October 16 - 18
14th EDITION 2015

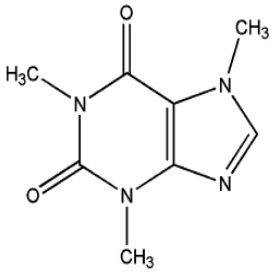
NO CONFLICT OF INTEREST TO DECLARE

October 16 - 18
14th EDITION 2015

Is caffeine beverage associated with an increased risk of atrial fibrillation?

Anna Vittoria Mattioli

Caffeine in coffee beverages



Caffeine is the most widely consumed behaviourally active substance in the world.

Almost all caffeine comes from dietary sources and most of it from coffee and tea.

The content of caffeine ranges from 40 to 180 mg/150 ml of coffee.

Ingestion of a single cup of espresso coffee provides a dose of 0.4-2.5 mg/kg of caffeine (calculated as 80-90 mg/cups of Italian espresso)

Caffeine in coffee beverages

The amount of caffeine in different espresso and brewed specialty coffee varies in different preparation.

There are hundreds of different coffee species, the two most common being “Robusta” and “Arabica”.

The modality of preparation (i.e. filtered, non-filtered, percolated) could influence the quantity of caffeine

The diluition could also influenced caffeine contents

McCusker 2003

Table II. Caffeine Content of Espresso and Brewed Specialty Coffees

Coffee and Origin	Amount	Caffeine Dose (mg)
Espresso coffees		
Big Bean Espresso, 1-shot	1 shot	75.8
Big Bean Espresso, 2 short shots	2 short shots	140.4
Big Bean Espresso, 2 tall shots	2 tall shots	165.3
Starbucks Espresso, regular, small	1 shot	58.1
Hampden Café Espresso	2 shots	133.5
Einstein Bros® Espresso, double	2 shots	185.0
Brewed specialty coffees		
Big Bean, regular	16 oz	164.7
Big Bean Boat Builders Blend, regular	16 oz	147.6
Big Bean Organic Peru Andes Gold, regular, country origin, Peru	16 oz	186.0
Big Bean French Roast, regular	16 oz	179.8
Big Bean Ethiopian Harrar, regular, country origin, Ethiopia	16 oz	157.1
Big Bean Italian Roast, regular, country origin, Brazil	16 oz	171.8
Big Bean Costa Rican French Roast, regular, country origin, Costa Rica	16 oz	245.1
Big Bean Kenya AA, regular, country origin, Kenya	16 oz	204.9
Big Bean Sumatra Mandheling, regular, country origin, Indonesia	16 oz	168.5
Hampden Café Guatemala Antigua	16 oz	172.7
Starbucks regular	16 oz	259.3
Royal Farms regular	16 oz	225.7
Dunkin' Donuts regular	16 oz	143.4
Einstein Bros regular	16 oz	206.3

Caffeine in coffee beverages

The variability in caffeine content may be due to many factors:

modality of preparation i.e. espresso or percolation,

different quality of coffee bean, roasting method and

the length of brewing time

In espresso coffee the variability is wider due to human manipulation involved in the production of the espresso extraction

Table III. Caffeine Content of Starbucks Breakfast Blend (Blend of Latin American Coffees)

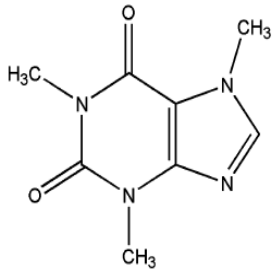
Day	Caffeine Dose (mg) in 16 oz
1	564.4
2	498.2
3	259.2
4	303.3
5	299.5
6	307.2

McCusker 2003

Caffeine: effects

Stimulates:

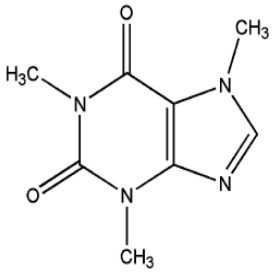
- central nervous system,
- gastric acid secretion
- coronary vessel dilation
- diuresis.
- fat oxidation in muscle,
- free fatty acid release from peripheral tissues
- increases basal energy consumption



It might impair insulin action by stimulating the release of epinephrine, a potent inhibitor of insulin activity and decreases insulin sensitivity in muscle.

Caffeine doses as low as 100 mg were associated with alertness, well-being, sociability, energy and willingness to work

Coffee and AF



- Studies examining the association between coffee consumption and atrial fibrillation have been inconclusive

- Coffee drinking has been associated with increased cardiovascular morbidity in some but not all prospective studies

- Although case-control studies found a positive association between coffee consumption and risk of atrial fibrillation, prospective cohort studies underlined a lower risk among individuals with higher coffee consumption

Acute effects of caffeine on heart rate variability in habitual caffeine consumers

No changes in heart rate variability in young healthy male habitual coffee consumers

	0 min	30 min	60 min	90 min
HR				
Placebo	73·2 (64·0–80·7)	70·1 (65·2–75·7)	68·6 (62·5–74·6)	67·7 (61·3–71·6)
100 mg	73·3 (65·7–80·3)	70·1 (63·0–76·7)	67·0 (60·7–73·9)	68·3 (59·3–72·6)
200 mg	74·5 (68·0–82·1)	70·5 (64·1–78·5)	71·5 (61·3–77·5)	70·7 (62·4–76·2)
P-value	0·838	0·967	0·792	0·589
RMSSD				
Placebo	56·3 (38·4–92·7)	62·8 (41·3–109·7)	59·9 (45·7–116·1)	66·5 (51·4–102·6)
100 mg	58·8 (34·1–77·1)	60·8 (36·1–79·0)	68·8 (43·9–89·0)	71·7 (50·4–102·0)
200 mg	52·8 (32·4–68·2)	55·5 (45·2–95·7)	63·0 (42·8–86·9)	67·4 (44·6–94·6)
P-value	0·273	0·792	0·356	0·531
SDNN				
Placebo	98·6 (76·1–146·8)	102·1 (75·9–163·2)	100·5 (82·1–155·0)	109·7 (92·0–151·5)
100 mg	102·7 (72·1–120·5)	105·4 (72·9–126·7)	111·8 (81·2–142·3)	119·2 (92·1–149·4)
200 mg	96·3 (68·1–109·8)	103·6 (81·9–140·4)	101·6 (77·0–133·2)	113·5 (86·5–138·4)
P-value	0·131	0·697	0·291	0·587
PNN50				
Placebo	28·5 (18·0–44·3)	32·3 (20·1–49·9)	33·4 (25·2–53·4)	40·3 (27·4–54·0)
100 mg	35·2 (14·1–44·2)	36·9 (16·9–47·4)	44·9 (24·1–50·8)	43·7 (20·6–54·2)
200 mg	30·6 (11·3–38·8)	36·1 (19·4–49·8)	37·0 (16·8–48·6)	38·4 (26·2–48·9)
P-value	0·273	0·465	0·531	0·531

Rauh R, 2006

Coffee and heart rate variability

in PNSA observed in the present study, together with the previously described increase in SNSA,[1] these autonomic disturbances would be expected to directly

Sondermeijer , 2002

273), ventricular fibrillation/flutter/cardiac arrest (code 427.4–5; n = 91), premature beats (code 427.6; n = 91), and other arrhythmia (code 427.8; n = 755). Analyses yielded estimates of hazard ratios (HRs), 95% confidence intervals (CIs), and p values. We performed similar analyses of the relation of tea to arrhythmia risk.

Similar analyses of total coffee intake were performed, including coffee as a continuous variable. This inverse relation was progressive in the largest intake categories: for example, at 4–6 cups/day, the HR for all arrhythmias was 0.84 (p = 0.05), and at >6 cups/day, it was 0.73 (p = 0.02). The results were similar for most of the specific supraventricular arrhythmia diagnoses. The HR for heavy coffee drinkers was >1.0 for paroxysmal ventricular tachycardia, but it was 0.5 for the composite

We performed most stratified analyses separately for atrial fibrillation, the diagnosis for half of all participants. The results for atrial fibrillation were consistently similar to those for all arrhythmias; for example, the HR of those drinking ≥4 cups/day were 0.83 for men, 0.78 for women, 0.78 for white persons, 0.65 for black persons, 0.79 if <60 years old at baseline, 0.83 if ≥60 years old at baseline, 0.64 if <10

The Permanente Journal/ Summer 2011/ Volume 15 No. 3

Klatsky , 2011

generalizability of the results.

In sex-specific analyses, coffee consumption was associated with a non-significant positive association in men, but with a non-significant inverse association in women. Whether men may be more sensitive to a high coffee or caffeine intake warrants further study.

Although available evidence does not indicate that coffee consumption increases the risk of developing AF, coffee (or caffeine) may trigger arrhythmia. In a study of 100 patients with idiopathic paroxysmal AF, 25 patients indicated coffee consumption as a triggering factor for arrhythmia [26]. In the COSM and the SMC, participants who had AF at baseline consumed, on average, less coffee than those without AF, suggesting that some individuals

formation on type of coffee (for exampl
and preparation method (for example, fil
and we had limited statistical power in ou
coffee abstainers as the reference. The m
herits the limitations of the included stu
tations in the other studies are about th
discussed for the COSM and the SMC.
could be of concern in any meta-analys
data. We observed no evidence of such bi
meta-analysis.

Two recent meta-analyses of the asso
caffeine intake and AF risk showed no ov
[11, 12]. In one of those meta-analyses,
six prospective studies, there was a statist

We conducted secondary analyses to test the associat between total fish and types of fish intakes and AF risk. We not observe a significant association between total fish intake AF risk. However, participants who consumed >4 serving dark fish/wk were at increased risk of developing AF (ha ratio: 6.53; 95% CI: 2.65, 16.06; $P < 0.0001$), as show **Table 3**. In contrast, there were no significant associations tween canned tuna fish, shrimp and shellfish, or other fish risk of AF (*see* supplemental Table 3 under "Supplemental d in the online issue). We also examined the sources of fiber types of grain and showed that neither fibers from cer vegetables, fruit, legumes, nor whole or refined grains associated with incident AF (*see* supplemental Table 4 u "Supplemental data" in the online issue).

Because of the largely negative results, we post hoc exam the study's statistical power. We had 80% power to dete hazard ratio ≥1.65 when the risk of AF in the first quartile given nutrient was compared to risk of AF in the fourth qua of that nutrient with the assumption of an increasing associa between intake and risk by using Cox proportional hazards gression analysis. For nutrients with inverse associations AF risk, we had 80% power to detect a hazard ratio ≥0.67 w risk of AF in the first quartile of a given nutrient was compa to risk of AF in the fourth quartile of that nutrient.

Conen, 2010

TABLE 3

Risk of atrial fibrillation according to total fish and dark-fish intake

	Frequency of fish intake			
	Never or <1 serving/wk	1–4 servings/wk	>4 servings/wk	*P*
Total fish				
No. of cases/participants	107/3365	156/5460	33/815	
Person-years of follow-up	12,872	20,919	3093	
Age, sex, and energy adjusted	1 (reference)[1]	0.91 (0.71, 1.17)	1.33 (0.89, 1.98)	
Multivariable adjusted[2]	1 (reference)	0.88 (0.69, 1.13)	1.25 (0.84, 1.86)	
Dark fish				
No. of cases/participants	248/8321	43/1298	5/21	
Person-years of follow-up	31,886	4932	67	
Age, sex, and energy adjusted	1 (reference)	1.02 (0.74, 1.41)	8.77 (3.61, 21.27)	
Multivariable adjusted[2]	1 (reference)	1.01 (0.72, 1.39)	6.53 (2.65, 16.06)	

[1] Hazard ratio; 95% CI in parentheses (all such values).

[2] Cox proportional hazards regression model adjusted for age, sex, BMI, systolic blood pressure, hypertension treatment, electrocardiogram, PR significant heart murmur, and heart failure.

Coffee, Alcohol, Smoking, Physical Activity and QT Interval Duration: Results from the Third National Health and Nutrition Examination Survey

Tea (cups/day)						
0	4137	407.2 (405.6, 408.7)	0.0 (reference)	0.0 (reference)	0.0 (reference)	0.0 (r
<1	3242	405.3 (403.8, 406.8)	−0.4 (−1.5, 0.8)	−0.4 (−1.6, 0.7)	−0.2 (−1.4, 1.0)	−0.1
1–3	343	403.4 (398.0, 408.8)	−1.8 (−4.5, 1.0)	−2.3 (−5.1, 0.5)	−2.4 (−5.4, 0.5)	−2.4
4–5	58	403.8 (393.3, 414.3)	−0.1 (−4.9, 4.7)	−0.8 (−5.2, 3.6)	0.8 (−4.2, 5.8)	0.6 (-
≥6	15	405.9 (393.7, 418.2)	0.3 (−9.1, 9.7)	1.2 (−8.4, 10.7)	−2.1 (−11.4, 7.2)	−2.0
p-trend		0.18	0.44	0.33	0.27	0.27
Caffeine (mg/day)						
<24.2	2080	408.4 (406.3, 410.4)	0.0 (reference)	0.0 (reference)	0.0 (reference)	0.0 (r
24.2–135.2	2425	405.8 (404.2, 407.4)	−1.6 (−3.0, −0.1)	−1.6 (−3.1, −0.2)	−1.1 (−2.6, 0.4)	−1.3
135.2–274.9	1489	406.6 (404.0, 409.3)	−0.1 (−1.4, 1.3)	−0.1 (−1.6, 1.3)	0.1 (−1.4, 1.6)	−0.1
≥274.9	1801	404.2 (402.5, 405.8)	−1.6 (−2.9, −0.2)	−1.3 (−2.7, 0.1)	−0.8 (−2.2, 0.6)	−1.2
p-trend		<0.001	0.05	0.13	0.35	0.17

a. Adjusted for age (continuous), race-ethnicity (non-Hispanic white, non-Hispanic black, Mexican-American, other), sex, and RR-interval (restricted qu
knots at the 5th, 50th, and 95th percentiles).
b. Further adjusted for BMI (continuous), high school education (yes, no), annual household income (<$20,000, ≥$20,000), and use of QT-prolongir
no).
c. Further adjusted for systolic blood pressure, blood pressure lowering medication, total and HDL cholesterol, diabetes, history of myocardial in
congestive heart failure, serum potassium (continuous), and serum calcium (continuous).
d. Further adjusted for smoking (current, former, never), number of drinks (continuous), and total physical activity (continuous).
doi:10.1371/journal.pone.0017584.t002

dependent variable. Independent vari

Table 4 Univariate and multivariate variable

Variable					
Coffee >3 cups per day					
BMI >30					
Stress >50 LCU					
Coffee >3 cups per day by nonhabitual drinker					
High alcohol consumption					
Low physical activity					
LDL cholesterol					

CI, confidence interval; LCU, life changes units; LDL,

Coffee >3 cups per day by nonhabitual drinker	0.22	0.08–0.121	<0.05		
High alcohol consumption	1.181	0.99–1.266	<0.05	0.034	0.08–0.(
Low physical activity	1.765	1.239–2.597	<0.05	0.46	0.67–0.(
LDL cholesterol	1.348	1.059–1.656	<0.05	0.075	0.095–0.2

CI, confidence interval; LCU, life changes units; LDL, low-density lipoprotein; OR, odds ratio.

Mattioli, 2008

The cohort provided a total of 275 136 person-years of risk ($\bar{x}$: 5.7 y; range: 0–8.1 y), and, during follow-up, 373 men (1.7%)

we used the lowest quintile of caffeine consumption
ence, the adjusted hazard rate ratios (95% CIs) in qui

TABLE 2
Incidence rates of atrial fibrillation or flutter in the Danish Diet, Cancer, and Health Study according to quintile of caffeine consumption

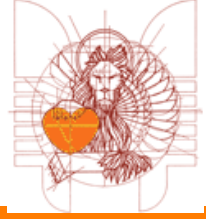
	Quintile				
	Quintile 1 (n = 9585)	Quintile 2 (n = 9577)	Quintile 3 (n = 9611)	Quintile 4 (n = 9585)	Quintile 5 (n = 9591)
Mean duration of follow-up (y)	5.8	5.7	5.7	5.7	5.8
No. of person-years of follow-up	55 303	54 755	55 212	54 671	55 195
No. of subjects with atrial fibrillation or flutter	115	130	98	108	104
Incidence rate per 10 000 person-years	20.8	23.7	17.7	19.8	18.8

Frost, 2005

who drink ordinary coffee (31). The consumption of decaffeinated coffee in Denmark, however, is negligible: in the year 1997, consumption of decaffeinated coffee in Denmark was <1% of the total coffee consumption (32).

248:1097–8.
2. Strubelt O, Diederich KW. Experimental treatment of the acut
vascular toxicity of caffeine. J Toxicol Clin Toxicol 1999;37:
3. Chopra A, Morrison L. Resolution of caffeine-induced comp
rhythmia with procainamide therapy. J Emerg Med 1995;13:1

Frost, 2005



Caffeine consumption and incident atrial fibrillation in women[1–3]

Age-adjusted incidence rate[1]	1.89	2.07	2.23	2.62	2.03	–
Age-adjusted relative risk: updated	Referent	0.95 (0.82, 1.11)	0.96 (0.72, 1.29)	1.23 (0.95, 1.57)	0.77 (0.44, 1.33)	0.(
Multivariable-adjusted relative risk[3]	Referent	1.01 (0.86, 1.17)	1.00 (0.74, 1.33)	1.25 (0.97, 1.61)	0.79 (0.45, 1.37)	0.:
Tea (cups/d)	0	0 to <1	1	≥2	—	–
No. of events	301	384	105	137	—	–
Age-adjusted incidence rate[1]	2.02	2.02	1.91	2.40	—	–
Age-adjusted relative risk: adjusted	Referent	0.89 (0.76, 1.03)	0.97 (0.74, 1.27)	1.19 (0.94, 1.52)	—	0.(
Multivariable-adjusted relative risk[3]	Referent	0.90 (0.77, 1.05)	0.97 (0.75, 1.27)	1.19 (0.93, 1.52)	—	0.(
Caffeinated cola (cans/d)	0	0 to <1	≥1	—	—	–
No. of events	726	176	23	—	—	–
Age-adjusted incidence rate[1]	2.12	1.77	2.02	—	—	–
Age-adjusted relative risk: updated	Referent	0.88 (0.75, 1.03)	0.91 (0.57, 1.45)	—	—	0.(
Multivariable-adjusted relative risk[3]	Referent	0.92 (0.78, 1.08)	0.92 (0.58, 1.48)	—	—	0.(
Decaffeinated cola (cans/mo)	0	1–3	≥4	—	—	–
No. of events	823	54	47	—	—	–
Age-adjusted incidence rate[1]	2.04	2.09	2.24	—	—	–
Age-adjusted relative risk: updated	Referent	0.98 (0.75, 1.28)	0.99 (0.77, 1.25)	—	—	0.:
Multivariable-adjusted relative risk[3]	Referent	1.03 (0.79, 1.34)	1.04 (0.82, 1.33)	—	—	0.:
Low-calorie caffeinated cola (cans/d)	0	0 to <1	1	≥2	—	–
No. of events	462	319	72	67	—	–
Age-adjusted incidence rate[1]	1.92	2.08	2.08	2.56	—	–
Age-adjusted relative risk	Referent	1.06 (0.92, 1.22)	1.04 (0.77, 1.42)	1.10 (0.78, 1.56)	—	0.(
Multivariable-adjusted relative risk[3]	Referent	1.05 (0.91, 1.21)	0.97 (0.71, 1.32)	0.96 (0.68, 1.36)	—	0.(
Low-calorie decaffeinated cola (cans/d)	0	0 to <1	1	≥2	—	–
No. of events	548	283	55	40	—	–
Age-adjusted incidence rate[1]	1.92	2.18	2.54	2.61	—	–
Age-adjusted relative risk	Referent	1.08 (0.95, 1.24)	1.30 (0.92, 1.85)	1.14 (0.72, 1.81)	—	0.:
Multivariable-adjusted relative risk[3]	Referent	1.09 (0.95, 1.26)	1.22 (0.86, 1.73)	0.98 (0.62, 1.56)	—	0.:
Chocolate (bars or packets/mo)	0	1–3	4	>4	—	–
No. of events	413	319	123	85	—	–
Age-adjusted incidence rate[1]	2.16	2.02	1.90	1.96	—	–
Age-adjusted relative risk	Referent	0.99 (0.85, 1.15)	0.88 (0.72, 1.09)	0.89 (0.68, 1.16)		0.:
Multivariable-adjusted relative risk[3]	Referent	0.99 (0.85, 1.15)	0.88 (0.71, 1.08)	0.86 (0.65, 1.13)	—	0.:

[1] Per 1000 person-years of follow-up.
[2] Hazard ratio; 95% CI in parentheses (all such values).
[3] Adjusted for age, systolic blood pressure, BMI, hypertension, diabetes, hypercholesterolemia, smoking, exercise, alcohol consumption, parental h of myocardial infarction, treatment group, fish intake, and race-ethnicity.

Conen, 2010

Elevated caffeine consumption did not confer an increased risk of incident AF in this large cohort of initially healthy women.

By contrast the consumption of small to moderate amounts of caffeine may have a small but significant protective effect on the occurrence of AF

Conen, 2010

Coffee and antioxidants

Anti-oxidant properties of coffee may be mediated by flavonoids, potassium, magnesium and other components that could have anti-inflammatory effects.

High coffee consumption is associated with low levels of inflammation and endothelial dysfunction in healthy and diabetic women

Regular consumption of food and beverages rich in flavonoids is associated with a decreased risk of cardiovascular mortality including coronary artery disease and stroke.

Coffee and antioxidants

TABLE 3

Contribution of different food groups to antioxidant intake in the 7-d weighed-record study and NORKOST2 study

	7-d weighed-record study	NORKOST2[1]
Total intake of antioxidants,[2] *mmol*	17.3 ± 9.4	17.6 ± 10.6
	% of total antioxidant intake	
Cereals	5	4
Fruits and berries	11	7
Fruit juices	2	2
Vegetables	2	2
Coffee	64	68
Tea	8	9
Wine	5	2
Other foods	5	8

[1] The NORKOST2 used an extensive, self-administered FFQ developed by the National Nutrition Council (33).

[2] Values are means ± SD, n = 61 (weighed-record study) or 2672 (NORKOST2).

Adherence to Mediterranean diet and intake of antioxidants influence spontaneous conversion of atrial fibrillation☆

October 16 - 18
14th EDITION 2015

4th quartile (Q4)	1.9 (1.58–2.81)
Antioxidants levels	
1st quartile (Q1)	0.33 (−0.19 to 1.6)
2nd quartile (Q2)	0.21 (−0.06 to 0.09)
3rd quartile (Q3)	1.0 (0.86–3.4)
4th quartile (Q4)	1.8 (1.56–2.99)
Caffeine intake	
1st quartile (Q1)	1.75 (1.23–2.6)
2nd quartile (Q2)	0.92 (0.26–1.38)
3rd quartile (Q3)	0.34 (0.12–1.01)
4th quartile (Q4)	0.1 (0.003–0.3)

Mattioli, 2013

Limitation of clinical studies

- the great majority of studies are observational
- the intake of coffee and caffeine come from self-assessment
- Modality of coffee preparation could influence the quantity of caffeine
- relationship between coffee and meals can influence bioavailability of caffeine
- only symptomatic events are reported and analyzed

- Pts with previous episodes of AF reduced coffee consumption…. Do this mean that coffee acts as a trigger?

Not only coffee……

The amount of caffeine in different beverages:

Cola Soda

Energy drinks

Table I. Caffeine Content of Energy Drinks, Carbonated Sodas, and Other Beverages

Beverage	Serving Size (oz)	Caffeine (mg/serving)
Energy Drinks		
Red Devil®	8.4	41.8
SoBe® Adrenaline Rush	8.3	76.7
SoBe® No Fear	16	141.1
Hair of the Dog®	8.4	none detected
Red Celeste™	8.3	75.2
E Maxx™	8.4	73.6
Amp™	8.4	69.6
Red Bull® Sugarfree	8.3	64.7
Red Bull®	8.3	66.7
KMX™	8.4	33.3
Carbonated Sodas		
Coca-Cola® Classic	12	29.5
Diet Coke®	12	38.2
Diet Coke® with Lime	12	39.6
Caffeine Free Diet Coke®	12	none detected
Vanilla Coke®	12	29.5
Pepsi®	12	31.7
Diet Pepsi®	12	27.4
Mountain Dew®	12	45.4
Mountain Dew® Live Wire™	12	48.2
Dr Pepper®	12	36.0
Diet Dr Pepper®	12	33.8
Sierra Mist™	12	none detected
Celeste™ Cola	12	19.4
Sprite®	12	none detected
Seagram's® Ginger Ale	12	none detected
Barq's® Root Beer	12	18.0
Pibb®Xtra	12	34.6
A&W® Root Beer	12	none detected
7-UP®	12	none detected
Other Beverages		
Nestea® Cool Lemon Iced Tea	12	11.5
Lipton® Brisk Lemon Iced Tea	12	6.5
Yoohoo® Chocolate Drink	9	< 2.7
Starbucks Doubleshot™	6.5	105.7
Starbucks Frappuccino® Mocha	9.5	71.8
Starbucks Frappuccino® Vanilla	9.5	63.8
Velda Farms® Chocolate Milk	16	< 3.8

Caffeine in energy drinks

October 16 - 18
14th EDITION 2015

						
Sugar	Ingredients	Sugar-Free	39 grams	31 grams	27 grams	52 grams
Sodium	Ingredients	39 mg	140 mg	40 mg	180 mg	260 mg
Caffeine	Ingredients	150 mg	114 mg	160 mg	160 mg	260 mg
Niacin	Ingredients	10 mg	28 mg	20 mg	20 mg	not listed
Vitamin B-6	Vitamins	5 mg	7.2 mg	2 mg	2 mg	4 mg
Vitamin B-12	Vitamins	125 mcg	7.2 mcg	6 mcg	6 mcg	0.6 mcg
Vitamin C	Vitamins	50 mg	--	--	--	--
Vitamin E	Vitamins	12.5 IU	--	--	--	--
Ready to Drink	Additional Info	--	✓	✓	✓	✓
Antioxidants	Additional Info	✓	--	--	--	--
Different Flavors	Additional Info	--	--	✓	✓	--
No Crash	Additional Info	✓	--	--	--	--
Cost per serving	Additional Info	$1.15	$2.99	$1.25	$1.25	$2.50

Guarana

Paullinia cupana, P. sorbilis

also known as Brazilian cocoa and 'Zoom'

Guarana is the plant having the highest caffeine content in the world. It also contains theobromine and other substances having therapeutic properties. It is used in an increasing way in energy drinks, in slim and reinvigorating products.

Energy drinks and AF

•The International Society of Sports Nutrition published a position paper on the use of energy drinks on spots performance. They found that consuming an ED (containing approximately 2 mg·kgBM-1caffeine) 45 to 60 minutes prior to anaerobic/resistance exercise may improve upper- and lower- body total lifting volume, but has no effect on repeated high intensity sprint exercise, or on agility performance

•They also concluded that indiscriminant use of ED, especially if more than one serving per day is consumed, may lead to adverse events and harmful side effects mainly related to high dosage of caffeine

Energy drinks and AF

- Despite several alert from Scientific Societies, energy drinks are usually associated in marketing campaign by manifacturers to healthy activities and wellness and the great majority of younger considered it harmless

- More data are needed about the potential toxical effects of ED especially when associated with alcohol

Energy drinks and AF

- The introduction of high amounts of caffeine, about 1 gram per day, and the combination alcohol-EDs can alter both the central and peripheral nervous system. The increase of heart rate causing major side effects such as anxiety, mood changes, insomnia, tachycardia, hypertension, cardiac arrhythmias and gastrointestinal disorders. EDs and the co-consumption of alcohol have been associated with renal impairment that seem to be able to be traced primarily to the effects of taurine on the excretory system

Energy drinks and AF

In conclusion:

- Data on caffeine and coffee consumption and risk of AF are controversial due to many confounding factors

- Data on caffeine and ED consumption and risk of AF are derived from “case reports” suggesting that more studies are needed

- ED are considered harmless, are easy to get and their consumption is increasing among young people and the mix of ED and alcohol is becoming very popular.