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Effects of Energy Drinks on Children, Adolescents and Young Adults

Background

"Energy drinks" are beverages that contain caffeine, taurine, vitamins, herbal supplements and sugar or sweeteners and are marketed extensively stating to improve energy, weight loss, stamina, athletic performance and concentration. These are distinct from sports drinks and vitamin waters. Energy drinks are available in >140 countries (including Sri Lanka) and the market consists of children (<12 years old), adolescents (12–18 years old), and young adults (19 –25 years old).

Caffeine is the main active ingredient in energy drinks; many of them contain 70 to 80 mg per 8-oz serving (3 times the concentration in cola drinks). Caffeine content can be nearly 5 times greater than that in 8 oz of cola drinks when packaged as "energy shots" (0.8–3 oz) or as 16-oz drinks. Energy drinks often contain additional amounts of caffeine through additives, including guarana, kola nut, yerbamate and cocoa. Guarana (Paullinia cupana) is a plant that contains caffeine, theobromine (a chronotrope), and theophylline (an inotrope). Each gram of guarana can contain 40 to 80 mg of caffeine and it has a potentially longer half life because of interactions with other plant compounds. Manufacturers are not required to list the caffeine content contributed by these ingredients, and therefore, the actual caffeine dose in a single serving may exceed the amount mentioned in the product label.

Effects of ingredients in Energy Drinks

Caffeine-Caffeine, the most commonly used psychoactive drug worldwide, may be the only psychoactive drug legally available over-the-counter to children. Caffeine is an adenosine and benzodiazepine receptor antagonist, phosphodiesterase inhibitor and central nervous system stimulant. In healthy adults, a caffeine intake of<400 mg/ day is considered safe; acute clinical toxicity begins at 1 g, and 5 to 10 g can be lethal.

Caffeine causes coronary and cerebral vasoconstriction, relaxes smooth muscles, stimulates skeletal muscle, has cardiac chronotropic and inotropic effects, reduces insulin sensitivity and modulates gene expression in premature neonates.

Large amounts of caffeine increase urine flow and sweat excretion and alter blood electrolyte levels. Although caffeine is a mild diuretic, consumption of < 500mg/day does not cause dehydration or chronic water imbalance.

Caffeine is a ventilatory stimulant with anti-inflammatory and broncho-protective effects. Caffeine has been linked to dyspnoea on exertion from central and peripheral chemoreceptor stimulation. In addition, increased breathing work may divert blood flow away from locomotor muscles and negate any ergogenic advantage. Cardiovascular effects of caffeine include decreased heart rate from stimulation of medullary vagal nuclei and increased blood pressure.

Adults who consume low-to-moderate amounts of caffeine (1–3 mg/kg or 12.5–100 mg/day) have improved exercise endurance, cognition, reaction time and mood with sleep deprivation. However, these studies typically involve habitual caffeine consumers and reflect withdrawal-symptom reversal.

Consuming 4 to 12 mg/kg of caffeine has been associated with undesirable symptoms, including anxiety and jitteriness. Headache and fatigue, common withdrawal symptoms can occur after short-term, high-dose use. Caffeine intoxication is a clinical syndrome of nervousness, irritability, anxiety, insomnia, tremor, tachycardia, palpitations and upset stomach. Additional adverse effects include vomiting and abdominal pain, hypokalemia, hallucinations, increased intracranial pressure, cerebral oedema, stroke, paralysis, rhabdomyolysis, altered consciousness, rigidity, seizures, arrhythmias and death.

Caffeine intakes of>300 mg/day have been associated with miscarriage and low birth weight. Long-term caffeine consumption relates to a lower risk of Parkinson disease and a slower age-related cognitive decline.

Effects of Caffeine in Children and Adolescents

Adolescent and child caffeine consumption should not exceed 100 mg/day and 2.5 mg/kg per day, respectively. For example, 8 oz of a popular energy drink provides 77 mg of caffeine or1.1mg/kg for a70 -kg male or 2.2 mg/kg for a 35-kg preteen.

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Whether the effects of caffeine in adults can be generalized to children remains unclear. In a study of 26 boys and 26 men, the same dose of caffeine affected blood pressure similarly, but heart rate was significantly lowered in boys, whereas there was no effect on heart rate in men. Boys also exhibited increased motor activity and speech rates and decreased reaction times than did men. Caffeine can improve attention, but it also increases blood pressure and sleep disturbances in children.

After cessation of caffeine in children who habitually consume caffeine, attention decreases and reaction time increases transiently and reported withdrawal-symptom (headache and dulled cognition) and these effects were reversed with a caffeine dose. Children who did not habitually consume caffeine reported no marked changes in cognitive performance with a caffeine dose.

Caffeine may affect future food and beverage preferences by acting on the developing child's brain reward-and addiction centre; this effect may be gender specific. A study has revealed that boys found caffeinated soda more reinforcing than girls, regardless of usual caffeine consumption.

Effects of Other Ingredients in Energy Drinks and synergistic actions-Popular media and case reports have associated adverse events with energy-drink consumption. Yet, few studies have examined the physiologic effects of individual ingredients or potential synergistic effects; furthermore, results of experimental studies have been inconclusive and occasionally contradictory.

Some studies of adults revealed improved mental alertness, reaction times and concentration with energy drinks. Others revealed no improvement compared with caffeine or glucose alone. One study compared a complete energy drink mixture to the glucose fraction, the caffeine fraction and the herbal fraction. Although individual components did not enhance cognition, combined ingredients did. Caffeine and taurine may synergistically decrease heart rate initially. Another study reported an average increase in systolic blood pressure of 9 to 10 mm Hg and an average increased heart rate of 5 to 7 beats per minute 4 hours after consumption. Caffeine and taurine containing beverages increased left atrial contractility, thereby increasing left ventricular end-diastolic volume and stroke volume. The caffeine-only group showed no changes in left ventricular function. Taurine may cause this increase in stroke volume by suppressing sympathetic nervous stimulation and influencing calcium stores in cardiac muscle. Results of human and animal studies have suggested that long-term taurine exposure may cause hypoglycemia but a decreased risk of coronary heart disease. Haematological and vascular effects include increased platelet aggregation and increased mean arterial pressure and a decrease in endothelial function. Guarana has antiplatelet aggregation properties in vitro, but how it functions physiologically in energy drinks is unknown.

A study of 20 healthy subjects revealed that caffeinated espresso had no effects on endothelial function. Caffeine alone did not affect platelet function. Ginseng, a common ingredient in many energy drinks, may lower blood glucose levels, but its actions in energy drinks are unclear.

Potential problems of Energy Drinks among children and adolescents

Cardiovascular Effects of Energy Drinks on Children and Adolescents-High doses of caffeine may exacerbate cardiac conditions for which stimulants are contraindicated. Of particular concern are ion channelopathies and hypertrophic cardiomyopathy (because of the risk of hypertension, syncope, arrhythmias and sudden death) and they are the most prevalent genetic cardiomyopathies in children and young adults.

Effects of Energy Drinks on children and adolescents with ADHD-Children with ADHD take stimulants for ADHD, which may increase heart rate and blood pressure. They have higher rates of substance abuse, including caffeine abuse, which blocks the A2A adenosine receptors and thereby enhances the dopamine effect at the D2 dopamine receptor, similarly to the way guanfacine works for ADHD. As with the ADHD stimulants, combined effects of energy drinks and antidepressants are unknown. For the subpopulation with methylphenidate cardiotoxicity, energy-drink use may increase cardiac events.

Energy-Drink Use in Children and Adolescents with Eating Disorders-Children and adolescents with eating disorders, especially anorexia nervosa, may regularly consume high amounts of caffeine to counter caloric restriction associated fatigue, suppress appetite and to produce looser stools and some diuresis. The risk of cardiac dysrhythmias and intracardiac conduction abnormalities from high-caffeine energy drinks in children with eating disorders at higher risk for cardiac related morbidity/mortality and electrolyte abnormalities is disconcerting.

Effects on Caloric Intake and Diabetes-Because obesity is epidemic, caloric increases from energy-drink consumption become important. Additional calories may increase blood pressure, blood glucose levels, BMI, calcium deficiency, dental problems, depression and low self-esteem. Sugar and caffeine may also synergistically increase post prandial hyperglycemia, which is of concern for children with diabetes.

Effects on Bone Mineralization-Early adolescence is the time of maximal calcium deposition in bone and caffeine interferes with intestinal calcium absorption. It remains controversial whether caffeine itself has the most marked effect on bone acquisition during adolescence or whether replacement of milk in take by caffeineated beverages is the leading contributor.

Conclusions

- Energy drinks have no therapeutic benefits and both known and unknown pharmacology of various ingredients, combined with reports of toxicity, suggest that these drinks may put some children at risk for serious adverse health effects.
- Typically, energy drinks contain high levels of caffeine, taurine and guarana, which have stimulant properties and cardiac and haematologic activity. But manufacturers claim that energy drinks are nutritional supplements, which shield them from the caffeine limits imposed on sodas and the safety testing and labelling required of pharmaceuticals.
- Other ingredients vary, are understudied and are not regulated.
- Youth-aimed marketing and risk-taking adolescent developmental tendencies combine to increase overdose potential.
- High consumption is suggested by self-report surveys but is under documented in children Interactions between compounds, additive and dose-dependent effects, long-term consequences and dangers associated with risky behaviour in children remain to be determined.

Source
Health Effects of Energy Drinks on Children, Adolescents, and Young Adults,

available from

http://www.ncbi.nlm.nih.gov/pmc/articles/PMC3065144/

Compiled by Dr. Madhava Gunasekera of the Epidemiology Unit

Table 1: Vaccine-preventable Diseases & AFP

27th April – 03rd May 2013 (18th Week)

Disease	No. of Cases by Province									Number of cases during current week in 2013	Number of cases during same week in 2012	Total number of cases to date in 2013	Total number of cases to date in 2012	Difference between the number of cases to date in 2013 & 2012
	W	C	S	N	E	NW	NC	U	Sab					
Acute Flaccid Paralysis	01	02	00	00	00	00	00	00	00	03	00	24	29	- 17.2 %
Diphtheria	00	00	00	00	00	00	00	00	00	-	-	-	-	-
Measles	09	16	02	00	00	03	00	00	00	30	00	285	20	+ 1325.0 %
Tetanus	00	00	00	00	00	00	00	00	00	00	00	07	04	+ 75.0 %
Whooping Cough	00	00	00	00	00	01	00	00	00	01	00	28	32	- 12.5 %
Tuberculosis	43	00	05	07	17	00	00	08	02	82	10	2816	3130	- 10.0 %

Table 2: Newly Introduced Notifiable Disease

27th April – 03rd May 2013 (18th Week)

Disease	No. of Cases by Province									Number of cases during current week in 2013	Number of cases during same week in 2012	Total number of cases to date in 2013	Total number of cases to date in 2012	Difference between the number of cases to date in 2013 & 2012
	W	C	S	N	E	NW	NC	U	Sab					
Chickenpox	12	07	13	07	05	08	05	02	08	67	14	1625	1908	- 14.8 %
Meningitis	05 KL=1 GM=3 CB=1	00	04 GL=2 MT=1 HB=1	04 JF=4	00	01 KR=1	01 PO=1	00	02 KG=2	17	02	392	226	+ 73.4 %
Mumps	02	02	03	03	01	05	04	00	04	24	18	579	1804	- 67.2 %
Leishmaniasis	00	01 KD=1	00	00	00	01 KG=1	04 AP=1 PO=3	00	00	06	00	384	233	+ 64.8 %

Key to Table 1 & 2

Provinces: **W**: Western, **C**: Central, **S**: Southern, **N**: North, **E**: East, **NC**: North Central, **NW**: North Western, **U**: Uva, **Sab**: Sabaragamuwa.

DPDHS Divisions: **CB**: Colombo, **GM**: Gampaha, **KL**: Kalutara, **KD**: Kandy, **ML**: Matale, **NE**: Nuwara Eliya, **GL**: Galle, **HB**: Hambantota, **MT**: Matara, **JF**: Jaffna, **KN**: Killinochchi, **MN**: Mannar, **VA**: Vavuniya, **MU**: Mullaitivu, **BT**: Batticaloa, **AM**: Ampara, **TR**: Trincomalee, **KM**: Kalmunai, **KR**: Kurunegala, **PU**: Puttalam, **AP**: Anuradhapura, **PO**: Polonnaruwa, **BD**: Badulla, **MO**: Moneragala, **RP**: Ratnapura, **KG**: Kegalle.

Data Sources:

Weekly Return of Communicable Diseases: Diphtheria, Measles, Tetanus, Whooping Cough, Chickenpox, Meningitis, Mumps.

Special Surveillance: Acute Flaccid Paralysis.

Leishmaniasis is notifiable only after the General Circular No: 02/102/2008 issued on 23 September 2008. .

Dengue Prevention and Control Health Messages

Thoroughly clean the water collecting tanks bird baths, vases and other utensils once a week to prevent dengue mosquito breeding.

Table 4: Selected notifiable diseases reported by Medical Officers of Health

27th April – 03rd May 2013 (18th Week)

DPDHS Division	Dengue Fever / DHF*		Dysentery		Encephalitis		Enteric Fever		Food Poisoning		Leptospirosis		Typhus Fever		Viral Hepatitis		Human Rabies		Returns Received
	A	B	A	B	A	B	A	B	A	B	A	B	A	B	A	B	A	B	%
Colombo	112	3033	1	56	0	10	0	44	0	13	2	103	0	5	0	30	0	0	**77**
Gampaha	56	1284	3	48	0	7	1	15	0	10	3	120	0	6	2	84	0	0	**73**
Kalutara	29	609	1	52	0	8	3	35	2	9	4	177	0	1	0	6	0	0	**92**
Kandy	22	633	5	38	0	5	0	7	0	6	1	29	3	52	0	47	0	0	**91**
Matale	5	169	0	33	0	1	0	2	0	0	1	20	0	1	0	16	0	0	**77**
NuwaraEliya	4	89	3	47	0	2	0	3	0	2	1	10	1	34	0	7	0	0	**77**
Galle	12	267	1	32	0	8	0	1	0	4	2	107	1	22	0	6	0	1	**74**
Hambantota	4	136	3	21	0	2	0	7	0	9	0	111	0	34	3	60	0	0	**67**
Matara	2	210	3	23	0	8	0	8	0	5	8	93	0	31	8	90	0	1	**94**
Jaffna	20	386	2	76	0	4	9	194	0	7	3	4	7	289	1	9	0	0	**92**
Kilinochchi	0	22	0	12	0	0	0	5	0	1	0	9	2	14	0	0	0	0	**50**
Mannar	2	46	1	17	0	1	1	44	0	11	0	9	0	13	0	0	0	0	**40**
Vavuniya	0	33	0	20	0	9	0	4	0	8	0	29	0	2	0	0	0	1	**50**
Mullaitivu	1	55	0	4	0	1	0	4	0	2	0	10	0	4	0	0	0	2	**80**
Batticaloa	11	287	7	66	0	3	0	0	2	5	3	19	0	2	0	4	0	0	**86**
Ampara	0	51	0	39	0	0	0	2	0	0	0	7	0	0	0	1	0	0	**29**
Trincomalee	4	119	1	25	0	1	0	2	0	1	0	46	0	4	0	2	0	1	**58**
Kurunegala	31	1610	2	79	2	19	0	20	0	3	7	138	0	14	1	26	0	1	**73**
Puttalam	7	477	1	23	0	4	0	5	3	34	0	12	0	9	0	1	0	0	**85**
Anuradhapu	11	271	1	29	0	11	0	1	0	2	9	208	0	10	0	11	0	0	**63**
Polonnaruw	4	166	1	34	0	0	0	8	0	0	5	96	0	1	0	17	0	1	**43**
Badulla	11	176	8	50	0	1	1	6	0	1	0	15	1	27	1	20	0	0	**65**
Monaragala	5	107	0	34	0	3	0	6	0	18	8	151	1	22	2	32	0	1	**64**
Ratnapura	28	721	4	160	2	77	0	17	0	12	5	179	0	15	2	112	0	1	**72**
Kegalle	15	423	0	22	0	10	0	6	0	3	5	55	1	39	4	96	0	0	**91**
Kalmune	2	413	0	36	0	1	0	3	0	17	0	4	0	2	0	4	0	0	**38**
SRI LANKA	**398**	**11739**	**48**	**1076**	**04**	**196**	**15**	**449**	**07**	**183**	**67**	**1761**	**17**	**653**	**24**	**681**	**00**	**10**	**73**

Source: Weekly Returns of Communicable Diseases WRCD).
***Dengue Fever / DHF** refers to Dengue Fever / Dengue Haemorrhagic Fever.
****Timely** refers to returns received on or before 03rd May, 2013 Total number of reporting units 336. Number of reporting units data provided for the current week: 245
A = Cases reported during the current week. **B** = Cumulative cases for the year.

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Comments and contributions for publication in the WER Sri Lanka are welcome. However, the editor reserves the right to accept or reject items for publication. All correspondence should be mailed to The Editor, WER Sri Lanka, Epidemiological Unit, P.O. Box 1567, Colombo or sent by E-mail to **chepid@sltnet.lk.**

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