

increasing amount of research that shows HIIT is a time-efficient, successful training method for young people and emphasise its applicability to coaches and sport scientists who want to maximise performance results.

6 Limitations and Future Directions

It is important to recognise a number of limitations despite the positive outcomes. First, there may be limitations on generalisability due to the small sample size ($n=40$) and its restriction to a specific sporting demographic. Second, self-reported external physical activities and training adherence may have introduced bias. Third, injury incidence, recovery indices, and perceived exertion were not tracked, despite the measurement of physiological outcomes. Long-term HIIT programs, larger and more varied cohorts, recovery techniques, and psychological reactions to high-intensity exercise should all be examined in future studies.

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Abhishek Balo and Pranjit Baruah conceived and designed the study. Abhishek Balo and Tonkey Pegu were responsible for data collection and experimental implementation. O. Jiten Singh performed the statistical analysis and interpreted the data. Sidhartha Rajbongshi drafted the manuscript. Pabitra Pran Gogoi and Arindom Baruah revised the manuscript critically for important intellectual content. Mantu Baro supervised the study. All authors read and approved the final version of the manuscript.

Conflict of Interest Disclosure

The authors affirm that this research was conducted without any commercial or financial relationships that could be construed as a potential conflict of interest.

References

- Armstrong N., and Barker A.R., 2011, Endurance training and elite young athletes, *Medicine and Sport Science*, 56: 59-83.
<https://doi.org/10.1159/000320629>
- Baquet G., Berthoin S., Dupont G., Blondel N., Fabre C., and Van Praagh E., 2010, Effects of high-intensity interval training on peak VO_2 in prepubertal children, *Medicine and Science in Sports and Exercise*, 23(6): 439-444.
- Bishop D., Girard O., and Mendez-Villanueva A., 2011, Repeated-sprint ability-Part II: recommendations for training, *Sports Medicine*, 41(9): 741-756.
<https://doi.org/10.2165/11590560-000000000-00000>
- Buchheit M., and Laursen P.B., 2013, High-intensity interval training, solutions to the programming puzzle: part I-Cardiopulmonary emphasis, *Sports Medicine*, 43(5): 313-338.
<https://doi.org/10.1007/s40279-013-0029-x>
- Bauer N., Sperlich B., Holmberg H.C., and Engel F.A., 2022, Effects of high-intensity interval training in school on the physical performance and health of children and adolescents: a systematic review with meta-analysis, *Sports Medicine-Open*, 8(1): 50.
<https://doi.org/10.1186/s40798-022-00437-8>
- Costigan S.A., Eather N., Plotnikoff R.C., Taaffe D.R., and Lubans D.R., 2015, High-intensity interval training for improving health-related fitness in adolescents: a systematic review and meta-analysis, *British Journal of Sports Medicine*, 49(19): 1253-1261.
<https://doi.org/10.1136/bjsports-2014-094490>
- Deng Y., and Wang Z., 2024, Effect of high-intensity interval training on cardiorespiratory fitness in children and adolescents with overweight or obesity: a meta-analysis of randomized controlled trials, *Frontiers in Public Health*, 12: 1269508.
<https://doi.org/10.3389/fpubh.2024.1269508>
- Edge J., Bishop D., Goodman C., Dawson B., and Mercier J., 2006, Effects of high-and moderate-intensity training on metabolism and repeated sprints, *Medicine and Science in Sports and Exercise*, 37(11): 1975-1982.
<https://doi.org/10.1249/01.mss.0000189374.55648.3f>
- Engel F.A., Ackermann A., Chtourou H., and Sperlich B., 2019, High-intensity interval training in youth athletes: a systematic review, *International Journal of Sports Physiology and Performance*, 14(2): 183-196.
<https://doi.org/10.1123/ijspp.2017-0478>
- Gibala M.J., Little J.P., Macdonald M.J., and Hawley J.A., 2012, Physiological adaptations to low-volume, high-intensity interval training in health and disease, *The Journal of Physiology*, 590(5): 1077-1084.
<https://doi.org/10.1113/jphysiol.2011.224725>
- Hanafi S., and Hasanuddin M.I., 2022, The effect of a high-intensity interval training (HIIT) program on increasing 50 m freestyle sprint speed in adolescent swimmers, *Journal of Physical Health and Recreation*, 5(2): 403-407.
<https://doi.org/10.55081/jphr.v5i2.4009>
- Helgerud J., Høydal K., Wang E., Karlsen T., Berg P., Bjerkaas M., Simonsen T., Helgesen C., Hjorth N., Bach R., and Hoff J., 2007, Aerobic high-intensity intervals improve VO_2 max more than moderate training, *Medicine and Science in Sports and Exercise*, 39(4): 665-671.
<https://doi.org/10.1249/mss.0b013e3180304570>
- Hottenrott L., Möhle M., Feichtinger S., Ketelhut S., Stoll O., and Hottenrott K., 2022, Performance and recovery of well-trained younger and older athletes during different HIIT protocols, *Sports*, 10(1): 9.
<https://doi.org/10.3390/sports10010009>