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To brew or not to brew: caffeine consumption motivations and psychological outcomes among young adults

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ABSTRACT

Caffeine is the most widely consumed psychoactive substance globally, with both beneficial and adverse psychological effects reported at different levels of consumption. This study investigates the role of motivations in moderating the relationship between caffeine intake and psychological outcomes, specifically stress, anxiety, and depression, among young adults ($N=176$, $M_{\text{age}} = 22.66$) utilising a cross-sectional design. Moderation analysis revealed that hedonic motivations, including emotional symptom reduction and enjoyment, moderate the relationship between caffeine intake and stress, as well as anxiety at low levels of motivation. Conversely, motivation for emotional symptom reduction moderated the relationship between caffeine intake and depression at high levels of consumption. These findings provide preliminary insights into how motivations influence the psychological impacts of caffeine and suggest potential directions for future research with implications for intervention. Further research is recommended to explore these findings across different populations and to validate motivation-based strategies for improving individual and public health outcomes.

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Introduction

Caffeine, the most widely consumed psychoactive substance globally, is consumed by over 85% of the population (Abdella et al., 2023). Found naturally in coffee, tea, and cocoa, and synthetically in energy drinks and medications, its average daily intake is around 150 mg, with young adults often consuming higher amounts (161–424 mg/day) (Abdella et al., 2023; Alateeq et al., 2021; Magalhães et al., 2021). Caffeine's primary physiological effects stem from its role as competitive antagonist at adenosine A1 and A2A receptors, reducing adenosine-mediated inhibition, thereby enhancing alertness, making it particularly appealing to young adults facing academic, occupational, and social pressures (Urry & Landolt, 2014).

While low to moderate caffeine intake (<400 mg/day) is generally regarded as safe (Smith et al., 2000; Wikoff et al., 2017) and linked to health benefits (Doepker et al., 2022; Mendoza et al., 2023), excessive consumption (>400 mg/day) is associated with negative outcomes, including cardiovascular symptoms, sleep disturbances, and mood dysregulation (Reddy et al., 2024; Smith et al., 2003). The psychological effects of caffeine, however, remain less clear. Some studies suggest protective effects, while others report detrimental effects, particularly at higher intake levels. Conversely, some research finds no significant associations between caffeine consumption and psychological outcomes, further adding to the ambiguity in the literature.

This conflicting evidence highlights the complexity of caffeine's impact on mental health and the need to investigate factors that might explain these mixed findings. One potential factor is the role of consumption motivations –which may influence how caffeine affects psychological outcomes. The current study aims to explore this relationship, focusing on stress, anxiety, and depression in young adults, a population uniquely susceptible to both high caffeine use and mental health challenges.

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Literature review

The increasing prevalence of mental health challenges alongside rising caffeine consumption has prompted research into their relationship. However, the existing literature remains limited and divided.

Caffeine and stress

Caffeine consumption has been shown to elevate stress-related physiological responses, including increased cortisol secretion and heightened blood pressure during acute stress (Stachowicz & Lebedzińska, 2016). Functional imaging studies also suggest that caffeine can alter brain connectivity, reducing activity in stress-regulating regions (Magalhães et al., 2021). Conversely, several studies have reported a non-significant relationship between caffeine intake and stress, particularly in studies controlling for lifestyle factors like sleep, diet, and exercise (eg Richards and Smith, 2016; Makki et al., 2023). These mixed findings suggest variability in caffeine's effects, likely due to individual sensitivity or contextual differences that remain unexplored.

Caffeine and anxiety

Similarly to stress, caffeine has been implicated in anxiety-related outcomes. Through antagonism of adenosine A1 and A2A receptors, caffeine has been demonstrated to modulate dopaminergic and noradrenergic pathways, although effects are context and dose-dependent (Maximino et al., 2011). While higher doses of caffeine have been associated with increased physiological arousal and anxiety-like responses, emerging evidence indicates that caffeine's effects on dopaminergic signalling are not uniformly excitatory. For example, low dose caffeine has been shown to attenuate dopamine release in the nucleus accumbens shell via A2A receptor antagonism, particularly within mesolimbic reward pathways (Bassareo et al., 2024), highlighting the complexity of caffeine's neuropharmacological effects.

Numerous studies have linked high caffeine intake to increased anxiety across diverse populations, including university students, adolescents, and working adults (Aleem et al., 2024; Cho et al., 2024; Richards & Smith, 2016). These findings align with a recent meta-analysis that found high caffeine intake to increase the risk of anxiety significantly (Liu et al., 2024). The same study demonstrated an omnipresence effect even at relatively low doses compared to non-consumers. However, there is some evidence that effects vary by source and dose. Long-term tea consumption, for instance, has been associated with reduced anxiety, potentially due to the presence of anxiolytic compounds like L-theanine (Chan et al., 2018; Unno et al., 2017). Similarly, moderate coffee consumption may exert protective effects in some populations, suggesting a dose-dependent and context-specific relationship (Nouri-Majd et al., 2022).

Caffeine and depression

A significant amount of research suggests a protective effect of caffeine against depression at moderate doses. Of note, a consistent finding is that of a J-shaped relationship whereby depression decreases initially with increased caffeine intake before rising beyond a certain peak (Bao et al., 2022; Grosso et al., 2016; Min et al., 2023). However, across the studies suggesting such a relationship, peaks vary significantly from 90 to 400mg/day. Nonetheless, this relationship may be attributed to caffeine's initial mood-related effects at low doses, given its role in dopaminergic signalling in the nucleus accumbens shell via A2A receptor antagonism (Bassareo et al., 2024; Urry & Landolt, 2014). However, as previously noted, caffeine's pharmacological effects are complex and likely dose-dependent, with higher levels of intake associated with physiological overstimulation and adverse psychological outcomes (Min et al., 2023).

Conversely, other studies have reported a significant inverse linear relationship between caffeine intake and depression, with the risk of depression decreasing by 8% for each cup/day increment without reaching a peak. Nonetheless, conflicting results have been reported, with some studies linking caffeine intake to higher rates of depression (Makki et al., 2023; Richards & Smith, 2016), even at relatively low intake levels (>142.8mg/day).

Caffeine consumption motivations

Motivation is a crucial driver of deliberate behaviour, serving as a catalyst for action towards a goal (Ajzen, 1991). In the context of caffeine consumption motivations, Graham's seminal work (Graham, 1988) identified four key motivations: stimulant and relief (personal factors) and sociability and beverage (social factors). Subsequently, a revised scale (Caffeine Motives Questionnaire) (Irons et al., 2014) identified motivations related to alertness, negative affect relief, reinforcing effects, and weight control using a theoretical approach to scale development. Conversely, an inductive approach was used to develop the Motivations for Caffeine Consumptions Questionnaire (Ágoston et al., 2018), which included dimensions like taste and habit, reflecting hedonic and routine-driven motivations. Motivations for caffeine consumption have also been shown to vary by source (Choi, 2020). Coffee and energy drinks are predominantly consumed for alertness and habitual reasons, while tea is for social purposes.

Additionally, demographic differences exist; younger adults consume caffeine for alertness, while older individuals favour hedonic reasons, such as taste and habit (Ágoston et al., 2018). Age-related differences in caffeine consumption motivations reflect broader lifestyle and routine patterns (Turner et al., 2023). Adolescents tend to consume caffeine in social contexts, while young adults, particularly students, are primarily driven by cognitive enhancement and mood reinforcement (Lone et al., 2023; Ludden et al., 2017). While these studies emphasise consumption patterns, other research has explored the broader impact of motivations on substance-use outcomes. A meta-analysis found that motivations moderate caffeine's effects on sports performance, with motivational and pharmacological effects contributing equally, though psychological outcomes were not addressed (Shabir et al., 2018).

Research on other substance use provides a framework for understanding how motivations might moderate caffeine's psychological effects. Cox and Klinger's (Cox and Klinger, 2011) motivational model explains why individuals engage in substance use by focusing on the pursuit of incentives that fulfil personal needs, such as increasing positive feelings or reducing negative ones. Although initially developed for alcohol use (Anthenien et al., 2017), the model is applicable to understanding motivations for using various substances. For example, for cannabis, coping motives have been shown to amplify adverse psychological outcomes, such as stress and depression (Glodosky & Cuttler, 2020). Similarly, ecstasy use for coping or energy motives predicted problematic patterns and poorer psychological outcomes (Sottile et al., 2023). Extending these findings to caffeine consumption, it is plausible that motivations like alertness, social interaction, taste, emotional relief, or symptom reduction could shape psychological outcomes. However, this speculation has yet to be examined.

Current study

Given the widespread use of caffeine and its potential psychological effects, there is a need to firmly establish the association between caffeine intake and different psychological outcomes such as stress, anxiety and depression.

Young adults are a key demographic for examining the relationship between caffeine intake and psychological outcomes, as they often rely on caffeine to manage academic, occupational, and social demands in fast-paced, high-pressure environments (Choi, 2020). Motivations have been shown to moderate negative outcomes for alcohol (Hauck-Filho et al., 2012), cannabis (Glodosky & Cuttler, 2020), and amphetamines (Sottile et al., 2023). While evidence demonstrates that motivations influence caffeine's effects on sports performance and response time (Shabir et al., 2018) and link substance use to psychological outcomes, their role in moderating caffeine's psychological impacts remains unclear. Investigating this relationship could offer critical insights for public health interventions, especially for young adults at risk of stress, anxiety, and depression. This study aims to address this gap by exploring how caffeine consumption motivations moderate the relationship between intake and psychological outcomes in young adults, hypothesising that: Caffeine consumption motivations will moderate the relationship between caffeine intake and psychological outcomes, specifically stress, anxiety, and depression.

Method

Participants and design

A cross-sectional survey method was employed. The predictor variable was caffeine intake, measured in milligrams per week (mg/w). Psychological outcomes (stress, anxiety, and depression) comprised the criterion variables. Motivations for caffeine consumption were used as moderators. Power analysis (power = 80%, $\alpha = 0.05$) using G*Power (Faul et al., 2007) for an expected medium effect size, $f^2 = 0.15$ (Liu et al., 2024; Wang et al., 2016) suggested a sample size of 123. Convenience sampling was used to recruit participants between the ages of 18 and 30 via SONA (online research platform) between March and August 2024. One hundred seventy-six participants (99 female, 68 male, nine third gender) with a mean age of 22.66 ± 3.27 were included in the analysis. 80.6% of participants were studying, and 47.2% were working.

Measures

Caffeine intake

Caffeine intake was measured using an adapted methodology (Richards & Smith, 2016). Participants were asked to indicate how often they consumed coffee, tea, soft drinks and energy drinks in an average week. Due to the varying levels of caffeine, coffee and tea were separated into four and three items, respectively, for commonly consumed types. Soft drinks and energy drinks used single items. For each caffeine source, participants were prompted to recall how many standard-sized servings they consumed over the last week. To facilitate accuracy, participants were provided with examples of beverages (eg for example one can of Coke, for example one cup of coffee). Total weekly caffeine consumption was calculated by multiplying participant's drinks by the respective caffeine content using previously established values (Brice and Smith, 2002).

Psychological outcomes (depression, anxiety, stress) were measured using the three subscales of the Depression, Anxiety, Stress Scale – 21 Items (DASS-21) (Lovibond & Lovibond, 1995). Participants rated 21 items (eg I felt that I was rather touchy) on a 4-point rating scale (0=Did not apply to me at all, 3=Applied to me very much) related to the last week. Items of each subscale were summed and multiplied by two as required by the authors. All subscales demonstrated good internal consistency reliability ($\alpha > 0.861$) for the current sample.

Caffeine consumption motivations

Two previously validated scales (Ágoston et al., 2018; Irons et al., 2014) exhibited poor factor loadings and inadequate internal reliability for the current sample, suggesting unsuitability for further analysis. As the two scales tapped on different motivations, items from both scales were collated, and an exploratory factor analysis was conducted to examine the underlying factor structure within the current sample to arrive at a more comprehensive scale (Supplementary Materials). Caffeine consumption motivations were then measured using the newly developed Motivation for Caffeine Intake Questionnaire (MCIQ-34). Participants rated 34 items on how likely each item represented their motivation for caffeine consumption using a 5-point rating scale (0=never, 4=always). The MCIQ-34 demonstrated good internal consistency reliability overall ($\alpha = 0.93$) as well as for each of the five subscales (Table 1). Full item factor loading is presented in Supplementary Table S1.

Procedure

Ethics approval (# H9421) was obtained from Human Research Ethics Committee, James Cook University. Participants were provided with an information sheet outlining the purpose of the study and their rights as participants. Informed consent was obtained prior to participants providing demographic information. Participants who met the age requirements were asked to indicate how often they consumed different caffeinated beverages in an average week and the brand names they most frequently consumed.

Table 1. MCIQ-34 Subscales with motivation descriptors and internal consistency.

Subscale (Items)	Motivation Descriptors	Example item	α [95% CI]
Alertness (8 items)	Increase focus, alertness, and combat fatigue.	'To help me concentrate.'	0.95 [0.95, 0.96]
Social (7 items)	As part of social interactions or shared experiences	'It is important in social situations.'	0.93 [0.91, 0.94]
Enjoyment (7 items)	For the enjoyment of taste or habitual activity.	'I like its taste.'	0.89 [0.86, 0.91]
Emotional Symptom Reduction (7 items)	To manage or improve mood related symptoms.	'It helps me deal with stress in my daily life.'	0.85 [0.81, 0.88]
Physical Symptom Reduction (5 items)	To manage or improve physical related symptoms.	'It reduces pain.'	0.75 [0.69, 0.80]

Note. α : Cronbach's alpha; CI: Confidence interval.

Subsequently, participants completed the MCIQ-34 and the DASS-21. Finally, participants were thanked for participating and presented with health information related to excessive caffeine intake.

Data analysis

Multivariate Multiple Regression (MMR; Dattalo, 2013) was used to investigate the relationships between total weekly caffeine intake and psychological outcomes. Additionally, multiple regressions were used to examine the relationships between the different sources of caffeine and psychological outcomes. Linear regression analysis investigated the relationship between caffeine motivations and caffeine intake. Furthermore, moderation analysis using the PROCESS macro was used to examine if motivations for consumption moderate the relationship between caffeine intake and psychological outcomes. MMR was conducted using R version 4.5.2 (R Core Team, 2025) using the *car* package (Fox & Weisberg, 2019). Remaining analyses were performed in SPSS (Version 29.0).

Results

Data screening and assumption testing

A Missing Value Analysis led to the removal of 60 cases with incomplete responses, while four missing single-item responses, deemed random, were replaced with item means. Assumptions were tested prior to analysis. Although the Shapiro-Wilk test indicated significant deviations from normality, these were deemed reflective of real-world variation. Stem-and-leaf plots confirmed normality for most variables except caffeine intake, which was still considered suitable for regression analysis.

Linearity and homoscedasticity of residuals were supported by scatterplot inspection. Five multivariate outliers were identified using Mahalanobis distance and removed. VIF values (1.07–2.33) indicated low to moderate multicollinearity among predictors, suggesting some reduction in unique variance but remaining within commonly accepted thresholds. The final sample consisted of 176 participants.

Descriptives and correlations

The means and standard deviations were computed for each variable of interest. Additionally, a bivariate Pearson's correlation was conducted to examine the relationship between variables of interest (see Table 2).

Caffeine intake and psychological outcomes

MMR was conducted to examine whether total weekly caffeine intake predicted psychological outcomes (anxiety, depression, and stress). The overall multivariate test was significant, $F(4, 171) = 10.55, p < 0.001$, indicating that caffeine intake was related to the set of psychological outcomes. Total weekly caffeine intake was a significant positive predictor for both anxiety ($b = 0.002, 95\% \text{ CI } [0.001, 0.004], p < 0.01$) and stress ($b = 0.003, 95\% \text{ CI } [0.001, 0.005], p < 0.001$). However, caffeine intake did not significantly predict depression, $b = -0.001, 95\% \text{ CI } [-0.002, 0.001], p = .55$. Caffeine intake explained a significant 4.4% of the variance in anxiety ($R^2 = 0.04$), 7% in stress ($R^2 = 0.07$), and a non-significant 0.2% in depression (see Table 3).

Table 2. Descriptive statistics and correlations between variables.

Variable	1	2	3	4	5	6	7	8	9	10	11	12
1. Anxiety	–											
2. Depression	0.67**	–										
3. Stress	0.79**	0.66**	–									
4. Alertness Motivation	0.16*	0.05	0.28**	–								
5. Social Motivation	0.14	0.02	0.08	0.07	–							
6. Taste/Habit Motivation	0.10	–0.02	0.14	0.23**	0.34**	–						
7. Emotional SR Motivation	0.22**	0.14	0.21**	0.35**	0.35**	0.54**	–					
8. Physical SR Motivation	0.22**	0.14	0.19**	0.25**	0.31**	0.35**	0.51**	–				
9. Caffeine from Coffee ^a	0.15	–0.07	0.13	0.29**	0.10	0.28**	0.20**	0.10	–			
10. Caffeine from Tea ^a	0.16*	0.10	0.21**	0.06	0.08	0.04	0.08	0.09	0.05	–		
11. Caffeine from Soft Drinks ^a	0.03	–0.11	0.16*	0.14	–0.01	0.17*	–0.12	0.17*	0.01	–0.15	–	
12. Caffeine from Energy Drinks ^a	0.13	0.03	0.17*	0.14	0.05	0.02	–0.05	0.13	0.01	0.03	0.33**	–
<i>Means</i>	9.81	10.92	12.95	17.38	7.90	14.75	7.99	2.88	494.46	139.15	175.00	181.59
<i>Std. Deviation</i>	9.13	10.56	10.04	9.58	7.18	7.46	6.30	3.55	626.81	173.40	266.83	436.39

Note. a – caffeine intake measured in mg per week. * $p < 0.05$, ** $p < 0.01$ (2-tailed).

Table 3. Caffeine intake as a predictor for psychological outcomes.

Outcome	<i>B</i> [95% CI]	Std. Error	β	<i>t</i>	f^2
Anxiety	0.002 [0.001, 0.004]	0.001	0.209*	2.82	0.042
Depression	–0.001 [–0.002, 0.001]	0.001	–0.046	0.55	0.00
Stress	0.003 [0.001, 0.005]	0.001	0.264**	3.62	0.075

Note. The table summarises three simple linear regressions, with weekly caffeine intake as a predictor. * $p < 0.01$, ** $p < 0.001$ (2-tailed).

To further explore the relationship between specific sources of caffeine and psychological outcomes, separate multiple regressions were conducted using total weekly caffeine intake from individual sources (coffee, tea, soft drinks, energy drinks) as predictors of each outcome (stress, anxiety, depression). With anxiety as the criterion variable, the overall model was significant, $F(4, 171) = 2.75$, $p = 0.03$, $R^2_{adj} = 0.04$, with caffeine from different sources explaining 4% of the variance in anxiety scores. Among the caffeine sources, only tea significantly predicted higher anxiety levels ($\beta = 0.16$, $t = 2.06$, $p = 0.04$, $f^2 = 0.02$), suggesting that anxiety increased as tea consumption increased.

When examining stress, a significant overall model accounted for 8% of the variance in stress scores ($R^2_{adj} = 0.08$), $F(4, 171) = 5.01$, $p < .001$. Regarding predictors, caffeine from tea ($\beta = 0.23$, $t = 3.06$, $p < 0.01$, $f^2 = 0.03$) and soft drinks ($\beta = 0.16$, $t = 2.00$, $p < 0.05$, $f^2 = 0.01$) were both significant positive predictors. Therefore, when caffeine intake from tea or soft drinks was higher, stress was also higher. Lastly, depression revealed a non-significant overall model, $F(4, 171) = 1.29$, $p = 0.26$, with no sources of caffeine significantly predicting depression. Given the minimal findings between caffeine sources, the remaining analyses were performed using total weekly caffeine.

Caffeine consumption motivations and caffeine intake

Total weekly caffeine intake for the sample was computed by adding caffeine intake from all sources ($M = 990.20 \text{ mg} \pm 881.24 \text{ mg}$), with a range from 0 to 4410 mg. A multiple linear regression was used to examine the relationship between caffeine consumption motivations and total weekly caffeine intake (see Table 4).

The overall model was significant, $F(5, 170) = 7.91$, $R^2_{adj} = 0.17$, $p < .001$. Of the five motivations, alertness, enjoyment, and emotional symptom reduction significantly predicted total weekly caffeine intake. The remaining motivations – social and physical symptom reduction – were not statistically significant predictors of caffeine consumption.

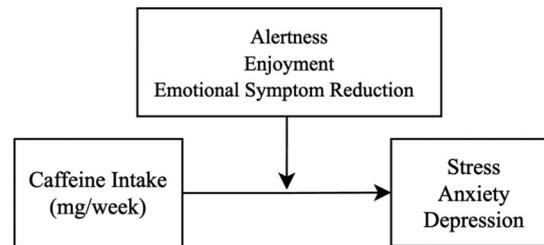
Moderating role of consumption motivations on psychological outcomes

To examine if motivations for consumption moderate the relationship between caffeine intake and psychological outcomes, a series of simple moderation analyses using ordinary least squares regression were conducted, with total weekly caffeine intake as a predictor of psychological outcome and consumption

Table 4. Caffeine consumption motivations as predictors of caffeine intake.

Subscale	<i>B</i> [95% <i>CI</i>]	Std. Error	β	<i>t</i>	<i>sr</i> ²
Alertness	29.02 [15.54, 42.50]	6.83	0.32**	4.25	0.086
Social	3.43 [-15.01, 21.87]	9.34	0.03	0.37	0.001
Enjoyment	31.96 [12.37, 51.55]	9.92	0.27*	3.22	0.049
Emotional SR	-34.50 [-60.12, -8.88]	12.98	-0.25*	-2.66	0.027
Physical SR	37.77 [-2.39, 77.94]	20.35	0.15	1.86	0.016

Note. * $p < 0.01$, ** $p < 0.001$ (2-tailed). sr^2 = partial correlations.

**Figure 1.** Conceptual moderation model.

motivations (alertness, enjoyment, emotional symptom reduction) as moderators of this relationship (see Figure 1). Only these three motivations were entered into the model as they were shown to be statistically related to caffeine intake. All psychological outcomes were entered into the model to explore possible relationships reliant on moderation. Values were conditioned at the 16th, 50th, and 84th percentile within PROCESS macro to simulate points (low, moderate, high) across continuous data.

Moderating role of alertness motivation

Moderation analysis was conducted using alertness motivation as the moderator and stress, anxiety, and depression as the criterion. No significant interaction between caffeine intake and alertness motivation was observed in all three models. Therefore, motivation for alertness was not a significant moderator in the relationship between caffeine intake and psychological outcomes.

Moderating role of enjoyment motivation

Three moderation analyses were conducted to explore the moderating role of enjoyment motivation on anxiety, stress and depression, of which two were significant. Both anxiety, $F(3, 172) = 4.75$, $p < 0.01$, $R^2 = 0.08$, and stress $F(3, 172) = 7.12$, $p < 0.001$, $R^2 = 0.11$ as the criterion yielded significant overall models. However, for depression, the model was not significant, $F(3, 172) = 0.540$, $p = 0.66$, $R^2 = .01$. For stress as the criterion, there was a significant interaction effect between caffeine intake and enjoyment motivation ($B = -0.0003$, $SE = 0.0001$, $t = -2.63$, $p < 0.01$, $f^2 = 0.04$), which is illustrated in Figure 2.

The effect of caffeine intake on stress was significant at low (16th percentile; $B = 0.005$, $SE = 0.001$, $t = 4.18$, $p < 0.001$) and moderate (50th percentile; $B = 0.003$, $SE = 0.001$, $t = 3.25$, $p < 0.01$) levels of enjoyment motivation but not at high levels of enjoyment motivation. Moreover, at low levels of caffeine intake, as motivation for enjoyment increased, stress also increased ($M_{low} = 9.01$ vs $M_{high} = 13.55$, $p < 0.01$). However, as caffeine intake increased further, stress decreased as motivation increased.

Similar to stress, with anxiety entered as the criterion, the interaction was significant, $B = -0.0002$, $SE = 0.0001$, $t = -2.40$, $p < 0.05$, with a small effect size, $f^2 = 0.03$, suggesting that the relationship between caffeine intake and anxiety is also moderated by enjoyment motivation (see Figure 3).

The effect of caffeine intake on anxiety was significant at low (16th percentile; $B = 0.004$, $SE = 0.001$, $t = 3.52$, $p < 0.001$) and moderate (50th percentile; $B = 0.002$, $SE = 0.001$, $t = 2.56$, $p < 0.05$) levels of enjoyment motivation but was non-significant at high levels of enjoyment motivation. Almost identical to stress, as caffeine intake increased, anxiety increased at low levels of enjoyment motivation level ($M = 7.00$ vs $M = 13.87$, $p < 0.05$) and moderate levels of enjoyment motivation ($M = 8.67$ vs $M = 12.15$, $p < 0.01$).

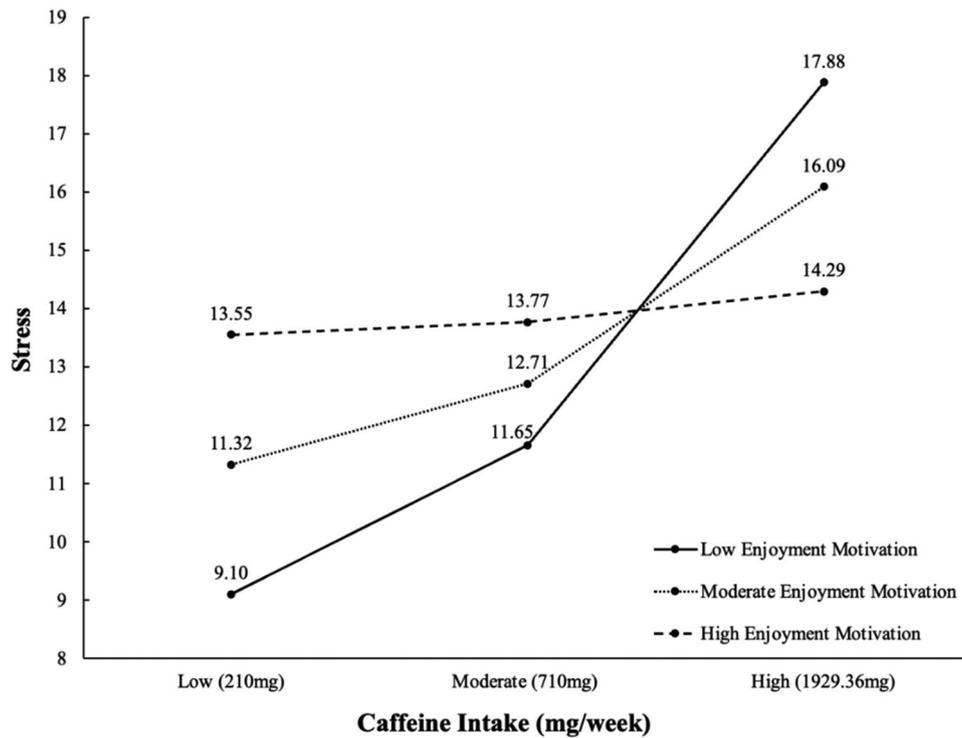


Figure 2. Moderating effect of enjoyment motivation on stress.

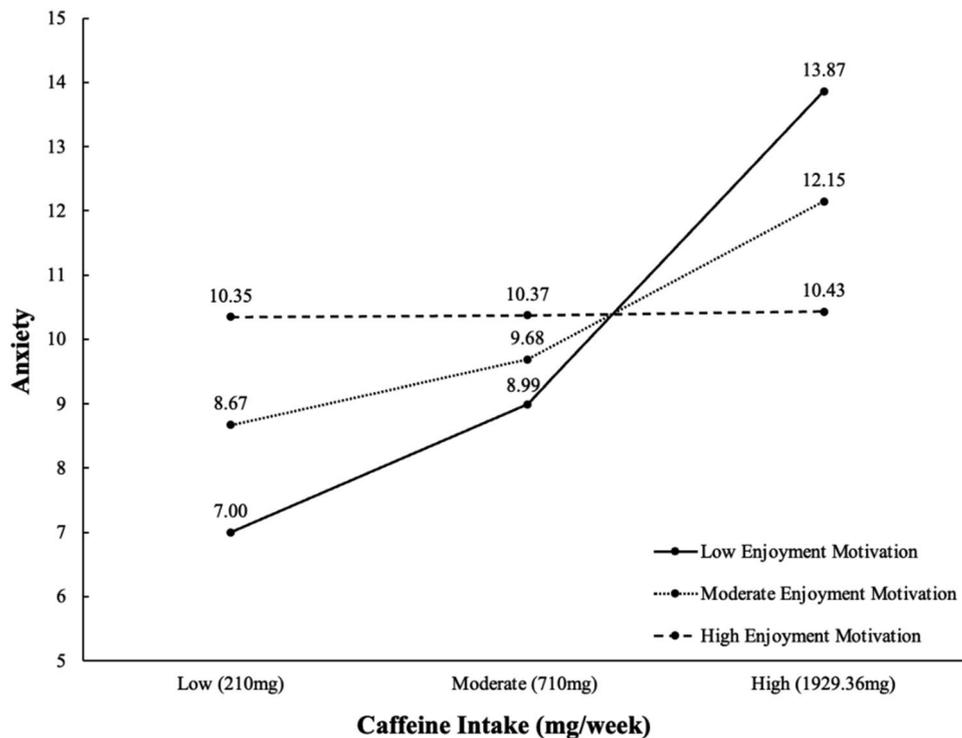


Figure 3. Moderating effect of enjoyment motivation on anxiety.

Therefore, the results illustrate that enjoyment motivation moderates the relationship between caffeine intake and stress and anxiety at low and moderate, but not high, motivation levels. At higher levels of enjoyment motivation, the positive association between caffeine intake and anxiety and stress was attenuated, suggesting that the psychological correlates of caffeine intake vary as a function of motivational context rather than reflecting a uniform effect across individuals.

Moderating role of emotional symptom reduction motivation

Subsequently, emotional motivation was examined as a moderator. The overall models were significant for stress, $F(3, 172) = 14.02, p < 0.001, R^2 = 0.20$; anxiety, $F(3, 172) = 11.02, p < 0.001, R^2 = 0.16$; and depression, $F(3, 172) = 4.31, p < 0.01, R^2 = 0.07$. The interaction between caffeine intake and emotional motivation was significant for both stress ($B = -0.0006, SE = 0.0001, t = -4.46, p < 0.001, f^2 = 0.12$) and anxiety ($B = -0.0005, SE = 0.0001, t = -3.93, p < 0.001, f^2 = 0.09$) at low and moderate levels of emotional symptom reduction motivation.

Specifically, at low levels of emotional motivation (16th percentile), higher caffeine intake led to an increase in both stress ($B = 0.007, SE = 0.001, p < 0.001$) and anxiety ($B = 0.005, SE = 0.001, p < 0.001$). However, at high levels of emotional motivation (84th percentile), the effect of caffeine intake was non-significant for both stress ($B = -0.002, SE = 0.001, p = 0.24$) and anxiety ($B = -0.002, SE = 0.001, p = 0.18$). Mirroring enjoyment, at low levels of caffeine intake, as motivation for emotional symptom reduction increased, stress ($M_{low} = 6.38$ vs $M_{high} = 16.03, p < 0.01$) and anxiety ($M_{low} = 4.28$ vs $M_{high} = 12.94, p < 0.01$) increased. However, as caffeine intake increased, low and moderate levels of motivation led to significant increases in stress and anxiety. In contrast, high motivation led to decreased stress, albeit non-significant. Interactions are presented in Figures 4 and 5.

Finally, the interaction between caffeine intake and emotional symptom reduction was significant when depression was the criterion, $B = -0.0005, SE = 0.0002, t = -2.99, p < 0.01$, and had a small effect size, $f^2 = 0.09$, confirming the presence of moderation. The effect of caffeine intake on depression was non-significant at both low (16th Percentile) and moderate (50th Percentile) levels of emotional symptom reduction and only became significant with high motivation (84th Percentile; $B = -0.004, SE = 0.001, t = -2.82, p < 0.01$). At low caffeine intake, as emotional symptom reduction motivation increased, depression increased ($M_{low} = 8.06$ vs $M_{high} = 15.55, p < 0.01$). However, at high caffeine intake, a cross-over effect was observed whereby as emotional symptom reduction motivation increased, depression decreased ($M_{low} = 11.54$ vs $M_{high} = 8.77, p < 0.01$). The interaction is presented in Figure 6.

The results indicate that emotional symptom reduction motivation moderates the relationship between caffeine intake and stress/anxiety at low to moderate levels but not high levels. Specifically, at low and moderate levels of emotional symptom reduction motivation, higher caffeine intake was associated with higher stress and anxiety, whereas at high levels of emotional symptom reduction motivation, this

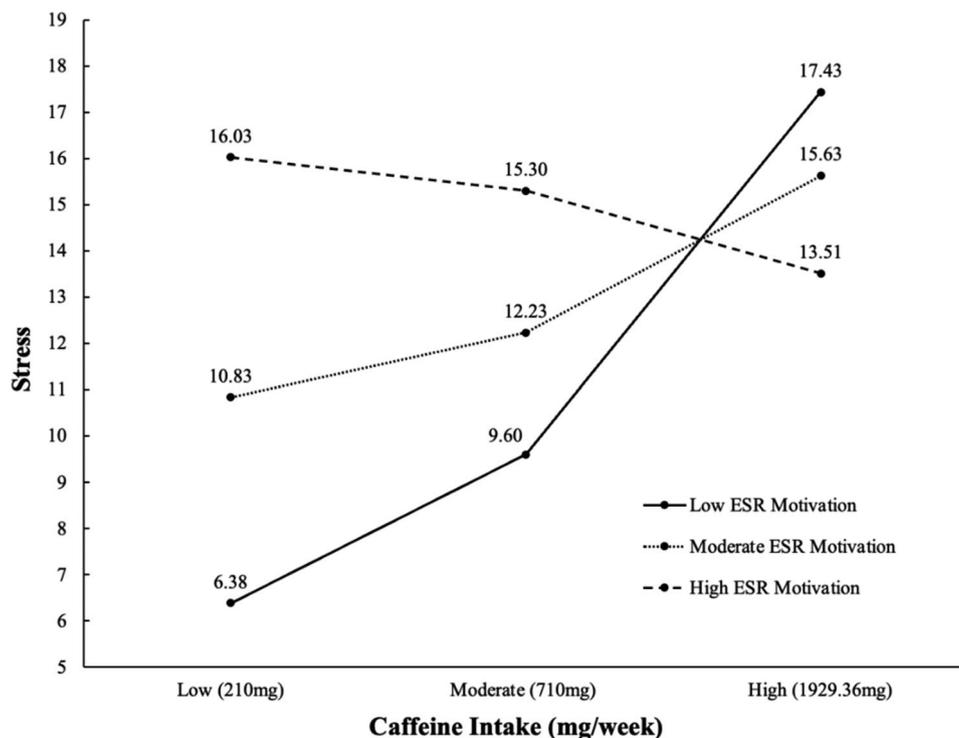


Figure 4. Moderating effect of emotional symptom reduction (ESR) motivation on stress.

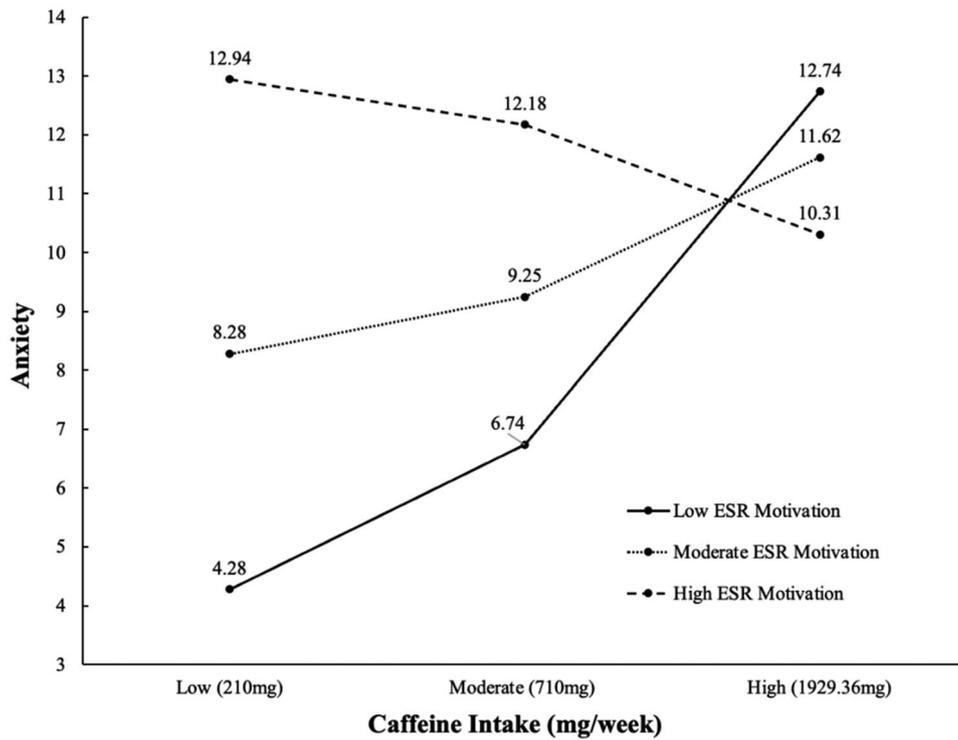


Figure 5. Moderating effect of emotional symptom reduction (ESR) motivation on anxiety.

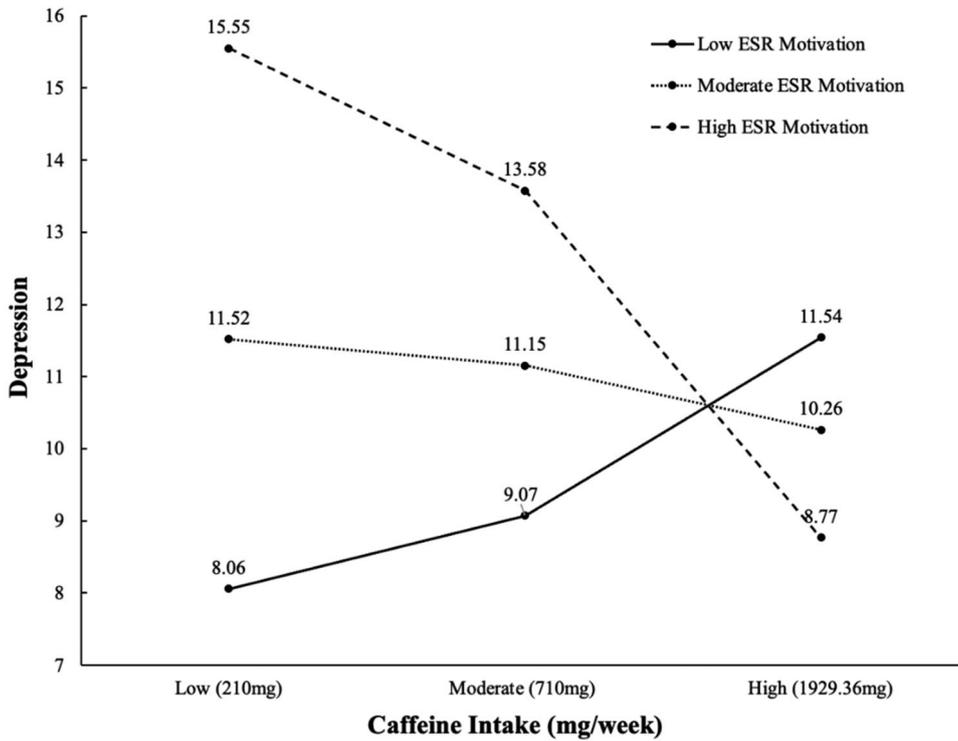


Figure 6. Moderating effect of emotional symptom reduction (ESR) motivation on depression.

positive association was not observed. For depression, caffeine intake was not significantly associated with depression at low and moderate levels of emotional symptom reduction motivation. In contrast, among individuals reporting high emotional symptom reduction motivation, higher caffeine intake was associated with lower levels of depressive symptoms.

Discussion

Caffeine intake and psychological outcomes

Caffeine intake was a significant predictor of both anxiety and stress, but not depression, which supports our first hypothesis. These results are consistent with previous literature (Aleem et al., 2024; Liu et al., 2024; Magalhães et al., 2021), which has linked caffeine consumption, particularly at higher dosages, to heightened psychological arousal, and in particular, Alateeq et al. (2021), who observed similar associations among young adults. These findings provide complementary support for prior findings in which high-dose caffeine's antagonism of adenosine A1 and A2A receptors has been associated with increased activity of noradrenergic neurons and elevated norepinephrine signalling, thereby enhancing central nervous system arousal and contributing to heightened stress and anxiety (Magalhães et al., 2021). However, it is noteworthy that the present findings diverge from those of Makki et al. (2023) and Richards and Smith (2016), who found no significant relationship between caffeine consumption and stress.

Interestingly, no significant direct relationship was found between caffeine intake and depression, which contrasts with several prior studies reporting either protective (Grosso et al., 2016; Min et al., 2023) or adverse effects (Marthoenis & Jannah, 2024). However, it must be noted that conclusions on protective J-shaped (non-linear relationship between two variables that initially decreases, then increases to become higher than baseline) effects of caffeine were based on large-scale studies with data from over 300,00 individuals (Min et al., 2023) or the result of a meta-analysis (Grosso et al., 2016) that included data from 23 studies. In comparison, the current study's finding of no association with depression may have been due to a limited sample size. Conversely, the study by Marthoenis and Jannah (2024) conducted in Indonesia reported a notably high prevalence of mental health concerns, with 23% of participants experiencing depression. Furthermore, 15.6% of the sample reported consuming 400 mg of caffeine per day, which represents an exceptionally high level of coffee consumption. Such findings suggest that the lack of a significant association between depression and caffeine intake may be due, in part, to different consumption profiles. Moreover, as identified in the present study and discussed in the subsequent section, the potential moderating role of motivations for caffeine consumption may provide further insights into inconsistent findings across studies.

Regarding the individual sources of caffeine, the present study found that caffeine from tea was a significant predictor of stress and anxiety. However, the effect size was small, and these findings do not align consistently with the broader literature, which has generally highlighted either neutral or beneficial effects of tea consumption on mental health (Chan et al., 2018; Unno et al., 2017). One plausible explanation for the association observed in the current study is the co-consumption of tea with high sugar content, particularly in the form of bubble tea, which was frequently reported as a major source of caffeine among the current population. Sugar has been linked to adverse psychological outcomes, including increased anxiety and stress, potentially counteracting any beneficial effects of tea (Park et al., 2016). This is further supported by the finding that caffeine intake from soft drinks, which also contain high sugar content, was associated with increased stress levels among the current sample. This suggests that the predictive effect observed here may be influenced by the synergistic effects of caffeine and sugar rather than caffeine alone. Interestingly, energy drinks were not a significant predictor, despite often containing high amounts of added sugar and bioactive ingredients (eg taurine, guarana, B-vitamins).

Moderating role of caffeine consumption motivations

The present findings demonstrated a significant moderating role of motivations for caffeine consumption on psychological outcomes, supporting the second hypothesis. Although several interaction effects were statistically significant, their magnitude was modest, reinforcing their interpretation as contextual modifiers rather than primary explanatory mechanisms. This is consistent with modelling caffeine intake as a continuous, normative health behaviour within the current non-clinical young adult sample, where large effects are not expected, and does not preclude practical significance (Cohen, 1992; Cohen et al., 1999; Funder & Ozer, 2019). Psychological outcomes such as stress and anxiety are multiply determined, and motivational factors are best conceptualised as contextual modifiers rather than primary drivers. In

practical terms, these effects suggest subtle but systematic differences in how caffeine use co-occurs with psychological symptoms across motivational contexts. Accordingly, even small effects may be meaningful when interpreted as indicators of systematic heterogeneity rather than causal impact.

Motivation for enjoyment moderated the relationship between caffeine intake and levels of stress and anxiety. High enjoyment motivation reduced caffeine's anxiogenic and stress-inducing effects, while low and moderate enjoyment motivation exacerbated these effects. This pattern may reflect tolerance or dependence processes, where habitual consumers require larger doses for homeostatic changes (Sweeney & Griffiths, 2024), and the physiological impact of caffeine is minimised when enjoyment is the primary motivator. Although this interpretation remains speculative given the cross-sectional design.

Motivation for emotional symptom reduction also emerged as a significant moderator, affecting all three psychological outcomes, including depression. High emotional symptom reduction motivation was associated with an attenuation of the positive association between caffeine intake and stress and anxiety. Notably, depression sharply decreased as caffeine intake increased for those highly motivated by emotional symptom reduction, mirroring previous findings (Wang et al., 2016). This contributes to existing disagreements in the literature, where studies reporting no relationship between caffeine and depression often had lower baseline depressive symptoms (Magalhães et al., 2021), while studies with significant effects reported higher baseline depressive symptoms (Min et al., 2023).

Both enjoyment and emotional symptom reduction motivations are hedonic, linked to pleasure-seeking and the avoidance of negative states (Labbe et al., 2015). These motivations influence caffeine's physiological and psychological effects, thus moderating its impact on outcomes. In contrast, alertness and social motivations are utilitarian and do not significantly affect psychological well-being in the same way (Ponsignon et al., 2024).

Physical symptom reduction was also expected to be a significant moderator, as it serves both hedonic and utilitarian purposes. However, issues with technical language or lack of specificity in the survey items may have hindered participants' understanding, limiting the ability to detect significant effects. These challenges are common when adapting items from existing scales (Boateng et al., 2018).

The findings align with Cox and Klinger (2004) model, which conceptualises substance use as goal-directed behaviour driven by the pursuit of specific incentives. The present study illustrates the model's relevance to caffeine consumption, showing that hedonic motives shape psychological outcomes. These findings also extend prior research on caffeine consumption's impact on physical outcomes (Shabir et al., 2018), suggesting that motivations influence physical and psychological outcomes.

Limitations and future directions

The present findings should be interpreted in light of several limitations. First, the correlational design precludes causal inference, and reverse causation cannot be ruled out (Grosso et al., 2017). Longitudinal and experimental designs would be better suited to capturing temporal dynamics and long-term effects of caffeine consumption on psychological outcomes.

Second, although the sample size was adequate to detect medium-sized effects, effect sizes for motivation-based moderation in caffeine research are not well established, making a priori power estimation challenging. The sample primarily consisted of Singaporean university students, and caffeine use patterns and motivations may vary across cultural and educational contexts, including differences in beverage types, social norms surrounding caffeine consumption, and typical contexts of use. Accordingly, the generalisability of these findings beyond similar young adult, university-based populations is limited. Replication in larger and more culturally diverse samples is warranted, particularly to detect potentially smaller effects.

Third, caffeine intake was assessed via self-report, introducing the possibility of recall bias and imprecision in estimating intake. The measure did not capture all possible caffeine sources, such as medications or chocolate. In addition, coffee, tea, and energy drinks contain bioactive compounds beyond caffeine, requiring findings to be interpreted cautiously and in conjunction with co-occurring ingredients (Miles-Chan et al., 2015; Stoikidou & Koidis, 2023). Future research would benefit from objective measures of caffeine exposure, such as biochemical markers, and from controlling for relevant covariates including sleep, physical activity, and age.

Fourth, while focusing on regular caffeine consumers enhanced ecological validity, the limited representation of very high consumers, with only a small proportion exceeding recommended daily intake thresholds, restricted examination of extreme consumption patterns. Future studies should oversample higher-consuming groups and explore cultural variability in caffeine use behaviours (Fredholm, 2010). Clinical research may also examine how motivational profiles shape caffeine's psychological correlates among individuals with elevated mental health symptoms.

Finally, the Motivation for Caffeine Intake Questionnaire (MCIQ-34) demonstrated acceptable internal consistency and a coherent factor structure within the present sample; however, further validation is required before broader generalisability can be assumed. The scale was derived through the aggregation and exploratory re-examination of items from existing instruments that showed inadequate psychometric performance in this dataset. While this approach facilitated a more comprehensive assessment of caffeine consumption motivations relevant to the sample, it also introduces limitations related to construct validity.

Notably, taste- and habit-related items loaded onto a broader enjoyment factor, diverging from the factor structures reported by Ágoston et al. (2018) and Irons et al. (2014). This reconfiguration may reflect sample-specific or contextual influences, as well as overlapping experiential dimensions of enjoyment, habit, and taste among young adult caffeine consumers. However, it also suggests that the emergent factors may not fully correspond to theoretically distinct motivational constructs described in prior research.

The scale's novelty therefore represents both a strength and a methodological vulnerability. Future research should establish construct validity using confirmatory factor analytic approaches, test measurement invariance across demographic and cultural groups, and examine convergent and discriminant validity with established motivational and substance-use measures.

Implications for practice

Motivations behind caffeine consumption may play a role in shaping how caffeine use is associated with psychological symptoms, with preliminary evidence suggesting that hedonic motivations, such as enjoyment and emotional symptom reduction, are associated with differences in the strength of associations between caffeine intake and psychological outcomes. This offers a potential and promising explanation for the mixed findings in prior studies that have reported either beneficial or adverse consequences of caffeine consumption. At an individual level, the findings may provide a much-needed framework for understanding individual differences in caffeine use and the influence of motivations, especially among young adults. For example, those motivated by emotional symptom reduction may consider managing their caffeine intake to align with times of greater need for mood enhancement. At the same time, individuals with motivations focused on alertness might benefit from monitoring intake to prevent anxiety. However, such observations should be interpreted descriptively rather than prescriptively, and do not imply causal effects.

Current insights also have implications for future research and the development of theory in health psychology. Rather than supporting direct public health recommendations, the findings suggest that motivational context may be a useful dimension to consider when examining normative health behaviours such as caffeine use. Tailored psycho-educational approaches, such as advising individuals with high anxiety sensitivity to limit caffeine intake or exploring whether incorporating caffeine into social contexts could enhance positive effects without leading to overuse, remain speculative and require confirmation in longitudinal or experimental studies. Accordingly, future public health campaigns should be informed by further empirical work before motivation-based strategies are translated into practice.

Conclusion

This study offers novel insights into the moderating role of caffeine consumption motivations in the relationship between caffeine intake and psychological outcomes, marking the first investigation of its

kind to the best of our knowledge. The findings suggest that caffeine's effect on stress, anxiety, and depression is not merely physiological but also psychological and is shaped by underlying consumption motivations, providing a substratum for future research. The implications extend beyond academic inquiry, suggesting that motivational factors may be a useful consideration in future intervention research to optimise caffeine's benefits and minimise harm. Replicating these findings across diverse populations would provide a deeper understanding of how motivations shape caffeine's impact on psychological health, helping to clarify the circumstances under which caffeine can be beneficial or detrimental. Ultimately, integrating motivation-based insights into public health strategies can lead to more effective guidance on caffeine use, enhancing well-being while mitigating associated harm.

Consent for publication

As part of informed consent, participants consented to deidentified data being used and disseminated in publications.

Institutional review board statement

This study was conducted in accordance with the Australian National Statement on Ethical Conduct in Human Research and the National Health and Medical Research Council Act 1992. Ethics approval (# H9421) was obtained from Human Research Ethics Committee, James Cook University.

Authors contributions

Conceptualisation, Data Curation, Writing – original draft, Writing – review and editing: R. Dimech; Methodology and Analysis: R. Dimech and D. Kaur; Supervision: D. Kaur.

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Data availability statement

The data presented in this study are openly available on OSF (<https://osf.io/5u3ph>).

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