

---

# Ergogenic Effects of Combined Caffeine Supplementation and Motivational Music on Anaerobic Performance in Female Handball Players: A Randomized Double-Blind Controlled Trial

Houda Bougrine\*<sup>1,2</sup>, Thierry Paillard<sup>3</sup>, Nidhal Jebabli<sup>4</sup>, Halil İbrahim Ceylan<sup>5</sup>, Julien Maitre<sup>6</sup>, Ismail Dergaa<sup>7,8</sup>, Valentina Stefanica<sup>9</sup>, and Abderraouf Ben Abderrahaman<sup>7</sup>

<sup>1</sup>University Pau and Pays de l'Adour, E2S UPPA, MEPS Laboratory, Tarbes, France – University Pau and Pays de l'Adour – France

<sup>2</sup>Physical Activity Research Unit, Sport and Health (UR18JS01), National Observatory of Sports, Tunisia – Tunisie

<sup>3</sup>University of Pau and Pays de l'Adour E2S UPPA, MEPS Laboratory, Tarbes, France – niversity of Pau and Pays de l'Adour E2S UPPA – France

<sup>4</sup>High Institute of Sport and Physical Education of El Kef, University of Jendouba, El Kef, Tunisia – Tunisie

<sup>5</sup>Physical Education of Sports Teaching Department, Faculty of Sports Sciences, Ataturk University, Erzurum, Türkiye – Turquie

<sup>6</sup>University of Pau and Pays de l'Adour, E2S UPPA, MEPS Laboratory, Tarbes, France – University of Pau and Pays de l'Adour, E2S UPPA – France

<sup>7</sup>High Institute of Sport and Physical Education of Ksar Said, University of Manouba, Mannouba 2010, Tunisia – Tunisie

<sup>8</sup>Physical Activity Research Unit, Sport and Health (UR18JS01), National Observatory of Sports, Tunisia – Tunisie

<sup>9</sup>Department of Physical Education and Sport, Faculty of Sciences, Physical Education and Informatics, National University of Science and Technology Politehnica Bucharest, Pitesti University Center, Pitesti, Romania – Roumanie

## Résumé

**Introduction:** Listening to self-selected motivational music (SSMM) during warm-ups and caffeine (CAF) intake before exercise (Bougrine, Ammar, Salem, Trabelsi, Jahrami, et al., 2024; Bougrine, Ammar, Salem, Trabelsi, Żmijewski, et al., 2024) have independently been shown to enhance athletic performance among female athletes. However, the combined effects of these strategies are not well understood within this population. This study investigated the influence of SSMM during warm-up, pre-exercise CAF intake independently, and the combination of both on the high-intensity, short-duration performance of female athletes.

**Methods:** Seventeen female handball players (age:  $16.7 \pm 0.4$  years) participated in a randomized, double-blind, crossover study, performing a series of tests under four conditions: (i) Placebo (PLA) with no interventions, (ii) music and placebo (MUS), (iii) CAF intake only,

---

\*Intervenant

and (iv) a combination of music and CAF (MUS + CAF). Capsules containing 6 mg·kg<sup>-1</sup> of CAF or cellulose (PLA) were ingested 60 minutes before testing, accompanied by or without SSMM during a standardized 10-minute warm-up. Tests included the countermovement jump (CMJ), modified agility T-test (MAT), repeated sprint ability (RSA) test, rating of perceived exertion (RPE), and monitoring of CAF side effects questionnaire.

**Results:** Results showed that MUS ( $p > 0.05$ ;  $p < 0.01$ ;  $p < 0.01$ ;  $p < 0.001$  respectively), CAF (all  $p < 0.001$ ), and MUS + CAF (all  $p < 0.01$  respectively) conditions significantly outperformed the PLA condition across CMJ, MAT, RSA Mean, and RSA Peak measures. While no significant differences were revealed between CAF and MUS + CAF condition, the best performances were observed during the MUS + CAF condition. RPE scores, however, remained consistent across conditions.

### Discussion:

Our findings are in same line with some studies have examined the independently effects of music (Bentouati et al., 2023; Cotellessa et al., 2024), moderate CAF dosage (Bougrine, Ammar, Salem, Trabelsi, Jahrami, et al., 2024; Bougrine, Ammar, Salem, Trabelsi, Żmijewski, et al., 2024), as well as the combined effects of CAF and music on exercise performance (Delleli et al., 2024; Qiu et al., 2025).

**Conclusion:** These findings highlight that warm-up routines incorporating either SSMM or a moderate dose of CAF (6 mg·kg<sup>-1</sup>) improve anaerobic performance metrics (CMJ, MAT, and both Peak and total RSA performance). While both interventions are effective independently, CAF intake demonstrates a more pronounced effect on performance. Notably, their combination provides a synergistic effect, making it the most effective strategy suggested for maximizing anaerobic performance in female athletes.

### References

- Bentouati, E., Romdhani, M., Khemila, S., Chtourou, H., & Souissi, N. (2023). The Effects of Listening to Non-preferred or Self-Selected Music during Short-Term Maximal Exercise at Varied Times of Day. *Perceptual and Motor Skills*, *130*(1), 539–554. <https://doi.org/10.1177/00315125221142662>
- Bougrine, H., Ammar, A., Salem, A., Trabelsi, K., Jahrami, H., Chtourou, H., & Souissi, N. (2024). Optimizing Short-Term Maximal Exercise Performance: The Superior Efficacy of a 6 mg/kg Caffeine Dose over 3 or 9 mg/kg in Young Female Team-Sports Athletes. *Nutrients*, *16*(5), 640. <https://doi.org/10.3390/nu16050640>
- Bougrine, H., Ammar, A., Salem, A., Trabelsi, K., Żmijewski, P., Jahrami, H., Chtourou, H., & Souissi, N. (2024). Effects of Different Caffeine Dosages on Maximal Physical Performance and Potential Side Effects in Low-Consumer Female Athletes: Morning vs. Evening Administration. *Nutrients*, *16*(14), 2223. <https://doi.org/10.3390/nu16142223>
- Cotellessa, F., Bragazzi, N. L., Trompetto, C., Marinelli, L., Mori, L., Faelli, E., Schenone, C., Ceylan, H. İ., Biz, C., Ruggieri, P., & Puce, L. (2024). Improvement of Motor Task Performance: Effects of Verbal Encouragement and Music-Key Results from a Randomized Crossover Study with Electromyographic Data. *Sports*, *12*(8), 210. <https://doi.org/10.3390/sports12080210>
- Delleli, S., Ouergui, I., Messaoudi, H., Bridge, C. A., Ardigò, L. P., & Chtourou, H. (2024). Synergetic effects of a low caffeine dose and pre-exercise music on psychophysical performance in female taekwondo athletes. *Revista de Artes Marciales Asiáticas*, *19*(1), 55–70. <https://doi.org/10.18002/rama.v19i1.2405>
- Qiu, B., Wang, Z., Zhang, Y., Cui, Y., Diao, P., Liu, K., Del Coso, J., & Liu, C. (2025). Effects of Caffeine Intake Combined with Self-Selected Music During Warm-Up on Anaerobic Performance: A Randomized, Double-Blind, Crossover Study. *Nutrients*, *17*(2), 351. <https://doi.org/10.3390/nu17020351>