PDF version

Review

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Abstract

Background: Injuries due to accidental crash are the 8th leading cause of death worldwide. Sleepiness results in disrupted neurological function and is a major risk factor for road traffic accidents.

Aims: This systematic review assessed the relationship between sleepiness during driving and road traffic accidents.

Methods: A systematic review was conducted using online databases such as Wiley Online Library, JSTOR, Medline, and PubMed. Full-text, English language articles published between May 2000 and November 2020 were retrieved. Road traffic accident was set as the outcome of interest and sleepiness during driving as the exposure. The review included studies containing adjusted risk estimates (95% confidence interval). Ten cross-sectional studies (N = 55,945), 5 case-control studies (N = 3821), and 2 cohort studies (N =16,875) were included.

Results: Over 50% of the participants in the different studies experienced sleep deprivation ranging from 3.5% to 67.3%. Abe et al. reported the highest (58%) frequency of sleepiness during driving in their cross-sectional study in Japan, and Nabi et al. reported the lowest (1.1%) in their cohort study in France.

Conclusion: Sleepiness and sleep deprivation were related to road traffic accidents; and sleep deprivation was the main contributor to drowsiness while driving.

Keywords: road traffic accidents, sleepiness, driving, observational study, risk assessment

Citation: Saleem S. Risk assessment of road traffic accidents related to sleepiness during driving: a systematic review. East Mediterr Health J. 2022;28(9):695–700. https://doi.org/10.26719/emhj.22.055
Received: 09/10/21; accepted: 11/05/22

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Introduction

Sleep is a dynamic process that affects the way our bodies function (1). Sleepiness can be defined as difficulty remaining awake even while carrying out activities (2). Sleep deprivation is defined as a state caused by inadequate quantity or quality of sleep, including voluntary or involuntary sleeplessness and circadian rhythm sleep disorders (3). Sleepiness results in disrupted brain functioning, such as reduced reaction time or decreased ability for decision-making. It is a major contributor to road traffic accidents, which often occur when a driver experiences drowsiness at the wheel, or due to sleep abnormalities, lack of sleep, alcohol consumption or medication (4). About 1.3 million deaths occur each year as a result of road traffic accidents globally, causing a 3% loss of the gross domestic product of most countries (5). The US National Highway Traffic Safety Administration has estimated that worldwide every year, about 100 000 road accidents are caused by drowsiness, accounting for > 1500 deaths and > 70,000 injuries (6).

In every country, road traffic accidents are a major public health problem and cause huge societal and financial burdens (7). Sleepiness causes disruption of neurological functions (8,9). Factors that contribute to the incidence of road traffic accidents range from continued driving even when feeling drowsy, having a physical condition, fewer sleeping hours, more working hours, and nutritional imbalances (10). Several studies during the last 20 years have suggested that sleepiness is among the main factors that cause road traffic accidents (11–15). Sleepiness

while driving contributes to 3% to > 30% of all road traffic accidents globally (16–18), which may involve a variety of sleep conditions but also may be caused by sleep deprivation (19–20). More than 20% of the drivers feel a need to stop driving at least once due to sleepiness (21). A religious lifestyle was found to be negatively associated with the risk of road traffic accidents, as were younger drivers (22,23). This systematic review was designed for a better understanding of the relationship between sleepiness and risk of road traffic accidents.

Methods

Study protocol

This systematic review protocol was developed keeping in view the requirements of the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) statement and guidelines 2020, without execution of a meta-analysis. The PRISMA statement is a guideline developed by an international group of 29 methodologists and experienced researchers in 2005. It comprises 27 checklists and 4-phase flow diagram to ensure transparent reporting of a systematic review [24].

Search strategy

The reviewer searched for articles published between January 2000 and December 2020 in Wiley Online Library, JSTOR, Medline and PubMed databases. The keywords used were: road traffic accidents, sleepiness while driving, and observational study. PRISMA information flow during the phases of this systematic review is presented in Figure 1 .

Search eligibility criteria

The reviewer included observational studies with adjusted risk estimates and outcome measure of road traffic accidents. Due to expected difficulties of quantification, excluded studies were experimental studies, case series without comparison groups and case reports.

Data extraction

The potentially relevant articles were screened by title and abstract and full text of the articles were retrieved from databases. Final eligibility was assessed independently keeping in view the PRISMA guideline checklist 2020, and the reviewer extracted the following details from the included studies: study design (cross-sectional, case-control and cohort), number of road accidents, frequency of sleepiness while driving, and the adjusted risk estimates of accidents resulting from sleepiness. For quality assessment purposes, the Newcastle Ottawa Scale was used with a total score for quality ranging from 0 to 9 (25). Participants' characteristics such as age, gender, and sleep disorders and lack of sleep due to workload/other causes were extracted. The overall frequency of sleepiness during driving was calculated using adjusted risk estimates.

Study selection

A total of 5651 articles were identified from Wiley Online Library, JSTOR, Medline and PubMed databases, where sleepiness while driving was among the causes of road traffic accidents. A total of 1132 duplicates (20.03%) were removed including 717 (63.33%) from JSTOR, and 415 from Medline and PubMed (36.66%). Out of the 4519 remaining articles (79.96%), 4283 were found to be unrelated (94.77%) and were excluded. The remaining 236 articles (5.22%) were fully reviewed and this led to a total of 17 observational studies (7.20%) that qualified for the systematic review. The 17 eligible studies consisted of a total of 76,641 participants worldwide (Table 1). There were 10 cross-sectional studies (55, 945 participants; 72.99%); 5 case-control studies (3821 participants; 4.98%), and 2 cohort studies (16,875 participants; 22.01%). Sixteen studies included both sexes while 2 Saudi Arabian studies were based on men due to the previous ban on female drivers. The ages of participants were 50 years in 6 studies.

Results

Results from all 17 studies showed that sleepiness and sleep deprivation were major contributors to road traffic accidents. The high frequency of sleepiness reported while driving, with significant odd ratios, makes this a significant risk factor for road traffic accidents. In these studies, > 50% (3.5–67.3%) of the participants agreed that they experienced sleep deprivation. Abe et al. reported the highest (58%) frequency of sleepiness during driving in their cross-sectional study (OR 12.90) in Japan, and Nabi et al. reported the lowest (1.1%) in a cohort study in France (OR 2.90) (Figure 2).

Liu et al concluded that a significant decrease in injuries related to road traffic accidents can be attained if fewer people drive when they are sleepy (26). Gottlieb et al. associated sleep apnoea with a 123% greater risk of road traffic accidents than apnoea unrelated to sleep (27). This shows that sleeping for 6 hours daily is connected to a 33% greater risk of accidents than sleeping for 7 or 8 hours per night. Comparatively, Cummings et al. reported such an accident risk to be 39.5% in a case–control study in the United States of America [14]. Lloberes et al found in a cross-sectional study in Spain that 35.3% of drivers fell asleep while driving (28). Pizza et al. reported 1.9 times greater risk of accidents in individuals with poor sleep quality making them to fall asleep while driving (29).

AlShareef et al. in a population-based analysis in Saudi Arabia showed the correlation between sleep and sleepiness during driving and reported that the strongest sleep predictor while driving was being a male driver (30). Most drivers in this study were men (86.5%) as women have only been allowed to drive in Saudi Arabia since June 2018. Sagaspe et al. found that 28% of drivers had at least 1 incident of uncontrollable sleepiness during driving, and about 5% of drivers had

an accident or near miss due to sleepiness (31). Stutts et al. reported that almost 8% of the drivers in road traffic accidents admitted consuming alcohol before causing a crash. However, this study highlighted potential bias because the data depended on self-reports and the drivers could have blamed longer work hours and poor sleep habits for their accidents (32).

Limitations of this review include the possibility of selection bias because of the methods used or participants involved. There may have been a residual confounding effect because studies were based on observational methods. Other possible risk factors for accidents, age, body mass index, medical conditions, alcohol and drug abuse, and sleep duration were not calculated in terms of ORs (adjusted) in all of the studies used for this review.

Conclusion

Driver fatigue or drowsiness is a road transport safety hazard. The risk of road traffic accidents increases proportionately when drivers experience sleepiness. Among the frequent explanations for sleepiness during driving were sleep disorders such as sleep apnoea and some behavioural factors, most importantly sleep deprivation. The risk factors for sleep deprivation were found to be driving at night, not getting enough sleep, and working or staying awake for long periods. Other factors were young age, male sex, office worker, smoker, shorter sleep duration, poor subjective sleep quality, moderate or severe excessive daytime sleepiness, and alcoholism. A minimum of 6 hours of sleep every day could significantly decrease the number of road traffic accidents.

To reduce the incidence of accidents related to sleepiness during driving, it is important to conduct safety checks before driving, monitor sleeping patterns, record and track driving hours, and conduct psychological assessments and behavioural training. The results show that road traffic accidents are consistently associated with sleepiness during driving. Therefore, awareness campaigns and strengthening of road safety programmes should be implemented to reduce the increasing number of road traffic accidents related to sleepiness during driving. Further studies will be required for a more in-depth analysis of this subject.

Funding: None

Competing interests: None declared.

Évaluation des risques d'accidents de la route liés à la somnolence au

WHO EMRO | Risk assessment of road traffic accidents related to sleepiness during driving: a systemati

volant : une revue systématique

Résumé

Contexte : Les traumatismes dus à un accident représentent la huitième cause de décès dans le monde. La somnolence entraîne une perturbation des fonctions neurologiques et constitue un facteur de risque majeur d'accidents de la circulation.

Objectifs : La présente revue systématique a évalué la relation entre la somnolence au volant et les accidents de la circulation.

Méthodes : Une analyse systématique a été réalisée en utilisant des bases de données en ligne telles que Wiley Online Library, JSTOR, Medline et PubMed. Des articles complets, en langue anglaise, publiés entre mai 2000 et novembre 2020 ont été extraits. L'accident de la circulation a été fixé comme le résultat d'intérêt et la somnolence au volant comme l'exposition. L'analyse comprenait des études contenant des estimations de risque ajustées (intervalle de confiance à 95 %). Dix études transversales (n = 55 945), cinq études cas-témoins (n = 3821) et deux études de cohorte (n = 16 875) ont été incluses.

Résultats : Plus de 50 % des participants aux différentes études ont connu une privation de sommeil allant de 3,5 à 67,3 %. Dans leur étude transversale au Japon, Abe et al. ont rapporté la fréquence de somnolence la plus élevée (58 %) et Nabi et al. la plus faible (1,1 %) dans leur étude de cohorte en France.

Conclusion : La somnolence et la privation de sommeil étaient liées aux accidents de la circulation, et la privation de sommeil était le principal facteur de somnolence au volant.

تقييم مخاطر الحوادث المرورية بسبب النعاس أثناء القيادة : استعراض منهجي

شهزاد سليم

الخلاصة

الخلفية: الإصابات الناجمة عن التصادمات هي السبب الرئيسي الثامن للوفاة في العالم.
والنعاس، بما يسببه من تعطيل للوظائف العصبية، عامل خطر أساسي للحوادث المرورية.

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JSTOR Library Online Wiley PubMed (2000 / .2020 (55 945 =) (95%) (3821 =) 5 (16 875 =)

50% (58%) 3.5% 67.3% (1.1%)

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