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Effects of Caffeine Mouth Rinse on Cognitive Performance and Psychological Responses in Trained Individuals: A Systematic Review

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ADMINISTRATIVE INFORMATION

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Conflicts of interest - None declared.

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Amendments - This protocol was registered with the International Platform of Registered Systematic Review and Meta-Analysis Protocols (INPLASY) on 3 September 2026 and was last updated on 3 September 2026.

INTRODUCTION

Review question / Objective PICO framework: (1) Population: trained individuals; (2) Intervention: caffeine mouth rinse; (3) Comparison: a non-caffeinated control condition; and (4) Outcomes: cognitive performance and/or psychological responses.

Rationale Caffeine mouth rinse (Caf-MR) has been proposed as a non-ingestive strategy to enhance cognitive performance and psychological responses. However, evidence in trained individuals remains limited and inconsistent, with substantial variation in study protocols and outcome measures. No clear synthesis has yet established whether Caf-MR provides meaningful cognitive or psychological benefits in this population. Therefore, a systematic review is warranted to consolidate the available evidence, clarify the consistency of reported effects, and

identify methodological priorities for future research.

Condition being studied This review focuses on trained individuals rather than a specific disease or clinical condition. The condition of interest is the cognitive and psychological response to caffeine mouth rinse (Caf-MR) in sport and exercise contexts. Outcomes include cognitive performance, such as reaction time, response speed, attention, and accuracy, as well as psychological responses such as perceived exertion, mood, and arousal.

METHODS

Search strategy Electronic searches were conducted in six databases: PubMed, Scopus, Web of Science, ScienceDirect, Embase, and the Cochrane Library. The searches were designed to identify randomized controlled studies examining

the effects of caffeine mouth rinse on cognitive performance and/or psychological responses in trained individuals.

The core search strategy combined terms related to caffeine mouth rinse with terms related to cognitive and psychological outcomes using Boolean operators. The following search terms were used and adapted according to the syntax and search functions of each database:

("caffeine mouth rinse" OR "caffeine oral rinse" OR "caffeine mouthwash" OR "caffeine rinsing") AND ("cognition" OR "cognitive" OR "attention" OR "reaction time" OR "executive function" OR "mental fatigue" OR "perceived exertion" OR "RPE" OR "arousal" OR "mood" OR "motivation" OR "alertness").

For Scopus, the search was conducted within the title, abstract, and keyword fields (TITLE-ABS-KEY), whereas the Web of Science search used the Topic field (TS). The corresponding search terms were adapted to the search syntax of PubMed, Embase, and the Cochrane Library. In ScienceDirect, the search was divided into three separate searches because of limitations on the number of Boolean connectors permitted by the database. The three searches covered: (1) cognition, cognitive performance, attention, reaction time, and executive function; (2) mental fatigue, perceived exertion/RPE, arousal, and mood; and (3) motivation and alertness. Results from these searches were subsequently combined and duplicates were removed.

The final electronic database searches were conducted on August 14, 2026.

Participant or population The population comprised trained individuals who regularly participated in structured exercise or sport training, including those with a competitive athletic background. Studies involving untrained or sedentary individuals were excluded.

Intervention Caffeine mouth rinse (Caf-MR), defined as rinsing a caffeine-containing solution in the mouth for a specified duration and then expectorating it without ingestion. Studies were eligible regardless of caffeine concentration or rinse duration, provided that caffeine was administered solely as a mouth rinse and was not combined with carbohydrate or other co-interventions.

Comparator The comparator was a non-caffeinated control condition. Eligible studies were

required to include a control or placebo mouth rinse without caffeine for comparison with the caffeine mouth rinse intervention. Studies without a non-caffeinated control condition were excluded.

Study designs to be included Randomized controlled studies, including randomized crossover and parallel-group designs, comparing caffeine mouth rinse with a non-caffeinated control condition were included. Non-randomized and observational studies were excluded.

Eligibility criteria Randomized controlled studies, including randomized crossover and parallel-group designs, comparing caffeine mouth rinse with a non-caffeinated control condition were included. Non-randomized and observational studies were excluded.

Information sources The primary information sources were six electronic databases: PubMed, Scopus, Web of Science, ScienceDirect, Embase, and the Cochrane Library. Searches were conducted using predefined combinations of terms related to caffeine mouth rinse, cognitive performance, and psychological responses. The final database search was conducted on August 14, 2026. Only peer-reviewed original studies published in English were considered eligible. No trial registries or grey literature sources were searched, and study authors were not contacted for additional or unpublished data.

Main outcome(s) The primary outcomes were cognitive performance and psychological responses following caffeine mouth rinse in trained individuals. Cognitive performance outcomes included response speed/reaction time, attention, executive or inhibitory control, and response accuracy. Psychological outcomes included perceived exertion, arousal, affective responses, mood, motivation, and effort-related readiness. Outcomes were evaluated by comparing caffeine mouth rinse with a non-caffeinated control condition.

Quality assessment / Risk of bias analysis Methodological quality was assessed using a modified Physiotherapy Evidence Database (PEDro) scale. An additional item was included to evaluate whether the effectiveness of blinding to the placebo condition was assessed, resulting in a total score ranging from 0 to 11. Studies were classified as excellent (10–11), good (7–9), fair (5–6), or poor (<5) in methodological quality.

Risk of bias was assessed using the Cochrane Risk of Bias 2 (RoB 2) tool. For randomized

crossover trials, the RoB 2 version specifically developed for crossover designs was applied, including assessment of bias arising from period and carryover effects. The domains evaluated included the randomization process, deviations from intended interventions, missing outcome data, measurement of the outcome, selection of the reported result, and, where applicable, period and carryover effects. Each domain was judged as low risk, some concerns, or high risk according to RoB 2 guidance.

Both assessments were conducted independently by two reviewers. Disagreements were resolved through discussion and consensus, with a third reviewer consulted when necessary.

Strategy of data synthesis Due to the limited number of eligible studies and substantial heterogeneity in caffeine mouth-rinse protocols, participant characteristics, cognitive and psychological outcome measures, and assessment procedures, a quantitative meta-analysis was not considered appropriate. Therefore, findings were synthesized qualitatively. Studies were grouped according to cognitive performance outcomes and psychological responses. Within each domain, results were summarized according to the direction and consistency of the effects of caffeine mouth rinse compared with a non-caffeinated control condition. Differences in participant characteristics, caffeine dose, rinse duration and frequency, timing of assessment, and outcome measures were also considered when interpreting the findings. Methodological quality and risk-of-bias assessments were incorporated into the overall interpretation of the evidence.

Subgroup analysis No formal subgroup analysis was performed because of the small number of included studies and substantial methodological heterogeneity. Potential sources of heterogeneity, including outcome domain, caffeine dose, rinse protocol, timing of assessment, and participant characteristics, were considered descriptively.

Sensitivity analysis No formal sensitivity analysis was performed because a quantitative meta-analysis was not conducted. The robustness of the findings was considered descriptively with reference to methodological quality, risk of bias, study characteristics, and consistency of findings across the included studies.

Country(ies) involved Taiwan (Republic of China) and Germany.

Keywords Caffeine mouth rinse; cognitive performance; reaction time; psychological responses; athletes; sports nutrition.

Contributions of each author

Author 1 - Lu Chieh-Ju - Literature search, study screening and selection, methodological quality and risk-of-bias assessment, data extraction and synthesis, and drafting of the manuscript.

Author 2 - Chi-Lun Tsai - Literature search, study screening and selection, methodological quality and risk-of-bias assessment, data verification, and critical revision of the manuscript.

Author 3 - Kuo-Pin Wang - The conceptualization and design of the review, supervised the methodology, resolved disagreements when necessary, contributed to the interpretation of the findings, reviewed and edited the manuscript, and supervised the overall review process.