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Sleep duration and caffeine consumption in a French middle-aged working population

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Abstract

Objective/background: To explore the association between sleep duration and daily caffeine intake in a working population. Caffeine acutely disrupts sleep in the laboratory, but the inter-relations between sleep and caffeine intake in daily life are ill-known.

Methods: Questionnaire and diary based survey of 1498 persons from the GAZEL cohort of employees of the National Electricity and Gas Company (EDF-GDF) working in various locations in the Paris and South-West France areas. We analyzed total sleep time, our primary measure, and time in bed, both by sleep logs. We assessed daily intake of caffeine, consumption of alcohol and tobacco, use of hypnotics, and daytime somnolence, all by questionnaire.

Results: Multiple linear regression analysis did not find a significant relationship between total sleep time and daily caffeine intake less than 8 cups of coffee per day, after controlling for age, gender, alcohol intake, smoking status, and use of hypnotics. By contrast, time in bed was reduced as caffeine intake increased ($\beta = -0.125$; $P < 0.001$). Higher caffeine intake was not related to a higher daytime somnolence.

Conclusion: Despite the well-known acute effects of caffeine on sleep, habitual use of up to 7 cups of coffee (or 600 mg of caffeine equivalent) per day was not associated with decreased duration of sleep.

Keywords: Sleep; Sleep hygiene; Caffeine; Insomnia; Somnolence; Epidemiology

1. Introduction

Caffeine is a widely used substance. It has been estimated that adults living in western societies have an average all-source daily caffeine intake of about 200–300 mg [1]. Within this dose-range and above, caffeine is thought to increase alertness, reduce sleep propensity and produce adverse effects in the central nervous system, such as insomnia. To date, most studies on the effects of caffeine intake have indicated that it has deleterious effects on sleep (increasing sleep onset latency, decreasing total sleep time and adversely affecting sleep quality), but this research has usually involved the administration of acute doses of caffeine near bedtime. Other studies which examine caffeine intake early in the morning also found significant reductions in total sleep time and sleep efficiency [2–4]. One of the limitations of these studies is that they are usually performed in laboratory contexts [5–9] and do not take into account the development of tolerance to chronic caffeine use [10,11]. Therefore, the effects of acute doses of caffeine on sleep may not accurately reflect the effects of its chronic daily use. In addition, there are considerable inter-individual differences in response to caffeine intake [12,13], possibly related to pharmacogenetic variability of caffeine metabolism [14]. To date, epidemiological description of sleep patterns in habitual caffeine users is limited. We therefore decided to address this topic in a French working population from data included in a larger study of health and lifestyle habits.

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2. Material and methods

2.1. Participants

Participants were recruited from the GAZEL cohort, a long-term prospective study started in 1989, whose aim was to monitor the evolution of several health indicators in employees of the National Electricity and Gas Company (EDF-GDF) [15]. Four thousand eight-hundred thirty GAZEL participants were asked by mail to fill in a 3-week sleep log to investigate sleep schedules during working days, and to respond to other questions concerning lifestyle [16,17]. Two thousand two-hundred sixty-five employees working in various locations in the Paris area and South-West France agreed to participate, of whom 2109 were classified as regular day shift workers. Our source sample was finally comprised of 2109 subjects. A total of 1498 subjects completed the study, providing full data sets in the main study variables (71% of the source sample).

We obtained approval for our study from the supervisory board of the GAZEL cohort and the National Commission on Informatics and Liberties (CNIL) concerning data protection and confidentiality. This study conforms to the Declaration of Helsinki.

2.2. Study design

Subjects were asked to report on sleep latency (bedtime to sleep onset), nocturnal awakenings, time in bed (bedtime to wake up time) and sleep duration. Based on this information, we calculated the mean total sleep time (time in bed minus sleep latency, duration of nocturnal awakenings and time from awakening to getting up), averaged from the working days during the three weeks of the study.

We used the Basic Nordic Sleep Questionnaire (BNSQ) [18] to evaluate the use of hypnotics during the past three months (Item 7: Have you used prescription sleeping pills during the past three months?), measured on a 5-point scale (never or less than once per month, less than once per week, on 1–2 days per week, on 3–5 days per week, daily or almost daily). Subjects were then classified into two groups: non- or irregular users of hypnotics if they reported never using hypnotics or using them less than three days per week, and regular users of hypnotics if they reported using hypnotics three or more days per week.

We used the *GAZEL questionnaire* items [15] to evaluate the daily consumption of caffeinated beverages, including coffee, tea and sodas. The number of beverages per day and types of beverage were converted into mg of absolute caffeine, according to standard caffeine content values provided by Barone et al. [19] (1 cup of coffee = 85 mg, 1 cup of tea = 30 mg and 1 can of cola = 36 mg). For practical reasons, mg of caffeine were then transformed into equivalent cups of coffee (85 mg caffeine).

Other factors measured by this questionnaire included age, gender, occupational status, alcohol intake and smoking status. Participants were classified as smokers if they reported smoking one or more cigarettes per day, and as non-smokers otherwise. Total weekly alcohol consumption was calculated by total number of glasses of wine, beer or spirits per week and transformed into units of alcohol (one unit is one measure of spirits, one glass of wine or one glass of beer) [20]. We then classified the subjects into two groups, non or light drinkers and heavy drinkers (more than 21 units of alcohol per week for men and 14 units per week for women [20]).

To assess the general level of daytime somnolence we used the Epworth Sleepiness Scale (ESS) [21], whose items evaluate the subjective sleep propensity in a variety of situations.

2.3. Statistical analysis

Our main outcome variable was total sleep time. For univariate analyses between total sleep time and putative associated variables, we used analysis of variance tests and Pearson correlation coefficients.

The relationship between caffeine consumption and total sleep time was tested by using multiple linear regression analysis, adjusted for potential confounders: age, gender, alcohol intake, smoking status and use of hypnotics. Interaction terms between the main predictor (caffeine intake) and the other predictive variables were also tested if they showed a significant effect on the dependent variable.

The same procedure was used to test the relationship between time in bed and somnolence as dependent variables and caffeine intake and the same set of variables described above. A P value of <0.05 was considered to be significant.

All analyses were performed with the SPSS PC+ statistical software, version 11.

3. Results

3.1. Characteristics of the study sample

The study sample did not differ from the source sample with respect to main demographic parameters.

In our sample, 64% were male. Mean age was 51 (3.2) years (range 44–58 years). Employees were classified into three subgroups according to employment grade: low (blue-collar workers, clerks and craftsmen), intermediate (supervisors, foremen, and mid-level professionals) and high (senior managers, engineers and other senior professionals). Forty-nine percent were classified in the high-grade group, 46% middle grade and 5% low grade. Mean caffeine intake was 225 (161) mg per day, or 2.6 (1.9) equivalent cups of coffee. The distribution of daily number of cups of coffee is displayed in Table 1. In the group of caffeine users ($n = 1349$, overall 90% of the population), 86% consumed coffee, while 30% consumed tea and only 3%