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Review

Alcohol-related cognitions in children (aged 2–10) and how they are shaped by parental alcohol use: A systematic review

Carmen Voogt[a,b,*], Miriam Beusink[a,b], Marloes Kleinjan[b], Roy Otten[a,c,d], Rutger Engels[b,e], Koen Smit[a,b], Emmanuel Kuntsche[a,f,g]

[a] Behavioral Science Institute, Radboud niversity, Nijmegen, P.O. Box 9104, 6500 HE Nijmegen, The Netherlands
[b] Trimbos Institute, Netherlands Institute of Mental Health and Addiction, P.O. Box 725, 3500 AS Utrecht, The Netherlands
[c] Pluryn, Research and Development, P.O. Box 53, 6500 AB Nijmegen, The Netherlands
[d] The REACH Institute, Arizona State University, Psychology Department, P.O. Box 876005, Tempe, AZ 85287-6005, USA
[e] Utrecht University, Department of General Social Sciences, P.O. Box 80140, 3508 TC Utrecht, The Netherlands
[f] Centre for Alcohol Policy Research, La Trobe University, 215 Franklin Street, Melbourne VIC 3000, Australia
[g] Institute of Psychology, Eötvös Loránd University, Budapest, Hungary

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ABSTRACT

Background: This systematic review aims to summarize the evidence of the impact of parental alcohol use on the acquisition of children's alcohol-related cognitions (alcohol-related knowledge, alcohol-related norms, alcohol expectancies) in the developmental period from age two to ten.

Methods: A computer-assisted systematic literature search was performed in PubMed, PsychINFO, ERIC, and EMBASE. Overall, 20 out of the 3406 unique articles identified in the first screening were included.

Results: The results revealed that children acquire knowledge about alcohol already at age two and from age four on, they understand its use in adult culture. By the age of four, children have certain alcohol expectancies. The evidence of the impact of parental alcohol use on the acquisition of children's alcohol-related cognitions is inconsistent so far with studies showing positive and no effects. Unfortunately, the existing evidence is limited because most studies a) were conducted exclusively in the United States and more than two decades ago, b) used cross-sectional study designs, and c) used non-representative samples recruited using convenience sampling strategies.

Conclusions: Research on children's alcohol-related cognitions is underdeveloped. To elucidate the conclusions about alcohol involvement in early life, studies with longitudinal study designs need to be conducted among representative samples of children and early adolescents by using age-appropriate measurement tools in a broader cultural context.

1. Introduction

Ample evidence has been presented on the distal and proximal factors that determine the full spectrum of alcohol use – from alcohol initiation to risky drinking – in adolescence and beyond (Ham and Hope, 2003; Kuntsche et al., 2004). However, an increasing number of longitudinal studies have demonstrated that proximal cognitive factors related to alcohol use are rooted in childhood (Schulenberg and Maggs, 2008). In childhood, parents are the principal socialization agents stimulating children's development (Steinberg, 2002). Consequently, they are the primary source of their children's alcohol-related knowledge (Zucker et al., 2008, 1995). The Cognitive Model of Intergenerational Transference (Campbell and Oei, 2010) assumes that parents' verbal affirmations of the perceived benefits of alcohol and children's observation of the effects of parental alcohol use are responsible for the intergenerational transference of alcohol-related cognitions, that is, what children a) know about alcohol (i.e., alcohol-related knowledge); b) know about alcohol use in adult culture (i.e., alcohol-related norms), and c) believe happens to others or themselves when drinking alcohol (i.e., alcohol expectancies).

A literature review conducted by Lang and Stritzke (1993) on children's alcohol-related cognitions showed that children are not 'innocent' with respect to alcohol. Already at age three, children have alcohol-related knowledge, as they can recognize and identify alcoholic

* Corresponding author at: Behavioral Science Institute, Radboud University, Nijmegen, P.O. Box 9104, 6500 HE Nijmegen, The Netherlands.
E-mail addresses: c.voogt@bsi.ru.nl (C. Voogt), mbeusink@trimbos.nl (M. Beusink), mkleinjan@trimbos.nl (M. Kleinjan), royotten@pluryn.nl (R. Otten), rengels@trimbos.nl (R. Engels), k.smit@bsi.ru.nl (K. Smit), ekuntsche@addictionsuisse.ch (E. Kuntsche).

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beverages. From age five on, children seem to be aware of age-related alcohol norms (e.g., only adults consume alcohol), hold sex-specific alcohol norms (e.g., males like alcohol-related activities more than do females), and know socially acceptable amounts of alcohol use (e.g., small versus large alcohol dose). Finally, as early as six years of age, children have certain alcohol expectancies that seem to shift from primarily negative to primarily positive by the age of ten. Based on observed situational determinants, children seem to acquire knowledge of alcohol itself and the role of alcohol in the social environment (i.e., norms) based on which they eventually develop alcohol expectancies (Zucker et al., 2008, 1995). In this respect, it is essential to evaluate what is already known regarding the developmental sequence from knowledge and norms to expectancies.

Unfortunately, since the review by Lang and Stritzke (1993) conducted more than two decades ago did not follow guidelines of the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) (Liberati et al., 2009; Moher et al., 2009), a comprehensive state-of-the-art knowledge of research on children's alcohol-related cognitions is currently lacking. Besides, the impact of parental alcohol use on the acquisition of children's alcohol-related cognitions was not considered in the previous review (Lang and Stritzke, 1993). It is crucial to understand this impact, as alcohol-related knowledge and alcohol-related norms are supposed to influence alcohol expectancies (e.g., 'I expect that alcohol makes me sociable') and the transition to drinking motives (e.g., 'I drank (for the first time) to enjoy a party'). According to the Motivational Model of alcohol use (Cox and Klinger, 1990, 1988), the latter is thought to constitute the final pathway to alcohol initiation (Kuntsche and Müller, 2012) and subsequent drinking patterns (e.g., binge drinking) (Andrews et al., 2011; Donovan et al., 2004; Windle et al., 2008). Risky drinking among young people is particularly alarming, as childhood is a critical period of cortical development, and it is important for establishing lifelong adult characteristics, which drinking could disrupt (Crews et al., 2007). Therefore, this systematic review aimed to summarize the evidence of the impact of parental alcohol use on the acquisition of children's alcohol-related cognitions (alcohol-related knowledge, alcohol-related norms, alcohol expectancies) in the developmental period from age two to ten. This particular age range was chosen to explore the development and increase of alcohol-related cognitions before adolescence. Scholars have suggested that the socialization into early alcohol use occurs before age ten (Zucker et al., 2008). This review builds on and extends the review of Lang and Stritzke (1993) by including studies published from 1976 to 2016 that focused on the acquisition of children's alcohol-related cognitions and on the impact of parental alcohol use on this acquisition. Our review also adheres to PRISMA guidelines (Liberati et al., 2009; Moher et al., 2009), thus reporting the findings in a comprehensive and transparent manner.

2. Material and methods

A computer-assisted systematic literature search was performed in collaboration with an information expert in searches for systematic reviews and meta-analyses in PubMed, PsychINFO, ERIC, and EMBASE in accordance with the PRISMA guidelines (Liberati et al., 2009; Moher et al., 2009). The review was registered in the Prospero database of systematic reviews (registration number CRD42016051080). Inclusion criteria were: a) full-text original articles published in the last forty years (from 1976 to 2016) and written in English; b) studies including children in the developmental period from age two to ten; and c) studies assessing children's alcohol-related knowledge, alcohol-related norms, and/or alcohol expectancies as outcomes only and/or in combination with parental alcohol use. The reviewed studies that comprised samples of children who were younger as well as older than the age of ten were included in the review. Of these studies, we only reviewed the results for the children within the age range between two and ten years (see Table 2 for specific information). Both explicit alcohol expectancies that rely on non-automatic cognitive motivational processes as well as implicit alcohol expectancies that rely on automatic underlying motivational processes were included (Thush and Wiers, 2007). Exclusion criteria were: a) full-text original articles published before 1976 and written in language other than English and b) commentaries, editorials, notes, and study protocols. In addition, the reference sections of identified articles were cross-checked in order to find relevant articles meeting the above-mentioned inclusion criteria. If full-text articles were not available, we contacted their authors to obtain them.

2.1. Data selection process

Fig. 1. shows the PRISMA study flow diagram (Liberati et al., 2009; Moher et al., 2009). The keywords used to identify relevant articles were; e.g.; 'knowledge' or 'schema' or 'awareness'; 'norm*' or 'appropriate*'; 'expectanc*' or 'perceived benefits'; 'child*' or 'youngster' or 'preschool*'; 'parent*' or 'father*'or 'mother*'; in combination with 'alcohol' or 'drinking'. We identified 3388 articles from the four search engines. Overall; 18 articles emerged from the screenings of the reference sections in the identified studies; resulting in 3406 unique articles (Fig. 1). Two authors (CV and MB) screened all articles independently based on their title and abstract to ascertain that they met the inclusion criteria. Articles that were published before 1976 (n = 14); commentaries (n = 10); editorials (n = 5); notes (n = 2); study protocols (n = 11); and those that did not focus on children's alcohol-related cognitions (n = 3320) were excluded. For the 44 remaining articles; the full text was obtained to check the compliance with the inclusion criteria. Once again; the same two authors (CV and MB) performed this task independently. Any disagreement between the two authors was resolved by consensus or; if the disagreement persisted; by consulting a third researcher (EK). Articles that did not meet the inclusion criteria were excluded (n = 24). In total; 20 articles were retained for further analysis.

2.2. Data extraction process and critical appraisal

Using a predefined scheme based on the PRISMA checklist (Moher et al., 2009), the following data were extracted from the 20 selected studies: a) study characteristics (i.e., author(s) and year of publication); b) methods (i.e., sample characteristics, sampling strategy, study design, and outcomes); c) results (i.e., main results), and d) conclusions. The risk of bias of the selected studies was evaluated using the Newcastle Ottawa Scale (NOS) (Wells et al., 2000), a widely used tool for assessing the quality of observational studies (Stang, 2010) that has been adapted for cross-sectional studies (Herzog et al., 2013).

3. Results

Table 1 provides an overview of the characteristics of the 20 selected studies in this systematic review. Of the 20 studies, 16 focused on children's alcohol-related knowledge (Austin and Nach-Ferguson, 1995; Casswell et al., 1988; Dalton et al., 2005; Flett et al., 1987; Fossey, 1993a, 1993b; Gaines et al., 1988; Greenberg et al., 1985; Hahn et al., 2000; Jahoda et al., 1980; Kuntsche et al., 2016; Mennella and Garcia, 2000; Noll et al., 1990; Tennant, 1979; Valentine et al., 2014; Zucker et al., 1995), five focused on children's alcohol-related norms (Jahoda et al., 1980; Kuntsche et al., 2016; Noll et al., 1990; Spiegler, 1983; Zucker et al., 1995), four focused on children's explicit alcohol expectancies (Austin and Nach-Ferguson, 1995; Flett et al., 1987; Kuntsche, 2017; Mares et al., 2015), and one focused on both explicit and implicit alcohol expectancies (Pieters et al., 2010). Eleven focused on the impact of parental alcohol use on the acquisition of children's alcohol-related cognitions (Casswell et al., 1988; Dalton et al., 2005; Gaines et al., 1988; Greenberg et al., 1985; Hahn et al., 2000; Jahoda et al., 1980; Mares et al., 2015; Mennella and Garcia, 2000; Noll et al.,

Table 1
Study characteristics, methods, results, and conclusions of 20 selected studies ordered chronologically from the most recent.

Study (year)	Methods		Results	Conclusions
	Number of participants; age range of participants; sampling strategy; mean age (SD) of participants; % of boys; study design; country	Outcomes	Main results	Conclusions
Kuntsche (2017)	198 children aged 4.0-6.0 (of which 19.2 aged 4.0, 43.4% aged 5.0, and 37.4% aged 6.0) recruited using a random sampling strategy; mean age is unknown; 47.0% boys; cross-sectional study; Switzerland.	Children's explicit AE (4 factors: arousal-positive, arousal-negative, sedation-positive, sedation-negative) and demographic characteristics (sex, age). The outcomes were measured by the Berkeley Puppet Interview in which 2 identical dog hand puppets made opposing statements about different opinions (e.g., 'I think when adults drink alcohol, they become happy' versus 'I think when adults drink alcohol, they do not become happy'). Children were asked 'And how about you, what do you think?'. The puppet with which the child agrees then repeats the child's answer, thereby appraising the child's answer. Trained interviewers administered responses individually.	Children had higher positive rather than negative explicit AE, yet no difference concerning arousal and sedation explicit AE emerged. Sex differences in sedation explicit AE were observed. Girls had higher positive sedation AE (adults become quiet, calm, or relaxed when drinking alcohol) and lower negative sedation AE (adults become depressed, bored, or sad when drinking alcohol) compared to boys. No age differences were noted for any of the 4 explicit AE factors.	Children (aged 4.0-6.0) had higher positive rather than negative explicit AE. No age differences for explicit AE factors emerged, yet sex differences indicated that girls had more positive explicit AE compared to boys.
Kuntsche et al. (2016)	301 children aged 3.0-6.0 recruited using a random sampling strategy; 5.4 (*SD* = 0.80) years old; 50.5% boys; cross-sectional study; Switzerland.	Children's alcohol-related knowledge, alcohol-related norms, and demographic characteristics (sex, age). The outcomes were measured using the eABT that presents 11 everyday life scenarios on a touch-screen computer. Children were asked a) to indicate what the displayed male and female adults and children drank by touching 1 of the 12 displayed beverages (4 alcoholic; 8 non-alcoholic), b) whether the beverages contain alcohol, and c) whether they know the names of the beverages.	Concerning alcohol-related knowledge, children identified 68.1% of the beverages as alcohol-containing and 83.2% as non-alcohol containing. They knew 46.6% and 73.1% of the alcoholic and non-alcoholic beverages by name. No sex differences were found in alcohol-related knowledge, yet the knowledge increased with age. Concerning alcohol-related norms, children assigned alcoholic beverages more often to males (42.2%) compared to females (28.7%) or children (12.7%) and adults were more often assigned alcoholic beverages at a party (39.4%) rather than when playing outdoors (34.7%). Sex and age differences in alcohol-related norms revealed that a) girls and older children assigned alcoholic beverages to children less often compared to boys and younger children and b) older children assigned alcoholic beverages to males more often compared to younger children.	Children (aged 3.0-6.0) could distinguish between alcoholic and non-alcoholic beverages. In addition, children could identify the content of alcoholic beverages and knew its use in adult culture. Sex and age differences in alcohol-related knowledge and alcohol-related norms were found.
Mares et al. (2015)	240 children aged 6.0-9.0 (of which 23.7% aged 6.0, 23.7% aged 7.0, 25.9% aged 8.0, and 26.7% aged 9.0) recruited using a random sampling strategy; 8.0 (*SD* = 1.13) years old; 47.9% boys; cross-sectional study; the Netherlands.	Children's explicit AE (positive and negative) and demographic characteristics (sex, age). Parents reported on alcohol use. Children's outcomes were measured using the Berkeley Puppet Interview in which 2 identical dog hand puppets made opposing statements. Children were asked 'And how about you, what do you think?'. The puppet with which the child agrees then repeats the child's answer, thereby appraising the child's answer. Trained interviewers administered responses.	Children had equally strong positive and negative explicit AE. No sex differences emerged in the strength of positive and negative explicit AE. Older children had less positive and more negative explicit AE compared to younger children. In addition, more paternal alcohol use was related to less negative explicit AE among girls. Moreover, more maternal alcohol use was related to less positive explicit AE while more paternal alcohol use was related to more positive explicit AE among older children.	Children (aged 6.0-9.0) had equally strong positive and negative explicit AE. No sex differences emerged in the strength of positive and negative explicit AE; however, age differences showed that older children had less positive and more negative explicit AE compared to younger children. In addition, parental alcohol use was related to children's positive and negative explicit AE.
Valentine et al. (2014)	Ten families consisting of 18 children aged 5.0–12.0 (of which 55.6% young and 44.4% old) recruited using a random sampling strategy; case study; United Kingdom.	Children's alcohol-related knowledge (product recognition and awareness of health risks and social harms associated with drinking and society rules). The outcomes were measured using a child-centered research process. For product recognition, children were asked to identify types of beverages (alcoholic and non-alcoholic) by smell and from a series of advertisements for common brands. To assess the awareness of health risks and social harms associated	Children had limited knowledge of specific types/brands of beverages: a few recognized specific beverages from television programs, yet the majority correctly identified only alcohol that their parents or relatives drank, in some cases recognizing gendered product preferences and the consumption of different beverages (cocktails and shots) on holiday. In addition, children were aware that alcohol is an adult product, yet they were not aware	Children (aged 5.0-12.0) could identify alcoholic beverages and the short-term health risks and social harms associated with drinking and society rules. This alcohol-related knowledge is gained through proximal processes, that is, their daily interactions with parents/older siblings in the family context and their media exposure rather than health campaigns or school interventions targeted at them.

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Table 1 *(continued)*

Study (year)	Methods		Results	Conclusions
	Number of participants; age range of participants; sampling strategy; mean age (SD) of participants; % of boys; study design; country	Outcomes	Main results	Conclusions
		with drinking and society rules, puppets and a doll's house with figurines were used for young children, while old children were shown clips from the cartoon series The Simpsons representing adults and children as drinking/drunk. The responses were audio-recorded and transcribed.	of the legal age for public consumption and the legal purchase age. Moreover, they were aware of some of the short-term health risks and social harms associated with drinking, including that alcohol: affects children more rapidly than adults; has physical effects on the body and social effects on behavior, and increases a risk of addiction.	
Pieters et al. (2010)	99 children aged 9.0–12.0 (of which 23.0% non-drinkers and 67.0% drinkers) recruited using a convenience sampling strategy; 10.2 (*SD* = 0.45) years old; 55.0% boys; cross-sectional study; the Netherlands.	Children's explicit AE (positive and negative), implicit AE, and perceived parental alcohol use. Children's explicit AE (modified version of the AE Scale for Children) and their perceived parental alcohol use ('Did your father/mother drink beer or wine last week?' with answers categories: 1 = no, 2 = once, 3 = a couple of times, 4 = every day) were measured by self-administered surveys in a classroom guided by trained research assistants. Children's implicit AE were measured by a modified version of the IAT in which 16 colored pictures of beverages (8 alcoholic; 8 soda) and 16 colored pictures of faces of children (8 happy; 8 angry) were presented on a computer. Children were asked to pick the pictures that correspond to the faces.	Children had positive and negative explicit AE and negative implicit AE. Concerning explicit AE, children did not differ in the degree to which they expected negative effects of alcohol use, yet drinkers anticipated more positive effects of alcohol use compared to non-drinkers. Concerning implicit AE, both drinkers and non-drinkers associated alcohol more strongly with angry faces than with happy faces. Perceived parental alcohol use was not related to children's explicit and implicit AE.	Children (aged 9.0-12.0) had positive and negative explicit AE and negative implicit AE. In addition, perceived parental alcohol use was not related to children's explicit and implicit AE.
Dalton et al. (2005)	120 children aged 2.0–6.0 (of which 30.0% minority and 70.0% non-minority) recruited using a convenience sampling strategy; mean age is unknown; 45.0% boys and 109 parents aged ≤ 29.0–49.0; 5.8% fathers; cross-sectional study; United States.	Children's alcohol-related knowledge (purchases and identification of grocery products). Parents reported on alcohol use, children's movie exposure, and demographic characteristics. Children's outcomes were measured using a role-playing scenario involving grocery shopping and a social event for adults guided by a researcher. Parental outcomes were measured using self-administered surveys.	On average, 17 (*SD* = 8.80) of the 73 grocery products were purchased. Of the 120 children, 61.7% bought alcohol, of whom a) 58.1% identified it by type (beer, wine, or booze) and b) 35.1% both beer and wine. Children's alcohol purchases were related to parental alcohol use and children's movie exposure: children were more likely to purchase alcohol a) when their parents reported drinking alcohol at least monthly compared to those who reported drinking alcohol less than monthly; b) as their viewing of movies rated for older audiences increased, and c) if children watched PG-13- or R-rated movies compared with those who watched only G-rated movies infrequently.	Children (aged 2.0-6.0) purchased alcohol and could identify the type of alcohol. Children's alcohol purchases were related to parental alcohol use and children's movie exposure.
Hahn et al. (2000)	126 children aged 5.0–6.0 recruited using a random sampling strategy; 5.8 (*SD* = 0.40) years old; 44.0% boys and 126 parents; 32.4 (*SD* = 8.90) years old; 3.2% fathers; cross-sectional study; United States.	Children's alcohol-related knowledge and demographic characteristics (sex, ethnic group). Parents reported on alcohol use and demographic characteristics (income, marital status). Children's outcomes were measured by the CDAI, a pictorial inventory consisting of 18 pictures (6 neutral; 12 related to alcohol, tobacco, or other drugs) administered by trained interviewers at school. A child bear is depicted together with a parent bear who performs different tasks. Trained interviewers administered responses individually.	Of the 120 children, 56% identified ≥ 1 alcoholic beverage and 50% recognized drinking and driving. No sex and ethnic differences in this alcohol-related knowledge were found. In addition, children's alcohol-related knowledge was not related to parental alcohol use.	Children (aged 5.0-6.0) could identify alcoholic beverages, yet this alcohol-related knowledge was not related to parental alcohol use. No sex and ethnic differences were found for alcohol-related knowledge.
Mennella and Garcia (2000)	150 children aged 3.8–6.0 (of which 20.0% lived in a household in which 1 or both parents were escape drinkers = 'escape group' and 50.7% who had no escape drinking mother or father = 'no escape	Children's alcohol-related knowledge (odor preferences and identification). Parents reported on alcohol use and reasons for drinking. Children's outcomes were measured using an age-	Concerning odor preferences, children preferred bubble gum (86.0%), followed by mineral oil (66.0%), beer (52.7%), and pyridine (11.3%), respectively. Children in the 'escape group' were	Children (aged 3.8-6.0) had alcohol-related knowledge, which is based on sensory experiences and experiences at home and the emotional context in which their parents

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Table 1 *(continued)*

Study (year)	Methods		Results	Conclusions
	Number of participants; age range of participants; sampling strategy; mean age (SD) of participants; % of boys; study design; country	Outcomes	Main results	Conclusions
	group') recruited using a convenience sampling strategy; 4.9 (*SD* = 0.04) years old; 44.7% boys; cross-sectional study; United States.	appropriate, game-like task in which odor stimuli (bubble gum, beer, pyridine/'spoiled milk', mineral oil) were presented individually in squeeze bottles. The stimulus bottle was held about 3 cm from the children's nose and 3 puffs of air were delivered to their nostrils. If children liked the smell, they should give it to Big Birdy, if they did not like the smell, they should give it to Oscar, both well-known Sesame Street character toys. Next, children were asked what the odor smelled like. The responses were administered by experimenters. Parental outcomes were measured using self-administered surveys.	more likely to dislike the beer odor compared to children in the 'no escape group'. This difference was odor specific. Besides, fathers of children who disliked the beer odor drank more than did fathers of those who liked the beer odor. Concerning odor identification, children most often correctly identified the odor of gum (48%), followed by beer (16%), pyridine (14.7%), and mineral oil (13.3%), respectively. There were no differences between the 'escape' and 'no escape' group.	experience alcohol.
Austin and Nach-Ferguson (1995)	213 children aged 7.0–12.0* recruited using a convenience sampling strategy; mean age is unknown; 47.0% boys and 276 parents; 24.0% fathers; cross-sectional study; United States.	Children's alcohol-related knowledge (general knowledge: factual information about alcohol and how frequently it is used, brand-specific knowledge: knowing brand names of various types of alcohol, including what type of alcohol a particular brand represents and what symbols are associated with particular brands, and total knowledge: sum of general knowledge and brand-specific knowledge), explicit AE (negative), and demographic characteristics (sex, age). Outcomes were measured using self-administered paper-and-pencil surveys in a classroom guided by adults if needed.	Children's alcohol-related knowledge was considerable, as they obtained a mean score of a) 6.3 (1–7) for general knowledge, b) 5.9 (1–13) for brand-specific knowledge, and c) 12.2 for total knowledge (1–19). Sex and age differences emerged in general knowledge and total knowledge but not in brand-specific knowledge: girls and older children (aged 10.0-12.0) had more knowledge compared to boys and younger children (aged 7.0-9.0), respectively. In addition, most children (60%) had negative explicit AE, as they disagreed that 'friends will think I am not cool if I do not drink beer or wine with them.'.	Children (aged 7.0-12.0) had alcohol-related knowledge and negative explicit AE. There were sex and age differences in total knowledge and general knowledge but not in brand-specific knowledge: girls and older children (aged 10.0-12.0) had more knowledge compared to boys and younger children (aged 7.0-9.0).
Zucker et al. (1995)	223 children (of which 62% were COAs and 38% were NCOAs) aged 2.9–6.5 recruited using a convenience sampling strategy; 4.5 (*SD* = unknown) years old; 100% boys and 223 parents; cross-sectional study; United States.	Children's alcohol-related knowledge, alcohol-related norms, and demographic characteristics (age). Fathers reported on alcohol use. Children's outcomes were measured using a modified version of the ABT in which 10 everyday life drawings are shown on a table. In every drawing, each character is drinking an unidentified beverage. Children were asked a) to indicate what the male and female adults and children drank in each drawing by pointing 1 of the 10 beverages (5 alcoholic; 5 non-alcoholic) and b) whether they know the names of the beverages. The paternal outcome was measured using paper-and-pencil surveys.	Concerning alcohol-related knowledge, of the 223 children, 88% identified ≥ 1 alcoholic beverage: this knowledge increased with age. CAOs were more likely compared to NCAOs to identify a) ≥ 1 alcoholic beverage, b) specific alcoholic beverages (beer), and c) a larger number of alcoholic beverages. Concerning alcohol-related norms, a) males were more often assigned alcoholic beverages compared to females and b) adults were more often assigned alcoholic beverages compared to children, and this knowledge increased with age. CAOs assigned more alcoholic beverages to adults than did NCAOs. Age and paternal alcohol use was related to children's provision of alcoholic beverages to males while maternal alcohol use was related to children's assignment of alcoholic beverages to females.	Children (aged 2.9-6.5) could distinguish between alcoholic and non-alcoholic beverages. This alcohol-related knowledge increased with age. In addition, children know its use in adult culture as a) males were more often assigned alcoholic beverages compared to females and b) adults were more often assigned alcoholic beverages compared to children, and this knowledge increased with age. Moreover, CAOs had more alcohol-related knowledge and alcohol-related norms than did NCAOs.
Fossey (1993a)	238 children (aged 5.5–6.5; aged 7.5–8.5; and aged 9.5–10.5) aged 5.5–10.5 recruited using a convenience sampling strategy; mean age is unknown; % of boys is unknown; cross-sectional study; United Kingdom.	Children's alcohol-related knowledge and demographic characteristics (age). The outcomes were measured using a modified version of Recognition of Smells Task in which children attempt to identify alcoholic beverages by smell (1st 'free identification' trial) and by pointing to pictures of the substances that were not correctly identified in the 1st trial (2nd 'assisted identification' trial). In the 1st trial, 9 jars with different odors (2 alcoholic: beer, whiskey; 7 non-alcoholic: mint, dettol,	In the 1st trial, 47.4% correct identifications of the odors were made versus 78.2% in the 2nd trial. In the 1st trial, children identified beer and whiskey on the 5th and 6th place. In the 2nd trial, children identified whiskey and beer on the 1st and 2nd place. Of the 238 children, 37.8% (beer) and 78% (whisky) did not recognize the odor in the 1st trial compared to 29% (beer) and 26% (whisky) in the 2nd trial. When combining the 2 trials, 94.5% identified beer and/or whiskey and 77.7% identified	Children (aged 5.5–10.5) could recognize and identify alcoholic beverages based on smell. This alcohol-related knowledge started at age 5-5-6.5 and increased with age.

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Table 1 *(continued)*

Study (year)	Methods		Results	Conclusions
	Number of participants; age range of participants; sampling strategy; mean age (SD) of participants; % of boys; study design; country	Outcomes	Main results	Conclusions
		vinegar, coffee, bubble bath, perfume, tomato) were presented. Children were asked a) whether they smelled the odor before, and, if yes b) what they thought about it, c) where they smelled it before, d) who used it, and e) whether they liked it. In the 2nd trial, 9 color photographs were presented. The responses were administered individually by trained examiners.	both alcoholic beverages, of which 26.5% identified alcoholic beverages without the aid of visual cues. In both trials, children's identification of beer and/or whiskey increased with age.	
Fossey (1993b)	228 children (of which 33% aged 5.5–6.5; 34% aged 7.5–8.5; and 33% aged 9.5–10.5) aged 5.5–10.5 recruited using a random sampling strategy; mean age is unknown; 49.6% boys; cross-sectional study; United Kingdom	Children's alcohol-related knowledge and demographic characteristics (age). The outcomes were measured using a modified version of the Judgement of Photographs Task comprising 20 photographs (adults engaged in an alcohol/tobacco-related activity or a non-alcohol/tobacco-related activity). Children were asked a) what they could tell about the beverages (1 = factual information: 'alcohol make you drunk'; 2 = positive information: 'alcohol taste nice'; 3 = negative information: 'alcohol is bad for you') and b) to put each photograph into 1 of the 4 boxes (1 = like very much; 2 = like a little; 3 = do not like a little; 4 = do not like at all).	Children aged 5.5–6.5 were more likely to report that they knew nothing about alcohol compared to children aged 9.5-10.5. Of the 5.5–6.5 year olds, factual information about alcohol was reported more often compared to negative information about alcohol. Factual and negative information about alcohol increased with age.	Children (aged 5.5-10.5) could tell factual ('alcohol make you drunk') and negative information ('alcohol is bad for you') about alcohol. This alcohol-related knowledge started at age 5.5–6.5 and increased with age.
Noll et al. (1990)	57 children (of which 51.0% aged 2.6–4.0 and 49.0% aged 4.1–5.8) aged 2.5–6.0 recruited using a convenience sampling strategy; 4.1 (*SD* = 0.92) years old; and 92 parents; 38.0% fathers; cross-sectional study; United States.	Children's alcohol-related knowledge, alcohol-related norms, and demographic characteristics (sex, age). Parents reported on alcohol use and demographic characteristics. Children's outcomes were measured using a smelling task in which children attempted to identify alcoholic beverages based on smell (1st uncued trial) and by pointing to a picture of the substances that were not correctly identified on the 1st trial (2nd cued trial). In the first trial, 9 jars with different odors (3 substances mainly used by children or by both children and adults = 'universal-use': apple juice, Playdoh, popcorn; 2 substances mainly used by adults = 'non-controlled adult-use': coffee, perfume; 4 substances whose use is legally limited to adults only = 'controlled adult-use': beer, whiskey, wine, cigarettes) were presented. Children were asked a) to identify what they smelled. In the second trial, 9 color photographs were presented. The responses were administered individually by trained examiners. Parental outcomes were measured using self-administered surveys.	Concerning alcohol-related knowledge, older children were better at identifying substances by smell compared to younger children in the 1st trial. Of the older children, 57% identified beer, wine, or whiskey compared to 21% of the younger children. When combining the 2 trials, 89%/69% of the older/younger children identified ≥ 1 alcoholic beverage. Children were better at identifying the universally used and the non-controlled adult-use substances compared to the controlled adult-use substances in both trials. Concerning alcohol-related norms, children reported that a) universal substances are used by adults and children (62%) and b) non-controlled adult-use substances (69%) and controlled adult-use substances (86%) are used by adults only. Age differences in alcohol-related norms are unknown. Moreover, parental alcohol use was related to children's ability to identify ≥ 1 alcoholic beverages. Those who were most successful at identifying ≥ 1 alcoholic beverage came from families in which both parents reported alcohol use. No sex differences in alcohol-related knowledge and alcohol-related norms emerged.	Children (aged 2.6-6.0) could identify alcoholic beverages based on smell: this alcohol-related knowledge started at age 3.0–4.0 and increased with age. In addition, children also know alcohol use in adult culture, as they reported liking substances that are used mainly by children and adults and generally reported disliking substances the use of which is legally limited to adults only. No sex differences emerged in alcohol-related knowledge and alcohol-related norms.
Casswell et al. (1988)	743 children aged 8.0–9.0 recruited using a random sample strategy; mean age is unknown; 52.8% boys; and 740 mothers; cross-sectional study; New-Zealand.	Children's alcohol-related knowledge. Mothers reported on their own and partner's alcohol use and alcohol-related problems in their children's social environment. Children's and maternal outcomes were measured using structured interviews administered by trained	Of the children, 6% knew nothing about alcohol effects; 94% gave ≥ 1 responses; 37% reported short-term effects, and 38% long-term effects. 'Getting drunk' was most often reported (71%). In addition, children's sources of alcohol-related knowledge were television (35%), parents or	Children (aged 8.0-9.0) could describe the effects of alcohol and know the concept drunkenness. Television was the major source of alcohol-related knowledge.

(continued on next page)

Table 1 *(continued)*

Study (year)	Methods		Results	Conclusions
	Number of participants; age range of participants; sampling strategy; mean age (SD) of participants; % of boys; study design; country	Outcomes	Main results	Conclusions
		interviewers. Children were asked a) what they know about what happens to people who drink beer, whiskey, wine, or any other alcoholic beverage; b) how they knew this, and c) the meaning of 'being drunk'.	siblings (26%), other sources (24%), and themselves by witnessing (21%). Moreover, more than half of the children reported ≥ 1 aspect of drunkenness (e.g., drinking too much alcohol (47%); physical signs (41%); antisocial behavior (31%)). The majority of the children recalled that mothers (68%) and fathers (76%) had told them nothing about alcohol.	
Gaines et al. (1988)	80 children in kindergarten (5-year olds), grade 3 (8-year olds), grade 6 (11 year olds), and grade 8 (13 year olds) (of which 25% in kindergarten and 25% in grade 3)** recruited using a convenience sample strategy; 48.8% boys; and their parents; cross-sectional study; United States.	Children's alcohol-related knowledge (adult's drinking motives and society rules and drinking constraints) and demographic characteristics (sex, age). Parents reported on alcohol use. Children's outcomes were measured by administering 6 drinking vignettes that depicted drinking motives: coping (escape from painful effect), social (facilitation of social interaction), and enhancement (celebration of positive event). Children were asked about the actor's drinking motives: a) why s/he drank, b) whether s/he intended to drink, c) how s/he felt before s/he drank, and d) how s/he felt after s/he drank. In addition, children were asked a) where do you see people drink (place), b) how old do you have to be to buy alcohol (rule), c) how old do you have to be to drink alcohol (rule), d) how old do boys/girls need to be to buy alcohol (rule), e) who says how old you have to be to drink (rule), and f) how much is a small/medium/large amount of beer, wine, or whiskey. The responses were administered individually by staff. Parental outcomes were measured by phone interviews administered by a graduate psychology student experienced in alcohol counselling.	Sex and age differences were noted in alcohol-related knowledge: girls and 8-year olds knew more about adults' drinking motives compared to 5-year olds and boys, respectively. Overall, children knew more about social motives rather than coping and enhancement motives. In addition, the mean number of places named where adults drink was 2.9 (*SD* = 0.72) and 3.1 (*SD* = 0.75) for 5- and 8-year olds, respectively. Most children were not aware of the legal age for public consumption and no more than 20% guessed the legal purchase age between 17–22 years. The 8-year olds knew more about society's rules and constraints compared to 5-year olds. Children agreed on the amount of a small or large amount of wine and whiskey, only 5-year olds had a larger standard for a medium amount of whiskey. Besides, 5-year olds did not differentiate beer from whiskey. The mean number of days a year on which children had seen either parent drinking were 107.7 (*SD* = unknown) and 96.4 (*SD* = unknown) for 5- and 8-year olds, respectively. Parental alcohol use was related to children's knowledge of adult's drinking motives among 8-year olds, but not among 5-year olds.	Children (5- and 8-year olds) had knowledge about adult's drinking motives, the amount of a small or large amount of wine and whiskey, and the places where adult's drink, but they were not well aware of the legal age for public consumption. Sex and age differences in alcohol-related knowledge indicated that girls and 8-year olds know more about adults' drinking motives compared to 5-year olds and boys, respectively. Parental alcohol use was only related to alcohol-related knowledge concerning adult's drinking motives of 8-year olds.
Flett et al. (1987)	743 children aged 9.0 recruited using a random sample strategy; 52.8% boys; cross-sectional study; New-Zealand.	Children's alcohol-related knowledge and explicit AE (positive and negative). The outcomes were measured using structured interviews administered by trained interviewers. Children were asked a) what they know about what happens to people who drink beer, whiskey, wine, or any other beverage; b) how they knew this, and c) the meaning of 'being drunk'.	Of the children, 6% knew nothing about alcohol effects, 8% reported pleasant or neutral effects, and 71% reported drunkenness. Children's sources of alcohol-related knowledge were television (37%), parents or siblings (27%), other sources (16%), and witnessing themselves (23%). More than 50% of the children reported ≥ 1 aspect of drunkenness (drinking too much (46%); physical signs (36%); antisocial behavior (7%)).	Children (aged 9.0) could describe the effects of alcohol and have negative explicit AE.
Greenberg et al. (1985)	57 children (of which 50.9% aged 2.5–4.0 = young and 49.1% aged 4.0–6.0 = old) aged 2.5-6.0 recruited using a convenience sampling strategy; 4.1 (*SD* = 0.92) years old; % of boys is unknown; and 57 parents (of which 40.4% were heavy drinkers, 26.3% moderate drinkers, and 33.3% light drinkers/abstainers); cross-sectional study; United States.	Children's alcohol-related knowledge and demographic characteristics (age). Parents reported on alcohol use, motivations for drinking, and demographic characteristics. Children's outcomes were measured using a smelling task game. In the 1st trial, opaque jars containing 9 different substances (3 alcoholic: beer, wine, whiskey: 6 non-alcoholic: apple juice, cigarette butts, coffee, playdoh, perfume, popcorn) were presented. Children were told to close their eyes and try to identify what	Most children identified substances by smell alone: older children were more successful in identifying alcoholic and non-alcoholic beverages compared to younger children. Of the young children 76% identified at least 1 of the 3 alcoholic beverages, and 89% of the older children correctly identified beer, wine, or whiskey. No sex differences emerged in identifying alcoholic beverages by smell. Parental alcohol use was related to children's identification of alcoholic beverages by smell: children with heavy	Children (aged 2.5–6.0) could identify alcoholic beverages based on smell. This alcohol-related knowledge was higher among older children compared to younger children and among children with heavy drinking parents compared to children with moderate/light drinking parents.

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Table 1 *(continued)*

Study (year)	Methods		Results	Conclusions
	Number of participants; age range of participants; sampling strategy; mean age (SD) of participants; % of boys; study design; country	Outcomes	Main results	Conclusions
		they were smelling. In the 2nd trial, 9 photographs were presented that showed the contents of the jars and children were told that the photographs were pictures of what was in the jars, and the task was repeated. The responses were administered individually by an experimenter at school. Parental outcomes were measured using self-administered paper-and-pencil surveys.	drinking parents were more often successful at exact identification of alcoholic beverages compared to children with moderate or light drinking parents in the 1st trial. Yet, across both trials of the smell task, 82% of the children successfully identified alcoholic beverages.	
Spiegler (1983)	60 children (of which 20.0% aged 5.5–6.5; 20.0% aged 6.5–7.5; 20.0% aged 7.5–8.5; 20.0% aged 8.5-9.5; and 20.0% aged 9.5–10.5) aged 5.5–10.5 recruited using a convenience sampling strategy; mean age is unknown; 50.0% boys; cross-sectional study; United States.	Children's alcohol-related norms and demographic characteristics (sex, age). The outcomes were measured using a pictorial interview consisting of 24 photographs (4 with alcohol: drinking beer, drinking whiskey, going to a bar, being drunk; 19 with eating food or drinking non-alcoholic beverages, and 1 with smoking) showing activities that people can do. Children were shown a box with 4 compartments ('like very much', 'like a little', 'dislike a little', 'dislike very much') and a picture of a same-sex child/male/female in front of the box. Children were asked to put the photograph in the box that asked how do they think a boy/girl/male/female like them/their father/their mother or like the boy/male/female in the picture feels about doing these activities.	Males were perceived as liking alcohol-related activities more compared to females and children, while females were perceived as liking alcohol-related activities more compared to children. No sex differences in alcohol-related norms emerged. Yet, children's perception of the social role (male, female, child) of drinking whiskey and going to a bar increased with age.	Children (aged 5.5–10.5) acquired alcohol-related norms as early as age 6. No sex differences were observed, yet age differences in alcohol-related norms were noted.
Jahoda et al. (1980)	113 children (of which 32.7% aged 4.0–5.6; 35.4% aged 5.7–6.6; and 31.9% aged 6.7–7.6) aged 4.0–7.6 recruited using a convenience sample strategy; mean age is unknown; 52.2% boys; and 113 parents; cross-sectional study; United States.	Children's alcohol-related knowledge, alcohol-related norms, and demographic characteristics (sex, age). Parents reported on alcohol use and demographic characteristics. Children's outcomes were measured using a pictorial interview consisting of 12 color photographs of bottles (6 alcoholic; 6 non-alcoholic), and 4 drawings (boy, girl, male, female engaged in the act of drinking). The bottle photographs were shown on a table. Children were asked to a) choose 3 bottle photographs, which contained the beverages the person depicted in the drawing 'would like the most', b) name each bottle photograph that was shown in a random order, and c) explain the difference between the alcohol and non-alcohol grouping of the bottle photographs. The responses were administered individually by student assistants. Parental outcomes were measured using self-administered surveys.	Concerning alcohol-related knowledge, about half of the 4.0-5.6 year olds correctly named an 'alcohol' label to the bottle photographs and about half of them correctly explained the differences between the alcohol and no-alcohol grouping of the bottle photographs. Concerning alcohol-related norms, more than 1/3 of the 4.0-5.6 year olds reported that adults prefer alcoholic beverages and children prefer non-alcoholic beverages. No sex differences in alcohol-related knowledge and alcohol-related norms emerged, yet age differences showed that 6.7–7.6 year olds had more knowledge about alcohol and its norms compared to the younger children. In addition, parental alcohol use was not related to children's alcohol-related knowledge and alcohol-related norms.	Children (aged 4.0–7.0) acquired alcohol-related knowledge and alcohol-related norms. No sex differences emerged, yet age differences were found. No relation was found between parental alcohol use and children's alcohol-related knowledge and alcohol-related norms.

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Table 1 (*continued*)

Study (year)	Methods	Outcomes	Results	Conclusions
	Number of participants; age range of participants; sampling strategy; mean age (SD) of participants; % of boys; study design; country	Outcomes	Main results	Conclusions
Tennant (1979)	46 children aged 5.0–6.0 recruited using a convenience sample strategy; mean age is unknown; 50.0% boys; cross-sectional study; United States.	Children's alcohol-related knowledge and demographic characteristics (sex). The outcomes were measured using interviews administered by a trained person. Children were shown a picture from a magazine, which depicted a man drinking bourbon. Children were asked to a) identify the behavior, b) explain its health implications, and c) identify the sources of knowledge about the behavior.	Of the children, 87% identified alcohol use behavior and 32.6% explained one or more health hazards of drinking alcohol. Children's sources of knowledge about alcohol use behavior were parents (21.7%), television (6.5%), and other (8.7%). No sex differences in alcohol-related knowledge were noted.	Children (aged 5.0-6.0) could identify alcohol use behavior and explain its health implications. No sex differences in alcohol-related knowledge emerged. Parents were the major source of alcohol-related knowledge.

Note: ABT: Appropriate Beverage Task; AE: alcohol expectancies; CAOs; children of alcoholics; NCAOs: children of non-alcoholics; CDAI: Child Drug Awareness Inventory; eABT: electronic Appropriate Beverage Task; IAT: Implicit Association Test; SD: standard deviation. *Results were only reported for the total age group (aged 7–12) and not separately for children in the required age range (2–10 years old). **Results are only reported for children in the required age range (aged 2–10).

1990; Pieters et al., 2010; Zucker et al., 1995). All 20 studies were observational, divided into 19 cross-sectional studies and one case study (Valentine et al., 2014). Although all studies had a similar study design, they varied greatly in other characteristics, such as sample size [from 18 (Valentine et al., 2014) to 743 (Casswell et al., 1988; Flett et al., 1987)], publication year [14 published before the year 2000 (e.g., Austin and Nach-Ferguson, 1995) and 6 after the year 2000 (Dalton et al., 2005; Kuntsche et al., 2017, 2016; Mares et al., 2015; Pieters et al., 2010; Valentine et al., 2014)], country where the studies were conducted [11 conducted in the United States (e.g., Dalton et al., 2005), 3 in the United Kingdom (Fossey, 1993a, 1993b; Valentine et al., 2014), 2 in the Netherlands (Mares et al., 2015; Pieters et al., 2010), 2 in Switzerland (Kuntsche et al., 2017, 2016), 2 in New-Zeeland (Casswell et al., 1988; Flett et al., 1987)], and sampling strategy [12 used convenience (e.g., Pieters et al., 2010); 8 used random (e.g., Kuntsche et al., 2016)].

Table 2 shows the results of the critical appraisal of the 20 selected studies. The quality of the studies ranged from two to seven stars on the ten-stars NOS (Herzog et al., 2013), with a median score of 4.5 stars. Concerning sample selection, eight studies used a random sampling strategy and seven studies had an acceptable sample size with more than two hundred participants. In addition, 19 of the 20 studies failed to report the comparability between the respondents and non-respondents' characteristics, which may imply self-selection bias. Moreover, four studies used a validated measurement tool to assess children's alcohol-related cognitions and most studies did not control for confounders (e.g., demographic characteristics) in their analyses. With respect to the outcomes, all studies used self-report measures, which can lead to information bias. In addition, all studies published since the 1990s described clearly the statistical tests used to analyze the data and reported *p*-values used to determine the statistical significance. Overall, the quality of the selected studies was considered moderate in this systematic review.

3.1. *Children's alcohol-related cognitions*

3.1.1. *Alcohol-related knowledge*

The 16 studies that focused on children's alcohol-related knowledge indicated that children as young as age two start to acquire knowledge of alcohol. Of these 16 studies, a) eleven revealed that children (aged 2.0–10.0) can distinguish between alcoholic and non-alcoholic beverages based on smell (Fossey, 1993a; Greenberg et al., 1985; Mennella and Garcia, 2000; Noll et al., 1990; Valentine et al., 2014), photographs (Austin and Nach-Ferguson, 1995; Hahn et al., 2000; Jahoda et al., 1980; Kuntsche et al., 2016; Zucker et al., 1995), or a role-playing scenario involving grocery shopping (Dalton et al., 2005). b) One study revealed that from age five and half on, children can tell factual ('alcohol makes you drunk') and negative ('alcohol is bad for you') information about alcohol (Fossey, 1993b). c) Three studies revealed that from age five on, children can describe the effects of alcohol (e.g., getting drunk, having accidents) (Casswell et al., 1988; Flett et al., 1987; Tennant, 1979), and d) one study revealed that from age five on, children know adults' drinking motives, drinking places, and the quantity of a small or large amount of wine and whiskey (Gaines et al., 1988). Of the seven studies that examined sex differences in alcohol-related knowledge, two revealed that girls had more knowledge compared to boys (Austin and Nach-Ferguson, 1995; Gaines et al., 1988), yet five studies revealed no sex differences (Hahn et al., 2000; Jahoda et al., 1980; Kuntsche et al., 2016; Noll et al., 1990; Tennant, 1979). All nine studies that examined age differences in alcohol-related knowledge revealed that the knowledge of alcohol increased with age (Austin and Nach-Ferguson, 1995; Fossey, 1993a, 1993b; Gaines et al., 1988; Greenberg et al., 1985; Jahoda et al., 1980; Kuntsche et al., 2016; Noll et al., 1990; Zucker et al., 1995).

Table 2
Results of the critical appraisal of the 20 selected studies.

Author's	Selection: total 5 stars				Comparability: total 2 stars	Outcome: total 3 stars		Total stars
	Representativeness of the sample[a]	Sample size[b]	Non-respondents[c]	Ascertainment of the exposure[d]	Based on design or analysis[e]	Assessment of the outcome[f]	Statistical test[g]	
Kuntsche (2017)	*		*	**		*	*	6
Kuntsche et al. (2016)	*	*		**	*	*	*	7
Mares et al. (2015)	*	*		**	*	*	*	7
Valentine et al. (2014)*	*			*		*	NA	3
Pieters et al. (2010)				*	**	*	*	5
Dalton et al. (2005)				*	**	*	*	5
Hahn et al. (2000)	*			**		*	*	5
Mennella and Garcia (2000)				*	**	*	*	5
Austin and Nach-Ferguson (1995)				*	**	*	*	5
Zucker et al. (1995)		*		*	*	*	*	5
Fossey (1993a)		*		*		*	*	4
Fossey (1993b)	*	*		*		*	*	5
Noll et al. (1990)				*		*	*	3
Casswell et al. (1988)	*	*				*		3
Gaines et al. (1988)				*		*		2
Flett et al. (1987)	*	*				*		3
Greenberg et al. (1985)				*		*		2
Spiegler (1983)				*		*		2
Jahoda et al. (1980)				*		*		2
Tennant (1979)				*		*		2

Note: *This study used a case study design, while the other 19 studies used cross-sectional study designs. NA: Not applicable. [a]1) Truly representative of the average in the target population (all participants or random sampling)*, 2) Somewhat representative of the average in the target population (non-random sampling)*, 3) Selected group of users, 4) No description of the sampling strategy; [b]1) Justified and satisfactory*, 2) Not justified; [c]1) Comparability between respondents and non-respondents characteristics is established, and the response rate is satisfactory*, 2) The response rate is unsatisfactory, or the comparability between respondents and non-respondents is unsatisfactory, 3) No description of the response rate or the characteristics of the responders and the non-responders; [d]1) Validated measurement tool**, 2) Non-validated measurement tool, but the tool is available or described*, 3) No description of the measurement tool; [e]1) The study controls for the most important factor (select one)*, 2) The study controls for any additional factor*; [f]1) Independent blind assessment**, 2) Record linkage**, 3) Self-report*, 4) No description; [g]1) The statistical test used to analyze the data is clearly described and appropriate, and the measurement of the association is presented, including confidence intervals and the probability level (*p*-value)*, 2) The statistical test is not appropriate, not described or incomplete.

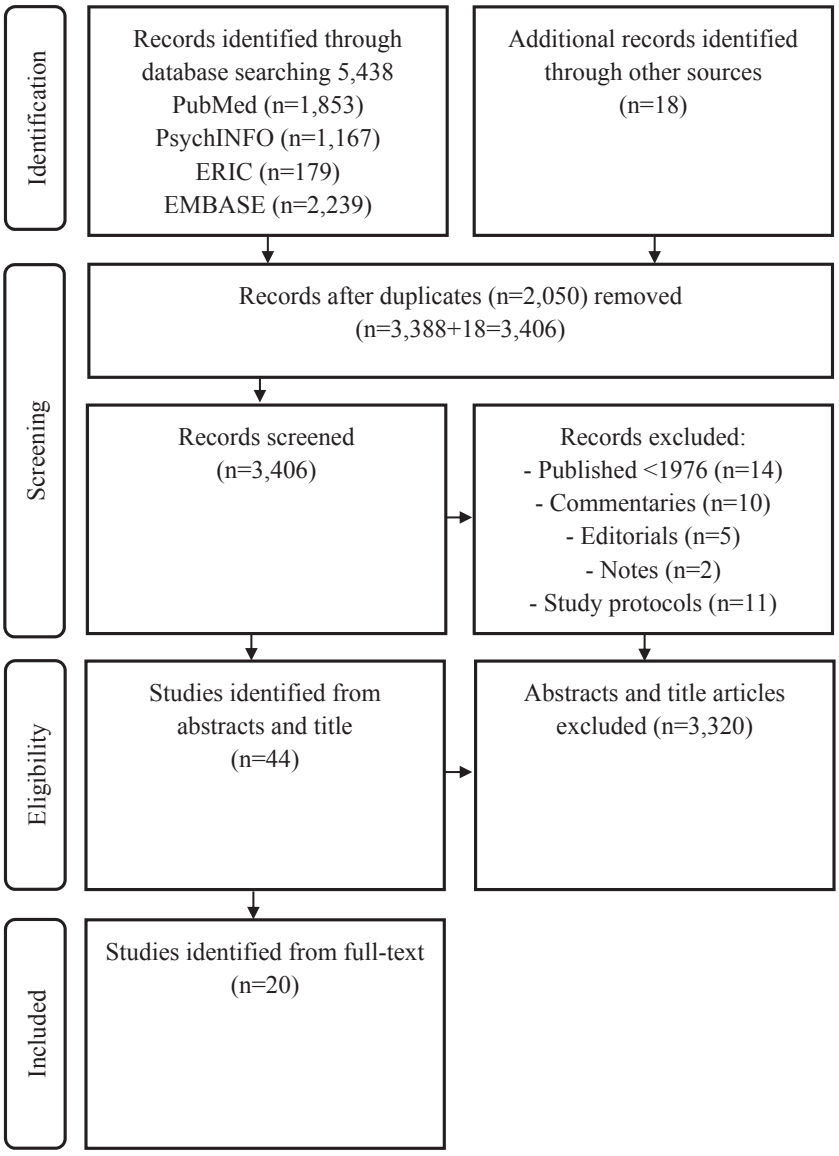

Fig. 1. PRISMA Study Flow Diagram of Research Results.

3.1.2. Alcohol-related norms

The five studies that focused on children's alcohol-related norms indicated that children as young as age four have knowledge of alcohol use in adult culture. For instance, children (aged 2.9–10.0) assigned alcoholic beverages more often to males (Kuntsche et al., 2016; Zucker et al., 1995) and perceived males as liking alcohol-related activities more often (Spiegler, 1983) compared to females and children. Children (aged 2.6–7.0) also reported that alcoholic beverages, such as beer, wine, or whiskey, are consumed by adults only (Noll et al., 1990) and that adults prefer alcoholic beverages while children prefer non-alcoholic beverages (Jahoda et al., 1980). Besides having knowledge of these sex-specific and age-related alcohol norms, children (aged 3.0–6.0 years) can indicate that adults drink in specific situations. For example, adults were more often assigned alcoholic beverages at a party rather than when playing outdoors (Kuntsche et al., 2016). Of the four studies that examined sex differences in alcohol-related norms, only one study revealed that girls had more knowledge of alcohol-related norms compared to boys, as they less often assigned alcoholic beverages to children (Kuntsche et al., 2016). The other three studies did not find any sex differences in children's alcohol-related norms (Jahoda et al., 1980; Noll et al., 1990; Spiegler, 1983). All four studies that examined age differences in alcohol-related norms revealed that knowledge of alcohol use in adult culture increased with age (Jahoda et al., 1980; Kuntsche et al., 2016; Spiegler, 1983; Zucker et al., 1995).

3.1.3. Alcohol expectancies

Of the five studies that focused on children's alcohol expectancies, two revealed that children, from age six on, have positive explicit alcohol expectancies (e.g., 'I think adults become friendly when they drink alcohol') (Mares et al., 2015; Pieters et al., 2010). Four studies revealed that children, from age six on, have negative explicit alcohol expectancies (e.g., 'I think adults become mean when they drink alcohol') (Austin and Nach-Ferguson, 1995; Flett et al., 1987; Mares et al., 2015; Pieters et al., 2010). One study revealed that children, from age four on, have higher positive rather than negative explicit alcohol expectancies (Kuntsche, 2017). Lastly, one study indicated that children, from age nine on, have negative implicit alcohol expectancies, as they associated alcohol more strongly with angry faces rather than with happy faces (Pieters et al., 2010). The two studies that examined sex and age differences in explicit alcohol expectancies showed opposite effects. A recent Dutch study showed that boys and girls had equally strong positive and negative explicit alcohol expectancies, yet older children had less positive and more negative explicit alcohol expectancies compared to younger children (Mares et al., 2015). In contrast, a recent Swiss study showed that girls have more positive explicit alcohol expectancies compared to boys, yet no age differences emerged

for explicit alcohol expectancies (Kuntsche, 2017).

3.2. The impact of parental alcohol use on the acquisition of children's alcohol-related cognitions

Of the eleven studies that focused on the impact of parental alcohol use on the acquisition of children's alcohol-related cognitions, nine focused on alcohol-related knowledge (Casswell et al., 1988; Dalton et al., 2005; Gaines et al., 1988; Greenberg et al., 1985; Hahn et al., 2000; Jahoda et al., 1980; Mennella and Garcia, 2000; Noll et al., 1990; Zucker et al., 1995), three focused on alcohol-related norms (Jahoda et al., 1980; Noll et al., 1990; Zucker et al., 1995), and two focused on alcohol expectancies (Mares et al., 2015; Pieters et al., 2010). The results revealed that the impact of parental alcohol use on the acquisition of children's alcohol-related cognitions is ambiguous. In some studies, parental alcohol use was positively related to children's alcohol-related knowledge (Casswell et al., 1988; Gaines et al., 1988; Greenberg et al., 1985; Mennella and Garcia, 2000; Noll et al., 1990; Zucker et al., 1995), alcohol-related norms (Dalton et al., 2005; Zucker et al., 1995), and explicit alcohol expectancies (Mares et al., 2015), yet other studies indicated no effect of parental alcohol use on children's alcohol-related cognitions (Greenberg et al., 1985; Hahn et al., 2000; Jahoda et al., 1980; Pieters et al., 2010).

4. Discussion

This systematic review aimed to summarize the evidence from the past forty years (1976–2016) on children's alcohol-related cognitions (alcohol-related knowledge, alcohol-related norms, alcohol expectancies) and the impact of parental alcohol use on the acquisition of these cognitions in the developmental period from age two to ten. This review showed that children already at age two start to acquire knowledge about alcohol, as they are able to distinguish alcoholic from non-alcoholic beverages; to distinguish factual and negative alcohol information; to describe alcohol effects; and to name drinking motives, places, and amounts of alcohol use (Austin and Nach-Ferguson, 1995; Casswell et al., 1988; Dalton et al., 2005; Flett et al., 1987; Fossey, 1993a, 1993b; Gaines et al., 1988; Greenberg et al., 1985; Hahn et al., 2000; Jahoda et al., 1980; Kuntsche et al., 2016; Mennella and Garcia, 2000; Noll et al., 1990; Tennant, 1979; Valentine et al., 2014; Zucker et al., 1995). From age four on, children start to understand that alcohol is usually restricted to adults and consumed in specific situations (Jahoda et al., 1980; Kuntsche et al., 2016; Noll et al., 1990; Spiegler, 1983; Zucker et al., 1995). By the age of four, children have certain, predominantly negative, explicit and implicit alcohol expectancies (Austin and Nach-Ferguson, 1995; Flett et al., 1987; Kuntsche, 2017; Mares et al., 2015; Pieters et al., 2010). The results of this review of children's alcohol-related cognitions are quite consistent with findings of the literature review of Lang and Stritzke (1993) conducted twenty-four years ago, thereby underscoring the need to conduct more studies in this area of research. The alcohol-related cognitions of children increase with age due to improved cognitive and language abilities (Berk, 2013; Dalton et al., 2005; Flavell, 1999; Ross et al., 2005). Although girls are biologically and social-culturally more mature and more advanced in their language development (Berk, 2013; Gaines et al., 1988), the evidence of sex differences in children's alcohol-related cognitions was inconsistent. One explanation may be that the alcohol-related cognitions depend more strongly on parental drinking habits and specific environmental factors rather than children's sex.

The evidence of the impact of parental alcohol use on the acquisition of children's alcohol-related cognitions has also been inconsistent so far, with some studies reporting a positive effect (Casswell et al., 1988; Dalton et al., 2005; Gaines et al., 1988; Greenberg et al., 1985; Mares et al., 2015; Mennella and Garcia, 2000; Noll et al., 1990; Zucker et al., 1995) and other studies finding no effects (Greenberg et al., 1985; Hahn et al., 2000; Jahoda et al., 1980; Pieters et al., 2010). The existing studies examined only parental alcohol use and not its visibility, that is, children's exposure to it. According to the Social Learning Theory (Bandura, 1977; Maisto et al., 1999), the degree to which the behavior of others is observable determines the acquisition of new knowledge. For example, some parents might drink frequently, that is, with colleagues after work or later in the evening when their children are in bed but not when their children are present. Other parents consume alcohol less frequently, but in presence of their children, in family-specific situations, such as when having meals, when playing a game, or when watching television. Therefore, children's exposure to alcohol use (Zucker et al., 2008) and observed situational determinants and personal consequences, such as mood change among drinkers, are more likely to affect children's alcohol-related cognitions rather than parental alcohol use per se. Possible differences in children's exposure to parental alcohol use across studies may explain why study findings diverge, as the existing studies measured the effects of parental alcohol use and not children's exposure to it on the acquisition of their alcohol-related cognitions.

The evidence of the impact of parental alcohol use on the acquisition of children's alcohol-related cognitions should be interpreted with caution due to methodological flaws of the selected studies in this systematic review. First, evidence is limited (i.e., only 20 studies were conducted in the past forty years), outdated (i.e., only 6 out of 20 studies were conducted after the year 2000), and comes almost exclusively from the United States (i.e., 11 out of 20 studies). Therefore, the degree to which the reported findings still apply today and the degree to which they apply to a broader cultural context remains unclear. The methodological challenges encountered when studying this population with limited reading and/or writing skills and undeveloped language skills that can be easily influenced by the researcher or by the ways in which questions are phrased might explain this undeveloped area of research on children's alcohol-related cognitions (Dalton et al., 2005). Besides, age-appropriate measurement tools for children tend to be costly and time and labor-intensive (Kuntsche and Zucker, 2016). Nonetheless, these methodological challenges do not justify the lack of knowledge of the development of children's alcohol-related cognitions. Another explanation for the undeveloped area of research on children's alcohol-related cognitions is the low prevalence of alcohol use among children (Zucker et al., 2009). Since most children start to drink alcohol during adolescence (Monshouwer et al., 2007; Van Dorsselaer et al., 2010), alcohol prevention and policies are mainly focusing on this age period. Scholars have argued, for instance, that postponing the age of alcohol initiation is crucial to prevent risky drinking and alcohol-related problems in adolescence and later in life (DeWit et al., 2000; Gruber et al., 1996; Hingson et al., 2000; Pitkänen et al., 2005). Although alcohol prevention should start early (Zucker, 2008), not much is known about what 'early' actually means. This is because the vast majority of studies on alcohol have been conducted among drinkers. Second, all evidence was obtained from cross-sectional study designs, which largely restricts conclusions about the causal impact of parental alcohol use on the acquisition of children's alcohol-related cognitions. Third, most evidence was collected from non-representative samples recruited through convenience sampling strategies that enhance the risk of selection bias, which is a systematic error in the deliberate selection of study participants (Kunz et al., 2007). Selection bias impairs the external validity, that is, the extent to which study findings can be generalized to other situations and populations. Safeguarding the external validity by using representative samples recruited through random sampling strategies is important particularly in the undeveloped area of research on children's alcohol-related cognitions to ascertain that study findings can be applied to a broader cultural context. Finally, no studies were identified that focused on the possible role of genetics in the acquisition of alcohol-related cognitions within the family context. Family, twin, and adoption studies have convincingly demonstrated that genes play an important role in the development of alcohol misuse and dependence, with heritability estimates in the range

of 50% to 60% for both males and females (McGue, 1999). Although genetic factors have been found to be important mostly for the increase in drinking once initiated (Agrawal et al., 2012; Dick, 2011; Kuntsche et al., 2004), they may indirectly influence the observational learning process by providing more opportunities for the child to learn alcohol-related cognitions when he or she has a parent who is more genetically prone towards alcohol use. Thus, even though genes may be less relevant for the child's alcohol cognitions, as opposed to the child's progression to more advanced drinking habits once initiated later in life (Kuntsche et al., 2004), future research efforts could explore the role of genetics in the acquisition of alcohol-related cognitions.

In sum, the research on children's alcohol-related cognitions is quite undeveloped. Moreover, empirical evidence of the role of exposure to (or visibility of) parental alcohol use in the acquisition of children's alcohol-related cognitions is missing in contemporary literature. To further contribute to the development of theories that would explain young people's alcohol initiation and precursors of risky drinking that contribute to the increased mortality in late adolescence and young adulthood (Rehm et al., 2001), future studies should explore the role of exposure to parental alcohol use in the acquisition of children's alcohol-related knowledge and alcohol-related norms as basis for alcohol expectancies, as well as the transition from drinking motives to alcohol initiation and subsequent use. Additionally, the role of siblings and extended family members in this regard deserves attention, as parental influences are not necessarily synonymous with family influences. If families consist of more than parents and one child, the exposure to alcohol should ideally be measured within the broader family context. For this purpose, future longitudinal studies should use age-appropriate measurement tools and representative samples of children and early adolescents. The widespread availability of computer technology and the Internet provides opportunities to develop electronic and cost-effective measurement tools for children (e.g., touch-screen tablets) and early adolescents (e.g., online surveys) that would be easy to implement. This would also allow us to determine whether lower alcohol exposure by parents, but also by siblings and other extended family members, is an important factor that could be incorporated into prevention programs for children and young adolescents and their parents to significantly contribute to primary prevention.

Conflict of interest

All authors declare that they have no conflict of interest.

Contributors

CV was responsible for the literature search, the data selection and extraction process, the critical appraisal, and writing the manuscript. EK and MB also contributed to the literature search and the data selection process, respectively. MK, RO, RE, KS, and EK reviewed drafts and revisions of the manuscript and contributed to writing. All authors contributed to and have approved the final manuscript.

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