

Table 6 Two-way Repeated Measures ANOVA for VO₂ Max and 30m Sprint

| Source | df | F (VO ₂ Max) | p (VO ₂ Max) | F (Sprint) | p (Sprint) |
|------------|----|-------------------------|-------------------------|------------|------------|
| Group | 1 | 4.23 | 0.043* | 5.11 | 0.027* |
| Time | 1 | 6.60 | 0.012* | 7.45 | 0.008** |
| Group×Time | 1 | 4.30 | 0.042* | 6.02 | 0.016* |
| Error | 76 | — | — | — | — |

Table caption: Group=HIIT vs Control; Time=Pre-test vs Post-test; Group×Time=Interaction effect, testing whether improvement over time differs between groups; $p < 0.05$, $p < 0.01$

The results of the ANOVA show that, in comparison to traditional training, HIIT produced larger pre-post improvements in both aerobic and anaerobic performance metrics. This supports the effectiveness of high-intensity interval training in adolescent athletes (Baquet et al., 2010; Costigan et al., 2015).

4 Discussion

The current study assessed at how an 8-week high-intensity interval training (HIIT) intervention affected teenage athletes' anaerobic performance (30-meter sprint) and aerobic capacity (VO₂ max). According to the results, the HIIT group significantly improved their sprint performance (-0.42 s) and VO₂ max (+5.2 mL·kg⁻¹·min⁻¹), whereas the control group only showed slight or non-significant changes. The HIIT group's improvement was significantly larger than the control group's, according to independent t-tests. Furthermore, the better effectiveness of HIIT was confirmed by the two-way repeated measures ANOVA, which showed significant Group×Time interactions for both sprint and VO₂ max.

These results support earlier research showing that HIIT is an effective and time-efficient training method for improving young athletes' aerobic and anaerobic fitness (Baquet et al., 2010; Buchheit and Laursen, 2013).

The observed gains in VO₂ max are consistent with previous research showing that HIIT programs in adolescents resulted in increases in aerobic capacity of 6-15% (Baquet et al., 2010; Engel et al., 2019). These parameters are supported by the current study's ~11% increase in VO₂ max in the HIIT group, which highlights how effective repeated short, high-intensity workouts are at promoting metabolic and cardiovascular adaptations (Buchheit and Laursen, 2013).

The HIIT group had an improvement in sprint performance of about 8%, which is consistent with findings from Racil et al. (2016), who found that adolescent athletes who followed comparable interval regimens saw significant decreases in sprint times. Further evidence that conventional continuous or low-intensity training may not adequately target the neuromuscular adaptations necessary for speed development comes from the control group's absence of significant sprint increases (Edge et al., 2006).

The observed benefits could be explained by a number of physiological processes. According to Gibala et al. (2012), HIIT is known to improve oxygen utilisation efficiency, stroke volume, and mitochondrial biogenesis. Due to their high levels of flexibility throughout growth and maturation, teenagers may experience these changes more quickly (Baquet et al., 2010). Additionally, because HIIT involves repeated sprints, it is likely that neuromuscular changes such as greater anaerobic glycolytic capacity and increased motor unit recruitment led to faster sprint timings (Racil et al., 2016).

These results imply that adding HIIT to youth training regimens can assist coaches and practitioners in two ways: it can increase sprint performance and endurance capacity in a comparatively short amount of time. This is especially helpful for teenage athletes playing sports like soccer, basketball, and hockey that call for both anaerobic and aerobic abilities. Furthermore, according to earlier research demonstrating its applicability in both sports and health-related situations, HIIT might provide a time-efficient substitute for athletes with constrained training schedules (Costigan et al., 2015).

5 Conclusion

In conclusion, the current study offers solid proof that, in comparison to conventional training methods, HIIT dramatically improves both aerobic and anaerobic performance in adolescent athletes. These results add to the