Does Caffeine Intake Impact Menstrual Function? Assessment of Caffeine Intake in Active Women with and Without Exercise Induced Menstrual Dysfunction (ExMD)

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Introduction

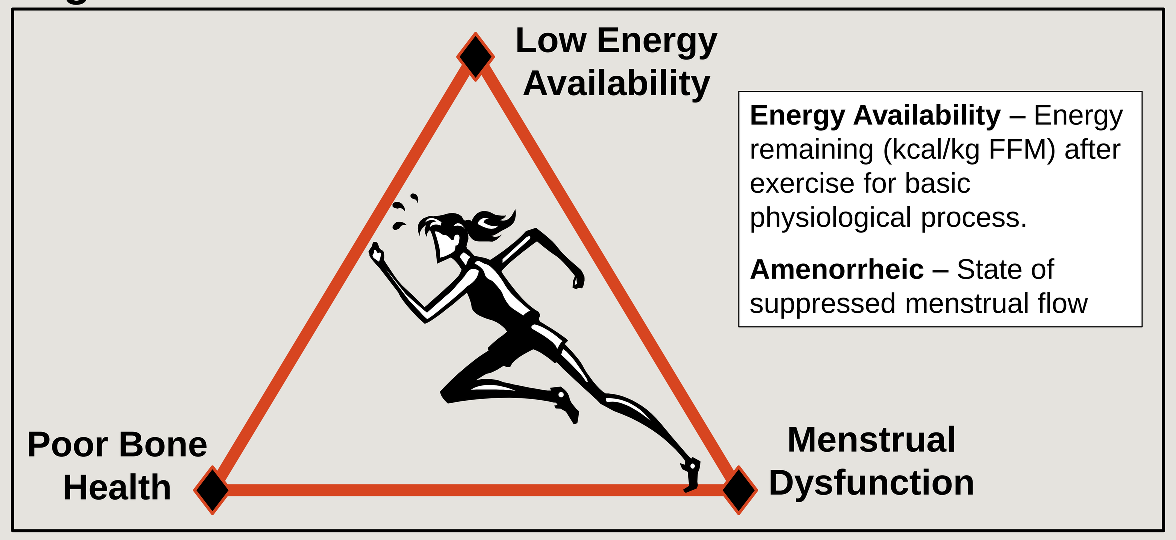
Active women with ExMD are at risk for the female athlete triad, a syndrome associated with negative energy balance, leading to menstrual dysfunction and eventually poor bone health [1] (see Figure 1).

High levels of caffeine intake may suppress estrogen synthesis, leading to an inverse relationship with caffeine intake and blood estrogen concentrations [2]. In addition, caffeine increases metabolic rate by 3-4% [3], thus, increasing total energy expenditure, which may contribute to a negative energy balance. Research suggests that low energy availability (<30kcal/kg FFM/d) disrupts estrogen synthesis [4]. Thus, high caffeine intake may contribute to low estrogen levels seen in ExMD athletes.

Research Questions:

- Do active women with ExMD consume more caffeine than their EU counterparts?
- Is there an inverse relationship between caffeine (mg/d) intake and energy intake (kcal/d) in active women?

Figure 1. Female Athlete Triad



Typical Caffeine Intake

Approximately 89% of women aged 18-34 years consume an average of 166mg caffeine per day [5]. Common sources of caffeine in the typical America diet are [6]…

Starbucks Pike Place Coffee (8oz)

180mg

Coca-Cola Classic (12oz)

23mg

Dove Milk Chocolate Bar

20mg

Tazo Earl Grey Tea (8oz)

62mg

Caffeine content obtained using Food Processor SQL (Version 9.91, 2006; ESHA Research).

Study Design/Methods Used

Endurance-trained women were recruited into one of two groups based on menstrual status, amenorrheic (ExMD) or eumenorrheic (EU) (see Table 1). The ExMD athletes participated in a 6-mo diet intervention where they consumed a non-caffeinated energy replacement beverage/d (Gatorade Nutrition Shake; 360 kcal, 54g CHO, 20g PRO, 8g FAT; ED=1.1 kcal/g). Weighed 7-d food logs and 7-d physical activity records were collected at baseline (EU) and pre/post-intervention (ExMD) and analyzed for energy and caffeine intakes and total energy expenditure using Food Processor SQL (Version 9.91, 2006; ESHA Research).

Results

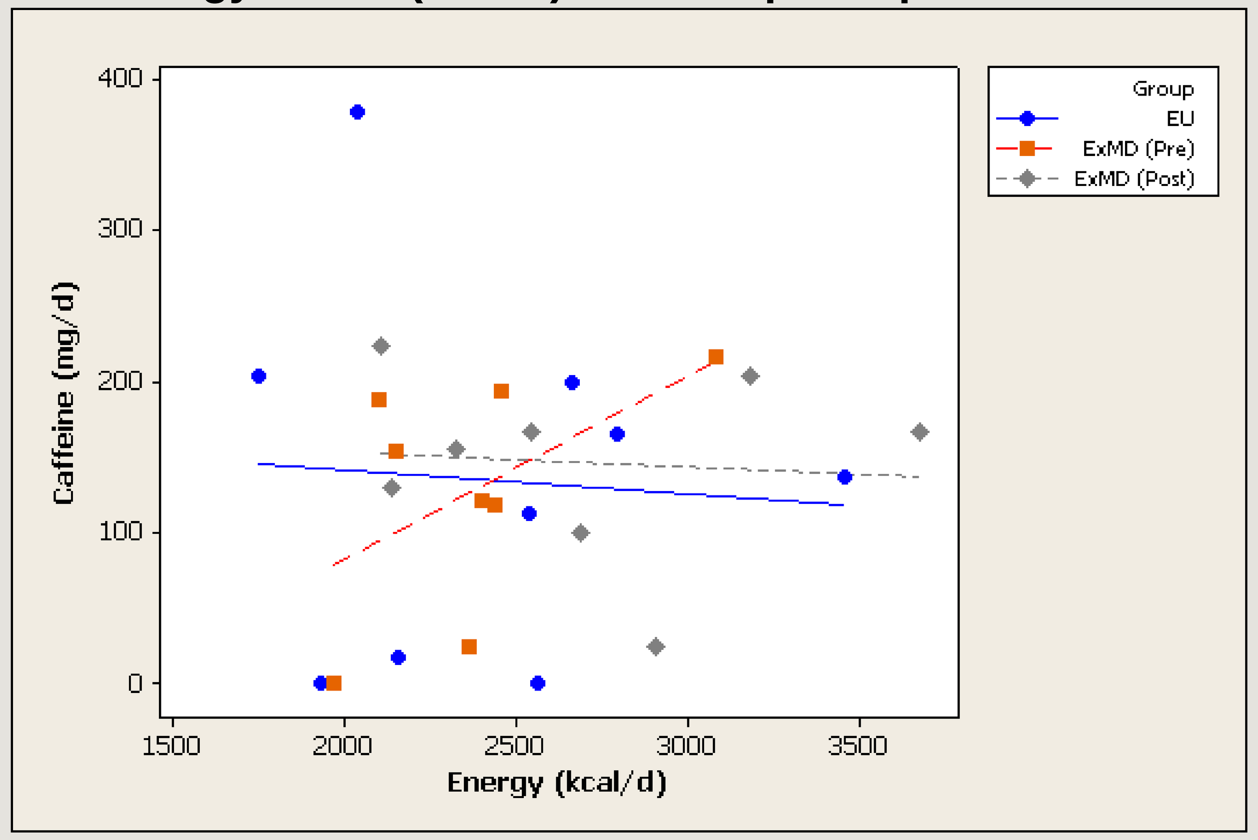
During the study, the most common sources of caffeine were coffee, tea, and soda. At baseline, the mean caffeine intake for the EU group (143 ± 116mg/d) did not differ from the ExMD group (145 ± 117mg/d) (p=0.83) (see Table 1). At post-intervention, mean caffeine intake for the ExMD group was 146 ± 63mg/d and did not differ from baseline (p=0.87). When mean caffeine intake was expressed relative to energy intake, mean caffeine intake was 62mg/1000 kcals/d (pre) and 58mg/1000 kcals/d post-intervention for the ExMD group vs. 62mg/1000 kcals for EU controls at baseline.

Table 1. Baseline Participant Demographics, Caffeine Intake, Estradiol Concentration, Energy Availability, and Energy Balance (mean ±SD).

	EU (n=9)	ExMD (n=8)
Variable		
Age (y)	24.6 ± 4.7	22.6 ± 3.3
BMI (kg/m²)	23.2 ± 3.0	22.3 ± 2.5
Body Fat[1] (%)	23.2 ± 4.7	22.0 ± 4.7
VO_2max (mL/kg/min)[2]	49.9 ± 5.0	49.0 ± 5.8
Energy Balance = Energy Intake - Total Energy Expenditure		
Energy Intake (kcal/d)	2430 ± 524	2,312± 324
Total Energy Expenditure (kcal/d)	2.601 ± 273	2,822 ± 264
Energy Balance (kcal/d)	(-171) ± 459	(-510) ± 361
Energy Availability (kcal/kg FFM/d)	32.9 ± 10.8	28.2 ± 9.0
Estradiol ($pmol \times L^{-1}$)	**158.1 ± 115.4**	**232.6 ± 260.7**
Caffeine Intake (mg/d)	**143 ± 116**	**145 ± 117**

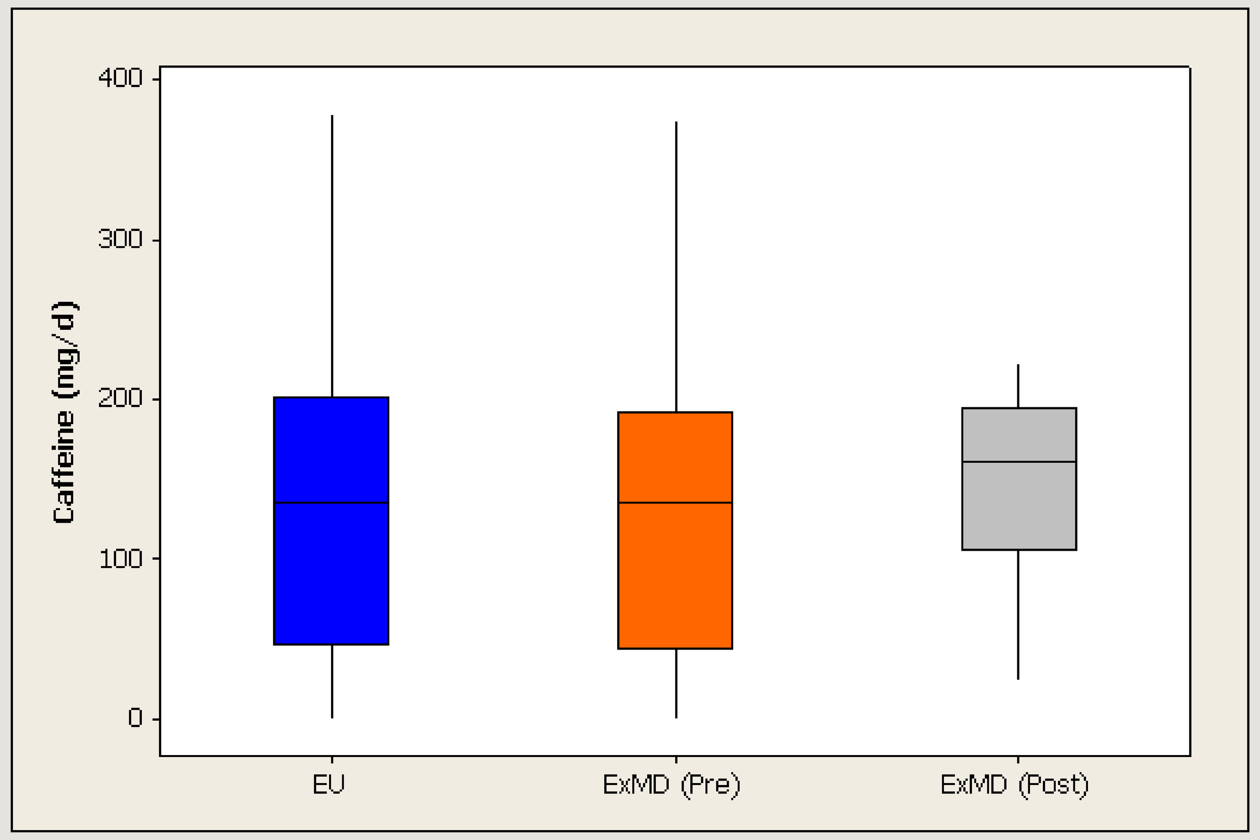
Energy availability calculated by estimating all planned exercise + biking + walking

Figure 2. Scatterplot of mean 7-d Caffeine Intake (mg/d) vs. Energy Intake (kcal/d) for each participant



One outlier was removed from ExMD (Pre) group as consumption of 1,327mg caffeine misrepresented data trend line.

Figure 3. Mean Caffeine Intake of ExMD Active Women at Baseline and Post-Intervention and Eumenorrheic Active Women at Baseline.



Ranges: EU 0 – 378.9mg/d, ExMD (Pre) 0 – 216.2mg/d, and ExMD (post) 24.7 – 223.9mg/d.

Summary/Conclusion

We found that endurance-trained women with ExMD did not consume more caffeine than their EU counterparts. Mean caffeine intake did not differ between groups at any time point (see figure 3). Participants with lower energy intakes might have greater fatigue and consume more caffeine. We did not observe an inverse relationship between energy intake and caffeine intake for any group at any time point (see figure 2).

Baseline ExMD subjects, who had a greater energy deficient that their EU counterparts, did not use more caffeine. All ExMD subjects increased energy intake and improved energy balance due to the intervention despite no change in caffeine intake. Because caffeine intake did not differ between groups (EU vs. ExMD) or time points (pre/post intervention), we conclude that caffeine intake was not driving the low estrogen levels observed in the endurance-trained women with ExMD.

Further research with a larger sample size is warranted to determine if caffeine intake in active women with ExMD is contributing to reduced estrogen levels and the development of ExMD.

References

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