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NARRATIVE REVIEW

The impact of coffee and caffeine on health and the possibilities of their supplementation for different populations

a narrative review

HIGHLIGHTS

- Moderate coffee consumption (2–5 cups/day) is associated with lower all-cause mortality, with the lowest risk at ~3.5 cups/day.
- 3–5 cups of coffee per day reduce cardiovascular disease risk by approximately 15% and show a linear inverse relationship with type 2 diabetes.

- Coffee and caffeine intake is correlated with lower risk of colorectal, endometrial, hepatocellular and skin cancers — WCRF 2025 explicitly recommends coffee for CRC prevention.
- Caffeine reduces the risk and slows progression of Parkinson's disease and lowers depression and dementia risk, with stronger effects in women.
- Supplementation should be individualised: ≤ 200 mg/day in pregnancy, last cup ≥ 9 h before sleep, and monitored for ICD-10 caffeine dependence (F15).

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ABSTRACT

BACKGROUND: Caffeine is the most widely consumed psychostimulant in the human diet, found in over 60 plant species and ingested mainly through coffee, tea, and soft drinks. Many people perceive caffeine as

unhealthy, yet growing evidence suggests moderate intake carries substantial benefits across multiple disease domains, though it has not been systematically considered as a clinical supplement.

AIM: To synthesise evidence on the health effects of caffeine and coffee and evaluate the feasibility of recommending supplementation as a preventive or adjunctive measure for specific patient populations.

MATERIALS AND METHODS: A literature search was performed using PubMed and Google Scholar, focusing on conditions most common in today's society. We prioritised meta-analyses, prospective cohort studies and randomised controlled trials, supplemented by governmental and NGO sources for statistics and policies.

RESULTS: Consumption of 2–5 cups of coffee per day was consistently associated with reduced all-cause mortality, lower risk of several cancers, and cardiovascular diseases. A linear inverse relationship was observed between intake and type 2 diabetes risk, also noted for decaffeinated coffee. Caffeine was associated with reduced Parkinson's disease risk and slower progression. Moderate intake of 3–5 cups appeared to lower depression risk, more strongly in women, and 2–3 cups daily was linked to reduced dementia risk and better cognitive outcomes, again more prominently in women.

CONCLUSIONS: Clinicians should consider integrating caffeine and coffee into preventive care discussions, accounting for contraindications, sleep disturbances, and dependence risk. Supplementation may benefit those at elevated risk of cardiovascular disease, type 2 diabetes, certain cancers, Parkinson's disease, depression, and dementia, particularly women and older adults. Further RCTs are needed to establish precise dosing guidelines.

KEYWORDS caffeine; coffee; supplementation; cardiovascular disease; type 2 diabetes; cancer prevention; neuroprotection; Parkinson's disease; dementia.

GRAPHICAL ABSTRACT

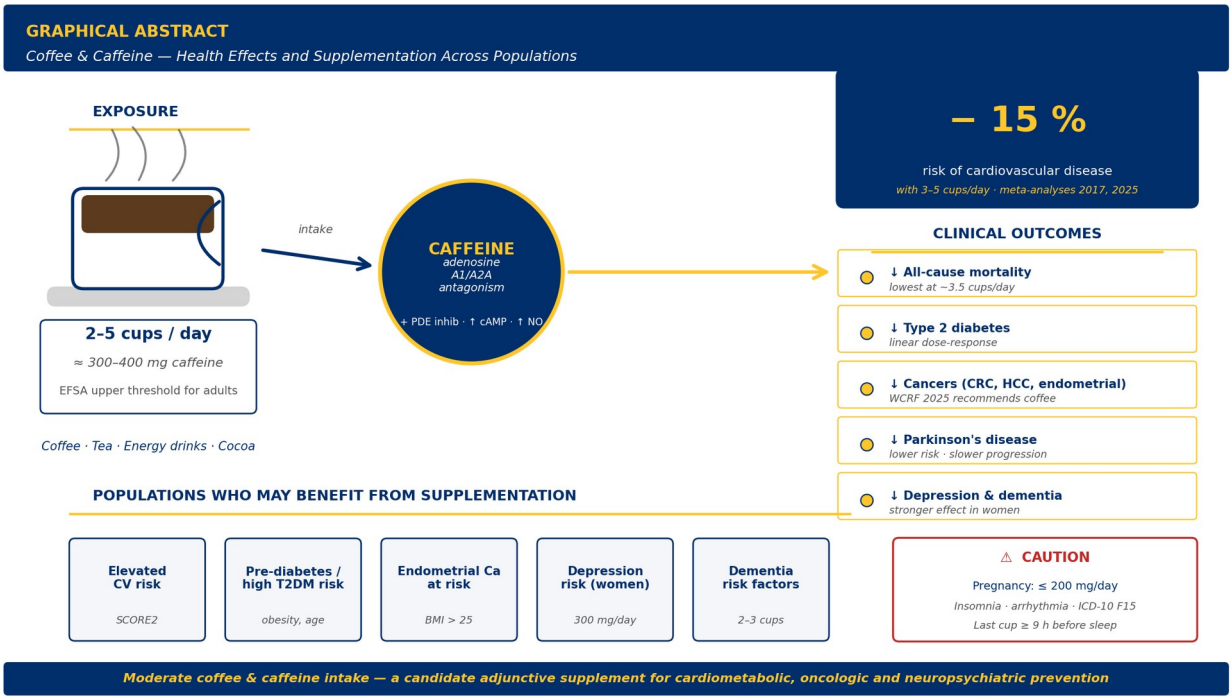

Figure 1. *Graphical overview of coffee and caffeine consumption — from exposure (2–5 cups/day) and the central adenosine-receptor antagonism mechanism through clinical outcomes (all-cause mortality, cardiovascular disease,*

T2DM, cancers, Parkinson's disease, depression, dementia) to candidate populations for supplementation and key safety considerations.

PLAIN LANGUAGE SUMMARY

Caffeine is the most widely used stimulant in the world. Most people take it in the form of coffee, tea, or soft drinks, and many of them think of it as something unhealthy. The scientific evidence, however, tells a much more positive story: moderate coffee drinking — about 2 to 5 cups a day — is linked to a lower risk of dying from any cause, a roughly 15% lower risk of cardiovascular disease, and a clear, dose-dependent reduction in the risk of type 2 diabetes (even when the coffee is decaffeinated). Coffee drinkers also tend to have lower rates of colorectal, endometrial, liver and some skin cancers — so much so that in 2025 the World Cancer Research Fund specifically recommended coffee for colon cancer prevention. Caffeine appears to slow the development and progression of Parkinson's disease and may reduce the risk of depression and dementia, with particularly strong benefits in women. The main cautions are clear: pregnant women should stay under 200 mg of caffeine a day, the last cup should be drunk at least 9 hours before bedtime, and anyone showing signs of dependence (a real diagnosis in ICD-10) should cut back. For most adults, however, a thoughtful daily coffee habit — or a caffeine tablet for people who don't like the taste of coffee — is a safe and surprisingly powerful tool that doctors should feel comfortable discussing with their patients.

TABLE OF CONTENTS

Section titles below are listed with their page numbers in the printed and PDF layout.

1. INTRODUCTION

Caffeine is the most frequently consumed psychostimulant substance in the diet [1,2]. It is a natural alkaloid found in the seeds, leaves, and fruits of over 60 plant species. The most widely distributed sources of consumed caffeine are coffee beans (species 'Coffea arabica' and 'Coffea canephora' (Robusta)) and tea leaves 'Camellia sinensis'. It can also be found, for example, in cocoa beans and yerba mate. The most consumed caffeine-containing beverage (CCB) worldwide is coffee, followed by soft drinks and tea [3], although soft drinks, including energy drinks, have been gaining popularity in recent decades [4].

The primary and most important mechanism of action of caffeine is its antagonistic effect on adenosine receptors (A1, A2A, A2B) in the central nervous system, particularly in the basal ganglia and striatum of the brain. At higher doses, it also inhibits phosphodiesterase enzymes, sensitizes calcium release channels, and acts as a GABA receptor antagonist. It acts on blood vessels by increasing cAMP levels in smooth muscle and endothelium, thereby enhancing nitric oxide production [5,6].

According to data from the European Food Safety Authority, the average daily caffeine intake among citizens of member states increases with age, amounting to 37–319 mg for adults aged 18–65, 23–362 mg for the 65–75 age group, and 22–417 mg for those aged 75 and over [7]. The highest caffeine consumption in Europe is recorded in Sweden and Finland, averaging over 400 mg per day [8]. A review conducted at the University of Buffalo published estimates of caffeine consumption for US citizens at an average of 180 mg/day, for the United Kingdom 130 mg/day, and for Japan 260 mg/day [9]. According to a study at Pennsylvania State University, caffeine consumption is higher in older age groups [10].

The most commonly consumed CCBs in Europe are coffee and soft drinks. Tea is the main CCB in Ireland, the United Kingdom, and Turkey. In North America, carbonated beverages and coffee predominate, while in Asia it is tea [7,11]. Many European countries (including Denmark, Portugal, and the United Kingdom), as well as the USA and Canada, recommend not exceeding a daily caffeine intake of approximately 300–400 mg [11]. This corresponds to approximately 4–5 cups of espresso and 7 cups of black tea [12]. For pregnant women, the recommended maximum daily dose is typically 200 mg. Although there are recommendations regarding the upper threshold of caffeine intake, specific amounts are not routinely advised for particular population groups [11,12,13].

2. EFFECTS OF CAFFEINE AND COFFEE ON HEALTH

A meta-analysis published in 2025 described prospective cohort studies collectively encompassing several million participants. According to the analysis, consuming 2 or more cups of coffee per day reduces the risk of death from any cause. The results were consistent across groups consuming 2–7 cups per day [14]. According to a 2019 meta-analysis, the risk of death from any cause was lowest at 3.5 cups of coffee per day [15].

The most common causes of death in Europe and the USA are cardiovascular diseases and cancers [16,17]. According to meta-analyses from 2025 and 2017, drinking 3–5 cups of coffee per day reduces the risk of cardiovascular disease by approximately 15% [14,18]. However, drinking more than 5 cups is correlated with a higher risk of cardiovascular death compared to non-consumers [18]. According to a growing body of evidence, moderate doses of caffeine, equivalent to 3–5 cups of coffee, do not increase the risk of arrhythmia [14,19]. A randomized clinical trial from January 2026 found that patients consuming 1 cup of coffee per day had a lower risk of recurrence of atrial fibrillation or flutter compared to the group that did not consume coffee [20].

Coffee consumption is correlated with a reduced risk of endometrial cancer, particularly in women with a BMI >25 kg/m² [21]. According to a 2023 meta-analysis, consumption of coffee and/or tea may reduce the

risk of hepatocellular carcinoma [22]. Coffee consumption is also correlated with a reduction in the risk of basal cell skin cancer [14]. It also correlates with a lower risk of colorectal cancer, breast cancer, and melanoma [18]. The World Cancer Research Fund, in its 2025 recommendations in the document entitled "Dietary and lifestyle patterns for cancer prevention: evidence and recommendations from CUP Global," included the statement: "For colorectal cancer prevention, there is a specific recommendation to include calcium-containing foods (such as dairy products) and coffee in this dietary pattern, with strong wording on avoiding processed meat" [23].

Type 2 diabetes (T2DM) is an independent risk factor for numerous other diseases [24,25]. Coffee and caffeine have been well studied with regard to reducing the risk of developing T2DM. Their consumption is also correlated with lower cardiovascular mortality in individuals with T2DM [14,18]. The correlation between the amount of coffee consumed or caffeine ingested is linear, and the risk of disease decreases with increasing consumption [18]. Notably, the risk is also reduced in the case of decaffeinated coffee, suggesting protective effects beyond caffeine alone [26].

2.1. Psychiatric Conditions

Numerous meta-analyses and studies indicate that consumption of coffee and/or caffeine reduces the risk of developing Parkinson's disease, and in those already affected, it is correlated with slower disease progression [27,28].

According to a 2020 meta-analysis, consumption of coffee and/or caffeine reduces the risk of developing depression. Higher doses of caffeine were associated with a lower risk of the disease, and the effect was stronger in women than in men. The authors highlight the fact that excessive caffeine consumption could potentially exacerbate depression in those already suffering from it, due to stimulation of the sympathetic nervous system. According to the same meta-analysis, moderate coffee consumption (3–5 cups) appears to reduce the risk of dementia, with the effect being stronger in women [29].

A 2018 study found that high caffeine intake (approximately 400–600 mg/day) in older individuals over 65 years of age with type 2 diabetes was correlated with better cognitive outcomes and greater grey matter volume in the brain compared to the group consuming lesser amounts or none at all [30]. Authors of a 2022 study suggested that high caffeine consumption may correlate with a higher risk of Alzheimer's disease (AD), noting that further research is needed, as the correlation between AD and caffeine remains uncertain [31]. However, a prospective cohort study from March 2026 involving over 100,000 participants demonstrated that consumption of caffeinated coffee and tea is associated with a lower risk of dementia and better cognitive outcomes, with the greatest differences observed at 2–3 cups of coffee per day [32].

2.2. Sleep

Caffeine may contribute to difficulties falling asleep, and shortens and reduces the quality of sleep. The effect is more pronounced the closer to the intended bedtime caffeine is consumed. According to a 2023 meta-analysis, to avoid this effect the last cup of coffee should be consumed approximately 9 hours before going to sleep [33,34].

3. CAFFEINE OR COFFEE SUPPLEMENTATION IN VARIOUS POPULATION GROUPS

As mentioned earlier, the maximum recommended daily dose of caffeine for an adult is typically 300–400 mg, equivalent to 3–5 cups of coffee. This dose is correlated with the greatest health benefits in the cited studies [14,18,21,27,30]. Although caffeine is such a widely consumed substance, particularly in coffee, some

individuals consume none at all, and others only in small amounts. For these individuals, specific doses of coffee or caffeine can be recommended for health purposes.

2–4 cups of coffee correlates most strongly with a reduced cardiovascular risk. In individuals with elevated risk, for example as calculated using the SCORE2 scale recommended by the European Society of Cardiology [35], supplementation with an appropriate amount of coffee could be recommended in addition to standard treatment. This type of approach may also be considered in individuals with existing arrhythmias. As the authors of a 2011 study concluded: "The inverse relations of coffee and caffeine intake to hospitalization for arrhythmias make it unlikely that moderate caffeine intake increases arrhythmia risk" [36]. Caffeine also does not affect the risk of arterial hypertension in the long term, and according to the latest data may even minimally reduce this risk [37]. The International Society of Hypertension, as part of lifestyle modification recommendations for individuals with arterial hypertension, advises "moderate consumption of unsweetened coffee and tea."

Another group that could benefit from caffeine or coffee supplementation are individuals at high risk of developing T2DM, such as older adults, obese individuals, those with low levels of physical activity, patients in a prediabetic state, or women who developed gestational diabetes (following the pregnancy period) [38]. In prediabetic individuals consuming larger amounts of coffee, cardiovascular risk is reduced [39]. For these individuals, one recommendation could be to consume 3–5 cups of coffee per day, or to supplement with 300–400 mg of caffeine. For those who do not tolerate caffeine, decaffeinated coffee could be recommended, as it also has a positive effect on T2DM risk [26].

Coffee may be a potentially beneficial supplement for women at high risk of endometrial cancer. Since the risk of this cancer decreases with the amount of coffee consumed [21], amounts of up to 4–5 cups per day could be considered. It should be noted, however, that most of the remaining health benefits plateau at 5 cups per day, and beyond this threshold, negative effects begin to outweigh the benefits. Such recommendations would be particularly relevant to consider in obese women at high risk of endometrial cancer, such as those with early menarche, late menopause, those using estrogen-only pills, or those with Lynch syndrome [40]. However, in the case of Lynch syndrome, the association between cancer risk reduction and caffeine consumption in such women warrants further investigation.

As mentioned earlier, the World Cancer Research Fund in its 2025 recommendations [23] suggests consuming coffee to reduce the risk of colorectal cancer. Regarding other cancers, either there are insufficient characteristic risk factors, or the available data are not strong enough to currently consider caffeine or coffee supplementation for prevention purposes; however, further research is needed, and such recommendations may be considered in the future.

Although many studies yield consistent results in which caffeine and coffee reduce the risk of developing Parkinson's disease, there are no specific risk factors unique to this condition [41]. Most of them, such as air pollution and pesticides, are factors encountered by virtually every individual. In addition, T2DM and cardiovascular diseases are mentioned, which have been discussed above. However, there are identified genes associated with an increased risk of PD. If these are detected in a given individual, it may be reasonable to introduce caffeine or coffee supplementation. To date, only one systematic review has described the association between certain genes in PD and caffeine-correlated risk reduction [42]; however, the volume of literature demonstrating the protective effect of caffeine and risk reduction in PD appears sufficient to consider such supplementation [27,28].

The protective effect of caffeine against developing depression is, depending on the study, greatest between 300 and over 550 mg of caffeine consumed daily. Taking into account the overall risks and benefits, it appears that 3–4 cups of coffee or supplementation with 300 mg of caffeine in individuals at risk of developing

depression may offer meaningful preventive benefits. Such an approach is all the more justified in women, for whom the protective effect is stronger [18,29]. Caution should be required in individuals struggling with insomnia, as caffeine reduces both the duration and quality of sleep, and sleep deprivation is one of the risk factors for depression [32,33,34,43,44].

In individuals presenting multiple dementia risk factors, such as social isolation, smoking, hypertension, etc. [45], supplementation would be beneficial, preferably from 2–3 cups of coffee per day [32]. In this case as well, this approach is all the more indicated for women due to better outcomes with respect to the protective effect [29]. Taking into account the aforementioned 2018 study [30], in older adults with type 2 diabetes a slightly higher dose of 3–5 cups could be considered, also in light of the diabetes itself.

All of the above considerations should exclude pregnant women, in whom excessive amounts of caffeine increase the risk of miscarriage, and it is reasonable to restrict intake to the maximum dose recommended by various organizations, most commonly 200–300 mg per day [11,12].

4. DISCUSSION

The aforementioned benefits of caffeine and coffee consumption are well-researched phenomena. Despite this, a large proportion of individuals consider their consumption to be unhealthy [46]. Moreover, women and older adults appear to be more skeptical about coffee, even though its consumption is in some situations more beneficial for them than for men (i.e., depression, dementia). Some individuals will forgo coffee consumption out of concern for health consequences and will not benefit from its potential health-promoting properties.

However, in certain conditions, there is a lack of RCTs to accurately determine the long-term effects of specific caffeine doses, such as in individuals with cardiac arrhythmias. In such cases, recommendations should be formulated with caution, and more RCT studies should be conducted. Caffeine Dependence Syndrome, classified in ICD-10, should also be taken into consideration. It is defined as “a cluster of behavioral, cognitive, and physiological phenomena that develop after repeated substance use and which typically include a strong desire to take the drug, difficulties in controlling use, persisting in use despite harmful consequences, a higher priority given to drug use than to other activities and obligations, increased tolerance, and sometimes a physical withdrawal state” [47]. Prior to recommending caffeine supplementation, the patient should be informed of the existence of this condition, and the risk of its occurrence should be monitored.

All in all, we claim that caffeine, alone or ingested with coffee, is a well-studied substance with the possibility of being used as a supplement for quite a range of patients with different backgrounds and medical statuses, and its use should be a discussed topic amongst medical professionals. The guidelines may include a beverage, with a roughly set amount of cups of coffee, or a pill with caffeine, strictly defined for a given patient.

5. LIMITATIONS OF THE STUDY

The major limitation of this study is that we did not take into account other substances contained in coffee. Therefore, if individuals who drink coffee were compared to non-drinkers, rather than caffeine consumers to non-consumers, the results might differ in the latter scenario. However, in every case we clearly indicated whether the results pertain to coffee or to caffeine alone. The majority of the disease states and disorders presented in this paper have studies examining both coffee and caffeine.

6. DISCLOSURE

6.1. Author Contributions

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All authors have read and agreed with the published version of the manuscript.

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Not applicable.

6.5. Conflict of Interest

The authors declare no conflict of interest.

6.6. Data Availability Statement

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6.7. Acknowledgements

Not applicable.

6.8. CRediT Author Contributions (taxonomy)

Mapped to the CRediT (Contributor Roles Taxonomy, NISO Z39.104-2022). Author initials: AP = Andrzej Palak; GG = Gabriela Grylowska; MR = Marcin Rebizant; APa = Anna Paluch; AA = Aleksandra Adamczyk; AŻ = Agata Żak; KG = Katarzyna Gunia; MB = Mateusz Banasik; AI = Anna Ignatowicz; MT = Michał Tryba.

- **Conceptualization:** AP, GG, APa, AI, MR
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