**The Effects of Alcohol Use on Prospective Memory: A Systematic Literature Review**

**Abstract**

*Objectives*: Alcohol use remains a public health concern with accumulating evidence pointing to alcohol-associated prospective memory (PM) deficits. PM is the cognitive ability to remember to perform an intended action at some point in the future. Following PRISMA guidelines, we searched the evidence base to identify and explore the evidence of a relationship between alcohol use and PM. *Methods*: We conducted a systematic literature search in Medline, Embase, Pubmed, CINAHL, PsycINFO and Web of Science databases. Studies were included if they met the following criteria: English language publication, healthy adult participants (16 years and over), primary data on the effects of alcohol on PM. *Results*: Eight peer-reviewed studies were eligible for inclusion, of which five were randomized controlled trials examining the acute effects of a mild dose of alcohol and three were cross-sectional studies assessing the long-term effects of different drinking patterns on PM. Four main findings were supported by the literature: (1) compared with placebo, an acute administration of a mild alcohol dose to healthy social drinkers may lead to poorer PM performance, (2) alcohol consumption over the recommended weekly units can be associated with impaired PM function, (3) other cognitive domains can play a contributing role in alcohol-induced PM impairment, and (4) following future event simulation alcohol-induced PM impairment may be improved. *Conclusion*: Alcohol consumption potentially impairs PM, even at a low modest dose. Considering the small number of studies and their methodological flaws, additional research is needed to decipher the alcohol-PM relationship and provide further supporting evidence.

**Keywords** Prospective memory; memory for intentions; alcohol; memory impairment; adult; systematic review.

**Introduction**

Alcohol use remains a public health concern causing more than 200 illnesses, injuries and other health conditions (Rehm & Shield 2019). In 2016, approximately three million deaths (equivalent to 5.1% of all global deaths) were attributable to harmful use of alcohol (World Health Organization [WHO], 2018). In the United Kingdom, harmful drinking refers to alcohol consumption exceeding 14 units per week for both males and females (UK National Health service [NHS], 2018). Despite its long recognition as a risk factor, the prevalence of alcohol consumption remains high. In Great Britain alone, approximately 29 million people (aged 16 years and over; 57% of the Opinions and Lifestyle Survey [OPN] respondents) reported drinking alcohol in 2017. Of these, 28% of men and 25% of women reported binge drinking on their heaviest drinking day (6/8 units) (Office for National Statistics [ONS], 2017). While in 2017, there were 7,697 alcohol-specific deaths in the U.K. (ONS, 2017).

Emerging evidence indicates an impact of alcohol use on prospective memory(PM). Prospective memory is an essential cognitive ability to remember to perform an intended task at an appropriate time in the future (McDaniel & Einstein, 2007), such as remembering to attend a meeting at 4pm or remembering to take medication (Heffernan, 2008). The realization of such intentions entails a multicomponent process (Ellis & Kvavilashvili, 2000; Kliegel, Martin, McDaniel, & Einstein, 2002), during which an intention is firstly formed and organized (encoding), then retained over a period of time (storage) during which the individual engages in other ongoing activities, and is finally carried out when the retrieval context (when) is recognized (cue identification) and the intended task (what) is recalled (retrieval). Retrieval of a previously formed intention from memory (when and what) implies a retrospective component of PM. Arguably, PM also relies on executive functions (e.g., planning, problem solving) for the coordination of this multicomponent process (Einstein & McDaniel, 1990; McDaniel, Howard & Butler, 2008; Kvavilashvili, 1987).

The retrieval context that activates the realization of the intention can be event-based (e.g., remembering to reply to an email when getting to work); time-based (e.g., remembering to meet a friend at 4pm) or activity-based (e.g. remembering to switch off the oven after cooking) (Einstein & McDaniel, 1996). Due to the absence of external cues, time-based PM (TBPM) tasks rely on self-initiated processes and have therefore been found to be more challenging than event-based (EBPM) and action-based (ABPM) tasks (Einstein, McDaniel, Richardson, Guynn, & Cunfer, 1995). In contrast, ABPM tasks are the least challenging because the external cue coincides with the completion of an ongoing activity (Shum, Ungvari, Tang, & Leung, 2004). Prospective memory tasks can also be further categorised into regular, irregular, long-term episodic and short-term habitual tasks. Regular tasks refer to recurring tasks, for example, remembering to take medication every morning, whereas irregular tasks are ‘one-off’ tasks, such as remembering to attend a dental appointment (Kliegel, Rendell, & Altgassen, 2008; Rendell & Henry, 2009). Long-term episodic tasks are irregular tasks that are completed hours or days after a cue to perform them, for example, “I missed an appointment I had scheduled”. Short-term habitual tasks refer to tasks that occur routinely and are completed within minutes of a cue to perform them (Hannon et al., 1995).

Prospective memory tasks therefore comprise activities of daily living (e.g., the returning of calls, attendance at meetings, paying of utility bills); hence, the importance of having an intact PM for maintaining autonomy, independence and an optimal quality of life should be clear.

Despite the accumulating evidence base on the exclusive effects of alcohol use on PM, there has not been a comprehensive narrative synthesis of these studies. Specifically, there has only been one meta-analytic review on the effects of licit (including alcohol) and illicit recreational drugs on PM. Although Platt and colleagues (2019) provide a meta-analytic review of the chronic effects of alcohol use (identifying seven studies), neither an examination of acute alcohol use on PM was conducted nor were its specific effects on PM (e.g. on the planning component of PM) reviewed. The effects of alcohol on ABPM were also not assessed.

To the best of our knowledge, this is the first systematic review to examine the effects of alcohol use on PM specifically. The primary aim of this review is to assess the effects of acute and non-acute (e.g. regular, long-term) use of alcohol on PM. The quality of the reviewed studies is also evaluated through a formal risk of bias assessment. This review also explores the contributing role of other cognitive domains including that of episodic future thinking. An examination of the alcohol-PM relationship can pave the way for further research on this under-researched area. Findings from this review may also contribute to the addictions field by adapting appropriate preventative and treatment strategies.

**Method**

A systematic literature search was conducted following PRISMA (Preferred Reporting Items for Systematic reviews and Meta-analysis) guidelines (Moher, Liberati, Tetzlaff, & Altman, 2009). Data were narratively, rather than meta-analytically, synthesized given the small number of published studies and the variability in the PM outcome measures (Higgins & Green, 2011).

***Selection Criteria***

Inclusion and exclusion criteria were applied during the formulation of both the search strategy and the study selection process (Table 1). Studies were included if the following criteria were applicable: English language peer-reviewed publication, healthy adult participants (≥ 16 years), primary data on the effects of alcohol use (moderate use, binge drinking, hangover) on PM (defined in terms of performance on PM tasks). Conference papers, posters and dissertations were excluded due to quality concerns. Studies in which alcohol was not the only substance of concern were not included in this review. This decision was based on recent evidence showing deleterious effects of other licit and illicit drugs on PM (Platt et al., 2019), and therefore an inability to disaggregate the specific effects of alcohol on PM in such studies. Studies with participants who reported having a current diagnosis or with a history of neurologically relevant diagnoses (e.g. ADHD), severe mental illness or substance use disorders, were not eligible for inclusion.

<<Insert Table 1 About Here>>

***Identification of Studies***

We used medical subject headings (MeSH) and text words to search for studies on six bibliographic databases (Medline, Embase, Pubmed, CINAHL, PsycINFO and Web of Science) from inception to July 2019. The search strategy was designed to be inclusive using PICOS (Participants, Interventions, Comparisons, Outcomes, and Study design) (Moher et al., 2009) and the following key terms were used, singly and in combination: prospective memor\*, prospective remember\*, time based prospective memory, event based prospective memory, memor\* for intention\*, everyday remembering, everyday memor\*, remember\* to remember, acute alcohol\*, acut\* intoxic\*, ethanol, drunk\*, drink\*, intoxicat\*, alcohol\* , alcohol-related disorders (see S1 for an example). The Boolean operators “AND”, “OR” were also used to complete the search strategy. In addition to searching the electronic databases, we also consulted the bibliography of pertinent literature reviews.

To identify relevant studies, one author (A.K.) first screened electronic titles, abstracts and keywords, then full-text articles. A 100% check was independently completed at each screening phase by a second author (J.S.S.). Any disagreements were resolved by discussion and consensus and any remaining disagreements were resolved by a third author (A.M.). A.K. also hand searched the reference lists of included articles and screened any relevant literature. Reasons for exclusion were documented.

***Data Extraction***

Using a data extraction form, A.K. extracted the following information: study characteristics (e.g. sample type and size, design, setting); sample characteristics (e.g., gender, age); characteristics of the sample’s drinking category (e.g. type); including, when available, average weekly alcohol consumption (in units), and number of hours of last alcohol use. Exclusion

criteria on sample characteristics were also extracted (e.g., diagnosis of substance use disorders, psychiatric illnesses, of any neurocognitive impairments, any other drug use).

Additionally, data on procedural aspects of the reviewed studies were extracted (e.g. blood alcohol concentration measure, ethanol dose, prior to experiment abstinence period). Information on PM (e.g., measure, type of PM assessed), other cognitive domains assessed (e.g. retrospective memory, executive functioning) and on main findings (e.g. alcohol did affect, alcohol did not affect) was extracted.

***Quality Assessment***

The methodological quality of the studies was assessed by performing a formal risk of bias assessment. The National, Heart, Lung, & Blood Institute (NHLBI) quality assessment tool (NHLBI, 2014) was used for observational and cross-sectional studies (see S2 for further information). The NHLBI tool has been previously used successfully by Carbia and colleagues (2018).

We followed PRISMA guidelines (Van Tulder, Furnal, Bombadier, Bouter, & Group, 2003) and Cochrane’s Handbook of Systematic Reviews of Interventions (Higgins et al., 2011) to assess the risk of bias in randomised controlled trials (RCTs). This process included screening for evidence of: (a) random sequence generation, (b) allocation concealment, (c) group similarity at baseline (i.e. age and drug use), (d) blinding of participants, (e) blinding of personnel, (f) blinding of outcome assessment, (g) timing of outcome assessment, (h) attrition bias, (i) selective reporting and (j) other bias. In addition to these, we also considered whether participants were assessed for other drug use (licit and illicit) (see S3 for a list of the criteria). Each domain was assigned a high, low, or unclear risk of bias. Where information was not provided, a ‘not available’ code was used.

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**Results**

***Main Findings***

We identified 518 articles through database searches. Handsearching of reference lists identified an additional 39. Retrieved articles were exported to Mendeley reference manager to remove duplicates (n = 235). Screening of title/abstract/keywords led to the exclusion of 305 articles. The main reasons for exclusion were the examination of other non-relevant topics and lack of primary data. Seventeen full-text papers were assessed for eligibility, nine of which did not meet the inclusion criteria and were therefore excluded (Figure 1).

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***Characteristics of the Studies***

Overall, research addressing the isolated effects of alcohol use on PM is rather limited. Most of the studies were from the United Kingdom (7/8) with one study being conducted in Germany (1/8). Samples comprised healthy nonclinical university students (8/8) aged between 17 and 36 years. The majority of studies reported that participants were aged between 18 and 35 years (5/8). The remaining three reported an age range of 18 to 36 years (1/8), of 17-19 years (1/8) and of 18-25 years (1/8). Samples mainly comprised of both males and females (7/8) with only one study reporting an all-male sample (1/8).

Two of the included studies examined the effects of binge drinking (BD) on PM (2/8), by comparing PM performance of heavy drinkers (total n = 49) with control groups (total n = 57). The impact of a state of alcohol hangover on PM was also assessed by one study (1/8), comparing the PM performance of an alcohol hangover group (total n = 25) with a control group (total n = 33). All three studies employed a cross-sectional design to explore their research aims, with EBPM being the most commonly researched PM type (3/3). The Prospective Remembering Video Procedure (PRVP) task was also the most used task (2/3).

Five studies (5/8) were RCTs that examined the effects of an acute modest dose of alcohol on PM performance in social drinkers. Specifically, three of these administered a 0.6g/kg dose of ethanol to the alcohol group, whereas two had an administration dose of 0.4g/kg. The alcohol groups (total n = 57) in the RCTs who were administered a dose of 0.4kg/kg ethanol, were compared with matched placebo groups (total n = 57) to explore the effects of this dose on PM (2/2), examined the role of executive planning in PM performance (1/2) and the prospective and retrospective component of PM depending on cue valence (1/2).

Of the three RCTs (3/5) that compared alcohol groups (administration dose of 0.6g/kg) with matched placebo groups, one employed a within-subjects design in an all-male sample to explore the role of executive functions in PM performance. In addition to examining the effects of acute alcohol on PM (3/3), the role of future event simulation on PM performance was also explored by one RCT study (1/3). Event-based PM (5/5) and TBPM (4/5) were the most researched types of PM with the Virtual Week (VW) task being used in two RCTs.

The main characteristics of the studies are summarized in Table 2.

<<Insert Table 2 About Here>>

***Quality assessment***

We used the NHLBI assessment tool to assess the methodological quality of the three cross-sectional studies (see Table 3). Two of these were of intermediate quality and one of poor

quality. The main limitations of these studies were a lack of biological screening methods to provide an accurate measure of drug use and an absence of non-alcohol control groups. None of these studies reported whether the outcome assessors were blinded or not and a sample size justification was not provided. Additionally, two of these studies did not assess the blood alcohol content of the participants prior to testing and their binge drinking definition varied in terms of the frequency criterion. The study sample in all three studies was of adequate size (i.e. ≥ 20) to detect a difference of 1 *SD* at alpha = 0.05 and beta 0.20 (Hinkle, Wiersma, & Jurs, 1994). Confounding variables (i.e. other drug use, substance use disorders) were clearly identified, measured and statistically controlled for in two studies. Overall, the research questions were explicitly defined and the study samples were sufficiently described (except for one study).

<<Insert Table 3 About Here>>

Five out of the eight reviewed studies were randomized controlled trials (RCTs). We rated their methodological quality according to the Cochrane Collaboration’s tool (Higgins et al., 2011). A main strength of these studies is their randomized controlled trial design. However, nearly all studies provided no details of randomization procedure and none provided details on allocation concealment (see Figure 2). In addition, most studies (4/5) provided no details on blinding of personnel (e.g. study coordinator) and blinding of outcome assessors (e.g. experimenters) (3/5). Other unreported aspects were whether participants were assessed for other drug use (legal or illegal) and if any exclusion criteria were applied accordingly.

All studies were independently reviewed by two authors (AK and AM), and ratings for quality were agreed on each metric. No differences in ratings between reviewers were identified through this process.

<<Insert Figure 2 About Here>>

***Narrative Synthesis***

Below we present a summary of the effects of alcohol use on PM organized by patterns of drinking (see Table 2 for more information). Data were narratively, rather than meta-analytically, synthesized given the small number of published studies and the variability in the PM outcome measures.

*A Moderate Dose of Alcohol*

Five RCTs assessed the acute effects of a modest dose of alcohol on PM in healthy social drinkers against their placebo group. Of these, three administered an alcohol dose of 0.6 g/kg and two a dose of 0.4 g/kg. An alcohol dose of 0.6 g/kg has been found to impair memory while leaving executive functioning intact (Finn et al., 1999; Townsend & Duka, 2002). A dose of 0.4g/kg was chosen by Walter and colleagues (2016) to reach a blood alcohol concentration near the legal limit of intoxication for driving in Germany. The same alcohol dose was chosen by Montgomery et al. (2011) due to the multitasking complexity of the JAAM assessment (Jansari et al., 2004).

An acute alcohol dose of 0.6 g/kg, (equivalent to 4-5 units) potentially impairs PM. Using the ‘Virtual Week’, Leitz et al. (2009) demonstrated that a moderate dose of alcohol could generally impair PM (i.e. regular, irregular, EBPM and TBPM). Retrospective memory and episodic memory deficits contributed to PM deficits but not the executive functioning deficits. Prospective memory impairments were also found by Paraskevaides et al. (2010). Using the same task, they found that an alcohol dose of 0.6 g/kg could produce EBPM deficits. An acute alcohol dose also had a negative impact on regular tasks and selectively impaired episodic memory. However, no TBPM impairments were evident. In line with Leitz et al.’s (2009) findings, they also found no executive function impairments.

Smith-Spark et al. (2016) also reported PM deficits following an administration of a 0.06 g/kg alcohol dose. Using the MIST-A and MIST-B measures, the alcohol group reported a poorer performance on response to time cues, 2- and 15-min delay intervals, and verbal and action-based responses. The alcohol group was also more likely to report no response errors or more loss of content errors. Contrary to Leitz et al. (2009) and Paraskevaides et al. (2010) findings, no event-based impairment was found by Smith-Spark and colleagues (2016).

Two of the five reviewed RCTs administered an alcohol dose of 0.4 g/kg in healthy social drinkers. Using the JAAM task, Montgomery et al. (2011) also found EBPM and TBPM, but not ABPM deficits. In addition, alcohol impaired executive functions such as planning, prioritization, creativity and adaptability. To explore the alcohol effects of a 0.4 g/kg dose, Walter et al. (2016) used a non-focal PM task with emotional targets to examine alcohol effects on PM. In non-focal memory tasks attention is not focused on relevant features of the PM task during the ongoing task (McDaniel & Einstein, 2007). This study demonstrated selective alcohol effects on PM components depending on the PM cue valence (i.e. neutral, positive, negative). Contrary to the above findings, Walter et al. (2016) did not replicate an alcohol-induced PM impairment.

Overall, the findings are indicative of selective impairments in PM in social drinkers following a mild acute dose of alcohol. Considering the variability in the methodology of the above studies (i.e. alcohol dose and PM outcome measures) and the inconsistency of findings, further research work is needed to elucidate the relationship between an acute alcohol dose and PM.

*Binge Drinking*

Two of the eight reviewed studies explored the effects of binge drinking on PM. Although the term ‘binge drinking’ stimulates debate, it is commonly used to refer to heavy alcohol consumption within a short period of time, usually in excess of eight units for men and six units for women (Gill, 2002). Both studies reported PM impairments associated with binge drinking in young adults. Heffernan and collaborators (2010) administered the PRVP and the Prospective and Retrospective Memory Questionnaire (PRMQ; Smith et al., 2000) to measure PM performance in binge drinkers against their controls (i.e. non-binge drinkers). Although no statistically significant differences were evident on long- and short-term PM lapses, binge drinkers exhibited EBPM deficits. Using the PRMQ and the CAMPROMPT measures, Heffernan et al. (2012) found TBPM deficits in binge drinkers. However, no EBPM differences were found between binge drinkers and their controls.

Although only two of the reviewed studies examine the effects of binge drinking on PM performance, their findings denote a possible association between the two which warrants further exploration.

*Alcohol Hangover*

Alcohol hangover refers to the presence of both mental (e.g. hyper-excitability, anxiety) and physical symptoms (e.g. headache, drowsiness, concentration problems, dizziness) following a single episode of heavy drinking arising when the blood alcohol concentration approaches zero (Van Schrojenstein Lantman et al., 2016). Heavy drinking can be defined as drinking in

excess of four alcoholic drinks for women and of five drinks for men (Heffernan, 2018). Only one of the studies reviewed examined the impact of a state of alcohol hangover on PM. Heffernan (2018) concluded that a state of alcohol hangover impeded EBPM. Using the PRVP measure, young adults (aged between 18 and 35 years old), recalled fewer items than the control group.

In summary, this finding potentially suggests an association between alcohol hangover and PM deficits. However, further research is required to support this finding.

*Mediation of an Alcohol-Induced Impairment*

The contributing role of other cognitive domains has been examined by four of the reviewed RCTs. Leitz et al. (2009) found that episodic memory (the recollection of specific personally lived experiences; e.g., Tulving, 2002) plays a crucial role in future remembering to perform irregular tasks. They also argued that retrospective memory plays a contributing role in PM deficits. Paraskevaides et al. (2010) however, concluded that PM impairments are not wholly attributable to retrospective memory deficits.

The role of executive functions in alcohol-induced PM deficits was explored by Montgomery et al. (2011) and Smith-Spark et al. (2016). Modest alcohol doses selectively impaired executive functioning in both studies. Montgomery et al. (2011) reported deficits in planning, prioritization, creativity and adaptability functions but not in the selection executive function. Time-based and EBPM deficits were also evident. The latter finding was further reinforced by Smith-Spark and collaborators (2016). Smith-Spark et al. (2016) found a link of specific executive functions to PM performance but not an overall one. Specifically, they found that executive function acted as a predictor of PM where time cues existed and when verbal responses were requested. Phonemic fluency was reported being the strongest executive

function predictor. It should however be noted that the executive function measures were administered to the participants prior to alcohol administration.

Using emotional targets, Walter et al. (2016) found that valence had detrimental effects on PM. Specifically, in the alcohol group, the PM component was weaker for negative than for neutral cues and the retrospective component was stronger for positive than for neutral cues. The alcohol group had a significantly lower prospective component for negative cues and a lower retrospective component for neutral cues.

The role of future-event simulation (FES) (episodic future thinking) in PM was assessed by two of the reviewed studies. Leitz et al.’s (2009) findings indicated that although the FES strategy improved EBPM performance in the placebo group, it did not enhance the performance of participants in the alcohol group. These findings contradict Paraskevaides et al.’s (2010) reported results which provided evidence suggesting that FES could overcome alcohol-induced impairments in both event- and time-based PM, and significantly more so in event-based PM.

**Discussion**

This systematic narrative review examined the effects (acute and non-acute) of alcohol on PM in non-clinical young adult samples. Additionally, the contributing role of other cognitive domains was explored. Despite being widely acknowledged that having an intact PM is important for daily functioning, research on its impact following alcohol consumption has been rather sparse. This is indicated by the limited number of studies identified for inclusion. Only eight studies met the inclusion criteria. Five were randomized controlled trials and three were cross-sectional studies.

There is consensus that an acute mild alcohol dose of 0.6g/kg can impair PM in healthy social drinkers (Leitz et al., 2009; Paraskevaides et al., 2010; Smith-Spark et al., 2016). Prospective memory deficits are also evident at a lower alcohol dose of 0.4 g/kg (Montgomery et al. 2011) although this finding has not been consistent (Walter et al., 2016). Global PM deficits were found in one study (Leitz et al. 2009), with deficits reported in regular (habitual), irregular (occasional), event- and TBPM performance as well as in impaired episodic memory. However, selective deficits were noted elsewhere (Montgomery et al., 2011; Paraskevaides et al., 2010) and none were reported by Walter et al. (2016).

Retrospective memory deficits were found to contribute to PM deficits (Leitz et al., 2009; Paraskevaides et al., 2010). Executive function (e.g. planning) was also found to play a key role in PM performance, both as a predictor (Montgomery et al., 2011) and as a mediator (Smith-Spark et al., 2016). These findings further highlight the distinctive roles of the retrospective memory (when and what intention to retrieve) and of the executive functioning (e.g. planning) as components of PM (Einstein & McDaniel, 1990).

In addition to the above, this review recorded deleterious effects of non-acute (i.e. chronic, long-term) alcohol consumption on PM. Alcohol consumption above the recommended weekly units (14 units per week for both males and females) (NHS, 2018) could lead to PM impairments (Heffernan, 2018; Heffernan et al., 2012; Heffernan et al., 2010). Binge drinking for example, was found to impair EBPM (Heffernan et al., 2010) and TBPM (Heffernan et al., 2012). Prospective memory deficits were also evident in heavy drinkers (consuming more than four and five alcoholic drinks for women and men, respectively) during a state of alcohol hangover.

Arguably, PM impairments following an acute moderate alcohol dose, can be eliminated using a future event simulation (FES) strategy (Paraskevaides et al., 2010). Simulating a future scenario (Schacter & Addis, 2007) also improved PM performance in individuals who were not administered an acute alcohol dose (Leitz et al., 2009; Paraskevaides et al., 2010).

Notwithstanding the above findings, various methodological issues were identified when assessing the quality of the studies reviewed. Specifically, the cross-sectional studies lacked clarity in the blinding of outcome assessors (experimenters) and one was assessed as being of ‘poor’ quality (Heffernan, 2018). The reviewed RCTs, also had an underreporting of the selection and allocation concealment procedures, with one study being assessed as having a high risk of performance bias (Walter et al., 2016) and one as having a high detection bias (Smith-Spark et al., 2016). Furthermore, alcohol and other drug use was mostly based on self-reporting and a BAC measure was not always used to verify abstinence. It should also be noted that not all studies used an objective measure of PM performance and reliability and validity psychometrics were not always reported. The majority of the studies were also conducted in the United Kingdom and all participants were university students. These methodological limitations have also been noted elsewhere (Platt et al., 2019).

***Strengths and Limitations***

To our knowledge, this the first comprehensive systematic review that exclusively investigates the effects of alcohol use (moderate use, binge drinking, alcohol hangover) on PM. There are, however, limitations. Firstly, we restricted the search to English language papers and we might therefore have omitted reviewing relevant papers published in other languages. The grey literature was also not searched. A meta-analysis was not possible due to the variability in PM outcome measures and the risk of bias detected in some of the included studies. We have also excluded studies examining the effects of heavy alcohol use on PM due to the reporting of concurrent drug use (licit and illicit) by the participants. However, the aim of this review was to assess the effects of alcohol exclusively.

***Conclusions***

Existing research, although limited, suggests PM impairments following an acute moderate alcohol dose in healthy social drinkers. Binge drinking has also been found to impair PM as well as a state of alcohol hangover. Retrospective memory, episodic memory and executive functions can have a contributing role in PM performance. However, in the light of the small number of studies examining the alcohol-PM relationship, and of their methodological flaws, further research is required to provide concrete evidence on this area. Future research can implement robust and more accurate measures of alcohol and drug use and administer objective measures of PM performance.

Within the addictions field, further research on the role of prospective memory in recovery can shed light on how these might interfere with treatment. Relapse for example, might be a failure to execute an intention (i.e., abstinence from substance use) (Heffernan et al., 2002). Prospective memory impairments might denote failure to remember to attend aftercare meetings or failing to remember to utilize relapse prevention strategies. Additionally, given that individuals with mild intellectual disability or borderline intellectual functioning are at risk for developing substance use disorders, research on PM deficits in this client group might also add to their current addiction care.

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**Disclosure of Interest**

The authors declare that they have no conflict of interest.

**Contributors**

All authors have contributed to the design and protocol of this review. Authors AK and JSS selected relevant articles. AK extracted and synthesized the data and wrote the first and subsequent drafts. All authors have approved the final manuscript.

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