

The Effects of a Seven-Day Ketogenic Diet on VO₂max and Body Composition in Physically Active Females

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Abstract

The ketogenic diet (KD) is a low-carbohydrate, high-fat diet that has gained popularity due to its beneficial effects on body composition. This study aimed to examine the effects of a seven-day KD on females. A graded exercise treadmill test was performed before and after seven days following the assigned diet to measure VO₂ and respiratory exchange rate (RER). The results suggest that the use of a short-term KD by physically active women can reduce body mass and increase the use of fats vs. carbohydrates during exercise without affecting maximal exercise performance.

Background

- Athletes are constantly in pursuit of enhancing their performance through various modalities, and one-way athletes have control is through implementing dietary changes. The ketogenic diet (KD) is a low carbohydrate (< 50 g, ≈ 10% total energy) (Aragon et al., 2017) high-fat diet that has gained popularity due to its beneficial effects on body composition
- Its impact on exercise performance, particularly endurance, high intensity, and strength, has also gained attention but research is minimal and conflicting.
- The physiological rationale for using a KD diet is to force the body to use fats as the primary energy fuel, a state referred to as ketosis. During long periods of intense exercise, fats are the primary energy source while sparing the limited glycogen stored in the liver and muscles (Burke, 2015).
- Most exercise studies have focused on the effects of KD on performance among elite-level male endurance (Burke et al., 2021; Goedecke et al., 1999; McSwiney et al., 2021), but there is a gap in the literature for females using a KD. Furthermore, little is known regarding the effects of a KD diet on exercise performance lasting less than 1 hour.

Purpose

This study examined the effects of a seven-day KD on VO₂, RER, body mass, and percent body fat in females.

Methods

Participants

- Twenty-two healthy, physical active females (age 22 ± 3.4 years; pre-test body mass 62.8 ± 12.6 kg).

Experimental Design

Study Control

For participants who were either not on any type of birth control or were on a non-hormonal contraceptive to perform their best, all pre- and post-testing was done during the luteal phase of their menstrual cycle. During the luteal phase, estrogen concentrations are high enough to increase lipid availability (Oosthuysse & Bosch, 210).

Pre-Test

Height and body mass measured. Performed a VO_{2max} test on a treadmill. The test began with a 2-minute warm up. After the warmup, participants started running at 7.0 km/h, speed increased by 1.5 km/h every 4 minutes. They ran until they were fatigued and chose to end the test.

Groups

KD group n = 10

Control group n = 12

Post-Test

Participants returned to the lab following 7-day diet intervention. All participants completed the same testing procedure as pre-test.

Statistical Analysis

- Data were analyzed using a 2 × 2 × 2 mixed factorial ANOVA for VO₂ and RER and a 2 × 2 mixed factorial ANOVA for body mass and body fat percentage (IBM SPSS Statistics 28 IBM Corporation Somner, NY).

Results

- There was no significant group × time × intensity interaction ($p = 0.336$). Furthermore, there were no significant group × time or group × intensity interactions ($p = 0.690$ and $p = 0.780$, respectively). However, there was a significant main effect for intensity ($p < 0.001$). Specifically, VO₂ increased from 60% to 80% to 100% VO_{2max}.
- There was a significant group × time × intensity interaction ($p = 0.024$) for RER. Follow up tests revealed a significant difference in RER between the control group and KD group ($p = 0.006$) from pre- to post-test at 100% VO_{2max} with the KD group demonstrating a lower value. In addition, the KD group had a significant decrease in RER at 80% VO_{2max} ($p = 0.015$) and 100% VO_{2max} ($p < 0.001$) from pre-to-post-test. Lastly, the control group significantly decreased in RER at 60% VO_{2max} ($p = 0.041$) from pre to post test.
- No significant interaction for body fat percentage were observed ($p = 0.643$) and there were no significant main effects for time ($p = 0.052$) or group ($p = 0.643$). However, there was a decrease in body mass from pre-to-post test for the KD group ($p < 0.001$), while there was no change for the control group ($p = 0.95$).

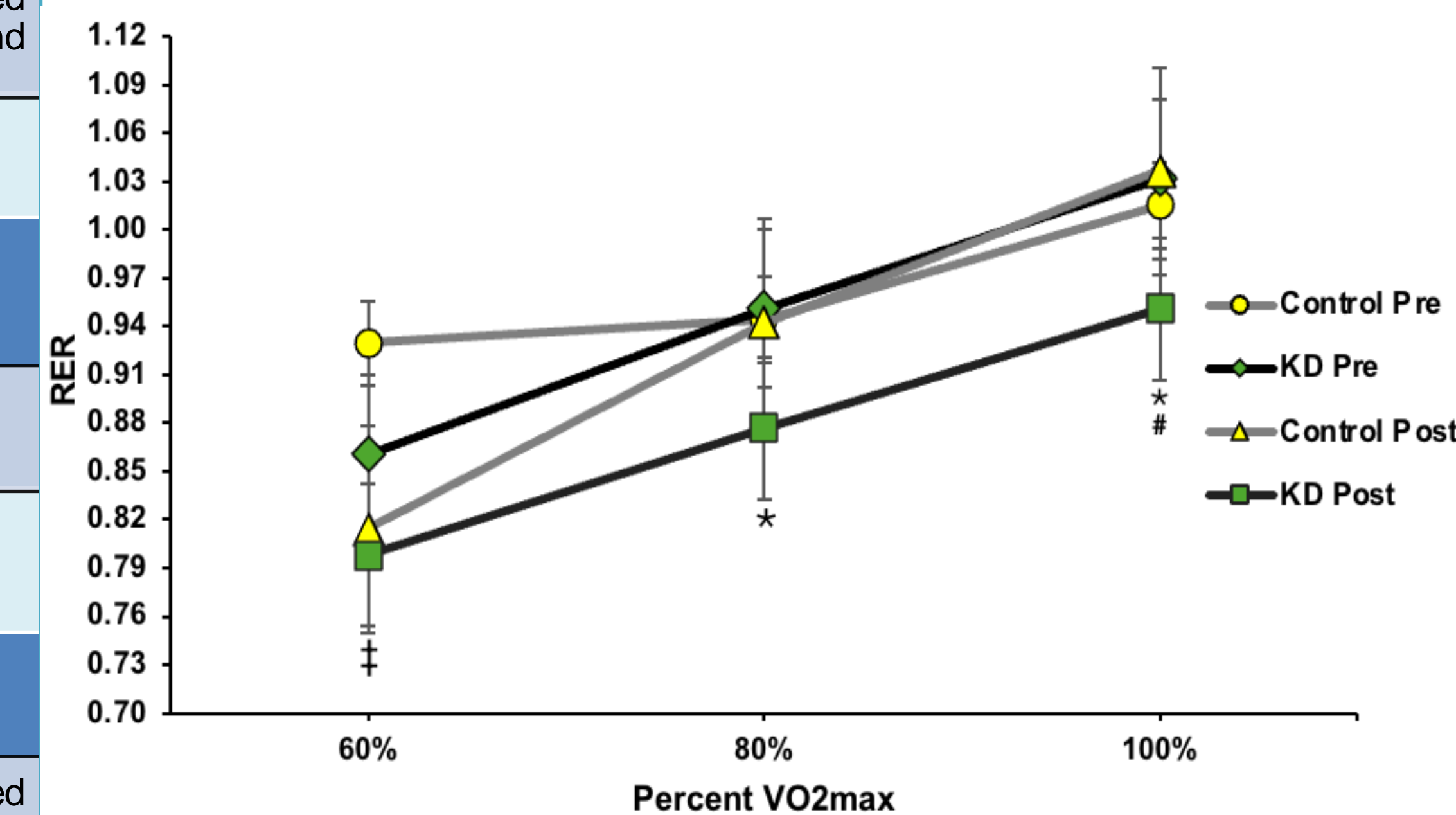


Figure 1. Mean ± SEM for respiratory exchange ratio (RER) at 60, 80, and 100% VO_{2max} pre- and post-test for control and ketogenic diet (KD) groups. † = Post-test value significantly lower than the pre-test value for the control group ($p < 0.05$); * = Post-test value significantly lower than the pre-test value for the KD group ($p < 0.05$); # = KD Post-test value significantly lower than post-test value for control group ($p < 0.05$).



Conclusion

The results of this study showed that RER was significantly lower during the post-test at 100% VO_{2max} for the KD group compared to the control group. Furthermore, RER was significantly lower at 80% and 100% VO_{2max} for the KD group from pre-test to post-test. As for body composition, BM significantly lowered for the KD group from pre- to post-test, while the control group saw no change in these variables over the seven days. Overall, the results suggest that after seven days of a KD, physically active females can increase the utilization of fats vs. carbohydrates during exercise without affecting maximal exercise performance while reducing body mass.

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References

Available upon request