



coffee&health

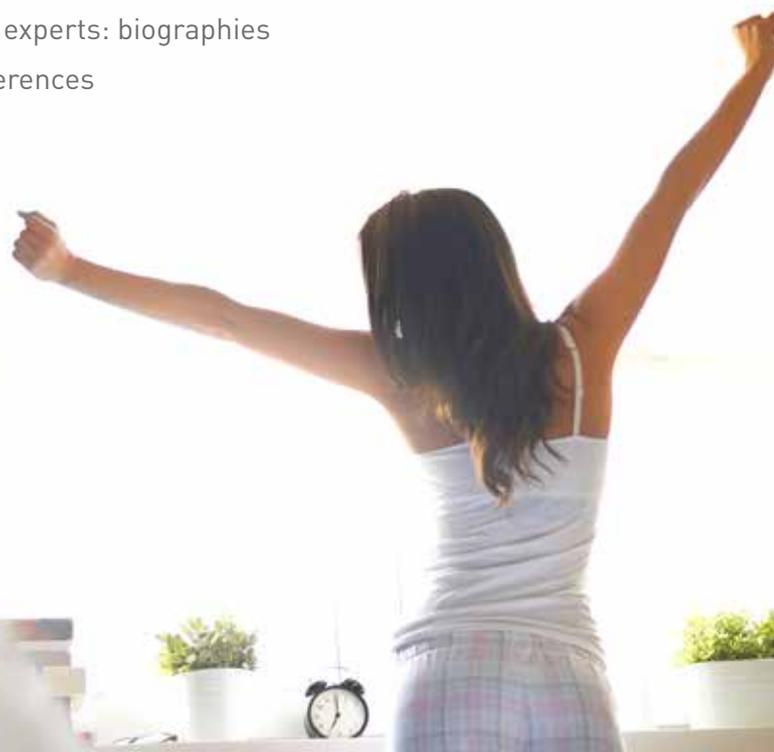
from the institute for scientific information on coffee

EXPERT REPORT

The good things in life: coffee and sleep

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Summary

The pressures of modern life highlight how challenging it can be for otherwise healthy adults to get enough sleep. Distractions, noisy environments, stress, and confusion over how many hours per night equates to a 'good night's sleep' confound the issue. Coffee is well-known for its ability to increase alertness, but the relationship between coffee and sleep is often less understood.

To explore the relationships between caffeine, coffee, and sleep further, ISIC invited eminent experts to discuss the latest scientific research, consumers' knowledge and attitudes, and the role healthcare professionals can play in disseminating healthy sleep advice. The experts looked at issues such as why some people don't get enough sleep, what happens when people are sleep-deprived, how caffeine may make us more alert, and why some people are affected by caffeine more than others.

The experts discussed the dual effect of the caffeine in coffee: able to promote alertness, and especially useful in situations such as long distance driving, it is also associated with sleep disturbance in some individuals. The amount and timing of caffeine consumption during the day may impact sleep, and individual factors such as a person's age, gender and habitual intake also affect a person's response to caffeine. Some people may therefore be particularly sensitive to caffeine, and as such, should be advised to avoid caffeinated beverages later in the day to limit any impact on sleep. Likewise, the number of hours' sleep per night varies widely between individuals, and this is further complicated by the fact that people often deprive themselves of sleep by staying up late. Healthcare professionals therefore have an important role to play in helping patients understand their own personal sleep requirements, and ensuring that they manage their daily caffeine intake according to their own sensitivity levels.





The experts



Dr Renata Riha

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Dr Elena Philippou

Assistant Professor in Nutrition-Dietetics at the University of Nicosia, Cyprus, and Visiting Lecturer at King's College London.



With guest commentary by Professor Hans-Peter Landolt

Co-director of the Clinical Research Priority Program Sleep and Health at the University of Zürich.





Foreword



Coffee is a complex compound and arguably one of the most researched elements of the diet. It contains over 1,000 components, one of the most notable of which is caffeine. There is a strong psychological element to coffee consumption and it is often a

deeply-ingrained part of many people's daily rituals, particularly at the start of the day. This consumption pattern has led to much research on how coffee or caffeine in the diet can affect alertness and sleep.

This report explores some of the ways in which people inadvertently disturb their own sleep, or fail to realise that they are not allowing themselves enough time in bed. With often-repeated and conflicting 'statements' about how many hours a night people need (ranging from Albert Einstein's reported 10 hours per night to former UK Prime Minister Margaret Thatcher's infamously brief four hours), it's not surprising that people become confused over what's right for them.

This report outlines the science surrounding coffee, caffeine and sleep, and suggests ways in which healthcare professionals can help people who are particularly sensitive to the stimulating effects of caffeine manage their sleep regime.



Dr Renata Riha
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July 2016



What counts as a good night's sleep and why is it important?

The discussion opened with Dr Riha highlighting the importance of a good night's sleep. Although it is difficult to quantify the exact amount of sleep required as it varies by individual, it is clear that adequate sleep contributes to normal cognitive function, including alertness and concentration. The importance of adequate sleep can be assessed by studying the effect of sleep deprivation. Studies show that sleep deprivation not only causes an increase in daytime sleepiness but can also impact performance, mood, and metabolic function. Sleep deprivation has been associated with an increased risk of glucose impairment and development of Type 2 diabetes, and evidence is growing of a potential impact on lifespan^{1,2,3}.

Poor/insufficient sleep leads to:

- ↘ Excessive daytime sleepiness
- ↘ Reduction in ability to concentrate
- ↘ Negative impact on mood
- ↘ Impairment of neurocognitive function
- ↘ Impairment of fine motor performance
- ↘ Worsening of metabolic function
- ↘ May impact lifespan

The commonest cause of excessive sleepiness is voluntary sleep deprivation, often associated with poor sleep hygiene practices. In other words, people deliberately stay up late, perhaps to watch TV or play computer games. The use of mobile phones and tablet devices close to bedtime is another distraction. A lack of sleep can have an impact on emotional, mental and physical well-being, so the effects can be far-reaching on daily life. Whilst sleepiness may have a primary cause, it can also be secondary to other conditions, such as stress and psychological problems, which may be poorly-recognised and identified.



Lifestyle factors that can hinder the pursuit of sleep

Although there is a large variability between individuals, a number of factors have been identified that may impact the amount of sleep an individual takes. Dr Riha outlined the factors involved, ranging from a lack of understanding of the importance of sleep to the sleeping environment itself.

- Poor understanding about how much sleep is needed and why
- Bedtime habits
- Smoking, alcohol or caffeine consumption
- Poor sleep hygiene
- Work demands: e.g. shift work
- Anxiety and stress
- Poor bedroom environments; general environment
- Pets and partners in the bedroom causing disturbances





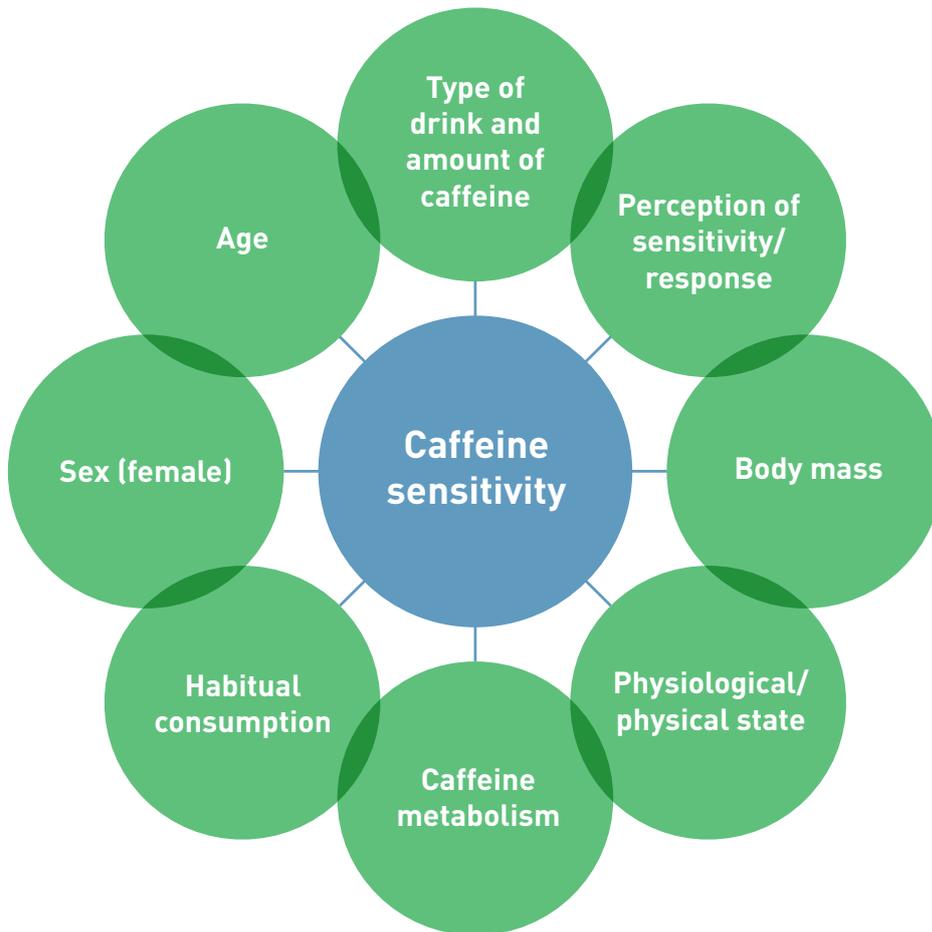
How caffeine affects sleep

Caffeine may have an impact on sleep for a number of reasons. Consumption of caffeine can prolong the time taken to fall asleep as well as reducing total sleep time and perceived sleep quality. Specifically, caffeine reduces slow wave, or deep sleep, and can increase wakefulness and arousals from sleep^{4,5}.

Older adults tend to be more sensitive to the effects of high doses of caffeine on sleep, although further work is required to confirm and document these effects and the mechanisms involved⁵. Dr Riha suggested that some people may not realise that as they age, their metabolism changes and hence so may their caffeine tolerance.

Some individuals seem to be unaffected by caffeine consumption, whilst at the other end of the scale, some people may be particularly sensitive to caffeine. The following chart summarises the factors that are known to affect the impact of caffeine consumption on the body.

Why does coffee affect some people's sleep more than others?

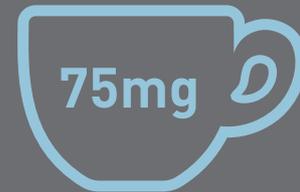




The relationship between coffee, waking performance and alertness

The experts agreed that a main effect of caffeine consumption is an increase in alertness. Research has proposed that an inverted U-shaped curve shows the association between caffeine intake and attention, suggesting that performance decrements can occur due to both under- and over-arousal⁷.

The experts discussed the adenosine theory behind the stimulating role of caffeine, stating that it is associated with an effect at the site of adenosine receptors. Adenosine is a compound in the body that binds to adenosine receptors in the brain, leading to a chain of events that reduce stimulatory neurotransmitters such as dopamine, in turn producing the sensation of 'being tired'. Because caffeine is similar in structure to adenosine, it is able to bind to receptors in place of adenosine. When this happens, it increases feelings of alertness. One study suggests that the availability of adenosine receptors may increase after prolonged wakefulness, and so caffeine is able to counteract the feelings of tiredness associated with increasing levels of adenosine⁸.



The European Food Safety Authority (EFSA) Panel on Dietetic Products, Nutrition and Allergies Scientific Opinion concluded that there is good consensus on the role of caffeine in increasing alertness and attention in healthy individuals at doses of at least 75mg caffeine⁶. A typical cup of coffee provides between 75 and 100mg caffeine.

ISIC European Consumer Research (2015)



79% believed that moderate coffee consumption can help alertness and concentration.



68% stated that they don't feel awake until they have had a cup of coffee.



Coffee, Caffeine and Sleep



Earlier this year, Ian Clark and I published a systematic review examining the results of 58 peer-reviewed epidemiological studies and clinical trials into the effects of caffeine and coffee on sleep⁵.

Overall, the review found that caffeine typically prolonged sleep latency, reduced total sleep time and sleep efficiency, and worsened perceived sleep quality. However, it was also clear that individuals respond differently to caffeine based on factors including their age and sensitivity levels. The studies we reviewed suggested possible evidence of a dose-response relationship between caffeine and sleep structure: for example, higher bedtime doses of caffeine reduced subjects' amount of slow wave sleep (also known as 'deep sleep').

We noted that caffeine exposure may be altered as a function of other factors including age and body weight. For example, older adults tend to consume the same amount of caffeine as younger adults but typically weigh less. Older adults may also self-limit the amount of caffeine they consume due to perceived sleep problems.

Several genes have also been identified that affect an individual's sensitivity to caffeine and its impact on sleep quality (the ADORA2A and ADA genes, as well as the DARPP-32 and PRIMA1 genes). The same amount of caffeine can therefore affect two otherwise similar individuals differently, depending on their genetic make-up.

In the paper we noted caffeine's value as an aid in reducing sleepiness and partly mitigating impairments on certain cognitive tasks after sleep deprivation, especially on tasks measuring processes of attention.

However, it is evident that more research into caffeine and sleep is needed, such as further investigation of how and why an individual's genetics could predispose them to caffeine-induced sleep changes, establishing timing and dose-relationships relating to EEG sleep variables, as well as into the effects of caffeine on women, older adults, and individuals outside North America or Western Europe.

Professor Hans-Peter Landolt (2016)



Practical benefits of coffee's effect on wakefulness

The ritual of enjoying a cup of coffee as the first drink of the day is standard for many people: some drink it to help them stay awake, while others drink it to 'wake themselves up'. Caffeine appears to reduce a phenomenon called sleep inertia, a condition characterised by a decline in motor dexterity and a subjective feeling of grogginess immediately following an awakening⁹.

Several studies have demonstrated that caffeine can have a positive effect on feelings of sleepiness, although the effects on alertness and waking performance are less well defined. There are many occasions in daily life when increasing alertness can be beneficial, and indeed potentially improve safety. Drowsiness can be triggered by irregular sleep patterns, caused, for example, by working night shifts, or by undertaking monotonous activities such as long distance driving.

Some studies have shown a beneficial effect of caffeine consumption on long distance driving, reducing the risk of crashing, and improving subjective and objective driving quality¹⁰ (nonetheless, drivers should always follow road safety guidelines).

Research summary

80mg caffeine improved subjective driving quality¹¹

200mg (one strong coffee) was as effective as a 30 minute nap in reducing driving impairment¹²





Common questions and advice for healthcare professionals

The experts discussed the fact that there is often public misunderstanding about different sources of caffeine in the diet. The main sources of caffeine are beverages such as coffee, tea, including green tea, and caffeinated drinks such as colas and energy drinks. Dr Riha mentioned bubble tea (a Taiwanese drink now fashionable in some Western countries) as another source. Dr Philippou added that because cocoa is a source of caffeine, chocolate will also contain small amounts of caffeine. If individuals do not realise that caffeine is found in a variety of beverages and food, they may fail to keep track of their total daily caffeine consumption from all sources.

Caffeine content of drinks and foods

Drinks/Foods	Volume	Caffeine (mg) Mean (range)
Filtered coffee	125ml	85 (60–135)
Espresso	30ml	60 (35–100)
Soluble instant coffee	125ml	65 (35–105)
Decaffeinated coffee	125ml	3 (1–5)
Tea (leaves or bag)	150ml	32 (20–45)
Iced tea	330ml	20 (10–50)
Hot chocolate	150ml	4 (2–7)
Caffeinated soft drinks	330ml	39 (30–48)
Sugar-free caffeinated soft drinks	330ml	41 (26–57)
Energy drinks	330ml	80 (70–120)
Chocolate bar	30g	20 (5–36)
Milk chocolate	30g	6 (1–15)
Dark chocolate	30g	60 (20–120)

<http://coffeeandhealth.org/topic-overview/sources-of-caffeine/>

Dr Philippou advised that many patients regularly ask their doctor questions about the associations between caffeine and sleep. The panel discussed some common questions on the issue of coffee and sleep.

One frequently-asked question is: ‘how long before bedtime can I drink coffee without it having an effect on my sleep quality?’. Collectively, the panellists’ response was that there is no generic answer to the question, because of significant individual variability. However, people can be advised to follow their own body responses and to choose appropriate drinks later in the day to suit their needs. Those who are more sensitive to caffeine are advised to avoid caffeinated drinks later in the day, or to switch to decaffeinated alternatives.



It was mentioned that many patients who present with significant tiredness looking for a cause are, in fact, simply getting too little sleep. Although precise sleep requirements cannot be given, as again the recommendation varies depending on a person's age and individual needs, the panel agreed that 5 hours' sleep a night would not be enough for an average adult. It was suggested that in general, babies and children need more sleep, while older adults need less. However, researchers are not sure why variations in sleep needs exist. A good indication of an individual's optimal number of hours' sleep per night is to ask them how long they lie in on weekends and use this as a benchmark. The experts concluded that approximately 7–8 hours' sleep per night would probably suit most of the general adult population. They also commented that young adults (18–20 years) still need significant sleep, most likely in excess of 7–8 hours a night, stressing that this was important to note as many people assume that this age group fall into the 'adult' category, when in fact they have discrete sleep needs.

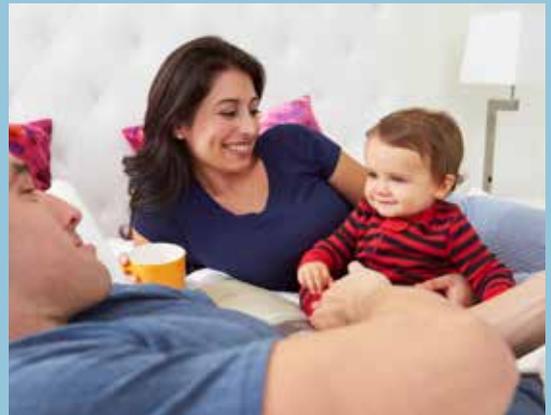
People are also often confused as to why some individuals can consume caffeinated coffee without noticing any effect on their sleep. Individual variability exists, associated with factors including age, sex, genetic variability and metabolic processes^{5,16}. In short, patients can be reassured that all individuals react differently to caffeine and can be advised to follow the signals from their own body when considering choice of beverages, particularly later in the day.

A further common question is: 'I am breastfeeding. If I drink coffee, will it affect the sleeping patterns of my baby?' Dr Philippou discussed the fact that there is no evidence that a caffeine intake of 200mg per day (up to 2 cups of coffee) in a breastfeeding mother will impact a baby's sleep.



European Food Safety Authority

The European Food Safety Authority report 'Safety of Caffeine' concluded that 'single doses of caffeine up to 200 mg and caffeine doses of 400 mg per day (about to 5.7 mg/kg per day) consumed by lactating women in the general population do not raise safety concerns for the breastfed infant'¹⁷.





Conclusion

It is clear that some people are particularly sensitive to the stimulating effect of caffeine and should be advised to avoid caffeinated beverages later in the day to limit any impact on sleep. However, some people's sleep does not seem to be affected by caffeine. These differences are explained by the fact that every individual will have a different response to caffeine, based on a number of variables, such as their age, gender, and genetic make-up.

There are many reasons why an otherwise healthy person's sleep patterns can be disturbed. Poor sleeping environments, or poor sleep hygiene, are common causes. Indeed, one of the commonest problems is that people simply do not allow themselves enough time in bed each night, and are consequently sleep-deprived. It's important to check that patients are being realistic about the number of hours' sleep they should be getting each night.

There are many beneficial effects associated with the stimulating effect of caffeine, including helping those suffering from jet lag, or those who work shift patterns or undertake monotonous tasks, such as long distance driving.

The most common sources of caffeine in the diet are coffee, tea and caffeine-containing soft drinks such as colas and energy drinks. Cocoa and chocolate also contain caffeine. Simple advice to avoid these later in the day may help to address sleep problems. Consumers should also track total caffeine consumption from all sources per day, not just coffee consumption, to get a true picture of their caffeine intake.

There is significant individual variability in the cause of sleep problems and the impact of caffeine in the body, such that generic advice is difficult to provide. Consequently, those who have such problems and concerns are advised to seek specific advice from a healthcare professional.





The experts: biographies



Dr Renata Riha

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Dr Riha has been a consultant in Sleep and Respiratory Medicine at the Royal Infirmary of Edinburgh since 2004. She qualified in medicine at the University of Queensland and is a Fellow of the Royal College of Physicians in Edinburgh. Currently, she is a member of the Harmonised Education in Respiratory Medicine for European Specialists (HERMES) taskforce in sleep medicine for the European Respiratory Society (ERS) and a member of the Scientific Committee of the European Sleep Research Society (ESRS). She is also involved with the ERS/ESRS working group in sleep education and exam standard setting for Europe. Dr Riha is an editorial board member of the journal SLEEP, an associate editor of the Journal of Sleep Research, and author of the book *Sleep: Your Questions Answered*.



Dr Elena Philippou

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Dr Philippou is a registered dietitian (RD), an Assistant Professor in Nutrition-Dietetics at the University of Nicosia, Cyprus, and a Visiting Lecturer in Nutrition-Dietetics at King's College London. She is a Fellow of the Higher Education Academy, UK and lectures on various topics, including Public Health Nutrition, Nutritional Assessment, and Medical Nutrition Therapy of various diseases. As a registered dietitian, she also holds private consultations on diet-related issues including obesity, cardiovascular disease and diabetes. Dr Philippou has published her research in international journals and is the editor of a textbook titled: 'The Glycemic Index: Applications in Practice' to be published by CRC Press, Taylor and Francis Group later this year.



With guest commentary by Professor Hans-Peter Landolt

Hans-Peter Landolt is a professor at the University of Zürich (UZH) and co-director of the Clinical Research Priority Program Sleep and Health of UZH. His main research focus lies on genotype-dependent differences in sleep, waking performance and response to sleep- and wake-promoting pharmacological agents.



About ISIC

The Institute for Scientific Information on Coffee (ISIC) is a not-for-profit organization, established in 1990 and devoted to the study and disclosure of science related to “coffee and health.” Since 2003 ISIC has also supported a pan-European education programme, working in partnership with national coffee associations in nine countries to convey current scientific knowledge on “coffee and health” to health care professionals.

ISIC respects scientific research ethics in all its activities. ISIC’s communications are based on sound science and rely on evidence and scientific studies derived from peer-reviewed scientific journals and other publications.

ISIC members are six of the major European coffee companies: illycaffè, Jacobs Douwe Egberts, Lavazza, Nestlé, Paulig, and Tchibo.

www.coffeandhealth.org

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