

Alcohol and Breastfeeding, a review of the issues

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Abstract

Moderate alcohol use by breastfeeding women appears to be relatively common. Alcohol concentrates in breast milk at levels slightly higher than in maternal blood, peaking at 30-60 minutes after consumption. Most studies find no link with the duration of breastfeeding unless drinking is fairly heavy (>2 standard drinks/day). However, seven studies have found that moderate maternal alcohol consumption was associated with a shorter duration of exclusive breastfeeding; one found no difference and one found an increase. Alcohol affects oxytocin release, leading to reductions in breast milk consumption in the following hours. Infant alcohol exposure may increase fussiness and reduce sleep, both temporary if the mother does not continue to drink. These effects on the infant and on the breastfeeding process could be interpreted by mothers as signs of infant dissatisfaction with their breast milk, “insufficient milk,” or other commonly expressed causes for suboptimal breastfeeding patterns. Chronic alcohol consumption, even if moderate, may have a number of more serious effects, including on infant development. In the early weeks or months of life, infant toleration of alcohol is lower than it is at later stages of infancy, and the early breastfeeding process is more susceptible to disruption. Therefore, it may be wise to advise mothers to continue their abstinence from alcohol during pregnancy into the first few months of breastfeeding. Little research has been done on how often women time their drinking so as to avoid infant exposure to alcohol. Health workers and others sometimes propagate myths that alcohol, especially alcoholic beer, is beneficial to breastfeeding. Research is needed in different cultures into whether various forms of cautionary messages are likely to discourage moderate drinkers from initiating breastfeeding or to shorten its duration, and which type of messages if any actually lead to a reduction in drinking during breastfeeding.

Introduction

This literature review is not a systematic review. It is a combination of an attempt to do a comprehensive survey of the existing literature and to highlight some of the key findings on the following topics.

- Maternal alcohol abuse and breastfeeding
- How common is alcohol use during breastfeeding?
- Impact of alcohol consumption on breastfeeding patterns
- Alcohol levels in breast milk, breastfeeding women, and breast-fed infants
- Adaptation of breastfeeding and drinking patterns to reduce infant exposure
- Effects on infants of moderate alcohol use during breastfeeding
- The impact of maternal alcohol use on the breastfeeding process
- Mothers' knowledge and attitudes about alcohol and breastfeeding
- Advice given to women about alcohol and breastfeeding

There is a surprising lack of research on these issues. In fact, a substantial proportion of the existing research has been done by a single researcher in the USA (JA Mennella; 14 citations in this paper) and two in Australia (RC Giglia, 10 citations; CW Binns, 8 citations).

There are hardly any cases in which an important finding on those topics has elicited confirmatory research, leaving us in limbo, with little we can rely on. There is perhaps enough to say that concern is justified but not panic.

Background

The issues surrounding alcohol and breastfeeding are difficult to explore scientifically because it is so challenging to design experimentation that is ethical. The only study I found that attempted a placebo-controlled design (Schuetze, Eiden, and Chan 2002) also had several other novel features and thus is examined in greater detail than others. Otherwise, methodological details are provided only when they are felt to be necessary to judge the quality of the data.

It is often difficult to separate the impact of maternal alcohol consumption during pregnancy from that which occurs during breastfeeding or the impact of concurrently used drugs from that of alcohol. Maternal stress may lead to increased alcohol consumption (Laborde and Mair 2011) (indeed, this may be advised to breastfeeding mothers) but stress may also lead to decreased breast milk production (Hodges et al. 2000). However, a study in Canada, while finding that women with a lower self-perceived mental health status were more likely to drink during pregnancy, found no difference regarding drinking during breastfeeding (Lange et al. 2016).

There are also definitional issues; for example, the definition of a “standard drink” in different countries usually means consumption of a single regular strength beer, a glass of wine, or a shot of spirits. But this can provide from 8-20 g of alcohol, with the US Centers for Disease Control (CDC) using 13.7g (Bowen and Tumback 2010) and Australian authorities using 10g. (On its website now, CDC uses 14g.) In research cited below, where the size of drinks is judged important, the quantity of alcohol involved is indicated in the way authors have defined it—but this is not always exact or in grams of alcohol.

In addition to an understandable hesitancy to admit heavy alcohol use (Charrel et al. 2010), particularly because of its association with stereotypes (Blum, Nielsen, and Riggs 1998), self-reported alcohol consumption tends toward underestimation (Little et al. 1984). Mothers may under-report use of substances they believe may be harmful to their baby, as suggested by the findings of one study where, at a later time, mothers reported higher levels of antenatal drug and alcohol use than they did while pregnant (Jacobson et al. 1991). When asked about past behavior, there is also a risk of recall error. Furthermore, there are other routes by which infants may ingest or be exposed to alcohol. For mixed fed infants, alcohol might be ingested from bottle feeds to which it has been added in order to attain sedative effects (Spear and Molina 2005).

The issue of breastfeeding and alcohol has been debated for years and has led to biases on both sides of the issue. On the one hand, health providers may be informed partly by a “breastfeeding community” that is concerned that public health guidelines recommending women avoid drinking alcohol during breastfeeding are too restrictive. It is often stated that this simply adds to all the multitude of rules that pregnant and breastfeeding women are expected to follow (Amir 2010), or threatens to make breastfeeding appear to be more difficult or less attractive to mothers. One Swedish study complains that advice to both breastfeed and avoid alcohol is moralistic and blames women (Bertils 2016). However, virtually no research was found in the present literature search that tests whether this is correct. On the other hand, those concerned more with the harm caused by alcohol than the harm caused by artificial feeding may present the issue in a one-sided manner. For example, Popova et al. (2013) state that “It has also been shown that women who consume alcohol during lactation breastfeed for a shorter duration.” However, the reference they cite (Giglia et al. 2008) found this only for women who drank more than two standard drinks (10g each) per day.

There has also been a tendency to frame the debate on this issue in terms of whether it is better for a mother who drinks moderately to breastfeed or artificially feed. Of course, if the alcohol intake is moderate, it is likely to be better for both mother and child to breastfeed. But at some point, alcohol use becomes too problematic for breastfeeding to make sense—possibly close to the level of alcohol abuse at which the continuation of child care by the mother becomes questionable. The more important question is whether the impact of alcohol use on the infant and on the breastfeeding process is severe enough to justify recommending that mothers avoid breastfeeding or greatly restrict it—while mentioning that breastfeeding plus moderate use of alcohol is preferable to artificial feeding.

There have been two systematic reviews of many of the issues covered here, published in 2006 (Giglia and Binns 2006) and updated in 2010 (Giglia 2010). A protocol for conducting a systematic review examining psychosocial and cultural interventions to reduce alcohol use during breastfeeding (Cassidy and Giglia 2012), but no such review has yet been published. A more recent review of many relevant issues was published in 2014 (Haastrup, Pottegard, and Damkier 2014), but it was not a systematic review. The present review updates and broadens those reviews.

Methods

This review is exploratory, aiming to be a relatively comprehensive overview of the existing literature on many topics related to breastfeeding and maternal alcohol consumption. It is not an attempt to arrive at evidence-based conclusions on any single topic and does not

conform to the requirements for structured literature reviews. One reason for this is that there are rarely more than one or two studies on any particular aspect of this issue.

Searches were conducted for relevant research articles on Pubmed, Web of Knowledge, and Google Scholar using the topic terms “alcohol” or “beer” linked with “breastfeeding” “breast feeding”, “breast-feeding” or “lactation” up through early 2019. The term “alcohol” was searched for in 3 journals specializing in breastfeeding and the terms “lactation” and “breast” were searched for in the six Science Citation Index Expanded journals with “alcohol” in the journal name. Reference lists of relevant articles were also used to identify further relevant research. In addition, 243 articles citing the Iowa Infant Feeding Attitude Scale (IIFAS), which has a question about whether alcohol use should proscribe breastfeeding, were examined for relevant findings. It was assumed that if the issue of alcohol and breastfeeding resulted in a significant finding, this would be mentioned in the abstract, and thus only abstracts were scanned for relevant findings, unless full-text articles were available through open access or from Hanyang University library digital subscriptions. A Google Scholar search was also conducted for the Swedish words “amning” and “alkohol”.

An indication of the strength of an association is given where it appears to add value (usually odds ratio—OR), but only when statistically significant. Confidence intervals and other indicators of variance are not given.

Since the focus here is on the impact of alcohol use during breastfeeding, research based only on alcohol use during pregnancy was not included. Animal studies on alcohol intake during lactation were also not included.

Maternal alcohol abuse and breastfeeding

A substantial level of alcohol consumption by breastfeeding mothers has a noticeable effect on infants. This was described already in about 600 BCE in an Ayurvedic text (Gupta and Mamidi 2015). In modern times, social services routinely identify, define and deal with cases where a mother’s alcohol abuse is so severe as to endanger the child (Lewis 1995; Swiderski et al. 2011). The US National Institute of Alcohol Abuse and Alcoholism defines risky drinking as consuming more than three standard drinks per occasion or more than seven per week for women. Excessive postnatal alcohol consumption, whether or not a mother is breastfeeding, is often accompanied by maternal distraction, neglect, and other mental health issues, posing risks to children during the first few years of life when they usually spend most of time with their mothers (Yang and Kramer 2012; Jester et al. 2000).

Few studies examine how common excessive drinking is among breastfeeding women. A telephone survey of 3600 women in France found that 6.8% of breastfeeding women engaged in binge drinking (Agnès, Stéphanie, and Laurence 2017).

There is a general belief that breastfeeding is likely less common among women who drink heavily (Bailey and Wright 2011). Data from many studies tend to support this. One national survey in the US in 1988 found that even heavy use of alcohol did not deter women from breastfeeding, but durations were shorter among those with risky drinking patterns (Howard and Lawrence 1998). A study in Perth found that women who took more than two drinks (10g alcohol each) per day were almost twice as likely to stop breastfeeding by six months of age (Giglia et al. 2008), even with other predictors of breastfeeding initiation and duration controlled for. Another study found that breastfeeding was less likely (OR 0.3) among women classified as “at risk” drinkers (defined as “consuming four or more drinks per occasion at least twice in the past 28 days or drinking an average of seven or more drinks per week;” “drink” was

not defined) (Jagodzinski and Fleming 2007a). Still another found that at 45 days postpartum 28% of those engaged in high-risk drinking (defined as (a) 3 or more drinking days per week or 5 or more drinks per day or 7 or more drinks per week prior to pregnancy; or (b) alcohol use once the subject knew that she was pregnant; or (c) 7 or more drinks per week or 3 or more drinking days per week or 4 or more drinks on 2 or more days in the last 28 days; or (d) 2 or more “yes” responses on TACE questions during the postpartum period.) were breastfeeding (Fleming et al. 2008). In a longitudinal study, Giglia et al. (2008) found that after 6 months of follow-up, women who consumed alcohol at levels of more than two standard drinks per day were almost twice as likely to discontinue breastfeeding as women who drank below these levels. Liu et al. (2015), in a large study in the US, found no significant link between breastfeeding initiation and binge drinking.

Though there appears to be almost no research on alcohol abuse and its impact on the breastfeeding infant, in one case study, a mother was taking 50 12-ounce (355 ml) beers per week because her friends said it would stimulate milk production (Binkiewicz, Robinson, and Senior 1978). Her four-month-old infant was diagnosed with pseudo-Cushing syndrome, which reversed when the mother stopped drinking.

How common is alcohol use during breastfeeding?

This section reviews available relevant data from around the world. Alcohol consumption by women is influenced by cultural factors. For example, it is apparently quite rare among Muslim women. The proportion of women who consumed alcohol during breastfeeding in various surveys varied from 83% (Matheson, Kristensen, and Lunde 1990) to 9% (Del Ciampo et al. 2009), as illustrated in Table 1.

Data presented in some other studies could not be summarized in Table 1 or provided additional information, summarized here. In Brisbane Australia, in 1981-3, over 7000 pregnant women were followed up until 6 mo postpartum, 80% of whom were breastfeeding. 26% of the total sample abstained from alcohol, 56% were light drinkers (<1/2 glass/d), 8% were modest drinkers (1/2-1 glass/d) and 11% were heavy drinkers (≥ 1 glass/d) (Tran, Najman, and Hayatbakhsh 2015). In another Australian study, 75% of women who were pregnant or breastfeeding in the past 12 mo reported regular use of alcohol (Higgins, Cooper-Stanbury, and Williams 2000). In rural western Australia, at 4, 6 and 12 months postpartum; 45.9%, 47.0% and 51.9% of breastfeeding mothers were consuming alcohol respectively (Tearne, Cox, and Giglia 2017). Women exclusively breastfeeding drank alcohol about as often as other breastfeeding women at ages 4 and 6 months.

In the prospective Perth Infant Feeding Study, 70% drank alcohol pre-pregnancy, dropping to about 37% during pregnancy and then increasing to about 40% where it remained during the following year. About 45% drank alcohol at least once during breastfeeding (Binns and Giglia 2005). In a German study, 70% drank before, decreasing to about 20% during breastfeeding (Logan et al. 2016).

Two studies have been done on representative samples of women in Oslo, Norway, about 15 years apart. In 1990, 98% initiated breastfeeding and 80% continued for at least 3 months (Matheson, Kristensen, and Lunde 1990). As shown in Table 1, only about 17% abstained from alcohol, whether or not breastfeeding; however, those who breast fed consumed only 1.3 drinks per week—with one drink defined as having 16-18g alcohol.

Table 1. Data on proportion of breastfeeding women consuming alcohol

Authors	Publication year	Country	Sample size	% consuming alcohol during breastfeeding
Matheson et al.	1990	Norway (Oslo)	885	83
Alvik et al	2006	Norway (Oslo)	1303	80 at 6 mo (51% in first 3 mo)
Malagi and Gocavi	1993	India (isolated tribe)	196	80
Backstrand et al.	2004	Mexico (one village)	58	72
Little et al.	1990	USA	220	66
Tay et al.	2017	Australia	402	61 (8 wk); 71 (12 wk)
McLeod et al.	2002	New Zealand	490	54
Terne et al.	2017 (data from 2010-11)	Australia	258	47 (at 6 mo)
Giglia and Binns	2007b	Australia	287	47
Giglia and Binns	2008 (data from 2001)	Australia	1268, national survey	48
Giglia and Binns	2008 (data from 1995)	Australia	1461 National survey	43
Binns and Giglia	2005	Australia	587	45
Maloney et al.	2011	Australia	807	43 (36 if also pregnant)
Aryal et al.	2016	Nepal	778	43
Arora	2017	Australia	935	32 ^a
Binns and Giglia	2005	Australia (aboriginal)	2365	25
Logan et al.	2016	Germany	856	20.5
Popova et al.	2013	Canada	National survey	20
Inoue	2012	Japan	1612	14
Nascimento et al.	2013	Brazil	157	12
Del Ciampo et al.	2009	Brazil	504	9

Note: This table was inspired by a table in a review by Haastrup et al. (2014). In most cases data do not represent the country, rather the studies were done in the country listed.

^aThis related to alcohol use postpartum in an entire population, but 92% initiated breastfeeding.

The authors of these Oslo studies state that alcohol consumption may have been linked to the socio-economic status of these breastfeeding women. In the second study, done in 2006, 86% breastfed for at least 6 mo, 51% drank during the first 3 mo postpartum (half of them more than once per day) and 80% drank alcohol 6 mo after delivery (Alvik, Haldorsen, and Lindemann 2006). Binge drinking (≥ 5 drinks/d) was reported by about 25% of the women who were still breastfeeding at 6 months. This suggests that while the proportion that drank during the early months may have declined over this 15-year period, the amount of alcohol breastfeeding mothers reported drinking had increased. Nevertheless, breastfeeding durations increased

substantially during the period.

In some cases, women apparently reduce alcohol consumption during pregnancy and then at some point after birth it returns to or close to pre-pregnancy consumption levels (Giglia 2010). In one study in Perth, done in 2002-3, 70% of women used alcohol before pregnancy, but only about half of them (35-40%) reported doing so during pregnancy and breastfeeding (Binns and Giglia 2005). In the US, one early study (Little, Lambert, and Worthington-Roberts 1990) found that 80% of women consumed alcohol during the month before conception, 40% did so during the last trimester of pregnancy, and by 3 mo postpartum, 70% were drinking. However, only 10% reported drinking more than once a day (15g alcohol/drink) during breastfeeding and fewer women reported binge drinking during breastfeeding.

Most surveys find higher levels of alcohol consumption during breastfeeding among women of higher socioeconomic status (Parackal, Ferguson, and Harraway 2007) and education (Giglia 2010; Agnès, Stéphanie, and Laurence 2017) or both (Tay et al. 2017). Primiparas and younger women are less likely to drink alcohol while breastfeeding (Laborde and Mair 2011). One Australian study in which 94% breast fed, found that among women <25 years old, 22% used alcohol during breastfeeding, while among older women 78% used alcohol (Giglia et al. 2008). Tay et al. (2017) found that older women were more likely to drink during breastfeeding, but this did not achieve statistical significance in adjusted comparisons ($p=0.07$).

Impact of alcohol consumption on breastfeeding patterns

The perception that alcohol consumption is not compatible with breastfeeding may be an indirect way in which maternal alcohol consumption reduces breastfeeding levels (Ware, Webb, and Levy 2014; Rempel 2004). One study among Korean university students found that current alcohol use had no impact on intention to breastfeed (Lee, Hyun, and Lee 2013). Table 2 lists what various studies have found regarding the association between moderate (usually defined as 2 or fewer drinks per day) alcohol consumption and the initiation and duration of breastfeeding and the duration of exclusive or near exclusive breastfeeding.

As seen in Table 2, most studies find no link between moderate alcohol consumption and the initiation or duration of breastfeeding. Further details for some studies are presented here. Breastfeeding women are less likely to be heavy drinkers postpartum than those who artificially feed (Howard and Lawrence 1998; Giglia et al. 2008; Jagodzinski and Fleming 2007b; Breslow et al. 2007; Donath and Amir 2008; Amir and Donnath 2009). Binns and Giglia (2005) found little evidence that drinking was associated with the duration of breastfeeding in national survey analyses from Australia, although at 40 weeks of age there was a small but statistically significant increase in the likelihood of cessation (OR 1.25).

In one Japanese study (Inoue 2012), maternal use of alcohol, controlled for numerous socioeconomic factors, was associated with an increased likelihood of continuing to breastfeed until 6 months (OR 1.5; but almost none was exclusive). In contrast, in one German study (Logan et al. 2016), women who resumed drinking by 6 weeks of age were twice as likely to have stopped breastfeeding by 6 months (HR 2.1) and those who had resumed drinking by 4 months were also more likely to have stopped by 6 months (HR 1.6). A study in Mauritius found that alcohol use was associated with a shorter period of breastfeeding and continuing beyond 24 months was more common among those who never drank (Motee et al. 2013).

Regarding the link between alcohol use during pregnancy and breastfeeding initiation, two studies have found that white but not black women were more likely to initiate breastfeeding if they had drunk alcohol during pregnancy, even after other factors were controlled for (Chin,

Myers, and Magnus 2008; Yi Kyung Park, Meier, and Song 2003). In Australia, Arora et al. (2017) found that drinking alcohol during pregnancy was linked to a 72% lower rate of initiation of breastfeeding (adjusted OR 0.28).

Table 2. Citations to studies on the link between moderate^a alcohol consumption and breastfeeding patterns

	No association	Negative association	Positive association
Initiation of breastfeeding	2 (Collins, DiSantis, and Nair 2011) (Binns and Giglia 2005)	1 (Arora et al. 2017)	0
Duration of exclusive ^b breastfeeding	1 (Hatsu, McDougald, and Anderson 2008); (Tearne, Cox, and Giglia 2017)	7 (Barria, Santander, and Victoriano 2008); (Mgongo et al. 2013); (Logan et al. 2016); (Chaves, Lamounier, and César 2007); (Binns and Giglia 2005); (Clifford et al. 2006); (Ortega-García et al. 2015)	1 (Adeniyi et al. 2019)
Duration of breastfeeding	15 (McLeod, Pullon, and Cookson 2002); (Little, Lambert, and Worthington-Roberts 1990); (Grossman et al. 1989); (Collins, DiSantis, and Nair 2011); (van Rossem et al. 2009); (Kim et al. 2003); (Parackal, Ferguson, and Harraway 2007); (Butler et al. 2004); (Weiser et al. 2009); (Racine et al. 2009); (Torriss et al. 2013); (Xu et al. 2010); (Simard et al. 2005); (Breslow et al. 2007); (Tay et al. 2017)	3 (Logan et al. 2016); (Motee et al. 2013); (Chaves, Lamounier, and César 2007)	2 (Inoue 2012); (Dozier, Nelson, and Brownell 2012)

^aThis is usually defined as routinely taking two drinks or less per day. In the US, “drink” is defined as containing 13.5g alcohol and in Australia 10g.

^b One study was on “full” and two on “predominant” breastfeeding

Stress and depression are common and serious issues postpartum in many countries (Halbreich and Karkun 2006) and may be linked to alcohol use (Kessler et al. 1996). In a study of women exposed to antidepressants during pregnancy, those who also then drank alcohol (53%) were more likely to initiate breastfeeding, even after socioeconomic status and other factors were controlled for (Gorman, Kao, and Chambers 2012). Another study found that when

stress was controlled for, alcohol use was protective against early cessation of breastfeeding (Dozier, Nelson, and Brownell 2012).

Regarding the potential impact of maternal alcohol use on the maintenance of exclusive or near exclusive breastfeeding, seven studies have found some indication that alcohol use may reduce the duration of exclusive (in one case “full” and in one case “predominant”) breastfeeding. In a Chilean study (Barria, Santander, and Victoriano 2008), 23% vs 13% used alcohol among those who did not and did exclusively breastfeed into the third month respectively (the relative risk of non-exclusive breastfeeding with alcohol use was 1.6). A multivariate analysis in Tanzania (Mgongo et al. 2013) found that the adjusted OR for exclusively breastfeeding up to six months was 0.4 if the mother drank alcohol. In a German study (Logan et al. 2016), women who resumed alcohol consumption before 6 weeks postpartum were more likely to stop predominant breastfeeding by 6 weeks (HR 1.6) and 4 months (HR 1.5). Resuming drinking later had no impact on infant feeding patterns. A longitudinal study in Brazil found use of alcohol to be associated with shorter durations of both exclusive and partial breastfeeding (Chaves, Lamounier, and César 2007). The effect on breastfeeding duration remained after multivariate analysis but not the effect on exclusive breastfeeding. Another study in Brazil found that the 10% of women who drank alcohol during pregnancy (its use during breastfeeding was not measured) were more likely to stop exclusive breastfeeding during the first three months (Sanchez et al. 2011). In Australia, Binns and Giglia (2005) found a weak negative association between alcohol use and breastfeeding duration, but it was stronger for full or exclusive breastfeeding. In a Canadian study (Clifford et al. 2006), among mothers fully breastfeeding (this meant breast milk, whether or not expressed, with or without water-based supplements, that is, “predominant breastfeeding”) at one week, fewer mothers practiced full breastfeeding at 6 months (24%) among those who used alcohol than among those who did not use it (40%). A study in Spain (Ortega- García et al. 2015) found less full breastfeeding (defined as giving the baby ≤ 1 bottle per week) at six months of life among women who consumed at least one alcoholic drink (undefined) per week (relative risk for no full breastfeeding at six months, 1.57).

In contrast, one study among women in Georgia, USA (Hatsu, McDougald, and Anderson 2008) and one in Australia (Tearne, Cox, and Giglia 2017) found no difference in amount of alcohol consumed by those practicing mixed feeding compared to those exclusively breastfeeding. In one study of HIV-infected mothers’ feeding choices in South Africa, alcohol use was associated with the choice of exclusively breastfeeding with an adjusted OR of 1.65 (Adeniyi et al. 2019).

Alcohol levels in breast milk, breastfeeding women, and breast-fed infants

With a low molecular weight, no protein binding, and being a strong base, alcohol diffuses in and out of breast milk depending on maternal blood alcohol levels, peaking 30-60 minutes after consumption (Giglia and Binns 2006; D’apolito 2013). After providing 0.3mg alcohol/kg of mother’s body weight, Chien et al. (2005) found that alcohol in breast milk reached a peak at 20-40 min after exposure, decreasing thereafter. Because none is absorbed into fat, alcohol levels will not build up in the mother or infant, as is the case for drugs like marijuana and cocaine.

Factors that influence the blood alcohol concentration (BAC) of the mother include her body weight, amount of adipose tissue and lean muscle tissue, stomach contents at the time of alcohol ingestion, the rate at which alcoholic beverages are consumed, and the amount and

strength of alcohol consumed. Maternal consumption of a half-liter of beer before breastfeeding results in 2.3 to 8.4 mg of alcohol per kilogram body weight ingested by the infant, 0.8 to 2.8 percent of the maternal dose (Mennella and Beauchamp 1993).

Lawton (1985) estimated (but did not measure) that even if a six-month old, 6.5 kg infant consumed 180 ml of breast milk from a mother who had drunk heavily (with 119 mg alcohol/dL blood, 0.119%), the infant would achieve only 6 mg alcohol/dL blood (0.006%). However, the liver of young infants detoxifies alcohol slowly, apparently at 25% (Pikkarainen and Raiha 1967) to nearly 50% (Idanpaan-Heikkila et al. 1972) of that in adults.

Alcohol levels in both fore- and hind-milk reflect changes in the mother's blood, though often at a slightly higher level (since alcohol is hydrophilic and breast milk has a slightly higher proportion of water than blood) (Lawton 1985). Because its elimination follows zero-order kinetics (a constant, predictable rate of elimination), pumping and dumping will not speed up the elimination of alcohol from breast milk (nor will coffee drinking or anything else except the time required for the liver to detoxify alcohol in the blood) (Koren 2002). However, the pharmacokinetics of alcohol varies greatly among lactating women, with coefficients of variation from 38-57% (Chien et al. 2005).

The BAC in women tends to increase more rapidly at times when estrogen levels are low, such as during lactation amenorrhea, when drinking will also lead to a higher level of intoxication (Schulte 1995). Pepino et al. (2007) found BAC responses to be lower overall after alcohol consumption in breastfeeding women, although the subjective effects (the mother's feelings of being affected by the alcohol) were similar. They did not indicate whether any of these women had lactation amenorrhea.

Adaptation of breastfeeding and drinking patterns to reduce infant exposure

In Australian research, one study (Maloney et al. 2011) found that 95% reported reducing their alcohol consumption during pregnancy or breastfeeding. Women taking more than two standard drinks per day were almost twice as likely to discontinue breastfeeding by six months as women who drank less than this (hazard ratio—HR, 1.9), with many potential confounders controlled for. Similarly, a Brisbane study found that women reduced their drinking substantially during pregnancy, especially heavy drinkers; at 6 mo postpartum, light drinkers had almost returned to baseline, but heavy drinkers still drank less than half what they drank before pregnancy (Tran, Najman, and Hayatbakhsh 2015). In a third Australian study (Tay et al. 2017), over 83% timed alcohol use to after a breast feed, and other 12% used other strategies, including eating when consuming alcohol. Also in Australia, Tearne et al. (2017) reported that 44%, 31% and 29% reported scheduling drinking to just after feeding the baby at ages 1 mo, 4 mo, and 6 mo or older.

One study found that only 28% of parents realized that pumping and discarding breast milk after drinking alcohol is not useful (Laanterä, Pietilä, and Pölkki 2010). A few other studies have reported somewhat more effective steps women took to reduce the effect of alcohol drunk during lactation. An online survey found that, of 836 women who had expressed breast milk, 10% did so in part to allow them to drink alcohol, although this was the major reason for only one woman (Clemons and Amir 2010). In Australia, Giglia and Binns (2007b) found that 25% of breastfeeding women drinking at one month postpartum timed it “just after breastfeeding,” decreasing to 21% at 4 mo and 8% after 6 mo. In a study of Japanese women, only 18% of those who drank alcohol during breastfeeding stated that they timed it to “just after breastfeeding” (Inoue 2012). In another Australian study, most women stated that they tried to time it so that

alcohol consumption occurred just after a breast feed or with an evening meal (Giglia et al. 2008). In another, most consumed alcohol at meal times with very few women timing it to just after a breast feed (Binns and Giglia 2005). Nascimento et al. (2013) reported that all breastfeeding women who consumed alcohol ate food at the same time, usually a snack of cheese.

Effects on infants of moderate alcohol use during breastfeeding

Children's learning about alcohol appears to occur at a very young age (Noll, Zucker, and Greenberg 1990). Maternal alcohol consumption changes the odor of breast milk, which can easily be detected by adults (Mennella and Beauchamp 1991). Infants exposed to breast milk alcohol mouth alcohol-scented toys more (Mennella and Beauchamp 1998) and consume more alcohol-flavored breast milk than those not previously exposed (Mennella 1997). As is true for several smells and tastes experienced in infancy, this may result in a more positive attitude toward alcohol later in life, as is true for prenatal alcohol exposure in humans and postnatal exposure in animal models (Nizhnikov et al. 2012), though the attitude later in life toward alcohol after postnatal exposure has not been studied directly in humans (Spear and Molina 2005). However, a small study in Brazil (N=33) found no correlation between self-described male alcoholics and whether their mother was an alcoholic while breastfeeding them (Sanchez 2016).

Since heavy drinking appears on average to be associated with a shorter period of breastfeeding, it is of interest that one study in Denmark found that early cessation of breastfeeding was associated with nearly a 1.5 times higher risk of hospitalization with alcohol-related diagnoses in adult life (Sørensen et al. 2006). However, a study in New Zealand found no relationship between being breast fed and later use of alcohol (Fergusson and Woodward 1999).

Alcohol in breast milk may affect infant sleep temporarily. In one study, a dose of 32 mg of ethanol (a typical dose that an infant will receive from breast milk one hour after the mother takes one drink--undefined) was added to ~100 ml breast milk for infants 6-26 weeks of age and the impact compared to that of vanilla-flavored breast milk (Mennella and Gerrish 1998). The alcohol reduced infant sleep during the following 3 hours from 78 to 57 minutes, with the reduction mainly coming from active sleep. A later study (Mennella and Garcia-Gomez 2001) suggested that if the mother does not continue to drink, the infant will compensate for this sleep deficit during the following 21 hours.

Regarding the impact on infant health, one study found no significant link between the extent of maternal use of alcohol during the first three months of life and risk of asthma at 3 years and current asthma at 7 years (Magnus et al. 2014). Nearly all research on the impact of alcohol on growth have been animal studies (Giglia and Binns 2006). Studies in pulque drinking communities in Mexico found no impact on growth at 6 mo (Flores-Huerta et al. 1992b), but poorer growth at five years (Backstrand et al. 2004). A few studies have examined whether alcohol in breast milk has developmental impacts on the infants. One study found a 4-5% deficit in motor development among one-year old infants regularly exposed to alcohol in breast milk (after alcohol exposure during gestation and >100 other variables were controlled for), with a dose-response relationship such that there was a 15% deficit with heavy drinking (Little et al. 1989). A later study by the same principal author failed to replicate these findings in children 1.5 years of age (Little et al. 2002).

Schuetze et al. (2002) conducted a similar study on younger (4-11 weeks) and exclusively breast-fed infants. It will be discussed here in more detail than other studies because of its unique and strong methodology and the unique variables measured. In one group, mothers consumed a 0.3g/kg dose of alcohol (vodka and tonic, ~1 standard drink for an average size women) within a 15-minute period, resulting in a BAC of 0.03. Another group received a drink with a negligible

amount of vodka floated on top to conceal which group they were in. Group allocations were reversed on a second visit.

A half hour later, mothers expressed 150 ml of breast milk, of which they fed 100 ml to their infants a half hour later. The feeding session and mother-infant interaction afterwards were videotaped and infant and maternal behaviors were coded by researchers blinded to their group. Infant arousal was then observed while the mother and infant were separated for one hour following this feeding session.

The higher the mother's BAC, the more time the infant spent crying. When infants consumed breast milk with alcohol, they changed behavioral states more often (suggesting less stable autonomic organization), slept less, and exhibited more startles. Repeated periods of autonomic instability such as those demonstrated in this study may be associated with a number of poor clinical outcomes later in life. During the videotaped feeding period, mothers in the alcohol group more often missed infant cues and there was a non-significant increase in dyadic conflict ($p=0.07$).

Another study (Gibson and Porter 2018) found a link between maternal alcohol consumption during breastfeeding and reductions in abstract reasoning at age 6 or 7 years. In a study of data from four active-case ascertainment studies of fetal alcohol spectrum disorders (FASD) among first grade students in South Africa, May et al. (2016) found evidence that alcohol use during breastfeeding (controlling for prenatal exposure and many other potential confounders) was associated with multiple negative developmental traits. The odds ratio for an FASD diagnosis by the first grade in school among children exposed to alcohol in breast milk was above 6.

Tay et al. (2017) found that, based on parental responses to questionnaires, maternal drinking moderately (2 drinks per day or less) at 8 weeks and again at 12 months was not linked to declines in infant development. Mothers who drank at 8 weeks postpartum gave a more favorable ranking for their infants regarding personal-social development at 12 months.

Some authors propose that developmental harm to infants is much more likely with chronic exposure to moderate levels of alcohol, suggesting that this may even be more harmful to the infant than rare consumption of excessive levels (Giglia and Binns 2006). One proposal is that the deficit identified in the motor development of infants exposed to chronic alcohol intake may be the result of continued disruption of active sleep subsequent to regular alcohol intake (Mennella and Gerrish 1998).

Early research has begun to examine a mechanism by which maternal alcohol consumption could affect breastfeeding infants. There is evidence that one way in which breastfeeding is beneficial for infants is by modifying DNA methylation and gene expression patterns. Such epigenetic changes refer to mitotically heritable alterations to cellular phenotype or gene expression that do not change the underlying DNA sequence. One study (Fransquet et al. 2016) found that postpartum maternal alcohol consumption increased dopamine receptor DRD4 methylation (at 13 of 19 CpG units), assessed among infants while breastfeeding during the first 8 weeks of life. The impact of postpartum alcohol on methylation was more powerful than for alcohol consumption during pregnancy (which was controlled for).

The impact of maternal alcohol use on the breastfeeding process

In both human and animal models, alcohol intake consistently causes a temporary decline in lactation performance (Giglia and Binns 2006). Particularly in women with a family history of alcohol abuse, alcohol consumption may result in a blunted prolactin response to suckling (Mennella and Pepino 2010). The fact that some studies have found alcohol to stimulate the

release of prolactin (Mennella, Pepino, and Teff 2005) and others have found that it decreases the release of prolactin (Volpi et al. 1994) is probably because alcohol appears to enhance the prolactin response if the breast is stimulated soon after consumption, but to reduce it when stimulation occurs later while maternal blood alcohol levels are declining (Mennella and Pepino 2008). Beer drinking may increase prolactin secretion, due not to alcohol but to a polysaccharide in barley, and thus this effect could be expected even from alcohol-free beer (Rayburn 2007).

With a relatively low maternal dose of alcohol at 1.5–2 g/kg body weight, the milk ejection reflex decreases by 80% (Cobo 1973). With a dose of >2 g/kg body weight, the reflex is completely inhibited. A dose of about ½ liter of beer containing 4.5% alcohol resulted in a 6 minute (19%) greater period of infant attachment to the breast and a 44g (19%) lower breast milk consumption in the following four hours than consumption of an equal amount of beer containing 0.5% alcohol (Mennella and Beauchamp 1993). This does not appear to be due to the taste or smell of the alcohol in the breast milk (Mennella 1997), but to reduced oxytocin release (Mennella and Pepino 2010), so that the infant obtains less milk despite more intensive suckling. The mother is unable to distinguish this reduction in her milk ejection reflex or in the amount of milk the infant consumes (Mennella and Beauchamp 1993). Many women experience that their breasts feel fuller at such times (Mennella and Garcia-Gomez 2001) and this may be part of the explanation for the myth that maternal alcohol consumption increases breast milk production (Mennella and Beauchamp 1991; Bowen and Tumback 2010).

Lower breast milk intake occurs in the 4-5 hours following ingestion of a dose of alcohol equivalent to about one standard drink (undefined, but likely the CDC standard of 13.5g) (Mennella and Pepino 2008). However, if mothers then refrain from drinking more, the infant compensates by taking more breast milk 8-16 hours later (Mennella 2001a). There was no significant difference in weight at 3 and 6 months in infants exposed to minimal to moderate levels of breast milk alcohol compared with those not exposed postnatally (Flores-Huerta et al. 1992a). Nor was any relationship found between maternal alcohol use during breastfeeding and infant growth or health in an Australian study (Binns and Giglia 2005).

Bed-sharing has a positive association with breastfeeding (Ball 2003). However, after consuming alcohol, mothers should avoid bed sharing (Baddock et al. 2006). Through this mechanism (reduced breastfeeding), regular maternal alcohol consumption could reduce breastfeeding frequency at night, but this has not been studied.

Mothers' knowledge and attitudes about alcohol and breastfeeding

In a small study in Australia, Giglia and Binns (2007a) found that mothers were much more aware of recommendations on alcohol use during pregnancy than during breastfeeding. These researchers did not believe that most Australian women are aware of potential risks to their infant of alcohol exposure, the impact on the breastfeeding process, or of options for safer alcohol consumption during breastfeeding (Binns and Giglia 2005).

One Scottish study found that 21% of women intending to breastfeed compared to 55% of women intending to formula feed thought occasional use of alcohol was incompatible with breastfeeding (Shaker, Scott, and Reid 2004). A later study in Scotland among women currently breast vs formula feeding found smaller differences (Dungy et al. 2008). Among college students in one study, 85% of women and 78% of men agreed with the statement that “Alcohol and caffeine are passed from the mother’s body to breast milk” (Kavanagh et al. 2012).

The IIFAS includes a question asking for agreement or disagreement with the statement that women who occasionally drink alcohol should not breastfeed. Results from studies that have

reported on the results of asking this question are listed in Table 3, ranked from highest (most restrictive in orientation) to lowest (most liberal).

Table 3. Percent agreement with the statement “Women who occasionally drink alcohol should not breastfeed”

	Location and type of sample	Percent who agreed
(Mosley, Stokes, and Ulmer 2005)	Missouri USA (African Americans)	76
(Inoue 2012)	Women at 18 mo postpartum, Himeji city, Japan	63
(Jefferson 2017)	Missouri USA (male and female university students)	61
(Vijayalakshmi, Susheela, and Mythili 2015)	Women in Bangalore, India	51
(Furaikh and Ganapathy 2017)	First time expectant fathers, Bangalore, India	45
(Safdar et al. 2017)	Breastfeeding women at hospital in Lahore, Pakistan	41
(Cotelo et al. 2018)	Low-risk expectant women in Galicia, Spain	32
(Riley 2007)	Junior and senior nursing students, New Hampshire USA nursing school	30
(Tohotoa 2012)	Mothers and fathers from Perth Australia maternity centers	28
(Cox, Giglia, and Binns 2015)	Women in rural western Australia (in 2010-12)	24
(Binns and Giglia 2005)	Women in hospital postpartum, Perth Australia	23

In Ireland, which has one of the highest alcohol consumption levels in Europe, on a scale of 1-5 (5 indicating total agreement), mothers gave an average score of 2.7 to the statement “A mother who occasionally drinks alcohol should not breast-feed her baby” (Sittlington et al. 2007). The authors of that study speculate that some who hold such a belief may prefer to avoid breastfeeding than to avoid alcohol. However, in surveys, the desire to drink alcohol is rarely listed as a reason for reducing or avoiding breastfeeding and even then, by only a small minority (Lamontagne, Hamelin, and St-Pierre 2009).

Public perception in the US is commonly that breastfeeding imposes many constraints on the mother; 45% in one study agreed that “A mother who breastfeeds has to give up too many lifestyle habits like favorite foods, cigarette smoking, and drinking alcohol” (Li, Fridinger, and Grummer-Strawn 2002). Blacks were three times as likely to have this perception as Whites. In a more recent study in the UK, this was not felt to be a serious constraint (Brown and Lee 2011).

Advice given to women about alcohol and breastfeeding

In folklore, alcohol has long been considered a galactagogue (Pepino and Mennella 2004; Flores-Huerta et al. 1992a; Schaffir and Czaplá 2012) or a way to lengthen the duration of breastfeeding (Bowen and Tumback 2010), and its maternal use at bedtime was often advised to

reduce fussiness and symptoms of colic or to sedate infants (Adams and Davidson 1987). In Taiwan, soup containing rice wine is traditionally prescribed for mothers during the first month postpartum (Chien et al. 2005). Myths about its benefits were disseminated by alcoholic beverage manufacturers in the past (Mennella and Beauchamp 1993). In the US, a special alcoholic beer for lactation was marketed from 1885 until Prohibition, sold in pharmacies and prescribed by physicians (Mennella 2001b).

Few studies have examined what advice mothers currently receive from health workers regarding alcohol use during breastfeeding. A small study in Australia found that midwives and pregnant women agreed that the only alcohol-related discussion that took place between midwives and patients was a brief screening question, though both stated they would feel comfortable to discuss the topic (Jones et al. 2011). An early study in Canada (Davidson 1981) found that 45% of mothers who received advice about drinking at one month postpartum were told that alcohol was desirable and an additional 42% were told it was acceptable. One survey in Argentina (Pepino and Mennella 2004) and two in the US (Mennella and Garcia-Gomez 2001; Mennella 2002) found that 25-35% of women reported that health professionals encouraged them to drink alcohol during breastfeeding, both to facilitate let-down and to benefit the infant (enhance sleep or prevent colic). Giglia et al. (2008) cite unpublished findings that 75% of Australian child health nurses who are asked by mothers recommend complete abstinence from alcohol during breastfeeding. Yet one Australian study at the same time found that women who attended antenatal classes were actually more likely to drink alcohol during breastfeeding than those who did not (Giglia et al. 2008). In Puerto Rico, a survey of 177 physicians found that 93% felt the use of alcohol was not advisable in breastfeeding women (Leavitt et al. 2009). A study of lactation consultants found that 11% stated that they would advise against use of alcohol during breastfeeding (Schaffir and Czaplá 2012). One study found beer to be the second most commonly used galactagogue by midwives in Switzerland (54%) and in Canada (25%) (Winterfeld et al. 2012). The Argentinean study (Pepino and Mennella 2004) also found that nearly half of breastfeeding women received advice from others and the majority of this was positive toward alcohol use during breastfeeding.

Official institutional advice has changed over time as evidence of the effects of alcohol consumption during breastfeeding has accumulated. For example, the American Academy of Pediatrics initially in 1994 simply stated that drinking alcohol was “usually compatible” with breastfeeding (American Academy of Pediatrics 1994). This changed to “should be minimized and limited to an occasional intake” in an AAP statement published in 2012 (Section on Breastfeeding 2012). Some authorities categorically recommend that alcohol should not be used during breastfeeding, including the US Department of Health and Human Services (2005). The 2010 Dietary Guidelines for Americans says that occasional drinking should not be a reason to avoid breastfeeding, but that alcohol should be avoided in the first three months of life. When taken, mothers should wait four hours before breastfeeding (U.S. Department of Agriculture and U.S. Department of Health and Human Services 2010).

There is little evidence on whether women advised not to drink during breastfeeding actually drank less often than those who were encouraged to drink or given no advice (Mennella 1997; Fleming et al. 2008). No research was located on whether such advice has any impact on levels of breastfeeding initiation or duration.

Conclusions

Clearly the public and sometimes even health workers are often uninformed and sometimes misinformed about the impact of maternal alcohol consumption on breastfeeding and

on the infant. However, a general impression one gets from the literature is that this and advice on this issue are becoming more evidence-based in recent years—as the evidence base grows. While the evidence base may be inadequate to recommend specifically what health worker training should say about consuming alcohol during breastfeeding, at the very least it should include debunking the myths that there are any benefits of consuming alcohol, either for the baby or for the breastfeeding process.

Moderate alcohol consumption may temporarily cause infant fussiness, disturbed infant sleep patterns, and interference with the milk ejection reflex. When drinking is chronic, the natural processes that overcome these effects may not have a chance to function, increasing the risk for infant developmental problems and other negative long-term outcomes.

The findings from few of the studies that give cause for concern about the impact on infants have been followed up on with repeat studies, leaving us uncertain as to whether further research might confirm them or not. Here are some of the most concerning findings where further research is crucial:

- Infants exposed to breast milk alcohol mouth alcohol-scented toys more (Mennella and Beauchamp 1998) and consume more alcohol-flavored breast milk than those not previously exposed.
- When infants consumed breast milk with alcohol, they changed behavioral states more often (suggesting less stable autonomic organization), slept less, exhibited more startles, and cried more (Schuetze, Eiden, and Chan 2002).
- Maternal alcohol consumption during breastfeeding was linked with reduced abstract reasoning at age 6 or 7 years (Gibson and Porter 2018).
- Fetal alcohol spectrum disorders were 6 times more common in infants exposed to alcohol in breast milk (controlling for prenatal exposure and many other potential confounders) (May et al. 2016).
- Maternal consumption of alcohol postpartum may change the epigenetic effects of breast milk (Fransquet et al. 2016).

Giglia and Binns (2008) write “In effect, this lack of knowledge may result in many women experiencing a perceived problem with their breastmilk supply (as a result of the alcohol-induced decrease in milk production), and result in the early cessation of breastfeeding.” While alcohol does not appear to affect the duration of breastfeeding, some of its effects on the breastfeeding process may cause common perceptions such as “the infant wants to wean,” “the baby no longer likes my milk,” or the perceived insufficient milk syndrome--which at least in the past, were the most commonly given reasons by mothers around the world for suboptimal breastfeeding patterns (Greiner, Van Esterik, and Latham 1981). Such perceptions could result in a shorter period of exclusive breastfeeding, as most relevant data so far suggest may be one result of maternal consumption of alcohol postpartum.

In most contexts, too little attention is given to the possibility of limiting the infant’s exposure to alcohol by scheduling drinking directly after breastfeeding has ended and/or pumping just before drinking for later use as needed (Giglia and Binns 2008). A nomogram (Ho et al. 2001) and a chart (Koren 2002) provide more detailed information on when the alcohol concentration in breast milk is likely to approach zero, based on the weight of the mother and the amount of alcohol consumed. There is also an application called Feed Safe which sets off a timer when breast milk is free from alcohol (White et al. 2016). Schulte (1995) lists other measures mothers can take to minimize alcohol exposure to the breast-fed infant.

There is little evidence on whether women advised not to drink during breastfeeding did so less often than those who were encouraged to drink or given no advice (Mennella 1997; Fleming et al. 2008). No research was located on whether such advice has any impact on levels of breastfeeding initiation or duration.

It is complex to determine what level of alcohol intake contraindicates breastfeeding. But at a public health level it is even more challenging to decide how liberal or restrictive general advice about alcohol use during breastfeeding should be. Harm could in theory result from messages that either (a) imply that breast milk alcohol is harmless, possibly initiating processes that lead to premature breast milk supplementation and thus early cessation of exclusive breastfeeding, or (b) alarm women who drink occasionally to the point where they unnecessarily avoid or shorten the period of breastfeeding.

The issue of alcohol consumption during pregnancy has been described as eliciting panic (Armstrong and Abel 2000). There is certainly no justification for causing this regarding breastfeeding and alcohol. However, research is needed in various cultural settings that specifically addresses the impact that variously worded messages on breastfeeding and alcohol consumption may have.

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