

Energy drink consumption and the relation to socio-demographic factors and health behaviour among young adults in Denmark. A population-based study

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Background: The objective of this study is to estimate the prevalence of energy drink consumption and examine the associations of socio-demographic factors and health behaviour with energy drink consumption among young adults in Denmark. **Methods:** The study is based on a public health survey from 2010 ($n=3923$). Multiple logistic regression analyses were used to analyse the association between weekly consumption of energy drink and the potential explanatory factors of interest. **Results:** In total, 15.8 % of the young adults drink energy drinks on a weekly basis. Men have higher odds of weekly energy drink consumption than women. The study also shows that young age, being employed and having a low educational level are associated with weekly energy drink consumption. According to health behaviour, daily smoking, high amounts of alcohol consumption, alcoholic binge drinking and being overweight are associated with weekly energy drink consumption. **Conclusion:** Compared with other European countries the prevalence of energy drink consumption is relatively low in Denmark. In Denmark energy drink consumption is typically a male phenomenon and there is a clear social gradient in the prevalence of energy drink consumption where the intake is far more common among people with low levels of education than among people with higher levels of education. This study also shows that there is some kind of 'add on' effect of energy drinks, meaning that people who also use other stimulants—such as alcohol and cigarettes—are more inclined to consume energy drinks.

Introduction

Energy drinks are beverages that are characterized by the addition of various energy-enhancing ingredients and are marketed to boost energy, decrease feelings of tiredness and enhance mental alertness and concentration.¹ The most common active substance in energy drinks is caffeine, which is often combined with taurine, D-glucurono- γ -lactone, guaranà, maltodextrin, ginseng, carnitine, creatine and ginkgo biloba. Other common ingredients are vitamins and artificial or natural sweeteners.^{1,2}

The diffusion of energy drinks in Denmark started in 1987 with the Austrian launch of the Red Bull, which quickly gained popularity in many European countries. The commercial success of Red Bull sparked the proliferation of similar products in the market.³ In Denmark, energy drinks constitute a relatively new product category in the wider soft drinks market. Red Bull was banned in Denmark until 2009 due to the unknown effect of taurine and the high amount of caffeine. In 2009, the Danish Veterinary and Food Administration approved an increase of the caffeine level in energy drinks and legalized taurine as a supplement in beverages. Since then the popularity of energy drinks has grown exponentially with sales that have doubled between 2010 and 2012.⁴ The rapid expansion of energy drink consumption has been one of the most notable trends in the soft drinks market of many countries³ and health authorities have expressed concern regarding the potential health effects of energy drink consumption. Owing to this concern, the Ministry of Food, Agriculture and Fisheries in Denmark ultimo 2011, implemented a national regulation on stronger caffeine warnings on food and beverages containing caffeine. Under the new Danish regulation, beverages with a high

caffeine content must be labelled: 'High caffeine content. Not recommended for children, pregnant women, and breast-feeding women'. This regulation corresponds to a future EU regulation that will be applied ultimo 2014.

Some studies have suggested that people drink energy drinks for a variety of reasons: to compensate for insufficient sleep, to boost energy, to concentrate while studying, while driving for long periods, drinking with alcohol while partying to improve taste of alcoholic drinks or to treat hangovers.⁵ Unfortunately, soft drinks such as energy drinks are associated with adverse health consequences, such as obesity,^{6,7} type 2 diabetes,⁸ increased risk for cardiovascular diseases⁹ and dental erosion or caries.^{10,11} Moreover, research has shown that due to the high amount of caffeine, high consumption of energy drinks is associated with insomnia, nervousness, headache, nausea, spontaneous abortion, tachycardia, increased platelet aggregation and decreased endothelial function.¹² In addition, high amounts of caffeine have the potential to interact with certain drugs and these interactions can change drug metabolism and cause side effects.^{13–17}

A small but growing number of researchers have examined the physiological and psychological impacts of these beverages. However, studies on what characterizes energy drink consumers are scarce and most of the studies on this topic are limited to include US college/undergraduate students and/or relatively small study populations.^{5,18–25} Moreover, it seems relevant to investigate energy drink consumption in association with major health-related risk factors (e.g. smoking, drinking, physical activity and dietary habits) because understanding this relationship is important for the design of public health interventions.

The objective of this study is to estimate the prevalence of energy drink consumption and examine the associations with

socio-demographic factors and health behaviour using a large population-based sample of young adults (age 16–24 years) in Denmark.

Methods

Data

This study is based on young adults in the age of 16–24 years who participated in a public health survey called 'How Are You?'. Denmark has ~5.5 million inhabitants and is administratively divided into five regions. This study is based on data from the Central Denmark Region. In all, 7042 young adults were invited to participate in the survey. Selected individuals received a letter of introduction that briefly described the purpose of the survey and the selected individuals were invited to fill out the enclosed paper questionnaire. Data were collected from February to April 2010. A procedure with three postal reminders was used.²⁶ The total response rate was 56%.

Statistical analysis

Every person living in Denmark has a unique identification 10-digit central personal registry number (CPR number). The sample was drawn from the Danish Civil Registration System using the CPR number as a key. Using the Danish Civil Registration System both respondents and non-respondents in the survey can be linked to central registers using the CPR numbers. Thereby, it was possible to calibrate weights that accounted for differences in selection probabilities and differences in response rates for different subgroups using a model-based calibration approach.^{26,27}

Two multivariable logistic regression tables were created. The first table shows the association between weekly energy drink consumption and socio-demographic factors (gender, age, employment status, educational level and ethnic background). In the adjusted analysis each socio-demographic factor was adjusted for the four other factors. For instance, gender differences were adjusted for age, employment status, educational level and ethnic background.

The second table shows the association between weekly energy drink consumption and health behaviour [smoking status, alcoholic binge drinking, high-risk alcohol consumption, leisure time physical activity, dietary habits and body mass index (BMI)]. In the adjusted analysis each health behaviour factor was adjusted for gender, age, employment status, educational level and ethnic background. The results are presented as percentages and unadjusted/adjusted odds ratios (ORs) and were tested at a 5% significance level. Statistical analyses were performed using STATA statistical software version 12.1.

Outcome variable

The outcome measure, frequency of energy drink consumption, was based on responses to this single item question: 'How often do you drink energy drinks (Red Bull, Cult, Burn, etc.)?' The examples of energy drink stated in the question (Red Bull, Cult and Burn) represent three of the most popular brands on the Danish market. No other kinds of energy drinks were mentioned. The possible responses to the question were: More than once a day; 5–7 times per week; 3–4 times per week; 1–2 times per week; rarely/never. In Denmark, 1 l of energy drink typically contains 320 mg of caffeine, which is about one-third of the amount in regular coffee.

Explanatory variables

To estimate the predictive value of socio-demographic factors, we included five variables: Gender, age, employment status, educational level and ethnic background. Employment status was collapsed into three categories [i.e. (i) employed, (ii) students and (iii) out of the

workforce]. The last category includes people who claim not to have a job and who are not enrolled in education. Using the Danish version of the International Standard classification of Education (ISCED) from Statistic Denmark, respondents were categorized into three groups of educational level: 'Low', 'medium' and 'high education' level. Students were categorized in accordance with the expected graduation level. Information of ethnic background ('Danish' or 'not Danish') derived from the Danish Civil Registration System. A person was defined as Danish if he or she has a Danish citizenship or if at least one of the parents is a Danish citizen.

To estimate the predictive value of health behaviour, six variables were included: smoking, high-risk alcohol consumption, alcoholic binge drinking, dietary habits, physical activity and BMI. In relation to physical activity, every person was asked: 'If we look back at the past year, what would you say best describes your leisure activities?' The responses were categorized into four groups [(i) vigorous, (ii) moderate, (iii) light and (iv) sedentary]. To assess binge drinking respondents were asked how often they consume five alcoholic drinks or more at one time. Respondents were categorized into two groups 'every day'/'weekly' vs. 'seldom'/'never'. Further, respondents were asked how many drinks per week they normally drink. High-risk alcohol consumption was categorized in accordance with the Danish Health and Medicine Authority's recommendations, that is, more than 21 drinks weekly for men and 14 drinks for women. People were asked to report smoking status and two groups were defined: 'current smoker' (daily or occasional) and 'never smoker'/'former smoker'. To measure dietary habits a score system was used. The measure is based on 30 different questions regarding intake of fruit, vegetables, fish and fat. Responses to these questions were summarized into categories of 'healthy diet', 'medium healthy diet' and 'unhealthy diet'. Finally, self-reported height and weight were used to calculate BMI and three BMI groups were defined: (i) BMI <25 (Underweight/normal weight), (ii) BMI 25–30 (Overweight) and (iii) BMI 30+ (Obese).

Results

Figure 1 shows that, in total, 4.3% of the young adults drink energy drinks 3–4 times per week or more frequent, 11.5% consume energy drinks 1–2 times per week and 84.3% rarely or never drink the beverage. In total, 15.8% drink energy drinks on a weekly basis. More men than women have a frequent energy drink consumption.

Table 1 shows the results from the multivariate logistic regression analysis on weekly energy drink consumption in relation to gender, age, employment status, educational level and ethnic background. The analysis indicates that after adjustment for other socio-demographic factors men have higher odds of weekly energy drink consumption than women (adjusted OR 3.9). The analysis also indicates that young age, being employed (vs. being a student) and a low educational level are associated with weekly energy drink consumption.

Table 2 shows the results from the multivariate logistic regression analysis on weekly energy drink consumption in relation to different health behaviour measures and BMI among young adults. The table shows that after adjustment for socio-demographic factors, daily smoking is associated with weekly energy drink consumption (adjusted OR 1.8). People who drink high amounts of alcohol and/or who binge drink at least once a week also have higher odds of drinking energy drinks on a weekly basis (adjusted OR 1.9 and 1.3, respectively). The table also shows that being overweight is associated with weekly energy drink consumption (adjusted OR 1.4).

Discussion

We found that, in total, 15.8 % young adults drink energy drinks on a weekly basis. A population-based survey including respondents

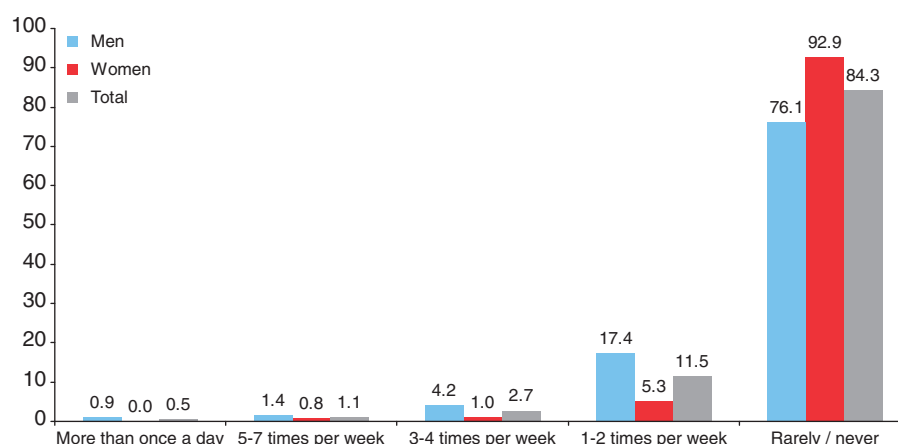


Figure 1 Frequency of energy drink consumption among men and women (Pct)

Table 1 Prevalence of weekly energy drink consumption in relation to different socio-demographic variables among young adults (16–24 years)

| | Pct. | ORs | |
|----------------------|------|------------|-----------------------|
| | | Unadjusted | Adjusted ^a |
| Gender | | | |
| Men | 23.4 | 4.1* | 3.9* |
| Women | 7.1 | 1 (Ref.) | 1 (Ref.) |
| Age (years) | | | |
| 16–18 | 19.1 | 1.8* | 1.7* |
| 19–21 | 16.2 | 1.5* | 1.6* |
| 22–24 | 11.5 | 1 (Ref.) | 1 (Ref.) |
| Employment status | | | |
| Employed | 18.1 | 1.8* | 1.7* |
| Student | 11.0 | 1 (Ref.) | 1 (Ref.) |
| Out of the workforce | 19.7 | 2.0* | 1.5 |
| Educational level | | | |
| Low | 22.4 | 4.9* | 2.7* |
| Medium | 15.8 | 3.2* | 1.6 |
| High | 5.6 | 1 (Ref.) | 1 (Ref.) |
| Ethnic background | | | |
| Danish | 15.3 | 1 (Ref.) | 1 (Ref.) |
| Not Danish | 19.4 | 1.3 | 1.2 |

^aAdjusted for gender, age, employment status, educational level and ethnic background.

*5% significance level.

from 16 European countries (Denmark not included) shows that 16% of adults (18–65 years) consume energy drinks at least once a week in an average month over the last year.³ This European study also finds that the prevalence of energy drink consumption is substantially higher among the younger age groups which could indicate that the prevalence of energy drink consumption in Denmark is relatively low compared with the average of the 16 other European countries. In Denmark, energy drinks constitute a relatively new product category in the wider soft drinks market which could be one of the reasons why young Danish adult more seldom drink energy drinks. Further, energy drinks are relatively more expensive compared with many other soft drinks that also could be part of the explanation.

Socio-demographic differences

The finding that men are much more likely than women to consume energy drinks is consistent with findings from other studies.^{18,28} An American study has concluded that energy drink use is strongly associated with a traditional masculinity ideology and risk taking.²⁴ Another study among college undergraduates has also

Table 2 Prevalence of weekly energy drink consumption in relation to different health behaviour measures and BMI among young adults (16–24 years)

| | Pct. | ORs | |
|-------------------------------|------|------------|-----------------------|
| | | Unadjusted | Adjusted ^a |
| Smoking | | | |
| Current smoker | 26.5 | 2.3* | 1.8* |
| Non-smoker | 13.4 | 1 (Ref.) | 1 (Ref.) |
| High-risk alcohol consumption | | | |
| No | 13.2 | 1 (Ref.) | 1 (Ref.) |
| Yes | 24.1 | 2.1* | 1.9* |
| Binge drinking | | | |
| Every day/weekly | 20.8 | 1.7* | 1.3* |
| Seldom/never | 13.4 | 1 (Ref.) | 1 (Ref.) |
| Dietary habits | | | |
| Healthy | 11.5 | 0.7 | 0.8 |
| Medium healthy | 16.3 | 1 (Ref.) | 1 (Ref.) |
| Unhealthy | 19.2 | 1.2 | 0.9 |
| Physical activity | | | |
| Vigorous | 22.6 | 2.0* | 1.3 |
| Moderate | 14.7 | 1.2 | 1.0 |
| Light | 12.7 | 1 (Ref.) | 1 (Ref.) |
| Sedentary | 15.7 | 1.3 | 1.0 |
| BMI | | | |
| Underweight/normal weight | 14.7 | 1 (Ref.) | 1 (Ref.) |
| Overweight | 19.3 | 1.4* | 1.4* |
| Obese | 18.7 | 1.3 | 1.0 |

^aAdjusted for gender, age, employment status, educational level and ethnic background.

*5% significance level.

concluded that frequent consumption of energy drinks can be recognized as a potential predictor of a toxic jock identity defined as a sport-related identity predicated on risk taking and hypermasculinity.²² It is well known that young men in general have unhealthier lifestyles than women also in relation to dietary habits.²⁹ Further, the marketing strategies of energy drinks are to a high extent associated with extreme sports such as snowboarding, rock-climbing, parasailing and motorsports, which means that the imagery of energy drinks revolves around the nexus of masculinity and risk taking.²² The fact that about one-quarter of the Danish young men consumes energy drinks on a weekly basis suggests that the marketing strategy has been successful among this segment of consumers.

This study showed that even after adjustment for age, people with low level of education more often than people with higher levels of education consume energy drinks. A large body of epidemiologic

data shows that diet quality follows a socio-economic gradient.³⁰ However, only a few studies have addressed the matter of social inequality in consumption of energy drinks due to the fact that most studies are based on socially homogeneous groups such as college students.^{5,19–21,31,32} In fact, this study showed that young people who work and who are not enrolled in education more often than students consume energy drinks. Although consumption of other soft drinks has been found to be higher among lower income groups³⁰ the lower energy drink consumption among students could be a result of the fact that energy drinks at the time of data collection in 2010 was much more expensive than other soft drinks beverages.

Health behaviour

The analysis shows that weekly energy drink intake is associated with daily smoking, binge drinking, high-risk alcohol consumption and being overweight which indicates that energy drinks more often is consumed by young people who also in other areas have an unhealthy and risky lifestyle. This could indicate that there is some kind of 'add on' effect of energy drinks meaning that people who also use other stimulants—such as alcohol and cigarettes—are more inclined to consume energy drinks. This may be a result of the way energy drinks typically are marketed. To give an example, Red Bull has cultivated a brand identity associated with concepts of aggressive risk-taking, speed, energy and extreme sports and their slogan is 'Gives our wings'.³³ Young men who also in other areas have unhealthy lifestyle could find this brand attractive.

To the best of our knowledge, only a few studies have studied energy drink consumption within a broader context of health-related behaviours. In an American study among college students Miller³⁴ found that frequent energy drink consumers more often than non-consumers reported drinking and having alcohol-related problems and were also more likely to be smoking cigarettes. Likewise, Park *et al.*²⁸ in an American nationally representative study found that people who drink sports and energy drinks more often smoke cigarettes and drink alcohol compared with people who do not drink the beverage.

As mentioned, we found that the prevalence of weekly energy drink consumption was higher among people who at least once a week drank five or more alcoholic drinks at one time and among people who drank high amounts of alcohol. Unfortunately, this study does not contain information on to what extent energy drinks are mixed with alcohol. However, several studies have pointed out that mixing energy drinks with alcohol is frequent among young people.^{20,32} Indeed, public health and safety officials have raised concerns about the health and safety consequences of combining alcohol with energy drinks. Mixing energy drinks with alcohol may be hazardous given the stimulant nature of energy drinks and depressant characteristics of alcohol. The mixture can prevent individuals from realizing how much they drink because the stimulant effect can mask the degree of intoxication.³⁵ Also, studies have shown that people who often combine energy drinks with alcohol have a higher risk than people who use alcohol alone with regard to alcohol-related consequences that include drinking to intoxication, being hurt or injured or riding with an intoxicated driver.^{35–38} Moreover, the mixture of alcohol and energy drinks is very dehydrating and together will hinder the body's ability to metabolize alcohol and further increase the toxicity of alcohol.³⁵

Strengths and weaknesses

A strength of this study is the large number of participants in the population-based survey ($n=3923$) and that the study includes a variety of socio-demographic and health behaviour measures. Most other studies about the characteristics of energy drink consumers are based on US college students and on relatively

small study populations.^{5,18–25} By studying the phenomenon using a population-based survey we ensure that the findings are not just a reflection of a local culture, for instance, on a specific campus and therefore this study contributes with findings of relevance in a wider European context. Our sample only covered the Central Region, Denmark but as Denmark is a relatively homogeneous country we would expect similar results for other regions of Denmark.

The present results should, however, be interpreted in light of the following limitations. First, the survey gives information about the frequency of energy drink consumption only, not the amount of the intake. The outcome measure, frequency of energy drink consumption, was based on survey participants' responses to this single-item question: 'How often do you drink energy drinks (Red Bull, Cult, Burn etc.)?' The examples of energy drinks stated in the question (Red Bull, Cult and Burn) represent three of the most popular brands on the Danish market. No other brands were mentioned. Therefore, we do not know exactly what people associate with energy drinks besides the specific brands. However, to our knowledge, the majority of energy drinks in the Danish market contains high amounts of caffeine and do not vary much according to other ingredients.

Conclusion

Compared with other European countries the prevalence of energy drink consumption is relatively low in Denmark. However, about one quarter of young men drink these beverages on a weekly basis, which indicates the energy drink consumption mainly is a male phenomenon. Also, there is a clear social gradient in the prevalence of energy drink consumption where the intake is far more common among people with low levels of education than among people with higher levels of education. This study also shows that there is some kind of 'add on' effect of energy drinks meaning that people who also use other stimulants—such as alcohol and cigarettes—are more inclined to consume energy drinks.

Funding

Central Denmark Region

Conflicts of interest: None declared.

Key points

- A strength of this study is that the study population is based on a population-based sample.
- There is a clear social gradient in the prevalence of energy drink consumption where the intake is far more common among people with low levels of education than among people with higher levels of education.
- High consumption of energy drinks is mainly a male phenomenon.
- Young adults who also use other stimulants—such as alcohol and cigarettes—are more inclined to consume energy drinks.
- Compared with other European countries the prevalence of energy drink consumption is relatively low in Denmark.

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