Original Article

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Withdrawal Symptoms and Executive Functions After 24-Hour Caffeine Abstinence in Office Workers with Habitual Coffee Consumption

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Abstract:

Objective: This research aimed to investigate withdrawal symptoms and executive functions (EFs) after 24-hour caffeine abstinence in office workers with habitual coffee consumption.

Material and Methods: Eighteen male office workers (age 32.94±4.14 years, computer use for work 5.33±0.77 h/d, caffeine consumption 225.83±88.80 mg/d) participated in this within-subjects designed experiment. Participants completed the Caffeine Withdrawal Symptoms Questionnaire, Trail Making Test (TMT), and Flanker Test after 24-hour caffeine abstinence, preceded by a baseline measure during normal consumption.

Results: The mean score for total caffeine withdrawal symptoms, drowsiness/fatigue, decreased alertness/difficulty concentrating, mood disturbances, decreased sociability/motivation to work, flu-like feeling, and headache was greater after caffeine abstinence compared with the baseline normal consumption (all p-values<0.05). The mean value for the TMTB number of errors was also greater after caffeine abstinence than the baseline normal consumption (p-value<0.05).

Conclusion: Acute caffeine abstinence produces withdrawal symptoms and impaired EFs in office workers with habitual coffee consumption, and the occurrence is different among individuals. Based on the earlier evidence and the findings of this research, habitual caffeine consumers should be cautious when abstaining from caffeine in their daily routine, and more occupational research is required to elucidate the impacts of caffeine abstinence among regular coffee consumers.

Keywords: caffeinated beverage, adenosine receptor antagonist, executive performance test, occupational research, white-collar worker

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Introduction

Coffee consumption is widespread worldwide among people of all ages and genders. Thailand, an important economic hub of the Association of Southeast Asian Nations (ASEAN), is among the top 50 coffee-consuming countries[1]. The largest population of coffee consumers in Thailand is office workers, particularly in urban areas[2]. In Bangkok, the capital of Thailand, it was found that office workers usually consume a cup of coffee in the morning before starting work. Most have repeated consumption throughout the day, and their daily consumption can be >5 cups[1,3]. Coffee is among the main contributors to daily caffeine intake. Coffee consumers also obtain caffeine from other beverages, foods, or drugs[4]. Caffeine has various side effects besides its benefits, and office workers are a central driver of the country's development. It is imperative that research on the impact of caffeine in this occupation is conducted, providing information regarding safety in occupations relating to coffee consumption.

Caffeine withdrawal is an abnormal condition occurring among regular coffee consumers after an abrupt decrease in or cessation of caffeine habitually consumed. Studies on this condition can be traced back more than a century, and it is now known that this condition causes clinically significant distress and impairment in daily, occupational, and social functioning[5,6]. However, research on caffeine withdrawal in occupations is scarce. Ultimately, the results of previous research, primarily examining caffeine consumers in general, remain uncertain regarding the type of disorders and timing of this condition. While the Diagnostic and Statistical Manual of Mental Disorder, 5th edition (DSM-5) indicates that five symptoms or signs usually emerge within 12-24 hours, peak at 1-2 days, and last for 2-9 days after caffeine abstinence[5], a critical review of caffeine withdrawal researches found 49 symptoms and nine signs, with peak 20-51 hours after abstinence[6]. Conversely, a retrospective study demonstrated that 14 well-described symptoms are reported up to 48 hours after ceasing[7]. This variability has been attributed to differences among individuals and within individuals across caffeine consumption and abstinence conditions[5,6]. Consequently, additional research on caffeine withdrawal in specific occupations is necessary to understand this issue better.

Office workers (e.g., executives, managers, politicians, and accountants) are the backbone of organizations. Today's office jobs require skills[8] based primarily on the executive functions (EFs) of the brain[9]. Ultimately, EFs are critical for optimal work performance, professional success, work engagement, organizational citizenship behaviors, and employee well-being[10-12]. With their paramount importance, the development of EF in the workplace has been highlighted. Meanwhile, a growing body of research has demonstrated that habitual caffeine consumers experience impaired EFs when caffeine is abruptly deprived as a consequence of caffeine's effect on blocking adenosine receptors in the brain. In this regard, various EFs are impacted (e.g., psychomotor speed, vigilance, and cognitive performance), and workers experience an impaired ability to perform regular tasks, such as proofreading, typing, and digit-symbol substitution[6,13]. However, previous research varies significantly concerning participants and methodology; thus, there is uncertainty regarding the incidence and timing of the impairments in different populations. Moreover, most previous research has used caffeine supplementation, which does not reflect natural consumption, to compare its abstinence effect[14]. Ultimately, research on the impacts of caffeine abstinence on work performance in employees is scarce, especially in office workers, as their autonomic nervous system functions, neurobiological characteristics, and neurocognitive performance diverge from those of other occupations[15,16].

This research aimed to use acute abstinence versus the preceding baseline caffeine consumption, which involves a natural pattern of caffeine consumption[6], to answer

whether caffeine cessation for 24 hours induces withdrawal symptoms and impaired EFs in office workers with habitual coffee consumption. In this research, a 24-hour window was used for caffeine abstinence because caffeine reaches peak plasma concentration within 30-60 minutes after absorption, with a half-life of 3-7 hours and near-complete elimination from the body within 12-24 hours[5]. A Caffeine Withdrawal Symptoms Questionnaire (CWSQ) by Juliano et al.[17] was used to assess withdrawal symptoms because of its high internal consistency and sensitivity to caffeine abstinence[18]. This research used the Trail Making Test (TMT) and Franker Test (FKT) of the Sport Science Bureau, Department of Physical Education, Ministry of Tourism and Sports, Thailand, to assess EFs because: 1) both correspond with the participants' occupational tasks and are the commonly-used neuropsychological tests[19,20], and 2) evidence has shown cultural differences on the FKT[21], and both were already evaluated for their reliability in Thai people[22]. This research hypothesized that caffeine cessation for 24 hours induces withdrawal symptoms and impaired EFs.

Material and Methods

Participant recruitment and screening

Office workers from the Department of Physical Education, Ministry of Tourism and Sports, Thailand, were recruited into this research through publicity sheets and word of mouth. The inclusion criteria consisted of having habitual coffee consumption, defined as drinking at least one cup of coffee in the morning for six months, working with a computer at least 4 h/d for three months, being 25-59 years old, having normal visual function, healthy, and exercising at least 20 min/d, twice a week for three months. Volunteers were initially screened via phone or word of mouth. They then underwent a screening procedure, which included personal information, physical examination, and history of illness, injury, medication use, caffeine and alcohol consumption, smoking, and exercise. Volunteers were excluded if they had a history of neurological problems, depression, anxiety, or usage of drugs related to the central nervous system.

Eighteen healthy men were eligible for the research. Their average (±standard deviation) age, body mass index, resting blood pressure, and resting heart rate were 32.94±4.14 years old, 26.52±3.29 kg/m^2, 125.83±8.68/77.61±7.78 millimeter of mercury (mmHg), and 76.56±9.62 Beats Per Minute (bpm), respectively.

All procedures in this research were consistent with the Declaration of Helsinki and approved by the Human Research Ethics Committee of Srinakharinwirot University, Thailand, with the Research Project No. SWUEC-G-323/2564E.

Study design and procedures

This research employed a within-subjects comparison method. Each participant reported to a laboratory for two consecutive days. The first day constituted the "baseline". They arrived at the laboratory at 8:00 a.m. in their normal caffeine consumption state, then consumed coffee at 8:10 a.m., the average time for the participants' morning coffee. This coffee was prepared by a researcher between 8:00 and 8:05 a.m. to be similar in type, taste, and quantity to those typically consumed by each participant. The participants consumed the coffee within 5 minutes and had 45 minutes of rest for absorption, while plain water was allowed ad libitum. At 9:00 a.m., they completed the CWSQ, followed by the EFs assessment tests. Thereafter, they started to abstain from caffeinated food or beverages. They returned to the laboratory at 8:00 a.m. the following day, which constituted "caffeine abstinence", to complete the CWSQ and perform the tests in the same manner as the first day. To standardize the study, the laboratory was enclosed, kept quiet, and maintained at a room temperature of 25-27 °C. The participants were asked to report to the

laboratory after sleeping for at least seven hours, fasting for 8–10 hours, and abstaining from taking muscle relaxants or pain-relieving drugs, alcohol consumption, and strenuous exercise for 24 hours.

Measurements

The amount of caffeine intake in milligrams was calculated by taking participants' coffee consumption data (i.e., type and amount of coffee consumed), which were obtained from the caffeine consumption questionnaire[23], to compare with the average caffeine content of Thai iced coffee, obtained from manufacturers.

The CWSQ is a 23-item questionnaire grouped into seven factors. The original English version of this questionnaire[17] was translated into Thai, using back translation[24], to be consistent with the participants' native language. The translated version, with the Cronbach alpha internal consistency coefficient of 0.80, was then used in this research.

According to Juliano et al.[17], the participants were instructed to rate each item regarding how they felt right now using a 5-point scale from 0, "not at all" to 4, "extremely". A total score for all items and a score for each factor were calculated, and as eight items were positively worded, their score was reversed before analysis.

The EFs assessment tests consisted of the TMT and FKT, which are a part of the Computerized Cognitive Test Battery of the Sport Science Bureau, Department of Physical Education, Ministry of Tourism and Sports, Thailand. The reliability of these tests is 0.52–0.95 and 0.53–0.76, respectively[22]. The program was downloaded from www.dpe.go.th and installed on a network computer using a standard keyboard and mouse. The TMT was divided into Part A (TMTA) and Part B (TMTB), comprising 25 circles distributed over the screen. The circles in the TMTA are numbered 1–25, and those in the TMTB include numbers (1–13) and letters (A–L). For both parts, the participants were required to draw lines using the mouse to connect the circles in ascending order, from 1 to 25, in the TMTA and alternating between the numbers and the letters in the TMTB as quickly and accurately as possible. The dependent variables were completion time, number of errors, the TMTB and TMTA completion time difference (B–A difference), and the TMTB and TMTA completion time ratio (B/A ratio). The FKT comprised congruent and incongruent trials, where a line of five arrows appears on a screen pointing to the left or right. In the congruent trials, all arrows faced the same direction. In the incongruent trials, a center arrow pointed in the opposite direction to the flanking arrows. The participants were asked to see the direction of the center arrow. They pressed the letter "Z" on a keyboard using their left hand when the arrow pointed to the left and pressed the symbol "/" using their right hand when the arrow pointed to the right. There were 40 trials, with an equal number of the congruent and incongruent trials appearing randomly. Each appearance lasted 500 ms, and the interstimulus intervals averaged 2.3±0.7 s and ranged from 1.0 to 3.9 s[22,25]. The average reaction times of correct responses and the accuracy of responses were recorded.

Data analysis

All variables were analyzed for mean and standard deviation (S.D.). The paired-sample t-test and Wilcoxon signed-rank test were employed to determine differences between the baseline and the caffeine abstinence conditions. Statistical significance was accepted at p-value<0.05. Data were analyzed using IBM SPSS Statistics 23.0 (Armonk, NY, USA). The proportion of the participants with variables changed from the baseline was also calculated.

Results

General information of the participants

Table 1 shows the duration of coffee consumption, the quantity of daily coffee and caffeine intake, the duration

of computer use per workday, and the duration of exercise per week of the participants.

Table 1 The participants' information regarding coffee and caffeine consumption, computer use, and exercise

Information	Mean±S.D.	Range
Coffee consumption duration (year)	6.28±2.88	1–13
Daily coffee consumption (cup)	1.44±0.62	1–3
Daily caffeine consumption (mg)	225.83±88.80	166–500
Computer use for work (h/d)	5.33±0.77	4–6
Exercise (min/wk)	274.17±183.99	60–630

S.D.=standard deviation

Caffeine withdrawal symptoms

Caffeine abstinence increased the mean score for the total withdrawal symptoms (p-value<0.01, Z=−3.73) and for factor 1 (p-value<0.01, Z=−3.72), 2 (p-value<0.01, 95% CI [−9.22, −4.56]), 3 (p-value<0.01, Z=−3.34), 4 (p-value<0.01, Z=−3.51), 6 (p-value< 0.01, Z=−3.26), and 7 (p-value<0.01, Z=−2.83), with the proportion of the participants at 100.0%, 100.0%, 100.0%, 77.8%, 88.9%, 77.8%, and 55.6%, respectively. Caffeine abstinence also increased the score for factor 5 in 27.78% of the participants. Some participants had a reduction in score for factors 3 (5.6%), 4 (5.6%), 5 (16.7%), and 6 (5.6%), and the score for factors 3–7 in some participants was unchanged (Table 2).

Executive functions

Caffeine abstinence increased the mean number of errors in the TMTB (p-value=0.05, Z=−1.96), with the proportion of the participants at 27.8%. Caffeine abstinence also increased the value of the TMTA and TMTB completion time, B–A difference, B/A ratio, and the FKT congruent and incongruent average reaction times of correct responses, and accuracy of responses in 66.7%, 50.0%, 38.9%, 27.8%, 61.1%, 5.6%, 33.3%, and 33.3% of the participants, respectively. In contrast, some variables decreased or did not change in some participants (Table 3).

Table 2 The scores (Mean±S.D.) of caffeine withdrawal symptoms and the proportion (%) of participants with increased and decreased score after caffeine abstinence

Caffeine withdrawal symptom scores	Mean±S.D.		Proportion of participants with changes in the scores after caffeine abstinence, % (n)	
	Baseline	Caffeine abstinence	Increased score	Decreased score
Total score	17.56±8.91	42.61±13.56**	100.0% (18)	0.0%
Factor 1 – Drowsiness/fatigue	2.28±2.40	8.72±3.77**	100.0% (18)	0.0%
Factor 2 – Decreased alertness/ difficulty concentrating	5.67±3.50	12.56±4.34*	100.0% (18)	0.0%
Factor 3 – Mood disturbances	1.00±2.22	3.72±3.30**	77.8% (14)	5.6% (1)
Factor 4 – Decreased sociability/ motivation to work	7.39±3.31	12.89±2.78**	88.9% (16)	5.6% (1)
Factor 5 – Nausea/upset stomach	0.78±1.93	1.06±1.83	27.8% (5)	16.7% (3)
Factor 6 – Flu-like feelings	0.39±1.20	2.28±2.08**	77.8% (14)	5.6% (1)
Factor 7 – Headache	0.06±0.24	1.44±1.50**	55.6% (10)	0.0%

Paired between baseline and caffeine abstinence condition: *p-value<0.05 and **p-value<0.01, S.D.=standard deviation

Table 3 The results (Mean±S.D.) of executive function assessments and the proportion (%) of participants with increased and decreased values after caffeine abstinence

Executive function tests			Mean±S.D.		Proportion of participants with changes in the scores after caffeine abstinence, % (n)	
			Baseline	Caffeine abstinence	Increased value	Decreased value
Trail Making Test	A	Completion time (s)	29.73±5.81	30.44±6.26	66.7% (12)	33.3% (6)
		Number of Errors	0.11±0.47	0.00±0.00	0.0%	5.6% (1)
	B	Completion time (s)	46.90±10.88	50.00±13.83	50.0% (9)	50.0% (9)
		Number of Errors	0.39±1.20	2.11±3.22*	27.8% (5)	16.7% (3)
	B–A difference		17.17±8.66	19.57±13.49	38.9% (7)	61.1% (11)
	B/A ratio		1.59±0.30	1.69±0.51	27.8% (5)	72.2% (13)
Franker Test	Congruent	Average reaction times of correct responses (msec)	392.72±34.67	398.22±38.95	61.1% (11)	38.9% (7)
		Accuracy of responses (%)	99.44±2.36	100.00±0.00	5.6% (1)	0.0%
	Incongruent	Average reaction times of correct responses (msec)	444.50±39.91	451.61±50.86	33.3% (6)	66.7% (12)
		Accuracy of responses (%)	96.28±5.74	100.00±0.00	33.3% (6)	44.4% (8)

Paired between baseline and caffeine abstinence condition: * p–value<0.05, S.D.=standard deviation

Discussion

This research evaluated withdrawal symptoms and EFs after 24–hour caffeine abstinence in office workers with habitual coffee consumption and compared the results with preceding baseline measures during typical caffeine consumption in the same participants. The finding was that caffeine abstinence increased the mean score for the total withdrawal symptoms and for factor 1–drowsiness/fatigue, factor 2–decreased alertness/difficulty concentrating, factor 3–mood disturbances, factor 4–decreased sociability/motivation to work, factor 6–flu–like feelings, and factor 7–headache, with the proportion of the participants at 100.0%, 100.0%, 100.0%, 77.8%, 88.9%, 77.8%, and 55.6%, respectively. After caffeine abstinence, the score for factor 5–nausea/upset stomach in 27.8% of the participants increased. In contrast, those for factors 3–6 in some participants decreased, and factors 3–7 in some participants did not change. Caffeine abstinence also increased the mean for the TMTB number of errors, with this proportion of the participants at 27.78%. Furthermore, caffeine abstinence increased the value for the TMTA and TMTB completion time, B–A difference, B/A ratio, and FKT congruent and incongruent average reaction times of correct responses, and the accuracy of responses in 66.7%, 50.0%, 38.9%, 27.8%, 61.1%, 5.6%, 33.3%, and 33.3% of the participants, respectively. In contrast, some variables decreased or did not change in some participants.

The increase in the mean score of caffeine withdrawal symptoms after caffeine abstinence in this research is consistent with the experimentally controlled prospective study of Juliano et al.[17] that found greater total withdrawal symptoms, drowsiness/fatigue, low alertness/difficulty concentrating, mood disturbances, low sociability/motivation to work, flu–like feelings, and headache after 16–hour caffeine abstinence compared with the baseline ad lib. consumption, without any significant difference in nausea/upset stomach. This may be due to the similarity of the research in terms of design (caffeine abstinence

compared with preceding baseline ad lib. consumption), caffeine abstinence period (as aligned with the critically reviewed literature of Juliano and Griffiths[6], in which onset of symptoms typically occurs 12–24 hours after abstinence), and the questionnaire used (the 23-item CWSQ comprising seven factors). Consistent with earlier evidence[6,17], the findings of this research indicate that 24-hour caffeine abstinence can produce withdrawal symptoms or subjective effects that are significantly more repulsive than the daily, routine experiences of office workers with habitual coffee consumption, and the translated CWSQ version (Thai language) can distinguish disorders between caffeine consumption and caffeine abstinence conditions. Furthermore, since the questionnaire used in this research was translated from the CWSQ of Juliano et al.[17], the lack of a significant increase in the mean score for nausea/upset stomach after caffeine abstinence may be due to low internal consistency for this factor in the original questionnaire. The score of this factor may increase when the caffeine abstinence period is longer than 24 hours. These assumptions should be evaluated in future research.

The proportion of participants with increased scores for headache and nausea/upset stomach after caffeine abstinence in this research is comparable to the rigorous review by Juliano and Griffiths[6], which revealed the median percentage of participants reporting the symptoms in the experimental research at 50.0% and 21.0%, respectively. This consistency supports the headache as a valid criterion of caffeine withdrawal and underscores the need for future research to assess nausea/upset stomach because earlier evidence has suggested that they are valid symptoms of caffeine withdrawal[7] and can result in significant impairments for individuals affected[17]. However, the proportion of participants with increased scores for the other factors in this research is greater than that of the critical review by Juliano and Griffiths[6]. This difference is due to the classification of individual symptoms into clusters/factors/categories. While this research used the CWSQ with seven factors, the prior reviewed literature identified 49 symptom categories[6]. This research is the first to use the translated CWSQ to investigate caffeine withdrawal in Thai populations.

The findings of this research are also consistent with those of prior experimental research showing the negative impacts of caffeine abstinence in specific populations with regular coffee consumption. For instance, Rogers et al.[26] studied university students and found that overnight caffeine abstinence impairs cognitive and psychomotor performance, decreases alertness and clear-headedness, and increases the perception of difficulty and tiredness in cognitive tasks. The experiment in team-sport athletes by Bougrine et al.[27] also demonstrated that 24-hour caffeine abstinence can impair cognitive abilities. Indeed, this research is the first to study male office workers who had computer typing as their primary job, using the TMT and FKT for evaluating the EFs after 24-hour caffeine abstinence preceded by baseline typical caffeine consumption. The participants, assessment methods, and study design of this research differ from those of the aforementioned research[26,27]. Rogers et al.[26] investigated the cognitive performance of female university students using a test battery, including focus of attention to the task, tapping speed task, simple reaction time task, impulsivity task, and hand steadiness task after overnight caffeine abstinence, followed by supplementation of a placebo or caffeine. Bougrine et al.[27] evaluated the cognitive abilities and side effects of caffeine consumption in female athletes using a test battery (i.e., simple reaction time test, choice reaction time test, attention task test, and mental rotation test) and questionnaire, respectively, after supplementation with a placebo or caffeine preceded by 24-hour caffeine abstinence. The consistency of the results of this and prior research[26,27], despite these differences, suggests that natural caffeine abstinence for 24

hours is detrimental to the neurological and psychomotor outcomes of working-age populations with habitual coffee consumption.

This research used the TMT and FKT to examine the EFs because both tests correspond with the participants' occupational tasks. They are the commonly used neuropsychological tests in general and clinical settings[19,20]. The CWSQ of Juliano et al.[17] was employed in this research to assess caffeine withdrawal symptoms because of its high internal consistency and sensitivity to caffeine cessation in regular caffeine consumers[18]. Nevertheless, a rigorous review of caffeine withdrawal has suggested that a wide range of factors can influence the results of the cognitive tests and questionnaire, eventually leading to a diversity of results in different research[6]. Since this review has suggested that peak intensity of withdrawal symptoms can range from 20-51 hours[6], the finding of this research is that there is no significant difference for the other variables of the TMT and FKT, except for the TMTB number of errors between caffeine abstinence and baseline typical consumption, which may result from the short time between the start of caffeine abstinence and the start of assessments. Moreover, this finding may be due to other factors, such as learning effects (the participants completed the CWSQ and EFs tests during baseline typical consumption before caffeine abstinence), low sensitivity of the TMT and FKT to measure the caffeine abstinence effects, or low caffeine consumption (the mean for caffeine consumption of the participants in this research was 2.87±0.99 mg/kg/d, which is classified as a mild consumer[28]). However, future research is warranted to elucidate these assumptions.

The mechanism of withdrawal symptoms and impaired EFs after caffeine abstinence in this research may be explained by the results of previous research. Research using the functional magnetic resonance imaging (fMRI) method revealed that the TMTB activates the ventral and dorsal visual pathways and the medial pre-supplementary motor area[29]. Using a continuous electroencephalogram (EEG) to assess the brain areas activated by the FKT, it was found that this task elicits the mid-frontal cortex, comprising the anterior cingulate cortex, recognized as a neural "hub", which is critically implicated in integrating cognitive, motor, and emotional control functions[30]. These findings align with research examining brain activity during a working-memory task, using the fMRI technique, indicating that caffeine abstinence reduces dorsolateral prefrontal cortex activity. Indeed, this brain region is critical for the execution of attention processes[31].

Furthermore, the research examining the neurological and subjective effects of caffeine withdrawal demonstrated that 24-hour caffeine abstinence can change cerebral blood flow velocity, increase EEG theta and decrease beta 2 power, increase the measures of tired, fatigued, sluggish, and weary, and decrease the ratings of energetic, friendly, lively, and vigor[14]. According to the findings of the research[14,29-31], caffeine abstinence in this research may have produced changes in the brain, such as blood flow and EEG, during rest, and while performing the TMT and KFT, eventually resulting in withdrawal symptoms and impaired EFs. However, more research is required to explore the mechanisms underlying the effects of caffeine abstinence on caffeine withdrawal and EFs.

Conclusion

The results of this experimental research suggest that caffeine abstinence for 24 hours produces withdrawal symptoms and impaired EFs in office workers with regular coffee consumption, and its impacts vary between individuals. This will increase awareness of habitual caffeine consumers about caffeine's adverse effects and provide information regarding the safety of caffeine-related occupations. Future research is needed to elucidate the impacts of caffeine on withdrawal symptoms and EFs in occupations and to clarify the underlying mechanisms.

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Conflict of interest

The authors declare no conflicts of interest, financial support, or sponsorship.

References

1. Asavatharakul N, Kalayasiri R. Caffeine addiction and mental health of employees in an organization in Bangkok. Chulalongkorn Med J 2023;67.
2. Burananonont PR, Dumrongsiri A. Factors affecting thai consumer's choice of coffee shops. Master thesis, thammasat university, sirindhorn international institute of technology [serial on the Internet]. Pathum Thani: thammasat university; 2022 [cited 2025 Jan 5]. Available from http://ethesisarchive. library. tu. ac. th/thesis/2022/TU_2022_6322040285_16673_22898.pdf
3. Thongrawd C, Rittboonchai W. Factors affecting coffee consumers' behavior: a case study of consumption in Metropolitan Bangkok. Interdiscip Res Rev 2018;13:1–6.
4. Jitra S. Risk management of foods containing caffeine [monograph on the Internet]. Bangkok: FDA Journal; 2012 [cited 2024 May 13]. Available from https://he01.tci-thaijo.org/index.php/fdajournal/article/download/138481/102937/
5. American Psychiatric Association. DIAGNOSTIC AND STATISTICAL MANUAL OF MENTAL DISORDERS (DSM-5™). Arlington: American Psychiatric Pub 2013.
6. Juliano LM, Griffiths RR. A critical review of caffeine withdrawal: empirical validation of symptoms and signs, incidence, severity, and associated features. Psychopharmacol 2004;176:1–29.
7. Ozsungur S, Brenner D, El-Sohemy A. Fourteen well-described caffeine withdrawal symptoms factor into three clusters. Psychopharmacol 2009;201:541–8.
8. JC-Lookingglass. The Office Staff: Your Duties from 9 to 5 [monograph on the Internet]. Makati: John Clements Consultants Inc.; 2024 [cited 2025 Jan 26]. Available from: https://johnclements.com/the-looking-glass/career-advice/office-staff-your-duties.
9. Nyongesa MK, Ssewanyana D, Mutua AM, Chongwo E, Scerif G, Newton CR, et al. Assessing executive function in adolescence: A scoping review of existing measures and their psychometric robustness. Front Psychol 2019;10:311.
10. Balconi M, Angioletti L, Crivelli D. Neuro-empowerment of executive functions in the workplace: the reason why. Front Psychol 2020;11:1519.
11. Nye CD, Ma J, Wee S. Cognitive ability and job performance: Meta-analytic evidence for the validity of narrow cognitive abilities. J Bus Psychol 2022;37:1119–39.
12. Tan CS, Nasir H, Pheh KS, Cong CW, Tay KW, Cheong JQ. The mediating role of work engagement in the relationship between executive functioning deficits and employee well-being. Int J Environ Res Public Health 2022;19:13386.
13. Mullins W. The effects of caffeine and caffeine withdrawal/deprivation on hostage negotiator performance. J Police Crisis Negot 2003;3:39–60.
14. Sigmon SC, Herning RI, Better W, Cadet JL, Griffiths RR. Caffeine withdrawal, acute effects, tolerance, and absence of net beneficial effects of chronic administration: cerebral blood flow velocity, quantitative EEG, and subjective effects. Psychopharmacology 2009;204:573–85.
15. Eslami A, Nassif NT, Lal S. Neuropsychological performance and cardiac autonomic function in blue-and white-collar workers: a psychometric and heart rate variability evaluation. Int J Environ Res Public Health 2023;20:4203.
16. Raine A, Laufer WS, Yang Y, Narr KL, Thompson P, Toga AW. Increased executive functioning, attention, and cortical thickness in white-collar criminals. Hum Brain Mapp 2012;33:2932–40.
17. Juliano LM, Huntley ED, Harrell PT, Westerman AT. Development of the caffeine withdrawal symptom questionnaire: caffeine withdrawal symptoms cluster into 7 factors. Drug Alcohol Depend 2012;124:229–34.
18. Shephard A, Barrett SP. The impacts of caffeine administration, expectancies, and related stimuli on coffee craving, withdrawal, and self-administration. J Psychopharmacol 2022;36:378–86.

19. Ashendorf L, Jefferson AL, O'Connor MK, Chaisson C, Green RC, Stern RA. Trail Making Test errors in normal aging, mild cognitive impairment, and dementia. Archives of Clinical Neuropsychol 2008;23:129–37.
20. Diamond A. Executive functions. Annu Rev Psychol 2013; 64:135–68.
21. Gutchess A, Ksander J, Millar PR, Uzundag BA, Sekuler R, Boduroglu A. Cultural differences in performance on Eriksen's flanker task. Atten Percept Psychophys 2021;83:882–98.
22. Department of physical education. Sports intelligence: The role of cognitive performance on sporting success in Thai youth athlete. Bangkok: Thailand; 2020.
23. Preston J, Mura A. Lessons from neuropsychologist John Preston, Psy. D. on stress, sleep, energy, and solutions that backfire. Int J Coach Organ 2006;4:16–21.
24. Brislin RW. Back-translation for cross-cultural research. J Cross-Cult Psychol 1970;1:185–216.
25. Addicott MA, Laurienti PJ. A comparison of the effects of caffeine following abstinence and normal caffeine use. Psychopharmacol 2009;207:423–31.
26. Rogers PJ, Heatherley SV, Hayward RC, Seers HE, Hill J, Kane M. Effects of caffeine and caffeine withdrawal on mood and cognitive performance degraded by sleep restriction. Psychopharmacol 2005;179:742–52.
27. Bougrine H, Ammar A, Salem A, Trabelsi K, Jahrami H, Chtourou H, et al. Effects of various caffeine doses on cognitive abilities in female athletes with low caffeine consumption. Brain Sci 2024;14:280.
28. Filip A, Wilk M, Krzysztofik M, Del Coso J. Inconsistency in the ergogenic effect of caffeine in athletes who regularly consume caffeine: is it due to the disparity in the criteria that defines habitual caffeine intake?. Nutrients 2020;12:1087.
29. Allen MD, Owens TE, Fong AK, Richards DR. A functional neuroimaging analysis of the trail making test-B: implications for clinical application. Behav neurol 2011;24:159–71.
30. Robble MA, Schroder HS, Kangas BD, Nickels S, Breiger M, Iturra-Mena AM, et al. Concordant neurophysiological signatures of cognitive control in humans and rats. Neuropsychopharmacol 2021;46:1252–62.
31. Lin YS, Weibel J, Landolt HP, Santini F, Slawik H, Borgwardt S, et al. Brain activity during a working memory task after daily caffeine intake and caffeine withdrawal: a randomized double-blind placebo-controlled trial. Sci Rep 2023;13:1002.