

Development of a tool to assess the caffeine intake among teenagers and young adults

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Summary

For the first time, a tool (questionnaire with calculation programme) to assess the caffeine intake among adolescents and young adults has been developed and validated. It has proved to be applicable in surveys of more than 200 students. The average workday caffeine intake was between 105 mg and 130 mg. Coffee was the major source.

Keywords: caffeine, caffeine intake, energy drinks, survey tool, coffee beverages

Introduction

Many foods and beverages contain caffeine. Caffeine is consumed because it may stimulate the central nervous system, which contributes to an increased alertness and attention. Sensitive adults and children in particular may suffer from various side effects due to caffeine, e.g., restlessness, dizziness, heart and pulse palpitation, vomiting and sleep disturbances [1, 2].

Currently, the following recommendations for caffeine intake are communicated in Germany: For adults there is no objection to moderate consumption of no more than

350 mg caffeine/day [3]. Pregnant women should not consume more than 300 mg of caffeine/day [1, 4]. Caffeinated beverages should be completely avoided in a child's diet [5]. Recommendations on acceptable levels for adolescents are not provided. Health Canada has recommended a maximum caffeine intake level of 2.5 mg/kg of body weight/day for children aged up to 12 years [6].

The fastest growing consumer group of caffeine in the last 30 years is children and adolescents [2]. During this time, coffee, caffeinated soft drinks and energy drinks have become increasingly popular. Adolescents are the main target group for many ready-to-drink coffee beverages and energy drinks. The consumption of energy drinks significantly increased in 2012 [7].

Previous research into caffeine intake [8–10] has demonstrated that, in spite of the dynamic market growth, there is little data on caffeine intake among children and adolescents. Only the European

Food Safety Authority (EFSA) has recently investigated the consumption of energy drinks in Europe and included the overall caffeine intake of 3 to 10 year-old children and 10 to 18 year-old adolescents [11].

Question

Our objective was to develop a self-completion questionnaire to assess caffeine intake in a flexible survey period that could be understood by adolescents and young adults [12] and to test it on students [13].

Methodology

Development of the survey tool

Initially, the tools and methods previously used for surveys of the overall caffeine intake among children, adolescents and young adults were reviewed [12, 13].

In spring 2012, the range of caffeinated foods and beverages and their usual portion sizes were researched for the survey tool. From this data, food groups were formed which had comparable caffeine content and were logically related in terms of consumer perception. Each group was assigned with everyday descriptions and average caffeine intakes as previously analysed at the CVUA Karlsruhe (Chemisches und Veterinäruntersuchungsamt [Chemical and Veterinary Investigation Office]) [8, 9, 10, 14, 15]. Caffeinated sports nutrition products, dietary supplements and

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Drink and food groups in everyday language: drinks/foods included	Portion sizes [mL]		Determination of caffeine content (in prepared drink)		
	large	small	number of measurements	mean [mg/L]	median [mg/L]
Coffee Coffee as a drink with caffeine (all preparation methods, including from extract) with or without milk	250	150	133	242	270
Decaffeinated coffee Coffee as a decaffeinated drink (all preparation methods, including from extract), with or without milk	250	150	19	11	2
Espresso Roasted coffee, coffee extract	-	60	21	299	148
Black, green, white, mate tea All infusions of black, green, white and mate tea	250	150	107	350	351
Cocoa drink Cocoa drinks pre-prepared or made from drink powder containing cocoa, cocoa powder or chocolate powder	250	150	123	31	27
Iced tea, drinks with tea extract All alcohol-free drinks (including from drink formulas and drink powders) with tea, tea extracts or tea-like products (e.g. lemon tea drink)	250	150	72	50	44
Cola, mixed cola beverages, e.g. cola with orange or cola with lemonade (not pure orangeade and lemonade) All caffeinated sodas and lemonades and also caffeinated soft drinks with added milk products	250	150	231	100	100
Energy Drink All caffeinated soft drinks, which in addition to the caffeine content limited to a maximum of 320 mg/L also contain one or several ingredients such as taurine, glucuronolactone and inositol	500	250	188	290	295
Energy drink All energy drinks in concentrated form	-	60	5	1300	1260
Alcopops with energy drink, cola or coffee All mixed drinks with alcohol and caffeine (e.g. various cocktails, beer with caffeinated lemonade, rum mixed with cola, etc.)	250	150	22	140	100
Chocolate All types of chocolates, pralines, chocolate bars		20 g	169	529 [mg/kg]	453 [mg/kg]

Tab. 1: Drinks and foods with portion sizes and caffeine content included in the survey tool



We would like to know how much caffeine you consume

Indicate in the table, how much you drank yesterday.

Put a line in the box for every cup/glass.

If you didn't drink the item, leave the box empty.

Portion sizes

Small cup 150 mL	Large cup 250 mL	Small glass 150 mL	Large glass 250 mL	Energy drink 250 mL can	Energy drink 500 mL can	Energy Shot 60 mL can	Espresso cup 60 mL	Chocolate bar 20g

For example, like this:

	Coffee	Cola, fizzy soft drink	Chocolate
Breakfast			

	Coffee	Decaffeinated coffee	Espresso	Black, green, white, mate tea	Cocoa drink	Iced tea, drinks with tea extract	Cola, mixed cola beverages (but not orangeade and lemonade)	Energy drink	Energy shot	Alcopops with energy drink, cola or coffee	Chocolate
Breakfast											
Between breakfast and lunch											
lunch											
Between lunch and dinner											
Dinner											
After dinner											

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Name: _____ Age: _____ Gender: female male
 Height: _____ Weight: _____ Date: _____

Abb. 1: Foodstuffs with portion sizes and caffeine content incorporated in the survey tool

medicinal products (e.g., powdered products for professional athletes or caffeine capsules) were excluded.

By means of several focus group discussions [for methodology see, e.g., 16, 17] with a total of 88 children, adolescents and young adults of both genders (aged 11–23) from different school types, the comprehensibility of terminology and portion sizes and the record, recall and food frequency questions as well as

the layout of the questionnaire were tested, evaluated and gradually improved; caffeine intake was also surveyed at the same time.

◆ Table 1 shows the foods and beverages used in the final survey tool with portion sizes and caffeine content. ◆ Figure 1 shows the caffeine questionnaire form with the 24-hour recall questions for self-completion. A programme based on Excel Version 14.0 (Microsoft Cor-

poration, Redmond, USA) was created to calculate the caffeine intake in mg/day and in mg/kg of body weight.

Validation of the survey tool

A 24-hour recall of caffeine intake on workdays was surveyed among students in the Life Sciences Faculty at the Albstadt-Sigmaringen University in 2013 during classes in ▶

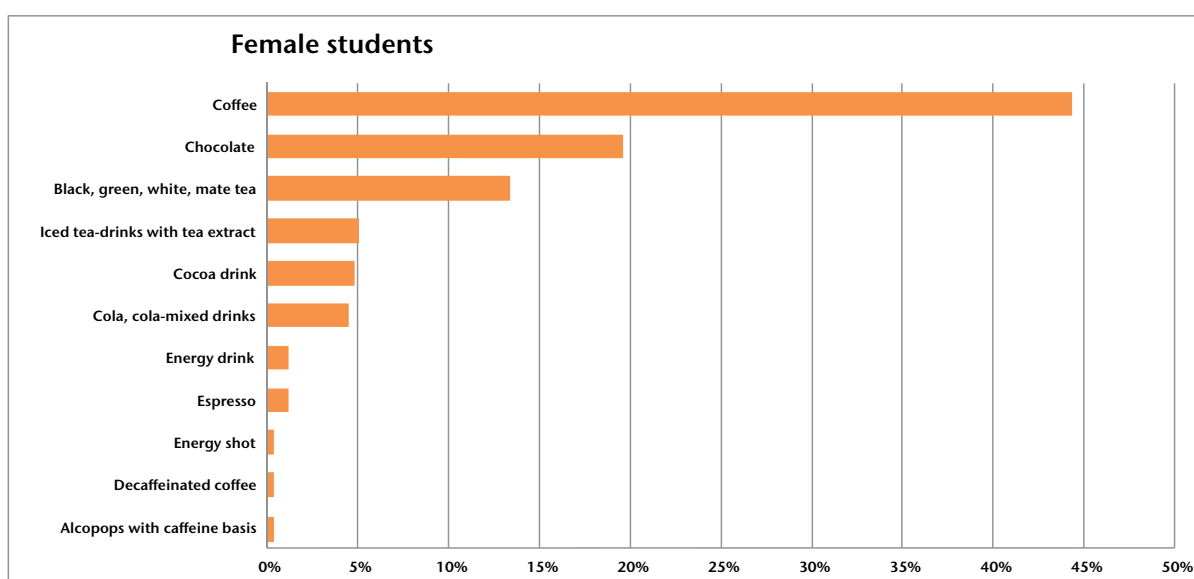
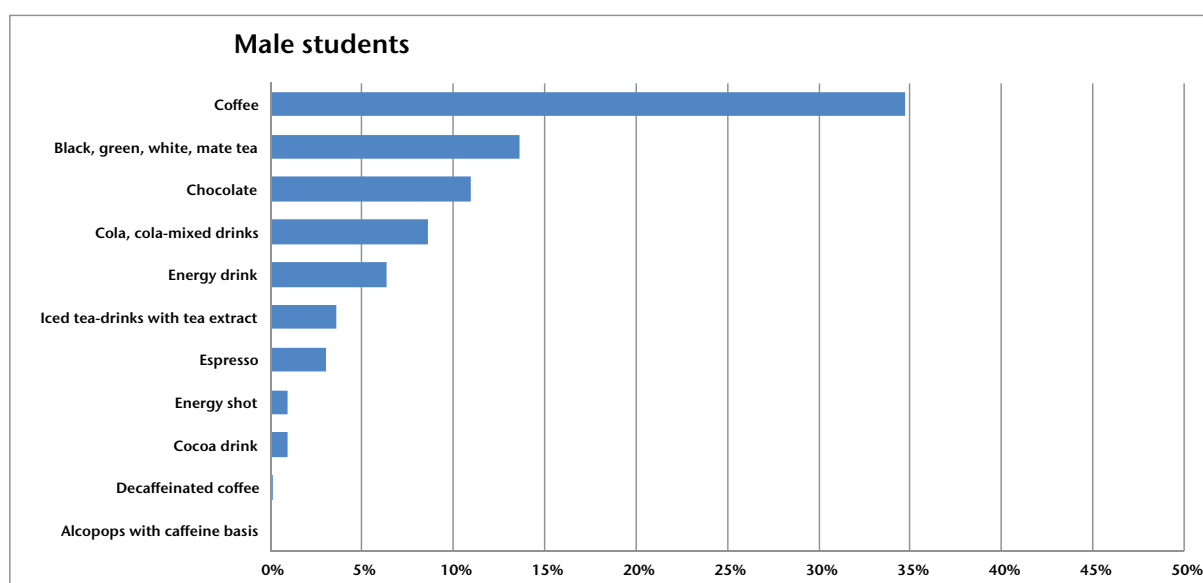


Abb. 2: Sources of caffeine intake of female students (n = 126) and male students (n = 55), mean from both survey periods, only workdays

Gender	Mean	SD	Median	Min	Max	Persons without caffeine intake [%]
Daily caffeine intake in mg/d						
Lecture time ¹						
f	105	108	73	0	589	5
m	119	117	87	0	517	15
Exam preparation time ¹						
f	114	95	88	0	419	7
m	130	142	81	0	645	16
Daily caffeine intake in mg/kg bodyweight						
Lecture time ¹						
f	1.8	2.0	1.2	0	11.1	5
m	1.5	1.4	1.1	0	5.6	15
Exam preparation time ¹						
f	1.9	1.7	1.5	0	8.5	7
m	1.7	1.9	1.0	0	8.6	16

Tab. 2: Daily caffeine intake in mg and in mg/kg bodyweight of 126 female students and 55 male students in the normal lecture time vs. exam preparation time in summer semester 2013 and number of students who consume no caffeine m = male; Min = minimum value; Max = maximum value; SD = standard deviation; f = female

¹ The trend towards a higher intake in exam preparation time vs. normal lecture time is statistically not significant (ANOVAfemale students, p > 0.05; ANOVAmale students, p > 0.05)

calendar week 22 (regular lecture week) and 26 (lecture week shortly before the examination period) by means of the above-mentioned tool. All present students participated voluntarily (week 22: 251 and week 26: 241 of a total of 486 registered students).

This article reports the results from a sub-group of 126 female students (average age: 22 ± 2 years) and 55 male students (average age: 24 ± 2 years) who participated in both surveys, but not the intake data from the other students or the adolescents in the focus groups. Individual caffeine intakes were calculated

using the above-mentioned Excel programme; the data analysis was carried out with Minitab (Version 16.0).

Results

The consumption of caffeinated foods and beverages during the previous 24 hours could be reported independently and without further explanations by interviewers by both the adolescents and young adults (from approx. 12 years old) in the focus groups and by students in the validation survey. ♦ Table 2

shows the average caffeine intake of students on workdays in both survey periods. ♦ Figure 2 shows the sources of caffeine intake on workdays.

Discussion

There is now a tool available to survey caffeine intake among adolescents and young adults, which is based on existing food and beverage ranges and an up-to-date analysis of caffeine content. A high caffeine intake is definitely regarded as problematic for children and adolescents [2]. The focus groups and validation survey, in line with the literature

[e.g. 8–11], demonstrated that there are “heavy user groups”, as underlined by the maximum caffeine intake of students in the magnitude of 419–645 mg on workdays.

In general, the average caffeine intake among students is 105–130 mg/workday, a level at which the substance can be assumed to already exhibit a small pharmacological effect [18]. However, this still lies significantly below the intake of 300 mg/day, which is considered critical for pregnant women.

A more rigorous assessment on the topic of caffeine intake among children, adolescents and young adults would be desirable at various levels. In particular, a recommendation for the maximum daily intake for all consumer groups should be developed. Our survey tool will be made available on request. As previously shown in a study based on the Nationale Verzehrsstudie II (NVS II [National Nutrition Survey II]) [10], coffee was also the most important caffeine source in the above-mentioned, non-representative collective. Contrary to popular belief, energy drinks seem to be of minor importance – except for some heavy users.

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Conflict of Interest

The authors declare no conflict of interest according to the guidelines of the International Committee of Medical Journal Editors.

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Authors' addition: In January 2014, the study “Event-Related Survey of High Consumers of Energy Drinks” was published in German by the Federal Institute for Risk Assessment (BfR). It investigated, among other aspects, the caffeine intake during the last 24 hours using questionnaires including lists of beverages. Settings were festivals, sporting events, LAN parties and clubs (http://www.bfr.bund.de/en/press_information/2014/05/people_consuming_high_amounts_of_energy_drinks_ignore_the_pick_me_up_risk-189287.html).

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