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Beverage caffeine intakes in the U.S.

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ABSTRACT

Caffeine is one of the most researched food components, with the vast majority of dietary contributions coming from beverage consumption; however, there is little population-level data on caffeine intakes in the U.S. This study estimated the caffeine intakes of the U.S. population using a comprehensive beverage survey, the Kantar Worldpanel Beverage Consumption Panel. A nationally representative sample of 37,602 consumers (aged ⩾ 2 years) of caffeinated beverages completed 7-day diaries which facilitated the development of a detailed database of caffeine values to assess intakes. Results showed that 85% of the U.S. population consumes at least one caffeinated beverage per day. The mean (±SE) daily caffeine intake from all beverages was 165 ± 1 mg for all ages combined. Caffeine intake was highest in consumers aged 50–64 years (226 ± 2 mg/day). The 90th percentile intake was 380 mg/day for all ages combined. Coffee was the primary contributor to caffeine intakes in all age groups. Carbonated soft drinks and tea provided a greater percentage of caffeine in the younger (<18 years) age groups. The percentage of energy drink consumers across all age groups was low (⩽10%). These data provide a current perspective on caffeinated beverage consumption patterns and caffeine intakes in the U.S. population.

1. Introduction

Caffeine is a widely consumed food constituent and as a result, the major sources, the quantity consumed, and the demographics of consumers have long been of interest. While chocolate and other cocoa-containing foods contribute small amounts of caffeine to the diet, the majority of the caffeine consumed comes from beverages (Frary et al., 2005; Somogyi, 2010). Caffeine intake varies across different types of beverages and in different population groups (Frary et al., 2005; Knight et al., 2004, 2006). Coffee typically contains more caffeine than most other beverages, and is widely and frequently consumed (Frary et al., 2005; Knight et al., 2004). Thus, it contributes significantly more to overall caffeine consumption within the population, particularly in adults. Carbonated soft drinks (CSDs), tea, energy drinks, energy shots, and some fruit or fruit-flavored and water beverages also contribute to total caffeine intake. Among children, CSDs had been shown to be the primary source of caffeine, compared to coffee in adults (Frary et al., 2005; Knight et al., 2004). Somogyi (2010) was perhaps the first to comprehensively investigate population-level data on newer categories of products such as energy drinks, energy shots, and other beverages containing caffeine. Smaller, segmented studies show that such drinks may be more commonly consumed by young adults, teenagers, college students, athletes, and military personnel (Heckman et al., 2010b; Lieberman et al., 2012; Norton et al., 2011).

Caffeine is one of many constituents in foods that can exert physiological effects. Scientific and historical evidence shows that among the healthy adult population, moderate caffeine consumption (e.g., (400 mg/day) is not associated with adverse health effects (Heckman, 2010a; Nawrot et al., 2003). Improvements in mental alertness, concentration, fatigue, and athletic performance are well documented benefits (Heckman, 2010a; Nawrot et al., 2003). Caffeine and/or coffee consumption has also been associated with weight loss, improved glucose tolerance and lower risk of type II diabetes, reduced risk for incidence of Parkinson's disease and improvement in Parkinson's symptoms, and reduced risk for

Abbreviations: CSD, carbonated soft drink; CSFII, Continuing Survey of Food Intakes in Individuals; FDA, Food and Drug Administration; KWP, Kantar Worldpanel; NDSR, Nutrition Data System for Research; NHANES, National Health and Nutrition Examination Survey; SIP, Share of Intake Panel; USDA, US Department of Agriculture.

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cancer at several sites (Butt and Sultan, 2011; Floegel et al., 2012; Higdon and Frei, 2006; Sinha et al., 2012).

While there are no specific recommendations for caffeine intakes in the U.S., the FDA released a letter in August 2012 stating that for healthy adults, caffeine intake up to 400 mg/day is not associated with adverse health effects (U.S. FDA, 2012a). The FDA clarified in a subsequent letter, issued in November 2012 that this value reflects the recommendations set forth by Health Canada based on the Nawrot 2003 review (U.S. FDA, 2012b). Health Canada issued recommendations in 2006 regarding levels of safe use to be $\leqslant$400 mg/day, and again in 2009 with specific recommendations for children (45–85 mg per day for 6–12 years; 2.5 mg/kg/day for $\geqslant$12 years) and pregnant women (<300 mg/day) (Health Canada, 2010). For certain occupational subgroups, such as military personnel, where sleep deprivation and the physical demands are a consideration, some experts have deemed 1000 mg/day and doses of 600 mg/day to be safe, though to achieve these higher levels from beverage sources alone may be challenging (Food and Nutrition Board, 2001; Lieberman et al., 2012).

Excessive caffeine intakes have been associated with anxiety, headaches, nausea, and restlessness (Heckman, 2010a; Nawrot et al., 2003). Side effects (i.e., headache, fatigue, drowsiness) may be experienced when caffeine intake is stopped suddenly; however, symptoms are generally mild and temporary (Heckman, 2010a; Nawrot et al., 2003). Some but not all studies have shown an increased risk of hypertension and cardiovascular disease (Nurminen et al., 1999; Heckman, 2010a; Mesas et al., 2011). Moderate caffeine intake (less than 400 mg/day for healthy adults) does not adversely affect cardiovascular health (Nawrot et al., 2003). Scientific data do not support adverse effects of moderate caffeine consumption below 300 mg/day on reproductive health or pregnancy outcomes (Brent et al., 2011; Kuczkowski, 2009; Peck et al., 2010).

Regardless of the longstanding consumption of caffeine-containing beverages in the diet, there is a lack of comprehensive and current population-based data on caffeine intakes. Most studies still cite information dating back to the 1980s and 1990s when Barone and Roberts (1996) highlighted results from earlier population-based surveys. In 2004 and 2006, Knight et al. published data from the Share of Intake Panel (SIP) a syndicated beverage survey conducted by NFO WorldGroup. In 2005, Frary and colleagues published caffeine intakes from the U.S. Department of Agriculture (USDA) Continuing Survey of Food Intakes in Individuals (CSFII) collected in 1994–1996 and 1998 (Frary et al., 2005). The CSFII study provided estimated caffeine intakes from both food and beverages using a different methodology than previous beverage consumption surveys (i.e., SIP) representing roughly the same time period. Other recent data on caffeine intakes and caffeinated food and beverages intakes are presented in a publically available U.S. Food and Drug Administration (FDA) report with data from the 2001–2006 National Health and Nutrition Examination Survey (NHANES) and other surveys (Somogyi, 2010).

There has also been an introduction of a greater variety of beverages in the marketplace. The introduction of functional beverages such as energy drinks, energy shots, as well as an array of specialty coffees, also highlights the importance of characterizing more recent beverage consumption patterns and caffeine intakes that may have evolved over the last decade. The objective of the present investigation was to estimate caffeine intakes in the U.S. population from the consumption of caffeinated beverages using a current (2010–2011) population-based beverage survey, the Kantar Worldpanel (KWP) Beverage Consumption Panel [formerly the SIP, conducted by NFO WorldGroup (Knight et al., 2004)].

2. Materials and methods

2.1. Survey description

KWP is a global consumer panel company focused on the continuous measurement and analysis of consumer behaviors. The Beverage Consumption Panel is the survey that was used for this study which includes a U.S. sample of panel members or respondents who are surveyed annually. This continuous survey has been conducted for over 30 years and targets U.S. consumers of all ages. The respondents for these analyses were recruited from a pool of about 1 million volunteer panel members with the goal to complete 40,000 surveys. U.S. Census demographic data are used to guide the selection of participants from the overall panel to participate in a representative Beverage Consumption Panel (U.S. Census Bureau, 2012). Sample selection characteristics included age, gender, race, Hispanic origin, geographic region, market size, household income, household size, and presence of children in the household. Only English-speaking participants were included in the survey and there were no questions or exclusions based on health conditions. Email was used to invite participants to complete a survey. Invitations were staggered in batches sent out weekly to ensure a balanced sample across all months of the year. Email invitations are sent to a parent or guardian of children aged 1–12 years asking the parent or guardian to complete a survey for their child. For teenagers aged 13–17 years, parental permission is obtained to allow their child to complete the survey on their own. The response rate for the survey was approximately 15%.

2.2. Data collection

Beverage data used for this study were collected by KWP from October 2010 through September 2011 as part of their survey of a panel of participants' aged $\geqslant$1 year. Data for children aged <2 years were excluded from the caffeine analysis since young children age 2 and above are more likely to be consuming beverages other than milk. Respondents completed an online beverage diary consisting of 7 consecutive days, recording all beverages consumed using a web-based form. Respondents are asked to enter their diary records once a day for each of the 7 days. They are also sent periodic reminders at 3 different time points throughout the week to remind them to participate regularly. Respondents cannot record beverages for future days but they are permitted to record or change beverages from prior days. The data collection included type, brand, preparation, location (home or away from home), and amount of all the beverages consumed. During the same week, respondents were also asked to record their height, weight, and demographic information. Respondents were given a small monetary incentive upon completion of the survey.

2.3. Caffeine database development

A list of all beverages consumed as part of the KWP survey was generated and provided to the Pennsylvania State University Diet Assessment Center for the development of a caffeine database. Caffeinated beverages were grouped into six general categories: coffee (e.g., specialty coffee drinks, iced coffee, brewed, instant, and decaffeinated coffee), tea (e.g., green tea, white tea and other varieties, iced tea), CSDs (both caffeinated fruit-flavored and cola beverages), chocolate drinks (including milk and cocoa), energy drinks, and energy shots. A few other beverages containing caffeine including fruit juice, flavored water, and sports drinks were also included in the energy drink category since the number of identified consumers was too low to create a separate category. There were 554 caffeinated beverages identified. Caffeine values (Table 1) were obtained from several resources since most food and nutrient databases have limited brand specificity, particularly for coffee and tea. Sources used included the USDA Food and Nutrient Database for Dietary Studies (version 4.1), the USDA National Nutrient Database for Standard Reference 24 (U.S. Department of Agriculture, 2011) and the Nutrition Data System for Research (Nutrition Coordinating Center, 2011). Other sources included food and beverage companies, websites [e.g., Energy Fiend (2012), which contains brand-specific data for caffeinated beverages], and a recent report published by the Yale Rudd Center (Harris et al., 2011). Default values were used in cases where no brand was specified or when caffeine values could not be determined for a specific brand. In general, default values were either the default value used in one of the food and nutrient database sources such as the National Nutrient Database for Standard Reference or were products that have the greatest market share. For example, most home-brewed coffee was assigned a default value of 11.9 mg per fluid ounce which is equivalent to the value in the USDA Standard Reference database for regular brewed coffee. The proportion of beverages assigned default values is dependent on the beverage category. This proportion is low (<20%) for commercial, bottled drinks (e.g., CSD's and energy drinks) but higher for coffee and tea (40–50%) where most home brewed varieties are assigned a default value.

2.4. Data analysis and measures

Caffeine database values expressed as milligrams of caffeine per fluid ounce were merged with the Beverage Caffeine Panel survey data to calculate the caffeine intake per survey respondent for each of the 7 days of beverage consumption.