

# Sleep problems and road accidents

## Background

Traffic accidents are considered a public health problem and demonstrate various causative factors including sleep deprivation, time and number of hours driving without rest, drugs with sedative action (anxiolytics, hypnotics, tricyclic antidepressants and antihistamines), sleep disorders (OSAS, narcolepsy), and alcohol consumption. There is growing concern on Health and Safety in the Transport Sector regarding drivers on their job performance show high risk of incidents of drowsiness. Numerous studies excessive sleepiness in drivers of public service is demonstrated due to the change in circadian rhythm and a high frequency of SAOS.<sup>1</sup> Excessive sleepiness and sleep deprivation They are considered high risk factors for development of suicidal ideation and behavior.

## Excessive sleepiness in labor performance delos drivers

It is estimated that drowsiness is involved in 18% of all car accidents, and up to 25% in accidents in a recent report carreteras. En a frequency of 20.3% of "serious accident" is estimated in the trucking industry caused by excessive somnolencia.<sup>2</sup> In a study published in SleepMedse refers to excessive sleepiness plays an important role in the frequency of traffic accidents on roads, with important consequences for drivers and passengers with a high mortality rate. 3.2% of the total deaccidentes occurred were attributed to sleep behind the wheel and porsomnolencia, with 11.4% mortality of drivers. This contrasts with 5.6% in fatal accidents not associated with drowsiness. Losses attributed to cause drowsiness occurred during the night or in the afternoon mitadde. In the study the high mortality related accidents drowsiness. Older study results are confirmed, show association with circadian disorders due to high frequency deaccidentes between 2-4AM.<sup>3</sup> Moreover, studies evaluating sleep disorders drivers show excessive daytime sleepiness caused by changes in the circadian rhythm and a high frequency SAOS.<sup>4</sup> Drivers toodaytime sleepiness have decreased the level of focus or concentration, and reduced ability to respond to conditions requiring immediate reactions. This variability in alertness can cause traffic accidents conelevada associated morbidity and mortality event, in addition to significant losses in infrastructure destruction and damage vehicles materiales.<sup>4</sup>

Although no driver is exempt from having a traffic accident by drowsiness, bus drivers and taxi drivers show an occupational hazard elevado.<sup>5</sup> Case et al.,<sup>6</sup> conducted a descriptive cross-sectional study to determine the characteristics of sleep in bus drivers and their relation to road accidents in Peru. The authors evaluated 166 male drivers mean age ( $\pm$ s) of 44.2 $\pm$ 8.7 years. Case et al.,<sup>6</sup> applied a questionnaire about sleep patterns that was previously validated and Epworth Sleepiness Scale. Of all drivers, 74% reported work in the night shift. Of these, approximately 50% was driving five to seven nights a week and the remaining drivers alternated driving 5 to 7 days daytime with 5-7 days in the evening. Bus while driving 75% of drivers reported experiencing fatigue, 45% and 30% indicated pestañeo pitch. They said drivers experience increased feelings of fatigue when driving at dawn. Hundred forty five drivers (87%) reported sleep inside the bus when they were in the terminal or during travel. The maneuver performed more frequently to reduce the feeling of fatigue when driving was listening to music (34%). 24% of drivers reported having

Volume 9 Issue 4 - 2018

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had an accident or being near an accident due to fatigue. 27% of drivers showed scores compatible with excessive sleepiness according to results Sleepiness Scale Epworth.<sup>30</sup> The maneuver performed more frequently to reduce the feeling of fatigue when driving was listening to music (34%). 24% of drivers reported having had an accident or being near an accident due to fatigue. 27% of drivers showed scores compatible with excessive sleepiness according to results Sleepiness Scale Epworth.<sup>30</sup> The maneuver performed more frequently to reduce the feeling of fatigue when driving was listening to music (34%). 24% of drivers reported having had an accident or being near an accident due to fatigue. 27% of drivers showed scores compatible with excessive sleepiness according to results Sleepiness Scale Epworth.<sup>5</sup> Rosales-Mayor et al.,<sup>7</sup> conducted a study to determine levels of fatigue and sleepiness in bus drivers. Rosales-Mayor et al.,<sup>7</sup> used a validated questionnaire to assess sleep patterns and the Epworth Sleepiness Scale. They applied the questionnaires in 100 bus drivers male with a mean age ( $\pm$ s) of 42.9 $\pm$ 9.9 years. Body Mass Index showed obesity in 22% of drivers. The average time ( $\pm$ s) as bus drivers was 13.7 $\pm$ 9.7 years. Ninety-eight drivers reported driving during the night shift, of which 66% were working 5-7 days a week in that turn. Drivers showed average score ( $\pm$ s) 7.1 $\pm$ 3.9 in the Epworth Sleepiness Scale. In addition, 13% of drivers reported excessive sleepiness, and 17% pestañeo. Fifty-nine drivers reported having had an accident; or, they have been at risk of an accident due alafatiga.<sup>7</sup> Risco et al.,<sup>8</sup> conducted a cross-sectional study to determine the prevalence of excessive sleepiness in bus drivers. Risco et al.,<sup>8</sup> evaluated drivers 434 aged 18-71 years (mean age, 35 years) by Sleepiness Scale Epworth.<sup>8</sup> The authors showed excessive sleepiness in 32.7% of choferes. Risco et al.,<sup>8</sup> determined as predictors of excessive sleepiness on night work shift ( $p=0.02$ ), habitual snoring ( $p=0.04$ ), depression ( $p=0.003$ ), anxiety ( $p=0.001$ ), and excessive alcohol consumption ( $p=0.04$ ).<sup>8</sup> De Oliveira Assis<sup>9</sup> and evaluated 262 bus drivers in order to identify risk factors associated with excessive sleepiness. Drivers had a mean age ( $\pm$  s) of 38.1 $\pm$ 5.8 years and were male. The average body mass index was 26.8  $\pm$  3.5 kg/m<sup>2</sup> and an average neck circumference ( $\pm$  s) 40.4 $\pm$ 2.5 cm was recorded. 28% of drivers were recorded >10 points on the Epworth Sleepiness Scale. In this regard, 48% reported excessive sleepiness while driving, and reported consuming snuff (27%), cola (55%), alcoholic beverages (65%) and coffee (88%) to be alert while driving the bus. Moreover, 48% of drivers referred to have crashed while driving. Of these, 8% said it was because of excessive sleepiness. Vennelle et al evaluated

677 bus drivers in Edinburgh to determine the frequency of daytime sleepiness and accident frequency. Vennelleet when applied to drivers a validated questionnaire and the Epworth Sleepiness Scale. Drivers had a median age of 42 years and 3.6% were females. Furthermore, they determined a median BMI of 27kg/m<sup>2</sup>. Vennelleet indicated that 11% of drivers reported snoozing at least once a month while driving. 53% reported having had an accident due to sleepiness. Drivers with scores  $\geq 10$  on the Epworth Sleepiness recorded a highest accident ( $p=0.027$ ). Vennelleet al reported a frequency corresponding to 20% of SAOS the choferes.<sup>10</sup> Rey de Castro et al.,<sup>11</sup> applied a questionnaire validated in a total of 238 bus drivers to assess the association between excessive sleepiness and frequency of road traffic accidents. The average age of respondents drivers accounted for 42.5 years and all were male. The average body mass index ( $\pm s$ ) drivers was 29 $\pm$ 4.4kg/m<sup>2</sup>. Drivers reported having an average ( $\pm s$ ) of 17.3 $\pm$ 9.8years work experience as bus drivers. In addition, they said driving during the day an average ( $\pm s$ ) 7.9 $\pm$ 2.5hours, and 47% reported sleeping less than 7 hours per day. 80% of drivers reported driving >5hours during the day continuously. The perception of fatigue when driving was 56%. Of all drivers, 32% reported having earring during driving. In addition, 81% of drivers said sleep in the luggage compartment of the bus. To stay alert, 27% of drivers reported water applied to the face, 18% said eating some fresh fruit and 14% reported fully open the window of the cab. As for the sleep pattern, 37% of drivers reported snore habitually. Moreover, 45% of said drivers have crashed; or, they have been at risk of an accident due to fatigue. This ratio showed significant association only with the blinking frequency and the perception of fatigue to conducir.<sup>11</sup> 18% reported eating some fresh fruit and 14% reported fully open the window of the cab. As for the sleep pattern, 37% of drivers reported snore habitually. Moreover, 45% of said drivers have crashed; or, they have been at risk of an accident due to fatigue. This ratio showed significant association only with the blinking frequency and the perception of fatigue to conducir.<sup>11</sup> 18% reported eating some fresh fruit and 14% reported fully open the window of the cab. As for the sleep pattern, 37% of drivers reported snore habitually. Moreover, 45% of said drivers have crashed; or, they have been at risk of an accident due to fatigue. This ratio showed significant association only with the blinking frequency and the perception of fatigue to conducir.<sup>11</sup> Dalziel & Job<sup>12</sup> conducted a study to identify factors associated with sleepiness in taxi drivers and their participation in the traffic accidents. They evaluated 42 taxi drivers in a metropolitan area. The average driving time per week was 59 hours. The nominally drivers worked 12-hour shifts, but the duration of the work shift was modified on demand service, showing increases in peak hours and nights so week. The authors noted that the number of traffic accidents was significantly associated but inversely proportional to the time to rest during the turno. Los drivers showed una actitud optimistic about their ability to drive and the feeling of drowsiness. It is important to note that no Chore reported having participated in a traffic accident by drowsiness. Older authors noted that conditions cambiantesen constantly driving the cab pueden ocasionar fatigue. That is, proper to drive a (talk to passengers, monitor dispatcher look passage, determine the route of travel) can be mentally taxing and therefore agotadoras.<sup>12</sup> cab activities listed Charlton et al.,<sup>13</sup> conducted a study to identify attitudes toward fatigue and drowsiness levels in 102 taxi drivers. 42% of drivers reported driving more than the recommended maximum of 11 hours previous 24 hours, and 39% reported experiencing fatigue. The study showed the optimistic attitude towards safe driving when fatigued, with only 2% of drivers consider sleepiness as a problem. The authors noted this result raises

the possibility that there unasubvaloración the level of sleepiness in these conductores.<sup>13</sup>

Lam<sup>14</sup> the evaluated records related traffic accidents to determine environmental factors associated with mortality from accidents and injuries taxi drivers. They reviewed records of 7,923 drivers involved in accidents, noting that 10% died or were injured. increased mortality and injury was evident in drivers female. In addition, they identified two risk factors associated with increased frequency of accidents including night work shift, and not take passage on board when it happened the accidente.<sup>14</sup> Susanto<sup>15</sup> to 103 taxi drivers evaluated to determine the frequency and factors associated with OSAS. Susanto et the OSAS showed at 52.4% of drivers. Their results indicated that the average BMI taxi drivers with OSAS was 25.18kg/m<sup>2</sup> $\pm$ 2.1 compared to the average BMI drivers without OSAS was 24.24kg/m<sup>2</sup> $\pm$ 1.3 ( $p=0.001$ ). Also, when comparing both groups significant differences were demonstrated in mean body weight (71.4kg $\pm$ 8.5 vs 65.8kg $\pm$ 5.7,  $p<0.001$ ), in the neck circumference (38.5cm $\pm$ 2.5 vs 37.2cm $\pm$ 2.0,  $p<0.001$ ) and waist circumference (91.5cm $\pm$ 7.9 vs 86.5 $\pm$ 5.5,  $p<0.001$ ). Symptoms that showed statistical difference between conductors with and without OSAS included habitual snoring (66.1% vs 33.9%,  $p=0.003$ ), feeling of not having slept well (77.1% vs 22.9%,  $p=0.001$ ), Drowsy driving (73.3% vs 26.7%,  $p=0.009$ ), and headache (83.3% vs 16.7%,  $p=0.001$ ). The authors reported as risk factors associated with OSAS a BMI with an OR=60 (95% CI=0.45-0.79,  $p=0.001$ ), family history of habitual snoring with an OR=4.9 (95% CI 1.8-13,  $p=0.002$ ), and duration of sleep less than 7 hours for a period of 24 hours with a OR=5.1 (95% CI 1.3-19.2,  $p=0.015$ ).<sup>15</sup> Benaicha et al.,<sup>16</sup> conducted a cross-sectional study to estimate the prevalence of fatigue taxi drivers. They evaluated 300 male bus drivers who worked both in rural and urban areas. The average age of the drivers was 42.5 $\pm$ 10.8 years. The mean BMI was 26.8 $\pm$ 4.3kg/m<sup>2</sup>. Drivers reported 8.3 $\pm$ 3.5 years experience as taxi drivers. Of all drivers, 2.3% were working the night shift, 57.1% in the morning shift, and 40.5% in both shifts. Benaicha et al.,<sup>16</sup> reported an average score of 13.5 $\pm$ 8.2 in Scale Pichot. Drivers reported sleeping an average of 6.7 $\pm$ 1.4 h per day. a corresponding 1.1 accidents per year rate was recorded at 2.7 $\pm$ . The results showed linear regression fatigue factors associated with income ( $p=0.017$ ). Growing evidence indicates that some disturbed sleep may promote or exacerbate mood disorders. Also are considered high risk factor for developing depression, bipolar disorder and suicidio.<sup>17</sup>

### Sleep disorders, suicidal ideation and behavior

Worldwide estimates indicate that 900,000 deaths occur annually from suicide. Recent clinical and epidemiological studies suggest that sleep deprivation, insomnia and nightmares are significant factors for increased risk of suicide. These factors are independent to control the influence derived from psychiatric comorbidities as depresión.<sup>17</sup> The National Information Center for Mental Health in the United States recommended considering sleep disorders among the top ten warning signs for the risk of suicidio.<sup>18</sup> In one study, Sabo et al evaluated the results of electrophysiological recordings performed in patients diagnosed with major depressive disorder and attempted suicide, compared with Ylos studies in depressed patients but they had a history of attempted suicidio.<sup>19</sup> Sabo et al.,<sup>19</sup> reportaron that brain activity during sleep he revealed a greater latency, and fewer delta type waves in patients who had attempted suicidio.<sup>19</sup> Moreover, Agargunet the evaluated patients with a history of suicide attempts, and showed significant proportion of EEG records showing reduced latency and greater amount of REM sleep.<sup>20</sup> In a study with monozygotic

adolescents showed that the association between sleep disorders with suicidal ideation persisted after controlling for genetic influences and ambientales.<sup>21</sup>

A suicidal ideation it is defined as the existence of indifferent to life and thoughts that may be associated with the development of specific plans to remove the vida.<sup>21</sup> Some studies indicate that electrophysiological recordings decreased quality of sleep is associated with increased number of suicide attempts. Moreover, research suggests that alterations in the chronobiological activity associated with suicidal ideation, noting that most suicide deaths occur between midnight and 4:59am.<sup>21</sup>

## Common mechanisms between sleep disorders and suicide risk

### Pessimism

Unaelevada studies report frequency of individuals with thoughts of suicidaque type additionally have pessimistic ideas. Refers to the pessimistic ideas form a specific part of a process called Cognition Pessimistic. This construct is different to what is usually considered to pessimism factor, and is demonstrated by studies psicométricos.<sup>22</sup>

### Impaired executive function

It is demostradoqueel insomnia and sleep deprivation are different conditions; however, they are characterized by decreased amount of sleep an individual requires. A minor amount of sleep is associated with difficulty making decisions; particularly those associated with finding solutions to everyday problems (cognitive dysfunction). Refers to the difficulty in executive function varies vulnerability of each individual, may be considered as the only suicide probability or opción.<sup>22</sup>

### Serotonin

The association between sleep disorders with suicidal behavior suggests that there is a neurobiological basis in common. Apparently, serotonin (5-HT) plays a significant role in both suicidal ideation and behavior and sleep regulation. A high concentration of serotonin is demonstrated during the waking state, it decreases in slow wave sleep, and evidence the lower concentration during REM sleep. However, the association between serotonin and sleep is complex. Recent studies indicate that the release of serotonin during the waking state promotes homeostatic regulation on slow-wave sleep. Thus, sleep deprivation and insomnia are associated with serotonergic dysfunction in the CNS, consisting of decreased synthesis which in turn, promotes the waking state. In various publications it is concerned that these conditions increase the risk for suicide, according to people with suicidal ideation and behavior show decreased serotonin. In addition, the modulation level executive prefrontal cortex function is performed by serotonin. Therefore, alteration of serotonergic mechanisms is considered as a risk marker for suicide, violent impulsivity and lower CAPACITY for solving problemas.<sup>23</sup>

### Hyperarousal

Converging lines of evidence point to recent primary insomnia as a condition hipervigila. Several authors have postulated that sleep deprivation causes dysfunction of hypothalamic-pituitary-adrenal (HPA) axis. HHA activation system results in secretion of hormones including corticotropin releasing hormone, adrenocorticotrophic hormone, and cortisol favors the hyperarousal. It is shown that

cortisol is a significant biological marker for suicide risk. Studies show increased risk of suicide associated with increased evening cortisol concentration prior to the onset of sleep. Some authors suggest that this increase could be due to dysfunction of the HHA system by insomnia and sleep deprivation. That is, the dysfunction in the HPA system causes a state of hyperarousal, and is a common feature between insomnia and sleep deprivation with suicidal behavior. Moreover, recently researchers postulated that the association between insomnia and sleep deprivation at high risk of suicide could be due to low concentration of "orexin" called hypothalamic peptides. These peptides involved on the regulation of sleep, appetite and state of vigilia.<sup>24,25</sup>

### Circadian rhythm

The association between insomnia and sleep deprivation with an increased risk of suicide, suggest that high number of suicides happen overnight. However, suicides are relatively rare between midnight and 8:00am The suicide rate increases between 8:00 am and noon. This, because individuals with evening chronotype experience greater feeling of discomfort at this time. Generally speaking, some people report being "early risers" or have a morning chronotype, and other individuals are described as "night owls" or chronotype evening. These concepts have been reinforced by studies with imaging the CNS, in which variations related to the feeling of affection structures are evident, and consistent with the chronotype the individual.<sup>1,23</sup> Yet to determine whether the chronotype is a high risk factor for suicide, per se. However, the morning schedule is associated with lower levels of aggression, protection from major depressive disorder, and provide relief of symptoms in major depression. Moreover, in the night time more often than individuals who reported having nightmares, difficulty sleeping, poor sleep quality, fewer hours of sleep and a well established correlation with depression it is evident. In addition, the evening chronotype correlates with a higher degree of impulsiveness and lethality suicide method in contrast to individuals matutino<sup>1</sup> type.<sup>23-26</sup> Choiet to conducted a study to assess the association between insomnia with suicidal ideation in 117 patients with OSAS, and showed correlation limits of statistical significance. The correlation stop show statistical significance after controlling results depending on the severity of depressive symptoms. However, Choiet al reported a rate of suicidal ideation in 20.5% of pacientes.<sup>27</sup>

In recently, Edwards et al.,<sup>28</sup> reported a significant decrease in the frequency of suicidal ideation in OSAS patients after three months of treatment with application of continuous positive pressure in the aérea.<sup>28</sup> via Chan et al.,<sup>29</sup> evaluated an integrated 253 patients with major depressive disorder cohort. The average age of patients was 50.8 years (86.6% women). Chan et al.,<sup>29</sup> formed three groups of patients by chronotype including morning (62), intermediate (142) and evening (49). They reported a frequency of insomnia 19.4%, 35.2%, and 45.4%, respectively. Patients were evaluated by questionnaire Hamilton to determine the severity of the depressive disorder, and recorded average scores of 8.4±5.3 points in patients with morning chronotype, 8.5±6.4 in the group of intermediate chronotypes, and 12.9±6.9 in patients chronotype evening. They also reported as many suicide attempts in the evening chronotype group (49%) than patients with chronotype morning and intermediate (32.3% and 18.7%, Dell'Osso et al.,<sup>30</sup> to prospectively evaluated 65 adult patients (33 men, 32 women), mean age (±s) of 45±14.8 years. All patients were diagnosed with Post Traumatic Stress Disorder according to DSM-5. Of all patients, 58.4% reported being employed

full or part time, and the rest said they were unemployed or retired. 56% reported married or cohabiting marital status. Patients were evaluated by applying the questionnaire MOODS-SR to determine the frequency of depression, mania, cognition and features in circadian rhythmicity. Dell'Osso et al.,<sup>30</sup> the determined existence of variations in circadian rhythmicity associated with the sense of energy, appetite, sexual activity, sleep pattern, and symptoms including headache, dry mouth, and constipation; as well as the feeling of warmth and cold. The authors evaluated the frequency of suicidal ideation, and reported significant association between circadian rhythmicity with suicidal ideation ( $p < 0.001$ ); also indicated that Dell'Osso et al.<sup>30</sup> the circadian variations in appetite were the main risk factor for suicide attempt with an OR = 2.09 (95% CI 1.1-3.8).<sup>30</sup> Yoon et al.,<sup>31</sup> the analyzed results of the "National Health and Nutrition Examination Survey in Korea" to determine the association between suicide risk of sleep deprivation. They assessed the information on 12,076 survey participants (7,164 men, 4,912 women) who were aged between 18-60 years. Yoon et al. demonstrated by significantly higher frequency of suicidal ideation participants who reported sleep  $\leq 5$  hours/day, compared with participants who reported sleep 6-9 hours / day (16.9% vs 10.7%,  $p < 0.001$ ). They also indicated that women had a significantly higher frequency of suicidal ideation regarding male participants (16.8% vs. 7.89%,  $p < 0.05$ ). Moreover, the authors showed that labor an amount  $\geq 60$  hours / week was a significant risk factor for suicidal ideation with an OR = 1.34 (95% CI = 1.15 - 1.57).<sup>31</sup> Global estimates indicate that 15% of the total economically active population works in "Shiftworking" comprising different times the traditional business hours between 9:00 am and 17:00 p.m.<sup>24</sup> In this scheme shifts include with evening hours of work, night, dawn and rotation horarios.<sup>1</sup>

The main physiological underlying incompatibility arises between work shifts and biological characteristics inherent to the circadian rhythm. In this regard, in some studies it refers some adaptation to the sleep-wake to changes in circadian rhythm cycle; however, they indicate that every adaptation is limited as the sleep-wake cycle comprises one circadian cycle between the various physiological functions that show this ritmicidad.<sup>1,32</sup> Sleep disturbances occur most often in works with nighttime and early morning. In these working hours, total sleep time decreases between one to four hours, and also decreases its calidad.<sup>33</sup> Shift work are frequently associated with excessive sleepiness that interferes with alertness and cognitive functioning. This has repercussions on the implementation of labor activities as well as on issues related to job security, even though ambientales.<sup>34</sup>

### Optimize conditions

In vulnerable individuals, the alteration in the circadian rhythm resulting shift work increases the frequency of mood disorder. In this regard, several studies suggest that the frequency of these disorders is associated with the exposure time to the modification of rhythmicity circadiana.<sup>34,35</sup> Recent studies indicate that the performance of people with excessive sleepiness in certain occupations shift schedules may impact on third parties; particularly in police organizations, areas of health care and services emergencia.<sup>34</sup> In numerous studies a high frequency of taxi drivers demonstrated with excessive sleepiness during their job performance. Also they indicate that drowsiness is a significant cause of traffic accidents. Sleepiness and sleep deprivation that verifies a significant proportion of taxi drivers are due to change in circadian rhythm and also SAOS.<sup>4</sup> the high frequency of excessive

sleepiness and sleep deprivation are considered high risk factors for developing suicidal ideation and behavior.<sup>23,30-58</sup>

### Acknowledgements

None.

### Conflict of interest

Author declares that there is no conflict of interest.

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