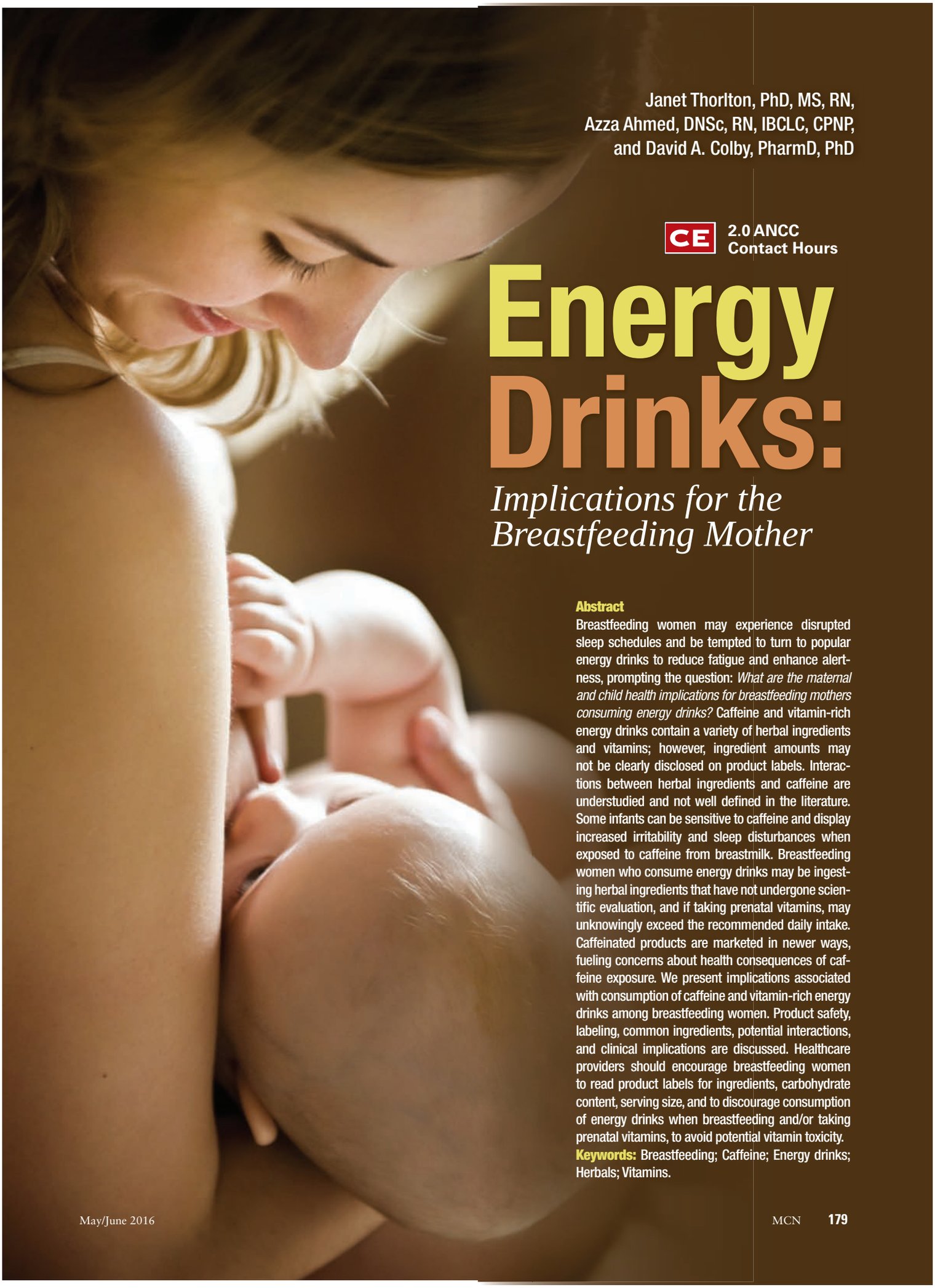


Janet Thorlton, PhD, MS, RN,
Azza Ahmed, DNSc, RN, IBCLC, CPNP,
and David A. Colby, PharmD, PhD

CE 2.0 ANCC Contact Hours

Energy Drinks:

Implications for the Breastfeeding Mother

Abstract

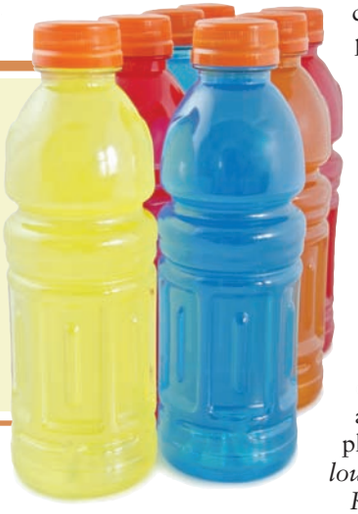
Breastfeeding women may experience disrupted sleep schedules and be tempted to turn to popular energy drinks to reduce fatigue and enhance alertness, prompting the question: *What are the maternal and child health implications for breastfeeding mothers consuming energy drinks?* Caffeine and vitamin-rich energy drinks contain a variety of herbal ingredients and vitamins; however, ingredient amounts may not be clearly disclosed on product labels. Interactions between herbal ingredients and caffeine are understudied and not well defined in the literature. Some infants can be sensitive to caffeine and display increased irritability and sleep disturbances when exposed to caffeine from breastmilk. Breastfeeding women who consume energy drinks may be ingesting herbal ingredients that have not undergone scientific evaluation, and if taking prenatal vitamins, may unknowingly exceed the recommended daily intake. Caffeinated products are marketed in newer ways, fueling concerns about health consequences of caffeine exposure. We present implications associated with consumption of caffeine and vitamin-rich energy drinks among breastfeeding women. Product safety, labeling, common ingredients, potential interactions, and clinical implications are discussed. Healthcare providers should encourage breastfeeding women to read product labels for ingredients, carbohydrate content, serving size, and to discourage consumption of energy drinks when breastfeeding and/or taking prenatal vitamins, to avoid potential vitamin toxicity.

Keywords: Breastfeeding; Caffeine; Energy drinks; Herbals; Vitamins.

Consumption of energy drinks has dramatically increased since their introduction into the market in 1960 (Preceden, n.d.). In adults, the daily caffeine intake from energy drinks underwent a 10-fold increase between the years 2001 and 2010 (Fulgoni, Keast, & Lieberman, 2015). Adverse effects have been associated with consumption, prompting proposed action for the United States Food and Drug Administration (US FDA) to increase regulatory scrutiny of energy drinks (Thorlton, Colby, & Devine, 2014; US FDA, 2013a). Women who are breastfeeding may experience disrupted sleep schedules (Doering, 2013) and be tempted to turn to popular energy drinks to self-manage sleep problems and postpartum fatigue (Smith & Forrester, 2013) prompting the question: *What are the maternal and child health implications for the breastfeeding mother who consumes energy drinks?*

Despite their popularity, there is limited evidence about the implications of energy drink consumption in breastfeeding women. There is no consistent definition for an energy drink; however, most contain a blend of caffeine, herbal ingredients, vitamins, amino acids, and sugar or sugar derivatives and interpretation of product labels can be confusing for consumers (Breda et al., 2014; Heckman & Gonzalez de Mejia, 2010; Seifert, Schaechter, Hershorin, & Lipshultz, 2011). We present an overview of implications associated with consumption of energy drinks among breastfeeding women. Product labeling, common ingredients, potential interactions, and implications for the breastfeeding woman are discussed.

A typical energy beverage contains 70–200 mg of caffeine per serving; some products contain more than one serving.



Product Labeling

Dietary supplements and conventional foods contain either a "Supplement Facts" or a "Nutrition Facts" label designed to assist consumers in maintaining healthy dietary practices (US FDA, 2014a). Energy drinks may be labeled as dietary supplements, or as conventional food products (US FDA, 2014a, 2015a). Product labeling varies, depending upon energy blend contents and manufacturer preferences (US FDA, 2013b). Dietary supplements contain caffeine, vitamins, minerals, amino acids, herbs, botanicals, or other ingredients used to supplement the diet (US FDA, 2013b, 2014a, 2015a). Conventional foods bearing a Nutrition Facts label are foods that are not considered dietary supplements (US FDA, 2015a).

Energy drinks containing a Nutrition Facts label may be purchased with Supplemental Nutrition Assistance Program benefits (formerly "Food Stamps"); however, those containing a Supplement Facts label are not eligible for purchase with these benefits (United States Department of Agriculture, 2014). Products containing a Supplement Facts label are regulated under the Dietary Supplements Health and Education Act (US FDA, 2014a, 2015a). Standards that apply to prescription medications for establishing premarket safety and efficacy do not apply to dietary supplements (US FDA, 2014a).

Energy shots, packaged in 50 ml bottles, account for more than 10% of the energy market, and energy drinks, packaged in approximately 240 ml cans, account for the remainder of sales in this multibillion dollar industry (Heckman & Gonzalez de Mejia, 2010; Somogyi, 2010). Both contain similar amounts of caffeine (e.g., 70–200 mg) and other ingredients, but energy shots are packaged in a concentrated form (Somogyi). It's important to note that although can/container sizes may contain similar volumes of liquid, serving sizes can range from 1 to 3 servings for a typical 240 ml can.

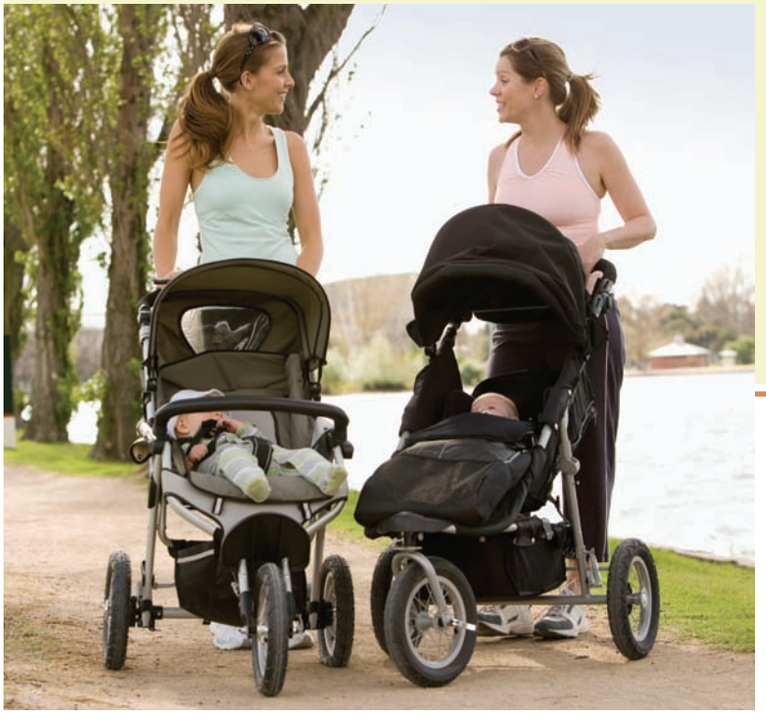
Labeling Terms explained. Detailed regulations about food and supplement product labeling are complex, and are beyond the scope of this paper. For those interested in learning more about US FDA laws, regulations, and information concerning labeling of food products, additional information can be found in the downloadable publication: *US FDA Guidance for Industry* (US FDA, 2013c).

To clarify present day labeling language, *Dietary Reference Intake* reflects reference values established by the Institute of Medicine (IOM), which include adequate intake and upper levels of intake (IOM, 2015). About 20 years ago, the term *Dietary Reference Intake* replaced the phrase *Recommended Daily Allowance* in the United States (IOM).

Recommended Daily Intake refers to the daily intake level of nutrients considered to be sufficient to meet requirements of the majority of healthy individuals in every demographic in the United States (IOM, 2015). The *Recommended Daily Intake* is used to determine the Percent (%) Daily Value of foods, is printed on nutrition facts labels in the United States and Canada, and is regulated by the US FDA (IOM).

Common Ingredients, Potential Interactions, and Implications

A typical energy drink contains a variety of ingredients (e.g., caffeine, taurine, guarana, ginseng, gingko biloba, yerba mate, and B vitamins) that may work together to stimulate the central nervous and cardiovascular systems



Healthcare providers should caution lactating women that limited evidence is available to support the use of herbal products and dietary supplements during breastfeeding, and if taking prenatal vitamins, they may unknowingly exceed the recommended daily intake.

(Amer, Cipriano, Venci, & Gandhi, 2015; IOM, 2015; Mitchell, Knight, Hockenberry, Teplansky, & Hartman, 2014; Seifert et al., 2011; Wolf, 2013). Excess consumption of stimulants can result in toxic effects ranging from agitation, cardiac arrhythmias, hypertension, sleep disturbances, digestive problems, seizures, acute renal failure, and even death (Seifert et al.; Wolf). Adverse interactions occurring between various herbal ingredients, caffeine, and pharmaceuticals have not been well characterized (Amer et al.; Sachs & American Academy of Pediatrics Committee on Drugs, 2013).

Herbs and dietary supplements may augment or antagonize the actions of prescription and nonprescription drugs (Wolf, 2013). These interactions are manifested most significantly with anticoagulants, cardiovascular drugs, oral hypoglycemic agents, and antiretrovirals (Amer et al., 2015; Gardiner, Phillips, & Shaughnessy, 2008; Shinde, Patil, & Bairagi, 2012).

Breastfeeding women who consume energy drinks may be ingesting herbal ingredients that have not undergone scientific evaluation (Budzynska, Gardner, Low Dog, & Gardiner, 2013; Gardiner et al., 2008; Mitchell et al., 2014; Shinde et al., 2012), and if taking prenatal vitamins, may unknowingly exceed the recommended daily intake. If daily intake exceeds the tolerable Upper Intake Level, risk for experiencing toxic effects can increase (IOM, 2015). Lactation Risk Categories, as noted by Hale & Rowe (2014) will be described for those herbal ingredients for which classifications have been determined. These risk categories are: L1: safest; L2: safer; L3: moderately safe; L4: possibly hazardous; L5: contraindicated in breastfeeding mothers (Hale & Rowe).

Caffeine. In the United States, the amount of caffeine constituting an "energy blend" does not need to be declared on product labels, making it challenging to estimate caffeine exposure by simply reading the label (US FDA, 2015b). Caffeine is considered *Generally Recognized as Safe* (GRAS) when consumed in moderation; therefore, is not subject to premarket review and approval (US FDA, 2013d, 2014b). Caffeine is classified as Lactation Risk Category L2, safe for breastfeeding, when consumed in moderation (i.e., ≤300 mg daily) (Berlin, Denson, Daniel, & Ward, 1984; Fulgoni et al., 2015; Hale & Rowe, 2014; Sachs & American Academy of Pediatrics Committee on Drugs, 2013; US FDA, 2013d).

Caffeine is a central nervous system stimulant and the most commonly ingested substance in the world (IOM, 2015). It is found in coffee, tea, chocolate, energy drinks, candy, bottled water, pharmaceuticals, and even food items (IOM, 2015; Somogyi, 2010). Though generally recognized as safe, caffeine consumption beyond moderate levels—about two cups per day—can pose safety concerns for infants (Hale & Rowe, 2014). The relative infant dose for caffeine (Lactation Risk Category: L2, safer) is 6% and anything less than 10% of the maternal dose is probably safe (Hale & Rowe). The time interval from administration of caffeine until it reaches the highest level in the mother's plasma, or T_{max} for caffeine is 60 to 120 minutes (Hale & Rowe).

Metabolism of caffeine occurs primarily in the liver by cytochrome P450 enzymes, which are also responsible for the metabolism of many drugs (Amer et al., 2015). There can be substantial variations of these enzymes in different persons, leading to differing rates of caffeine metabolism and sensitivity (Amer et al.). When consumed in large amounts, caffeine can cause toxic stimulatory effects, insomnia, irritability, and dehydration (IOM, 2015; Mitchell et al., 2014). Caffeine is known to cross the placenta and is found in breast milk (Seifert et al., 2011; Somogyi, 2010). Until several days after birth, newborn infants lack the necessary enzymes to properly metabolize caffeine (Somogyi). The average half-life of caffeine in adults is 3 to 7 hours; however, in a newborn it lasts 3 days (up to 120 hours) (Seifert et al.; Somogyi). Although less than 1% of ingested caffeine passes into breast milk, it may contribute to

Table 1. Comparison of B Vitamin Daily Values† to Typical Prenatal Vitamins and Energy Drink; Toxic Effects, and Potential Interactions

B Vitamin:	DV (LR) for Pregnant & Lactating Women	Typical Prenatal Vitamins*	Typical 8 oz Energy Drink* (%DV)	Typical 2 oz Energy Shot* (%DV)
Thiamin (B1)	1.7 mg (NR)	3 mg	1.5 mg (100%)	— (80%)
Riboflavin (B2)	2.0 mg (L1)	2 mg	1.7 mg (100%)	— (30%)
Niacin as niacinamide (B3)	20 mg (NR)	20 mg	20 mg (100%)	30 mg; (150%)
Pantothenic acid (B5)	10 mg (NR)	10 mg (100%)	2 mg; (50%)	20 mg (200%)
Pyridoxine (B6)	2.5 mg (L2; L4 in high doses may inhibit lactation)	2 mg (100%)	2 mg; (250%)	40 mg; (2,000%)
Folate; folic acid (B9)	800 mcg (L1)	400 mcg	800 mcg (200%)	400 mcg; (100%)
Cobalamin (B12)	8 mcg (L1)	6 mcg	2 mcg; (80%)	500 mcg; (8,330%)

Note. †DV = Daily Values adapted from U.S. Food & Drug Administration Guidance for Industry: A Food Labeling Guide, 2013, Appendix G. Daily Values for Pregnant and Lactating Women.

LR = Lactation Risk Categories: L1 = safest, L2 = safer, L3 = moderately safe, L4 = possibly hazardous, L5 = contraindicated, NR = not reviewed. Adapted from *Medications and mothers' milk. 13th ed.* by T.W. Hale, 2008.

* Ingredient listings from assorted popular prenatal vitamin and energy drink/shot used to obtain amounts per serving.

mg = milligrams; mcg = micrograms

irritability and changes in sleep patterns in breastfed infants (Budzynska et al., 2013; Wolf, 2013). Chronic use of caffeine may reduce breast milk iron content (Nehlig & Debry, 1994).

Taurine. Taurine is an amino acid that occurs naturally in humans and is typically found in meat and fish (Heckman & Gonzalez de Mejia, 2010). Taurine is a popular ingredient in energy drinks, touted to enhance endurance performance, and is considered safe (Heckman & Gonzalez de Mejia). However, more research is needed to better understand the health effects of large quantities of taurine in combination with ingredients contained in energy drinks (Heckman & Gonzalez de Mejia). A lactation risk category for taurine has not been established; therefore, it is recommended to avoid use during pregnancy and lactation (Medscape Drugs & Diseases, 2015).

Guarana. Commonly added to energy drinks and weight loss products, guarana is a natural stimulant herb, which following ingestion, is also secreted in breast milk (Amer et al., 2015; Budzynska et al., 2013; Shinde et al., 2012). Evidence indicates that no adverse effects are associated with guarana consumption; however, the caffeine from guarana is released at a slower rate, allowing for a longer stimulatory effect (Heckman & Gonzalez de Mejia, 2010). Products containing guarana have an indeterminate amount of caffeine, which makes estimation of total caffeine content challenging (Heckman & Gonzalez de Mejia). A lactation risk category for guarana has not been established; therefore, it is recommended to avoid use during pregnancy and lactation (Medscape Drugs & Diseases, 2015).

Ginseng, Ginkgo Biloba, & Yerba Mate. These botanicals are used to enhance cognitive performance (Vallerand, Deglin, & Hopfer, 2013) making those popular ingredients in energy drinks. In high doses, ginkgo can cause nausea, vomiting, diarrhea, heart palpitations, headaches, and restlessness (Shinde et al., 2012), and ginseng has been reported to cause similar symptoms and sleep disturbances (Budzynska et al., 2013; Heckman & Gonzalez de Mejia, 2010; Wolf, 2013). Ginseng and gingko are implicated in many clinically relevant drug interactions, and could interfere with the action of antidepressants, block the action of warfarin, and potentiate the effects of insulin (Amer et al., 2015; Heckman & Gonzalez de Mejia). To be safe, persons using these medications should refrain from consuming these products (Amer et al.). The lactation risk category for ginseng and for gingko biloba is L3 (moderately safe) (Hale & Rowe, 2014).

Yerba Mate is a central nervous system stimulant, often consumed as a tea and used for obesity management (Amer et al., 2015). The caffeine concentration in 8 oz

Caffeine is being increasingly added to a variety of foods and beverages, making it challenging to determine actual caffeine exposure.

(240 ml) of yerba mate is approximately 78 mg (Amer et al.). A lactation risk category for yerba mate has not been established; therefore, it is recommended to avoid use during pregnancy and lactation (Medscape Drugs & Diseases, 2015).

B Vitamins. B vitamins are commonly found in prenatal vitamins (IOM, 2015) and energy drinks, and include thiamin (B1), riboflavin (B2), niacin (B3), pantothenic acid (B5), pyridoxine (B6), biotin (B7), folate/folic acid (B9), and cobalamin (B12). Toxicity can result from taking excess doses of niacin or pyridoxine (Heckman & Gonzalez de Mejia, 2010; IOM, 2015). In high doses, niacin can cause skin flushing and liver toxicity and potential vitamin–drug interactions can occur if consuming alcohol or isoniazid (Heckman & Gonzalez de Mejia; IOM, 2015). Chronically exceeding the Upper Limit of pyridoxine (B6) can cause progressive sensory neuropathy, ataxia, and severe impairment of position and vibration senses when dosages exceed 400 mg per day (IOM, 2015). Potential vitamin–drug interactions can occur if consuming alcohol, oral contraceptives, anticonvulsants, corticosteroids, isoniazid, levodopa, penicillamine, hydralazine, and cycloserine (IOM, 2015). Large amounts of folic acid can precipitate or mask the effects of a vitamin B12 deficiency, such as anemia and neurological disorders (IOM, 2015). Potential vitamin–drug interactions can occur if taking cobalamin (B12) and also consuming alcohol, oral contraceptives, anticonvulsants, 5-fluorouracil, methotrexate, metformin, antacids, or nitrous oxide (IOM, 2015).

Due to the high B vitamin content contained in prenatal vitamins and energy drinks, breastfeeding women may be at additional risk for toxicity if they are consuming energy drinks, especially in large quantities. In one review of selected B vitamin supplements and energy drinks, several products failed quality testing for reasons such as exceeding established tolerable upper intake levels and possibly placing consumers at increased risk for toxicity (Consumer Lab, 2015). Table 1 offers a comparison of B vitamin percent Daily Value (based on recommended daily allowances for pregnant women ages 19–50) to typical prenatal vitamin and popular energy drink/shot ingredients, along with the Lactation Risk category for pregnant and lactating women (Hale & Rowe, 2014; USFDA, 2013c). Ingredient listings from assorted popular prenatal vitamins and energy drinks/shots were used to obtain typical amounts per serving displayed in Table 1.

Where to find more information. To learn more about toxicological information on drugs, herbs, and their safety in nursing mothers and infants, healthcare providers should consult the LactMed® Drugs and Lactation Database, which contains comprehensive, up-to-date information on drugs and herbal products that may be found in breast milk. LactMed® is available at: http://toxnet.nlm.nih.gov/newtoxnet/lactmed.htm, is updated monthly, and contains information about possible adverse effects of various substances to the breastfeeding infant. A LactMed® phone app is also available and may be downloaded from http://toxnet.nlm.nih.gov/help/newtoxnet/lactmedapp.htm.

The United States Department of Agriculture offers a Web-based *Interactive Dietary Reference Intake Tool* for healthcare professionals, which is available at http://fnic.nal.usda.gov/fnic/interactiveDRI/ and may be used to calculate daily nutrient recommendations. These databases can aid healthcare providers and lactation consultants in obtaining current information on drugs and nutrient needs, to help guide their advice to breastfeeding women.

Clinical Implications

Women who are breastfeeding should be asked if they are consuming energy beverages, how many beverages are being consumed per day, and cautioned to note the labeled serving size, to not exceed ≥300 mg of caffeine per day. If consuming products containing guarana, they should be cautioned that this ingredient also has a stimu-

Suggested Clinical Implications

- Energy beverages (i.e., drinks and shots) are not recommended for children, pregnant, or nursing women and persons sensitive to caffeine.
- Severe fatigue and sleep problems are most prevalent during the weeks following childbirth; however, these problems are sometimes overlooked.
- Encourage breastfeeding women to read product labels for ingredient content, and serving size; explain adverse side effects.
- Discourage consumption of energy drinks when taking vitamins, to avoid potential vitamin toxicity; discourage use in combination with alcohol or other medications.
- A typical energy beverage contains 70–200 mg of caffeine per serving; however, some products contain more than one serving.
- Lactating women should limit caffeine consumption to <300 mg/day.
- Caffeine is being increasingly added to a variety of foods and beverages, making it challenging to determine actual caffeine exposure.
- Lactating women should be cautioned that there is limited evidence to support use of herbal products and dietary supplements during breastfeeding.
- Suspected adverse reactions from energy beverage consumption may be reported to MedWatch: 800-FDA-1088, or by completing an online reporting form available on the Web site: www.fda.gov/Safety/MedWatch/

lant effect. Aside from caffeine-rich beverages (e.g., energy drinks, soda, cocoa), women who are breastfeeding should be educated to read product labels, as caffeine is also an ingredient in chocolate and other food products. Lactation consultants and nurses are in a unique position to assess for maternal fatigue and teach alternative strategies to manage fatigue other than using energy drinks and caffeine. Giallo, Cooklin, Dunning, and Seymour (2014) found that professional-led phone support and self-directed care interventions led to fewer fatigue symptoms and positive attitude toward self-care health behavior among postpartum mothers. Doering and Durfor (2011) reported that women can be taught how and when to access social support to promote sleep and prevent fatigue, and to obtain instruction on sleep hygiene and infant day/night entrainment that may help women maximize sleep opportunities during the early postpartum period with regard to the woman's sleep environment.

Lactation consultants and clinicians should monitor for regulatory updates and encourage breastfeeding women to heed product label warnings, and discourage consumption of energy beverages in combination with alcohol or other medications. Breastfeeding women may experience fatigue and disrupted sleep schedules and tempted to turn to popular energy drinks to reduce fatigue and enhance alertness. Although breastfeeding mothers can safely consume caffeine in moderation, they should exercise caution where energy drinks are concerned. Caffeine-rich energy drinks contain understudied herbal ingredients, and caffeine content is not clearly disclosed on product labels. Ingredients contained in energy blends vary by manufacturer; ingredient amount and serving size also varies. Excess energy drink consumption can potentially result in adverse effects related to high vitamin content and stimulant-containing ingredients. ✣

Janet Thorlton is an Assistant Professor, Purdue University, Johnson Hall School of Nursing, West Lafayette, IN. The author can be reached via e-mail at jthorlto@purdue.edu

Azza Ahmed is an Assistant Professor, Purdue University, School of Nursing, West Lafayette, IN.

David A. Colby is an Associate Professor, University of Mississippi, Medicinal Chemistry, Department of BioMolecular Sciences, Oxford, MS.

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