to remain awaken at least two to three times per week. Severe sleepiness linked with fatigue is associated with safety hazards e.g., near crashes.[24]

In a study aimed to check association between sleep quality, sleep apnea and sleepiness in drivers, the sample among qualified drivers was picked via convenience sampling method. About 25.8% drivers had obstructive sleep apnea, 96% drivers were with undesirable sleep quality and 6.8% drivers had abnormal sleepiness during day. The results of this study recommended that there should devise strategies to moderate driving time in day as well as night and should be short brakes during driving.[25]

A study involving 154 drivers regarding sleepiness symptoms during driving and their relation to preceding sleep and work discussed that 33% drivers had sporadically sleepiness and 8% reported frequent sleepiness. And 118 drivers stated that they had to discontinue driving because of excessive sleepiness and tiredness. Poor quality sleep, lesser sleep hours, irregular work hours and above all preceding sleep before driving was the main contributor to sleepiness during driving. And there was no effect of working experience, age and sort of work with sleepiness among participants.[26]

In current study 40 male professional drivers working in night shift were included. Sleep was common among night drivers as 21 (52.5%) drivers reported sleep sometimes while night driving. And 7 (17.5%) drivers feel sleep disturbance while 9 (22.5%) drivers had sleep disturbance at sometimes because of night shift driving. A significant number of drivers either sleep for longer or shorter hours per day infrequently undergo sleep while driving. It might be as working at night disturbs natural internal circadian sleep wake cycle so inducing drowsy sleep during driving.10% drivers were involved in road traffic crashes and 5% were those who occasional asleep while driving.

This study aimed how sleep disturbance affects ocular health (for example, burning sensation in eyes, eye redness, itching, watering eyes, eye fatigue or tiredness, head-light piercing from onrushing vehicle) and visual performance during night driving. Filtness AJ, et al. studied concerning sleep related eye symptoms and their potential for identifying driver sleepiness. They choose 16 participants but they did not choose night shift professional drivers. The results showed that four sleep related eye symptoms i.e., eye strain, heavy eyelids, difficulty to keep eyes open and difficulty to focus seemed to be good indexes of sleepiness in real road driving conditions. Their results are shown in (figure 4) about prevalence of eye symptoms.[10]

Another study had shown that most recurrent symptoms of sleepiness reported by drivers while driving were yawning (94%), eye fatigue (83%) and sensation of heavy eyelids (75%).[26] But present study reports that burning in eyes, eye fatigue, eye redness, watering from eyes and flashlight piercing (glare) were usually reported by drivers with occasional sleepiness during night driving. 20% drivers responded in yes for redness in eyes and 30% had ocular redness at times. 12.5% drivers had watering from eyes and 22.5% reported watering occasionally. 12.5% drivers responded yes and 17.5% had occasional burning sensation in eyes. 30% drivers had frequent eye fatigue while 35% had ocular fatigue off and on. A study concluded that common visual impairments deteriorate the driver's visual potential to discern pedestrians during night driving. So, drivers should put on their best optic correction and maintain ocular health to avoid

hazardous decline in visual performance.[27]

It has been described that in simulating driving conditions, deprive in sleep prompted reduction in visual abilities of subjects to distinguish signal in central area of visual field.[28] In this study, 17% drivers feel decrease of visual performance with passage of time during night driving. It seems to be due to prevailing fatigue and sleepiness. Out of 21 (52.5%) drivers falling asleep during driving, 6 (15%) drivers reported decrease of visual performance.

Visual functions play prime contribution for safe driving particularly visual acuity. For safe driving, standard visual acuity requirement in most countries is 20/40 (6/12) in both eyes.[18] But there is notable variation of visual standards globally. VA requirement for private license vary from at least 6/9 to 6/60 and requirement for visual field varies from 110° to 150°.[29] At night visual performance for driving is affected by low illumination environment, so in current study we set criteria for normal VA as 6/9 in both eyes and 8 (20%) drivers had defective distance visual acuity evaluated using Snellen illiterate-E chart. 4 (10%) drivers were involved in road traffic accidents while driving at night three with normal and one with defective visual acuity and there was not found statistically significant correlation of visual functions with road crashes. So, it suggests that defective visual acuity is not primary cause of road crashes, besides visual acuity, there are multiple factors that may affect visual performance for driving at night and lead to road traffic accidents. Pepple GF, et al. conducted a study to assess relevance between ocular status of professional drivers and road traffic accidents. Out of four hundred participants, 7 (1.8%) were with visual impairment, 18 (4.5%) were color vision deficient ($p>0.05$) and drivers with defected visual field were 4% ($p>0.05$). Out of 182 drivers who were involved in road crashes, only 2 (1%) had visual impairment ($p>0.05$). They found cataract as the principal root of defective vision (42%). They concluded that there was no statistically significant relation of visual impairment and road traffic accidents and possibly other factors may be cause of road crashes.[30] And these findings are in relevance with this study. A study on four hundred and seven professional drivers reported that about 17% participants had visual acuity below than minimal standard VA necessary for driving.[31] Another study on commercial drivers (340 participants) recorded that about 15% drivers had VA below 6/9 in both eyes.[18] This study shows correlation with current study.

Color vision is also requirement in road traffic regulations by traffic signals. In present study, Ishihara color vision chart was used to evaluate color vision. Just 1 (2.5%) driver was found with severe defective color vision and he was not aware of this defect. In 2019, a survey involving 300 professional drivers in Karachi, reported that 7 drivers were complete color blind and two drivers had problem to recognize green and red colors. None of these was aware of this imperfection.[32] Contrast sensitivity becomes more important for safe driving in dim light conditions especially at night. Contrast sensitivity was assessed using Pelli Robson contrast sensitivity chart. 15% drivers were found with mild defective contrast sensitivity. 10% drivers were with constricted visual field checked by confrontation method. A study on 55 male night shift drivers presented that 9% were with reduced visual field, 18% with mild defective contrast sensitivity and 13% had defective visual acuity.[15] This study shows correlation with current results.

In the light of above discussion, it is evident that

sleep disturbance and sleep while driving are common among night shift drivers which negatively impact on drivers' health, visual and driving competencies and impose a huge barrier for road safety. Besides these normal visual functions are also essential elements for safe driving and road safety. So there should be campaigns for creating awareness about these factors among drivers particularly night shift drivers by national highway authorities as well as medical professionals to ensure road safety.

CONCLUSION

It is concluded from this study that sleep disturbance is not much common among night drivers. 7 (17.5%) drivers reported sleep disturbance and 9 (22.5%) had occasional disturbance in sleep. And it has no statistically significant relation regarding its effects on ocular health and visual performance yet significant number of drivers with either frequent or infrequent sleep disturbance commonly report ocular fatigue. But watering from eyes, eye redness, burning in eyes and above all eye fatigue was common among drivers who report occasional sleep while night driving.

AUTHOR CONTRIBUTIONS

Ali Asad:
Concept, Design, Data Collection
Humera Zafar Ali:
Data Collection, Literature Review, Drafting
Andleeb Zahare:
Data Analysis, Literature Review
Samreen Jamal:
Data Collection and Analysis, Critical Review
Rashida Riaz:
Statistical Analysis, Manuscript Review

SUGGESTIONS

Drivers should take break after some hours of night driving or whenever they feel sleepiness and eye tiredness. Avoid night driving while feeling sleepiness. If you feel tired or ill, don't drive. (https://headfastco.wordpress.com/2011/03/24/national-highway-motorway-police-pakistan-rules/) Driving can make driver to feel sleep. To help avoid this, make sure there is a supply of fresh air into your vehicle. If you feel tired while driving, find a safe place to stop and rest. (https://headfastco.wordpress.com/2011/03/24/national-highway-motorway-police-pakistan-rules/) Do not sleep while driving or leave your vehicle un-attended. *(https://headfastco.wordpress.com/2011/03/24/natio nal-highway-motorway-police-pakistan-rules/)* Drivers should wear optimum optical correction (glasses or contact lenses) to avoid potentially dangerous reductions in visual performance particularly during night driving. At night or in poor visibility, do not use tinted glasses, lenses or visors. *(https://headfastco.wordpress.com/2011/03/24/national-highway-motorway-police-pakistan-rules/)* Drivers should regulate their daily sleep-wake hours to fit for night driving and to avoid sleepiness dominancy while night driving to ensure road safety. Drivers should have ocular check-up at least once a year either they feel any eye related problem or not. There should be free visual screening programs within motor parks for drivers by road safety stakeholders and philanthropists. There should be awareness campaigns to educate commercial drivers on the dangers of inattentive driving. Don't drive at night without proper tail lights. *(https://headfastco.wordpress.com/2011/03/24/natio nal-highway-motorway-police-pakistan-rules/)* Driver must have a valid driving license and current fitness certificate to ensure road safety. *(https://headfastco.wordpress.com/2011/03/24/natio nal-highway-motorway-police-pakistan-rules/).*

Table 1: Distribution by Night driving, Sleep pattern, Ocular health, Visual performance and Visual Functions (n=20)

			No. of participants (%)
Distribution by Night Driving and Sleep Pattern	Night Driving Experience	6 month-1yr	2 (5.0%)
		1yr-5yr	0 (0.0%)
		5yr-10yr	4 (10%)
		>10yr	34 (85%)
	Daily Sleep Hours	3-4 hours	3 (7.5%)
		4-6 hours	11 (27.5%)
		6-8 hours	15 (37.5%)
		8-10 hours	11 (27.5%)
	Night Driving Hours	4 hours	1 (2.5%)
		6 hours	16 (40.0%)
		8 hours	8 (20.0%)
		10 hours	15 (37.5%)
	Sleep While Driving	No	19 (47.5%)
		Sometimes	21 (52.5%)
	Sleep Disturbance	Yes	7 (17.5%)
		No	24 (60.0%)
		Sometimes	9 (22.5%)
Distribution by Ocular Health	Ocular Burning	Yes	5 (12.5%)
		No	28 (70.0%)
		Sometimes	7 (17.5%)
	Ocular Redness	Yes	8 (20.0%)
		No	20 (50.0%)
		Sometimes	12 (30.0%)
	Ocular Itching	Yes	4 (10.0%)
		No	33 (82.5%)
		Sometimes	3 (7.5%)
	Watering	Yes	5 (12.5%)
	while driving	No	26 (65.0%)
		Sometimes	9 (22.5%)
	Ocular Fatigue	Yes	12 (30.0%)
		No	14 (35.0%)
		Sometimes	14 (35.0%)
	Flashlight Piercing	Yes	16 (40.0%)
		No	14 (35.0%)
		Sometimes	10 (25.0%)
Distribution by Visual Performance	Decreased visual performance	Yes	7 (17.5%)
		No	28 (70.0%)
		Sometimes	5 (12.5%)
	Traffic signal recognition	Yes	39 (97.5%)
		No	0 (0.0%)
		Sometimes	1 (2.5%)
	Sign boards recognition	Yes	38 (95%)
		No	0 (0.0%)
		Sometimes	2 (5.0%)
	RTA while night driving	Yes	4 (10.0%)
		No	36 (90.0%)
Distribution by Visual Functions and Past Ocular Examination	Visual acuity	Normal	32 (80.0%)
		Defective	8 (20.0%)
	Color vision	Normal	39 (97.5%)
		Severe defective	1 (2.5%)
	Visual field	Normal	36 (90.0%)
		Constricted	4 (10.0%)
	Contrast sensitivity	Normal	34 (85.0%)
		Mild defective	6 (15.0%)
	Past ocular examination	Yes	23 (57.5%)
		No	17 (42.5%)

Table 2: Correlations of Driving, Sleep Pattern, Ocular Health and Visual Performance (p-value ≤ 0.05 is significant)

Driver Age		0.003	0.835	0.459	0.540	0.905	0.512	0.147	0.855	0.204	0.668	0.745	0.063	0.346	0.045	0.351	0.022	0.012
Night Driving Experience	0.003		0.009	0.001	0.898	0.235	0.263	0.140	0.867	0.291	0.812	0.783	0.502	0.681	0.555	0.560	0.195	0.277
Daily Sleep Hours	0.835	0.009		0.021	0.243	0.925	0.002	0.232	0.937	0.328	0.072	0.652	0.766	0.191	0.848	0.204	0.381	0.667
Night Driving Hours	0.459	0.001	0.021		0.820	0.318	0.251	0.164	0.244	0.696	0.065	0.030	0.835	0.252	0.514	0.369	0.804	0.499
Sleep While Driving	0.540	0.898	0.243	0.820		0.964	0.987	0.643	0.703	0.030	0.462	0.552	0.609	0.348	0.944	0.626	0.355	0.898
Sleep Disturbance	0.905	0.235	0.925	0.318	0.964		0.394	0.170	0.581	0.216	0.769	0.929	0.579	0.923	0.220	0.585	0.820	0.359
Ocular Burning	0.512	0.263	0.002	0.251	0.987	0.394		0.004	0.998	0.066	0.001	0.636	0.106	0.076	0.005	0.132	0.773	0.296
Ocular Redness	0.147	0.140	0.232	0.164	0.643	0.170	0.004		0.997	0.512	0.201	0.672	0.854	0.189	0.028	0.288	0.717	0.328
Ocular Itching	0.855	0.867	0.937	0.244	0.703	0.581	0.998	0.997		0.009	0.353	0.511	0.362	0.013	0.963	0.982	0.466	0.382
Watering	0.204	0.291	0.328	0.696	0.030	0.216	0.066	0.512	0.009		0.055	0.412	0.502	0.113	0.885	0.196	0.637	0.052
Ocular Fatigue	0.668	0.812	0.072	0.065	0.462	0.769	0.001	0.201	0.353	0.055		0.150	0.876	0.237	0.064	0.899	0.437	0.476
Decreased Visual Performance	0.745	0.783	0.652	0.030	0.552	0.929	0.636	0.672	0.511	0.412	0.150		0.964	0.916	0.238	0.001	0.837	0.319
Flashlight Piercing	0.063	0.502	0.766	0.835	0.609	0.579	0.106	0.854	0.362	0.502	0.876	0.964		0.786	0.845	0.679	0.015	0.634
Traffic Signal Recognition	0.346	0.681	0.191	0.252	0.348	0.923	0.076	0.189	0.013	0.113	0.237	0.916	0.786		0.822	0.824	0.623	0.680
Sign Boards Recognition	0.045	0.555	0.848	0.514	0.944	0.220	0.005	0.028	0.963	0.885	0.064	0.238	0.845	0.822		0.074	0.481	0.554
RTA While Night Driving	0.351	0.560	0.204	0.369	0.626	0.585	0.132	0.288	0.982	0.196	0.899	0.001	0.679	0.824	0.074		0.543	0.074
Visual Acuity	0.022	0.195	0.381	0.804	0.355	0.820	0.773	0.717	0.466	0.637	0.437	0.837	0.015	0.623	0.481	0.543		0.389
Contrast Sensitivity	0.012	0.277	0.667	0.499	0.898	0.359	0.296	0.328	0.382	0.052	0.476	0.319	0.634	0.680	0.554	0.074	0.389	

Table 3: Sleep. Ocular Health, Visual Performance* Sleep Disturbance

		Sleep Disturbance Because of Night Driving			
		Yes (%)	No (%)	Sometimes (%)	Total (%)
Daly Sleep Hours	3-4 hours	0 (0.0%)	2 (5.0%)	1 (2.5%)	3 (7.5%)
	4-6 hours	1 (2.5%)	7 (17.5%)	3 (7.5%)	11 (27.5%)
	6-8 hours	6 (15.0%)	7 (17.5%)	2 (5%)	15 (37.5%)
	8-10 hours	0 (0.0%)	8 (20.0%)	3 (7.5%)	11 (27.5%)
	Total	7 (17.5%)	24 (60.0%)	9 (22.5%)	40 (100%)
Sleep while driving	No	1 (2.5%)	16 (40%)	2 (5%)	19 (47.5%)
	Sometimes	6 (15%)	8 (20%)	7 (17.5%)	21 (52.5%)
	Total	7 (17.5%)	24 (60%)	9 (22.5%)	40 (100%)
Ocular burning	Yes	2 (5%)	1 (2.5%)	2 (5%)	5 (12.5%)
	No	4 (10%)	20 (50%)	4 (10%)	28 (70%)
	Sometimes	1 (2.5%)	3 (7.5%)	3 (7.5%)	7 (17.5%)
	Total	7 (17.5%)	24 (60%)	9 (22.5%)	40 (100%)
Ocular redness	Yes	2 (5%)	4 (10%)	2 (5%)	8 (20%)
	No	5 (12.5%)	12 (30%)	3 (7.5%)	20 (50%)
	Sometimes	0 (0.0%)	8 (20%)	4 (10%)	12 (30%)
	Total	7 (17.5%)	24 (60%)	9 (22.5%)	40 (100%)
Ocular itching	Yes	1 (2.5%)	2 (5%)	1 (2.5%)	4 (10%)
	No	5 (12.5%)	20 (50%)	8 (20%)	33 (82.5%)
	Sometimes	1 (2.5%)	2 (5%)	0 (0.0%)	3 (7.5%)
	Total	7 (17.5%)	24 (60%)	9 (22.5%)	40 (100%)
Watering from eyes	Yes	1 (2.5%)	3 (7.5%)	1 (2.5%)	5 (12.5%)
	No	5 (12.5%)	17 (42.5%)	4 (10%)	26 (65%)
	Sometimes	1 (2.5%)	4 (10%)	4 (10%)	9 (22.5%)
	Total	7 (17.5%)	24 (60%)	9 (22.5%)	40 (100%)
Ocular fatigue	Yes	3 (7.5%)	5 (12.5%)	4 (10%)	12 (30%)
	No	1 (2.5%)	13 (32.5%)	0 (0.0%)	14 (35%)
	Sometimes	3 (7.5%)	6 (15%)	5 (12.5%)	14 (35%)
	Total	7 (18.5%)	24 (60%)	9 (22.5%)	40 (100%)
Decreased visual performance	Yes	2 (5%)	4 (10%)	1 (2.5%)	7 (17.5%)
	No	3 (7.5%)	18 (45%)	7 (17.5%)	28 (70%)
	Sometimes	2 (5%)	2 (5%)	1 (2.5%)	5 (12.5%)
	Total	7 (17.5%)	24 (60%)	9 (22.5%)	40 (100%)

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