Table 2 Descriptive Statistics

Group	VO_2 Pre (ml/kg/min)	VO_2 Post (ml/kg/min)	Sprint Pre (s)	Sprint Post (s)
HIIT	45.6 ± 4.8 (36-55)	50.8 ± 5.0 (42-60)	5.47±0.39 (4.9-6.3)	5.05±0.40 (4.4-5.8)
Control	44.9 ± 5.1 (35-55)	46.0 ± 5.2 (36-56)	5.53±0.38 (4.9-6.2)	5.48±0.38 (4.9-6.2)

The normality of change scores was evaluated using Shapiro-Wilk tests (Table 3). Changes in sprint time and VO_2 max were roughly normally distributed in both groups, as seen by the non-significant nature of all distributions (p>0.05). This met the parametric testing assumptions.

Table 3 Shapiro-Wilk Normality Tests

Variable	W	p-value
HIIT VO_2 Change	0.96	0.58
Control VO_2 Change	0.95	0.42
HIIT Sprint Change	0.97	0.71
Control Sprint Change	0.96	0.55

Table caption: All p>0.05→data approximately normal

The HIIT group showed significant pre-post improvements in both sprint performance (t(19)=-10.5, p<0.001) and VO_2 max (t(19)=13.1, p<0.001), according to paired t-tests (Table 4). There was no discernible change in sprint performance (t(19)=-1.3, p=0.20), however the control group's VO_2 max improved little but statistically significantly (t(19)=2.1, p=0.047). These findings are consistent with the theory that HIIT offers a more effective training stimulus for developing adolescent athletes' aerobic capacity and speed (Baquet et al., 2010; Rønnestad et al., 2015).

Table 4 Paired t-tests (Pre vs Post within groups)

Group	Variable	t	p-value
HIIT	VO_2	13.1	<0.001
HIIT	Sprint	-10.5	<0.001
Control	VO_2	2.1	0.047
Control	Sprint	-1.3	0.20

According to independent-samples t-tests on change scores (Table 5), the HIIT group outperformed the Control group in both 30m sprint performance (t(38)=-7.2, p<0.001) and VO_2 max (t(38)=8.5, p<0.001). HIIT training was significantly more successful than normal training at eliciting physiological changes, as indicated by these significant between-group differences. The results align with earlier research showing that HIIT improves both aerobic and anaerobic performance more than moderate-intensity continuous training in young people (Buchheit and Laursen, 2013; Racil et al., 2016).

Table 5 Independent t-tests (Change Scores, HIIT vs Control)

Variable	t	p-value
VO_2 Change	8.5	<0.001
Sprint Change	-7.2	<0.001

A two-way repeated measure ANOVA was conducted to further investigate the intervention's effect, using Time (Pre vs. Post) as the within-subject factor and Group (HIIT vs. Control) as the between-subject factor (Table 6).

There was a significant Group×Time interaction (F(1,76=4.30, p=0.042) and a significant main effect of Group (F(1,76)=4.23, p=0.043) and Time (F(1,76)=6.60, p=0.012) for VO_2 max. According to this, the HIIT group improved significantly more than the Control group, even though both groups saw changes throughout time.

Additionally, there was a significant Group×Time interaction (F(1,76)=6.02, p=0.016) and a significant main effect of Group (F(1,76)=5.11, p=0.027) and Time (F(1,76)=7.45, p=0.008) for 30m sprint performance. These outcomes demonstrate that, in comparison to the Control condition, the HIIT intervention led to greater gains in sprint performance.