Chinese Journal of Traumatology 20 (2017) 166–172

Contents lists available at ScienceDirect

Chinese Journal of Traumatology

journal homepage: http://www.elsevier.com/locate/CJTEE

Original article

Alcohol consumption for simulated driving performance: A systematic review

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ARTICLE INFO

Article history:
Received 17 November 2015
Received in revised form
21 May 2016
Accepted 30 May 2016
Available online 14 April 2017

Keywords:
Alcohol abstinence
Alcohol-related disorders
Alcohol drinking
Automobile driving
Computer simulation

ABSTRACT

Purpose: Alcohol consumption can lead to risky driving and increase the frequency of traffic accidents, injuries and mortalities. The main purpose of our study was to compare simulated driving performance between two groups of drivers, one consumed alcohol and the other not consumed, using a systematic review.

Methods: In this systematic review, electronic resources and databases including Medline via Ovid SP, EMBASE via Ovid SP, PsycINFO via Ovid SP, PubMed, Scopus, Cumulative Index to Nursing and Allied Health Literature (CINHAL) via EBSCOhost were comprehensively and systematically searched. The randomized controlled clinical trials that compared simulated driving performance between two groups of drivers, one consumed alcohol and the other not consumed, were included. Lane position standard deviation (LPSD), mean of lane position deviation (MLPD), speed, mean of speed deviation (MSD), standard deviation of speed deviation (SDSD), number of accidents (NA) and line crossing (LC) were considered as the main parameters evaluating outcomes. After title and abstract screening, the articles were enrolled for data extraction and they were evaluated for risk of biases.

Results: Thirteen papers were included in our qualitative synthesis. All included papers were classified as high risk of biases. Alcohol consumption mostly deteriorated the following performance outcomes in descending order: SDSD, LPSD, speed, MLPD, LC and NA. Our systematic review had troublesome heterogeneity.

Conclusion: Alcohol consumption may decrease simulated driving performance in alcohol consumed people compared with non-alcohol consumed people via changes in SDSD, LPSD, speed, MLPD, LC and NA. More well-designed randomized controlled clinical trials are recommended.

Introduction

The correlation between alcohol and vehicle-related death and injury was identified in an editorial of the Quarterly Journal of Inebriety for the first time in 1904.[1] Nowadays it is well accepted that alcohol consumption can lead to risky driving and increase the frequency of traffic accidents and related injuries and mortalities.[1,2] About 40% of all traffic mortalities are associated with alcohol, regarded as the most important human cause of severe automobile crashes.[2,3] Hence, there is a powerful linkage between alcohol consumption and risky driving behaviors, so driving after alcohol drinking is forbidden by law in many countries. A legal range for maximum blood alcohol concentration (BAC) was from 0.01% to 0.08% in different countries.[1] Scientific literature showed that BAC of 0.05% could impair motor vehicle driving.[4]

Driving performance has been already evaluated in many studies and it is believed that consumption of alcohol can influence some driving skills like choosing an appropriate speed, time and frequency of overtaking, braking, steering and determining the distance with other vehicles. Lane position, line crossing, number of crashes, speed deviation and time at maximum speed are other

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Peer review under responsibility of Daping Hospital and the Research Institute of Surgery of the Third Military Medical University.

http://dx.doi.org/10.1016/j.cjtee.2017.04.002

indexes to evaluate driving performances in this area.[4–7] An important mechanism for these effects is associated with distraction caused by alcohol.[8] Also it is proposed that alcohol intake can impair neurological and cognitive functions. Furthermore it can lead to an increase in reaction time to potential hazards and a decline in short-term memory of drivers. Some factors like age, gender and driving skills could have some exacerbating effects on the alcohol-related driving. These effects seemed to be limited whereas BAC and complexity of the driving tasks were proposed as the most important factors here.[3] A significant association of other drug administration like dexamphetamine and caffeine along with alcohol on risky driving was reported.[9,10] Interestingly, simulated driving researches exceedingly helped traffic scientists in recent years.[11,12]

Our study used a systematic review to compare simulated driving performance between two groups of drivers, one consumed alcohol and the other not.

Materials and methods

Data resources

In this systematic review, electronic resources and databases including Medline via Ovid SP, EMBASE via Ovid SP, PsycINFO via Ovid SP, PubMed, Scopus, Cumulative Index to Nursing and Allied Health Literature (CINHAL) via EBSCOhost were comprehensively and systematically searched.

Search strategy

Our search strategy made by an expert librarian covering an appropriate combination of all keywords related to the concepts of driving, risk taking, dangerous behavior, aggressive behavior, riding, accident, motor vehicle, automobile, and motorcycle. We tried to have a protocol for our search strategy to be as sensitive as possible. No language and time preference were applied and it was noted that the last search was performed on January 31, 2014.

Study eligibility

Articles were included if they were randomized controlled clinical trials (RCTs) and their main intervention was related to effect of alcohol consumption on simulated driving performance. We considered no limitation on age, gender and race. The studies were also included if they evaluated following outcomes: lane position standard deviation (LPSD), mean of lane position deviation (MLPD), speed, mean of speed deviation (MSD), standard deviation of speed deviation (SDSD), number of accidents (NA) and line crossing (LC).

Study selection and data extraction

We had two independent groups for article reviewing, so that each group reviewed about half of all papers in article screening in two levels (title and abstract screening) based on Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guideline for systematic reviews.[13] Each paper in each group was independently investigated by two authors and was included if both authors had agreement. At the end of screening, disagreements about any paper were resolved with group discussion. After that, remained disagreements were resolved by more discussion and consensus with other colleagues out of two groups. Finally data regarding characteristics of included papers (study design, participant, intervention, risk of biases and outcomes) were recorded in a data collection form.

Risk of bias assessment

Every included paper was assessed for any bias risk including random sequence generation (selection bias), allocation concealment (selection bias), blinding of participant and personnel (performance bias), blinding of outcome assessment (detection bias), incomplete outcome data (attrition), selective reporting (reporting bias), co-interventions, intention to treat analysis, group similarity at baseline, compliance, timing of outcome assessments and other biases. Each item rated as high, low or unclear (in case of inadequate data) risk of bias for each paper. We scored high and unclear risks as 0 and low risk as 1. Our assessment for risk of bias was similar to Rasouli et al's method.[14]

Results

Study screening and characteristics of included papers

A total of 3618 papers were found through database searching after removing duplications. After title and abstract screening, 3570 papers were excluded because of irrelevancy to our topic and 33 full-text articles were assessed for eligibility (Fig. 1). Finally, 13 randomized clinical trials were included in qualitative synthesis. Characteristics of these included papers are shown in Table 1.

Risk of bias assessment

Based on Table 2, all included papers got a score $\leq$3 (out of 12) for risk of bias assessment, so all were categorized as high risk for bias. Based on this assessment, no study was excluded from our project.

Outcome evaluation

Following outcomes were investigated in the included papers: LPSD, MLPD, speed, MSD, SDSD, NA, and LC. The outcome comparison between alcoholic and non-alcoholic participants is shown in Table 3. The frequencies of the articles which showed significant relationships between alcohol consumption and related outcomes were as follows: SDSD 75%, LPSD 66.6%, speed 60%, MLPD 50%, LC 50%, NA 25% and MSD 0. Another considerable issue was related to effect of different BACs on the evaluated outcome. We tried to investigate this issue. However, in different articles, different BACs had been evaluated in our included outcomes. So unfortunately we could not pool related data. Considering Oxford Centre for Evidence-Based Medicine,[15] the level of evidence of our systematic review was 1a-, which meant that our systematic review had troublesome heterogeneity. We also found some other outcomes in these papers that were related to the purposes of our systematic review. However, these outcomes had been evaluated in just one of 13 included studies, so we did not mention them in Table 3. They were listed as follows: lane changes plus cars passed, time at maximum speed, mean values of errors occurred for speed, use of turn signals and time taken to drive fixed sections of route. Here we evaluated all of these outcomes individually.

LPSD

A driver should maintain a desired position within lane. Greater within-lane deviation can be considered as an indicator for poorer driving precision. Eight studies evaluated LPSD.[3,4,6,9–11,16,17] Because of many differences among these studies including existence of co-intervention, different alcohol dosages, different methods for alcohol measurement and different speed limitations, we could not conduct a meta-analysis here. Also in the studies by