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Global Trends in RCTs Related to High-Intensity Interval Training and its Multi-Dimensional Application: A PubMed Review – Based Bibliometric Analysis from 2000 to 2026

Manish Acharjee[1], Yashwant Gahlot[2], Rahul Dev Choudhury[3], Sunita Arora[4], Anek Goel[5], Sandeep Kumar Dwivedi[6], Om Prakash Mishra[7*]

[1]Research Scholar, Department of Physical Education, Lovely Professional University, Phagwara - 144411, Punjab, India; ORCID: 0009-0002-6630-2768
[2]Assistant Director of Physical Education, Department of Physical Education and Sports, Maharaja Ganga Singh University, Bikaner – 334004, Rajasthan, India; ORCID: 0009-0000-0911-1426
[3]Assistant Professor, Regional College of Physical Education, Panisagar-799260, Tripura, India; ORCID: 0000-0002-8570-532X
[4]Professor, Department of Physical Education, Lakshmibai College, University of Delhi, Ashok Vihar – 110052, Delhi, India; ORCID: 0009-0009-0846-2844
[5]Associate Professor, Department of Physical Education, Deen Dayal Upadhyaya College, University of Delhi, Dwarka – 110078, Delhi, India; ORCID: 0009-0006-8748-2541
[6]Assistant Professor, Department of Physical Education, Swarnim Gujarat Sports University, Desar – 391774, Vadodara, Gujarat, India; ORCID: 0009-0007-2369-063X
[7]Associate Professor, Department of Physical Education, Swarnim Gujarat Sports University, Desar – 391774, Vadodara, Gujarat, India; ORCID: 0009-0000-0840-7647
Corresponding author: Om Prakash Mishra, Email address: dr.omprakashmishra@gmail.com, Postal address: 405, Emerald Residency, Sama-Savli Road, Sama, Vadodara, Gujarat – 390008, India.

ABSTRACT:
Studies on high-intensity interval training (HIIT) have shifted from improving athletic performance to clinical interventions addressing various pathological conditions across diverse populations. However, the structure of its randomized controlled trials (RCTs) remains unmapped. The PubMed database was searched for human RCTs published between 2000 and 2026, yielding 694 eligible trials after screening. Biblioshiny and VOSviewer were used to identify publication growth, author and institutional collaboration networks, the most influential and contributing authors in HIIT-related RCTs, and thematic analyses of research hotspots and keywords based on their occurrence. The RCTs appeared in 247 journals, with an annual growth of 18.84%, a peak of 132 published RCTs in 2025 and 34.29% international co-authorship. Among 4530 contributing authors, Ulrik Wisloff from the Norwegian University of Science & Technology is the most productive author, and the University of Copenhagen is the leading institute in conducting RCTs related to HIIT. The thematic analysis of keywords showed three emerging research areas: (1) Physiological and ergogenic correlates of HIIT, (2) Metabolic and cardiometabolic correlates of HIIT, and (3) Rehabilitation and clinical applications of HIIT, particularly in stroke and cancer patients. The research trends of RCTs related to HIIT have expanded from a sports context to a metabolic, oncological,

neurological, and cardiac population with a greater emphasis on treating patients suffering from cancer and stroke. However, further RCTs must consider large sample sizes and more standardized trials to achieve greater efficacy.

1. INTRODUCTION

High-Intensity Interval Training is defined as exercise with short bursts of intense activity followed by periods of recovery or low-intensity exercise (Gibala et al., 2012). Historically, interval training was developed to improve elite Olympic athletes' performance by enhancing aerobic capacity and exercise tolerance (Billat, 2001; Demarle et al., 2001). Subsequently, various studies on human physiology demonstrate HIIT's potential to induce significant cardiovascular and metabolic adaptation compared to moderate-intensity training. In a sporting context, interval training protocols such as HIIT include periods of intensive activity that need to be performed at "all-out" or "near-maximal" effort, requiring ≥ 90 VO_2max or ≥ 75% of maximal power, along with an active or passive recovery phase, and are a better alternative compared to moderate – intensity continuous training (MICT) (Atakan et al., 2021). These findings contributed to researchers assessing the short- and long-term effects of HIIT beyond sport-specific performance. HIIT has gradually evolved from a training strategy focusing mostly on athletic performance to an exercise intervention assessed across various clinical and health-related settings.

HIIT is well known to improve aerobic capacity and cardiovascular fitness. Additional advantages of HIIT include improvements in anthropometric measures, glucose metabolism, arterial compliance, and inflammatory markers across multiple populations (Martland et al., 2020). Although HIIT was introduced as a widely adopted means to develop athletic performance, RCTs have demonstrated significant benefits of HIIT across diverse populations for clinical and health promotion (Ross et al., 2016; Martland et al., 2020; Edwards et al., 2023). randomized controlled trials (RCTs) suggest HIIT can significantly enhance maximal oxygen uptake (VO2max) and cardiorespiratory fitness, and produce beneficial adaptations in resting heart rate, blood pressure, stroke volume, and cardiac output (Edward et al., 2023; Poon et al., 2024). In addition to cardiovascular fitness, HIIT reduces cardiometabolic risk factors, including reductions in body mass, body fat, waist circumference, fasting insulin, low-density lipoprotein (LDL-C), triglycerides, cholesterol and inflammatory markers and enhances high-density lipoprotein (HDL-C) and glucose regulation (Edwards et al., 2023). A recent study by Poona et al., (2024) suggests that adults with metabolic syndrome showed improvements in waist circumference, blood pressure, lipid profile, and blood glucose following HIIT.

HIIT has been investigated for its potential to alter the conventional components of metabolic syndrome; it also has a significant influence on the distinct pathological process associated with metabolic dysfunction (Khalafi & Symonds, 2020; Jimenez-Maldonado et al., 2020). An important domain is chronic low-grade inflammation, linked to metabolic deterioration and insulin resistance. Findings from a meta-analysis by Khalafi & Symonds, (2020) on HIIT intervention in metabolic disorder reveal that HIIT can significantly reduce adipokine and inflammatory profiles, particularly tumour necrosis factor-α, leptin, and adiponectin, implying a potential factor in reducing metabolic inflammation. Other clinical applications concern hepatic metabolic dysfunction, particularly metabolic dysfunction-associated steatotic liver disease (MASLD). HIIT has been linked to decreased intrahepatic lipid accumulation and a reduction in alanine aminotransferase and aspartate aminotransferase (Fu et al., 2025).

In addition to these conditions, RCTs on HIIT have been conducted in oncology, specifically among cancer patients. RCTs suggest that HIIT enhances certain functional and patient-reported outcomes during or after cancer treatment. A systematic review and meta-analysis of 35 RCTs revealed significant improvement in aerobic fitness, quality of life, diastolic blood pressure, and pain among cancer patients participating in HIIT (Toohey et al., 2023).

Objectives of the Study

The study will assess the temporal growth of RCTs published in PubMed from 1st January 2000 to 23rd August 2026, along with identifying key contributing authors and institutes in the RCTs related to HIIT. Additionally, it further analyses the occurrence of keywords to identify various research hotspots and emerging research trends in RCTs related to HIIT and its multi-dimensional application.

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Significance of the Study

The increasing application of High-Intensity Interval Training across cardiovascular, metabolic, athletic, and oncological domains has expanded a diverse literature of RCTs. Previous research has focused on the effects of HIIT on specific outcomes in distinct populations. Almost no study has been conducted assessing the global evaluation and thematic structure of these RCTs based on HIIT. This study performed a bibliometric analysis of randomized controlled trials published in the PubMed database from 2000 to 2026 to identify publication trends, contributing authors and institutions, key research themes, and emerging multidimensional applications of HIIT.

2. MATERIALS AND METHODS

2.1 Search Strategy

Studies were extracted from PubMed over the period from 2000 to 2026. The PubMed database was used because it is a highly recognized database providing access to articles from various biomedical and life sciences literature (Lu, 2011). Because the study examined research trends of Randomized Controlled Trials (RCTs) in the multidimensional applications of High-Intensity Interval Training, a specific search string was designed to cover articles on athletic performance, cardiometabolic risk factors, health promotion, clinical rehabilitation, and weight management, rather than focusing on any specific dependent outcome.

2.2 Data Extraction & Description of Included Studies

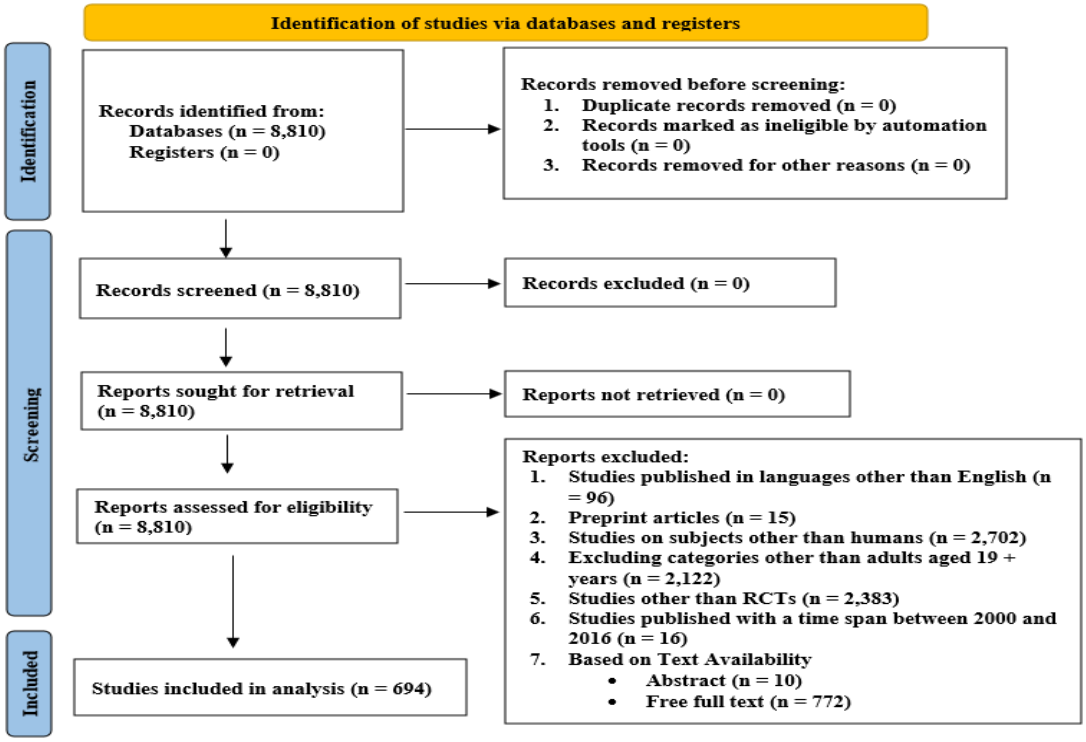


Figure No. 1: PRISMA FLOW CHART (Moher et al., 2009)

For identifying the articles, the following combination of keywords was used ("High Intensity Interval Training" OR "High-Intensity Interval Training" OR "HIIT" OR "High Interval Intensity Exercise") AND ("Cardiovascular" OR "Weight Management" OR "Cardiometabolic Risk Factors" OR "Obesity" OR "Athletic Performance" OR "Physical Fitness" OR "Rehabilitation" OR "Metabolic Syndrome" OR "Insulin Sensitivity" OR "Aerobic Performance"). During the identification, a total of 8,810 articles were retrieved from PubMed, as shown in Figure 1. During screening, 96 articles were excluded as they were written in a language other than English. The database included 15 preprint articles, which were excluded later, along with 2,702 articles which consist non-human subjects. Since our study included only RCTs to analyse the bibliometric data of the most impactful articles with intervention and treatment efficacy, 2,383 articles were further excluded because they were observational in nature or systematic reviews and meta-analyses that summarised findings from studies related to HIIT across

various domains. 16 articles were excluded as they failed to meet the inclusion criteria for the time span of the study, i.e., 2000 to 2026. After excluding 782 articles due to unavailable text, a total of 694 articles were included for the analysis.

2.5 Analysis Tool

Biblioshiny and VOSviewer were used to analyse the bibliometric data of the RCTs related to HIIT. The analysis represents the network visualization of co-authorship among authors and institutions, with the most contributing authors and institutions in RCTs related to HIIT. Parameters of analysis include local citation, global citation, and the h-index of authors. Cluster-wise thematic analysis of keywords assessing the emerging trends in RCTs related to HIIT, along with identifying the current hotspots related to HIIT protocol.

3. RESULTS AND DISCUSSION

3.1 Overall Information



Figure No. 2: Overall Information of Bibliometric Data of Literature Related to High-Intensity Interval Training

Figure 2 indicates that the dataset includes 694 RCTs from 247 PubMed-indexed journals, with 4530 authors investigating the various outcomes of HIIT across clinical, physiological, and performance-related aspects in adults. Among 694 studies, two RCTs (0.3%) were conducted by individual authors, while the remaining 99.7% of RCTs were conducted collaboratively with multiple authors. This is further supported by a relatively higher co-authorship of 8.4 per document. International co-authorship of 34.29% suggests a meaningful level of cross-country collaboration, along with 18.84% of annual growth rate demonstrating a positive acceleration of experimental research consisting randomized trial in controlled settings on various HIIT programs. Additionally, 2,179 authors' keywords show a diverse terminology base, indicating a wider thematic variability across the selected studies, with 5.12 average document age demonstrating that the selected literature is recent.

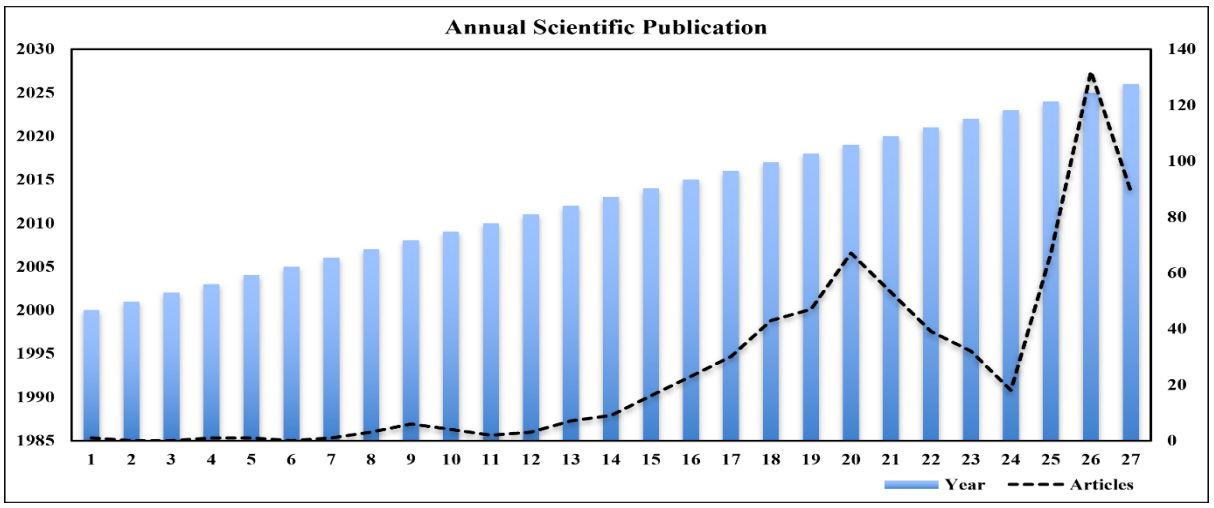


Figure No. 3: Temporal Growth of RCTs related to High-Intensity Interval Training

As shown in Figure 3, a limited number of RCTs were conducted from 2000 to 2013, indicating relatively limited research attention to High-Intensity Interval Training (HIIT) on various physiological benefits and athletic performance during the early years of the study period. However, from 2014, an increasing trend of publications is observed, with 279 RCTs conducted from 2014 to 2020. The highest number of publications was in 2025, with 132 RCTs, which reflects the increasing scientific interest in HIIT as a time-efficient training program, along with the expansion of research assessing its effect on cardiometabolic health factors, various physiological parameters promoting athletic performance, and distinct modalities of HIIT in promoting clinical rehabilitation.

Table No. 1: Top 10 Authors Contributing towards the Literature on High-Intensity Interval Training

Rank	Author	Local Doc. Count	Global Doc. Count	Total Citations	h-Index
1	Ulrik Wisloff	14	524	36,355	97
2	Jonathan P. Little	12	380	17,918	66
3	Jarna C. Hannukainen	11	108	4,403	39
4	Jin Li	11	4,405	132,715	153
5	Pirjo Nuutila	10	667	35,014	94
6	Kiris A. Virtanen	09	192	15,846	52
7	Martin Halle	09	609	26,466	69
8	Havard Dalen	08	321	8,497	46
9	Martin J. Gibala	08	365	22,533	68
10	Yang Liu	08	11	376	06

As shown in Table 1 and Figure 2, of the 4,530 contributing authors, Ulrik Wisloff is the most-profiled author from the Norwegian University of Science & Technology, with 14 RCTs. Based on the analysis of the authors' keywords for Ulrik Wisloff, he emphasized assessing the different cardio-respiratory and cardiac function adaptations in adults with different modalities of high-intensity interval training. The second most ranked author is Jonathan P. Little from the University of British Columbia, with 12 articles out of 524 studies focusing on metabolic and glycemic effects of high-intensity interval training in preventing or managing Type 2 Diabetes Mellitus (T2DM). The major objectives of the studies conducted by Jonathan P. Little are focused on assessing how short bursts of intensive exercise help to vary blood sugar and use energy effectively rather than stating the cause-and-effect relationship between high-intensity interval training and T2DM, blood glucose or energy metabolism. Jonathan C. Hannukainen from the University of Turku ranked third among the top 10 authors with 12 RCTs. The key focus of Jonathan C. Hannukainen was similar to that of Jonathan P. Little, while both focused on assessing structured HIIT on glucose metabolism and insulin regulation. However, studies of Jonathan P. Little go beyond clinical trials to examine lipid metabolism, myocardial substrate, and fatty acid handling using Positron Emission Tomography (PET) and Magnetic Resonance Imaging (MRI). The three most relevant papers of the top 3 ranked authors shown in Table 1 are cited in Table 2.

Table No. 2: Key Publications of Top 3 Authors in the field of High-Intensity Interval Training

Author	Publication
Ulrik Wisloff	1. Effects of High-Intensity Interval Training, Moderate Continuous Training, Or Guideline-Based Physical Activity Advice on Peak Oxygen Consumption in Patients with Heart Failure with Preserved Ejection Fraction: A Randomized Clinical Trial (Muller et al., 2021). 2. Effect of 24 sessions of High-Intensity Aerobic Interval Training carried out at either High or Moderate Frequency: A Randomized Trial (Hattle et al., 2014). 3. Exercise Patterns in Older Adults Instructed to Follow Moderate - or High-Intensity Exercise Protocol: The Generation 100 Study (Retilo et al., 2018).

Jonathan P. Little	1. An Acute Bout of 4 × 4 – min or 10 × 1 – min HIIT Improves β-Cell Glucose Sensitivity in Postmenopausal Females with Type 2 Diabetes: A Secondary Analysis (Low et al., 2025). 2. Oligofructose-Enriched Insulin Intake, Gut Microbiome Characteristics and the VO_2 Peak Response to High-Intensity Interval Training in Healthy Inactive Adults (William et al., 2022). 3. Carbohydrate Feeding During Recovery alter the Skeletal Muscle Metabolic Response to Reported Sessions of High–Intensity Interval Exercise in Humans (Cochran et al., 2010).
Jarna C. Hannukainen	1. Left Ventricular Vascular and Metabolic Adaptations to High-Intensity Interval and Moderate Intensity Continuous Training: A Randomized Trial in Healthy Middle-Aged Men (Eskelinen et al., 2016). 2. Exercise Training Reduces Intrathoracic Fat Regardless of Defective Glucose Tolerance (Honkala et al., 2017). 3. Intramyocellular Lipid Accumulation after Sprint Interval and Moderate–Intensity Continuous Training in Healthy and Diabetic Subjects (Sjoros et al., 2019).

3.2 Analysis of Authors Collaboration

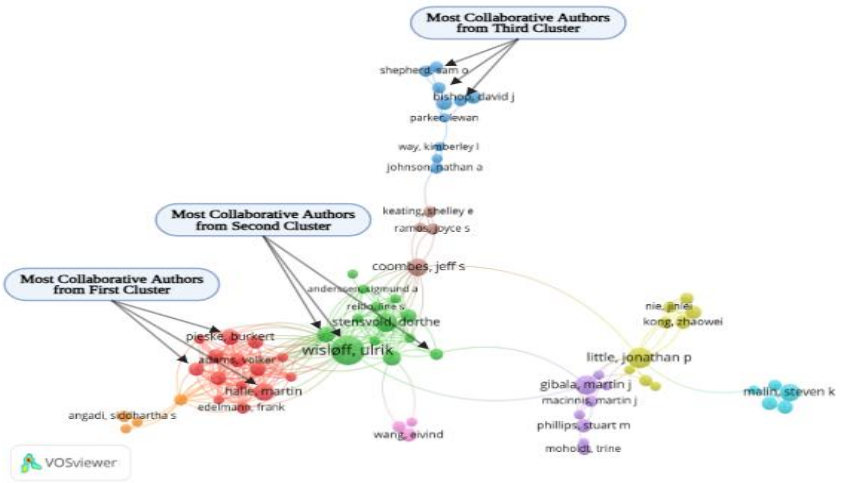


Figure No. 4: Scientometric Network Visualisation of Authors' Collaboration in Literature of High-Intensity Interval Training

The scientometric network visualisation shown in Figure 4 represents the collaboration of authors from different institutes and countries publishing a minimum of 3 RCTs on High-Intensity Interval Training in the PubMed database. Different colours represent distinct clusters; node size in each cluster represents the number of publications by an author, and the line thickness represents the strength of the link between clusters and authors. Martin Halle is the most influential author from the first cluster, with a total link strength of 59, collaboratively publishing 7 RCTs in literature related to HIIT. Followed by Burkert Pieske from the German Centre for Cardiovascular Research, having a link strength of 54 and 6 published RCTs focusing on key areas such as HIIT, exercise therapy, echocardiography and exercise physiology. Stephan Mueller from TUM Klinikum ranked third in the ranking with 52 total link strength and 16 RCTs.

The highest total link strength of 69 was observed for Ulrik Wisloff from the second cluster, being the most collaborative author in the dataset, investigating 14 RCTs on HIIT; he was the most contributing author, as shown in Table 1. Harverd Dalen and Oivind Rognmo were the second and third most influential authors, with 41 and 32 total link strength, publishing 6 and 5 RCTs, respectively. Similarly, from the third cluster, Christopher S. Shepherd had a link strength of 10 with 4 document counts, followed by Nigel K. Stepto with a total link strength of 8 and Itamar Levinger and Lewan Parker, both having equal link strength of 7 but different article counts of 5 and 3, respectively.

3.3 Analysis of Keywords

Keyword analysis can identify recent trends and hot topics in studies related to High-Intensity Interval Training. Using Biblioshiny, we analyse the 60 most frequent authors' keywords in different HIIT-related literature, as shown in Figure 5. The

word cloud conveys frequency through font size, while the tree map shown in Figure 6 provides percentage distribution and precise counts through box area.



Figure No. 5: Word Cloud of Top 60 Authors' Keywords used in the Literature related to HIIT

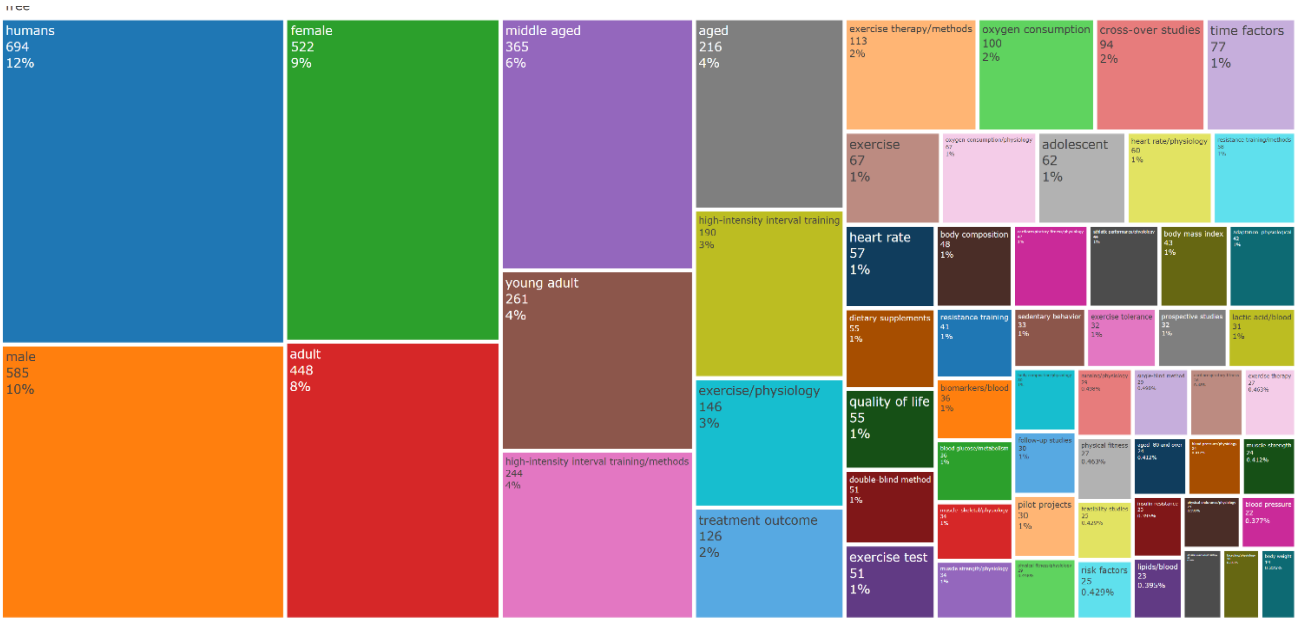


Figure No. 6: Tree Map Representing the Percentage Distribution of Top 60 Authors' Keywords related to HIIT

Both figures show that demographic/subjects descriptors – "humans" (694 occurrences,13%), "male" (585 occurrences, 10%), "female" (522 occurrences, 9%), "adults" (448 occurrences, 8%), "middle-aged" (365 occurrences, 6%), and "aged" (216 occurrences, 4%) dominate the keyword set. This reflects conventional PubMed-indexed standards, where such terms are applied to almost all records, rather than signifying any specific theme focus. Beyond the above description, the keywords include "high intensity interval training", "exercise/physiology", "oxygen consumption", and "resistance training/methods", confirming the least essential thematic core of the literature. But the tree map further reveals an extensive tail of secondary keywords ("cross-over studies", "dietary supplements", "quality of life", "body composition"), which indicates that the research

area investigating HIIT programs is more diverse across various outcomes instead of being centralized in a limited number of specific sub-themes.

Thus, the software VOSviewer was used for the network visualization of keywords and to identify key themes and current hotspots in the application of HIIT. The analysis was conducted to identify the co-occurrence of keywords with a full count strategy, considering the minimum number of occurrences of words to be four. A total of 379 keywords out of total 2,477 keywords met the threshold and are presented in Figure 7.

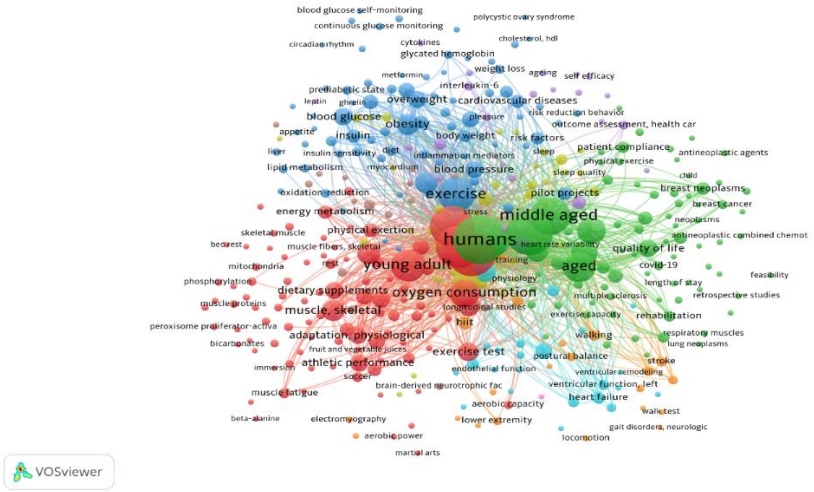
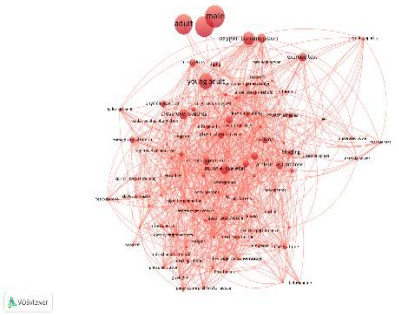
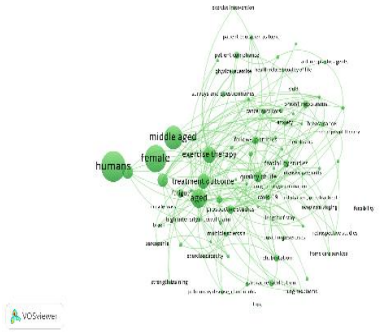


Figure No. 7: Network Visualization of Co-occurrence of Keywords in RCTs related to HIIT

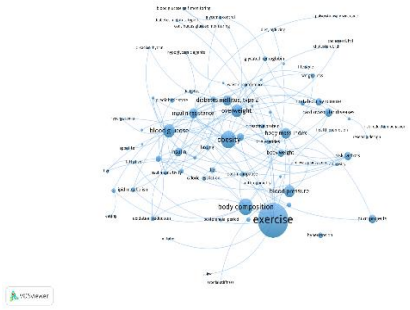
A total of 9 clusters were formed using VOSviewer. The size of circles in Figure 7 represents the frequency of occurrence of the terms; different colours represent distinct clusters; the thickness of the lines represents the link strength of the keywords within clusters. The frequency of major keywords was discussed in Figure 6. Among the 9 clusters, the maximum total link strength was observed in the first three clusters compared to the remaining 6 clusters, where the keywords were more scattered with relatively lower link strength. Table 3 represents the cluster-wise analysis of the top 3 clusters, indicating emerging trends in RCTs related to HIIT.

Table No. 3: Thematic Analysis of Top 3 Clusters Based on Co-occurrence of Keywords related to High-Intensity Interval Training

Clusters	Thematic Interpretation
 First Cluster	***Physiological & Ergogenic Correlates of HIIT*** Anchored by sprint interval and interval training, this cluster maps the physiological mechanism underlying HIIT, focusing primarily on RCTs in young adults and male subjects. Integrating cardiorespiratory parameters (oxygen uptake, anaerobic threshold, & aerobic capacity) indicating HIIT's cardiopulmonary demand; a radiobiology aspect (antioxidants, oxidative stress, & superoxide dismutase) reflects the oxidative demand of HIIT; a skeletal-muscle bioenergetics component (mitochondria, glycogen, muscle contraction, biopsy, & signal transduction) suggests metabolic and mitochondrial remodelling due to HIIT; ergogenic nutritional components (creatine kinase, caffeine, and beta-alanine) provided RCTs on fatigue buffering strategies during HIIT sessions, along with assessing applied performance factors (running, athletic performance, bicycling, aerobic and anaerobic power) with an endocrinological aspects (hydrocortisone, muscle fatigue, and



Second Cluster



Third Cluster

testosterone). This cluster indicates emerging RCTs on HIIT in a multidimensional field integrating oxidative, cardiopulmonary, nutritional, and endocrinological pathways to explain its physiological efficacy in developing athletic performance.

Rehabilitation & Clinical Application of HIIT

Occurrence of terms such as treatment outcome, exercise therapy, and quality of life; this cluster bridges the rehabilitative and clinical application of HIIT across varied patient populations, substantially female, middle-aged, and aged human subjects. This cluster integrates oncological components (breast cancer, breast neoplasms, cancer survivors, neoadjuvant therapy, & antineoplastic agents), indicating HIIT's role in cancer rehabilitation; a cardiopulmonary/critical-care component (pulmonary diseases, chronic obs, cardiac rehabilitation, lung neoplasm, intubation intratracheal, and breathing exercises) showing the physiological benefits of HIIT in respiratory & cardiac recovery; a musculoskeletal and functional elements (muscle mass, sarcopenia, strength training, multiple sclerosis, & exercise capacity) capture HIIT's application in preserving physical functioning across neuro-degrative and chronic conditions. RCTs suggest studies on HIIT extended beyond athletic performance to clinical rehabilitation of athletes and non-athletes in diverse physiological parameters.

Metabolic & Cardiometabolic Correlates of HIIT

Presence of keywords such as obesity, exercise, and body composition; the metabolic and cardiometabolic effects of HIIT focusing on outcomes related to lipid, glycaemic, and adiposity regulation. The cluster integrates glycaemic-control factors (insulin resistance, blood glucose, insulin sensitivity, diabetes mellitus, T2DM, glycated haemoglobin, hyperglycaemia & continuous glucose monitoring), reflecting HIIT's effect in regulating insulin efficacy in the human body and glucose homeostasis; lipid metabolism parameters (lipid metabolism, cholesterol, HDL-C, LDL-C, triglycerides, fatty liver, caloric restriction, & fasting) further highlight the studies of HIIT on dyslipidaemia and hepatic lipid metabolism; adiposity along with anthropometric components (body weight, body mass index, waist circumference, anthropometry, overweight, adiposity) suggest HIIT induced changes in body composition along with components of cardiometabolic risk factors (cardiovascular diseases, hypertension, metabolic syndrome, arterial stiffness & C-reactive protein).

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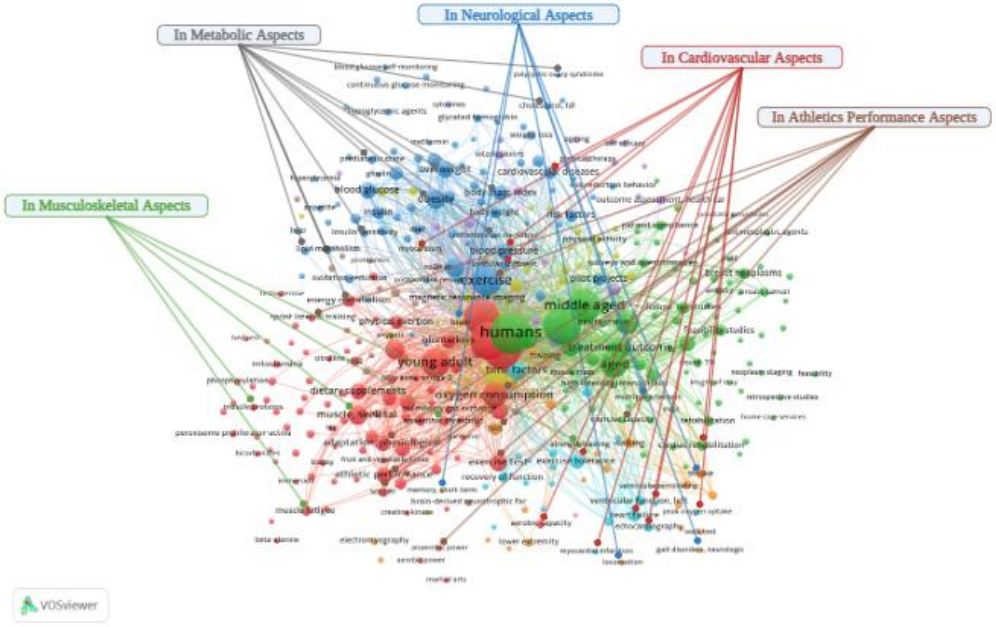


Figure No. 8: Current Hotspot & Application Area of High-Intensity Interval Training in Various Fields

Table No. 4: Thematic Analysis of Current Hotspot across RCTs related to High-Intensity Interval Training as shown in Figure 8

Dimension	Interpretation
Metabolism Aspect	The occurrence of terms such as metformin, high-density lipoprotein, glycated haemoglobin, and energy metabolism, highlighted by the light black arrow, indicates a potential research focus on assessing HIIT's effect on metabolic regulation. Additionally, the presence of terms such as obesity, glucose homeostasis, insulin sensitivity, body composition, and weight loss suggests that extensive RCTs were conducted on glucose metabolism, adiposity, and metabolic risk factors. The presence of the terms lipid metabolism and HDL-C, LDL-C and cholesterol demonstrates interest in the broader metabolic consequences of HIIT.
Cardiovascular Aspects	The terms such as blood pressure, vascular stiffness, myocardial infarction, heart failure, cardiac rehabilitation, cardiovascular diseases, and exercise tolerance emphasise the use of RCTs assessing the effect of HIIT on hemodynamic responses, cardiovascular functioning and cardiac rehabilitation. The existence of terms blood pressure and vascular stiffness suggests the research interest towards cardiovascular risk factors, while myocardial infarction, ventricular performance, and heart failure reflect clinical application of HIIT on specific cardiovascular parameters.
Musculoskeletal Aspects	The thematic interpretation of terms related to this domain reflects RCTs concerned with assessing the application of HIIT on muscular adaptation, skeletal-muscle functioning, strength, physical capacity, and fatigue. Additionally, the presence of training modalities such as resistance training or strength training highlights the comparison of HIIT with other training modalities for specific muscular adaptations. Furthermore, lower-extremity, muscle fatigue, and terms related to lower-body extremity suggest studies on functional, performance and exercise-related muscular responses.
Athletic Performance Aspects	Terms such as soccer, sprint interval, physical exertion, anaerobic power, exercise testing and training reflect a distinct athletic performance, while keywords related to exercise physiology include oxygen consumption, maximal oxygen uptake, aerobic power and capacity, and muscle fatigue. This domain reflects the application of HIIT to

	sports performance and physiological adaptations. The presence of soccer indicates a sports-specific application of HIIT, while spring interval training indicates a strategic application of HIIT.
Neurological Aspects	This domain is characterised by keywords such as multiple sclerosis, stroke, brain, memory, brain-derived neurotrophic factor, gait disorders, and locomotion. The presence of these terms explains HIIT-related RCTs on neurological health, rehabilitation, functional recovery, and cognitive functioning. The presence of gait and locomotion-related terms indicates research interest in restoring and improving functional abilities among individuals with neurological conditions.

3.4 Analysis of Co-Authorship and Top 10 Institutes in the Field of HIIT

Table No. 5: Top 10 Most Relevant Institutes Contributing to the RCTs of HIIT

Rank	Institute	Country	Article Count
1	University of Copenhagen	Denmark	174
2	Norwegian University of Science and Technology	Norway	113
3	Karolinska Institute	Sweden	82
4	The University of Queensland	Australia	81
5	University of Alabama at Birmingham	United States	77
6	McMaster University	Canada	75
7	Victoria University	Australia	71
8	University of Turku	Finland	69
9	Monash University	Australia	58
10	Federal University of Rio Grande Do Norte	Brazil	52

The most contributing institute is the University of Copenhagen in Denmark, with 174 RCTs related to HIIT, followed by the Norwegian University of Science and Technology with 113 documents. University of Turku ranks third with 82 RCTs. The number of publications of RCTs related to HIIT by the top 25 relevant institutes worldwide is shown in Figure 9.

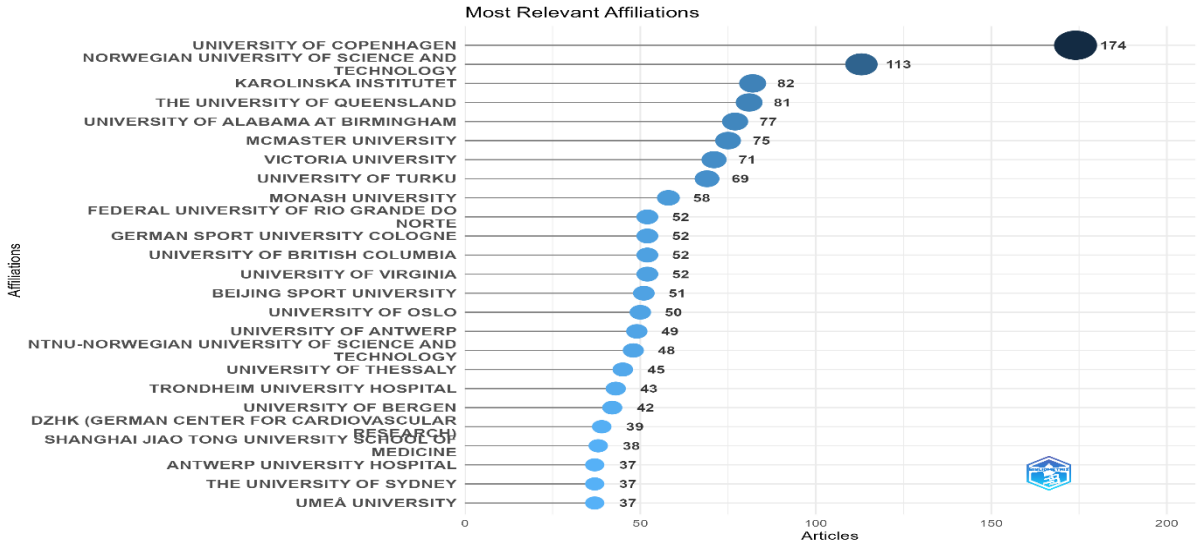


Figure No. 9: Top 25 Most Relevant Institutes Publishing RCTs related to HIIT from 2000 to 2026

3.5 Discussion

Analysis of 694 RCTs identifies a significant annual growth rate of 18.84%, reflecting expanding research on the multidimensional nature of HIIT from athletic performance to clinical rehabilitation to cardiology, oncology, and neurology. The trajectory shown in Figure 3 culminated in a peak of 132 RCTs reported in 2025, while the most concentrated period of publication was between 2014 and 2020, with 279 RCTs. The average document age was 5.12 years, indicating that the field is comparatively young and rapidly evolving. The growth is not merely quantitative but also qualitative, reflecting a diverse scope of research. Earlier studies often compared HIIT to MICT in health or athletic populations (Guo et al., 2023; Gripp et al., 2021; Menz et al., 2019). However, recent trends suggest a shift towards clinical populations, including those with heart failure (Ellingsen et al., 2017; Turri-Silva et al., 2021), stroke (Moncion et al., 2024; Marzolini et al., 2023; Boyne et al., 2023), and multiple sclerosis (Youssef et al., 2024; Campbell et al., 2018; Amato et al., 2024).

Figure 8 shows the thematic analysis of the current hotspot. Table 4 identifies the multidimensional application of HIIT in (1) Human Metabolism: aerobic and anaerobic capacity (Vasconcelos et al., 2020), glucose haemostasis: fasting glucose, HbA1c, and insulin resistance (Jelleyman et al., 2015; Winding et al., 2018), markers of insulin resistance and sensitivity (Jelleyman et al., 2015), lipid metabolism (Amato et al., 2024), body composition and adiposity: body weight, fat mass, and body fat percentage (Martinez-Rodriguez et al., 2021; Wewege et al., 2017; Maillard et al., 2018), mitochondrial function and oxidative capacity (Vasconcelos et al., 2020; Wu et al., 2021), along with other metabolic consequences (Isanejad et al., 2023; Meng et al., 2022); (2) Cardiovascular Parameters: systolic and diastolic blood pressure (Carrasco-Poyatos et al., 2024), endothelial functioning and vascular elasticity (Turri-Silva et al., 2021; Su et al., 2024), cardiac remodelling and HIIT as therapeutic exercise efficacy (Ellingsen et al., 2017; Turri-Silva et al., 2021), rehabilitation of patients with ischemia and autonomic nervous system balance (Carrasco-Poyatos et al., 2024), assessment of ventricular performance through left ventricular ejection fraction (Ellingsen et al., 2017), comparative maternal and fetal cardiac response to HIIT and MICT during pregnancy (Wowdzia et al., 2023), and fitness benefits of HIIT on VO_2 max and muscular endurance (Menz et al., 2019), patients recovered after stroke (Moncion et al., 2024) and patients with rheumatoid arthritis (Bilberg et al., 2024); (3) Musculo-skeletal parameters includes: possession of epigenetic memory of HIIT (Pilotto et al., 2025), improvement in muscle mitochondrial quality control processes in healthy and obese older population (Marcangeli et al., 2022; Gibala et al., 2012), addressing the limp muscle dysfunction in patients with COPD (Alcazar et al., 2019). (4) Athletic Performance: more emphasis was placed on assessing the VO_2 max and aerobic capacity of sedentary and athletic populations following sprint interval training (SIT) and HIIT. Improvement in VO_2 max was observed with recreationally active and healthy sedentary adults (Sloth et al., 2013), and in athletes participating in striking and grappling in combat sports (Vasconcelos et al., 2020). Following SIT training, improvements in aerobic fitness were observed in soccer players, with an increase in ventilatory thresholds and maximum oxygen uptake (Yang et al., 2024). HIIT has been proven to be a necessary stimulant for improving endurance performance when volume-based training plateaus (Laursen & Jenkins, 2002). Linear speed and the ability to change direction rapidly significantly improved in basketball and soccer players (Cao et al., 2025; Yang et al., 2024). While conventional increases in training volume often fail to yield additional training improvements, HIIT enhances endurance through increasing skeletal muscle buffering capacity (Larusen & Jenkins, 2002). HIIT-induced block periodization for elite cyclists manages and improves various physiological capacities over long cycles (Ronnestad & Hansen, 2018).

The cluster-wise analysis identified three major clusters shown in Table 3. The first cluster focuses on physiological and ergogenic correlates, specifically cardio-respiratory fitness and maximum oxygen uptake. RCTs of Hov et al., (2023) and Wen et al., (2019) continue to improve the protocol of high-intensity interval training to optimise these variables. The bibliometric association between HIIT and cardiometabolic outcomes, such as insulin sensitivity and glucose regulation, remains high (Jelleyman et al., 2015; Ryan et al., 2020; Poon et al., 2024). In the second cluster, cardiovascular health remains a central theme, with trials evaluating feasibility and safety (McGregor et al., 2023; Taylor et al., 2020). RCTs have also explored the HIITs' effect on heart rate variability in ischemic patients (Carrasco-Poyatos et al., 2024). RCTs on HIIT for faster stroke recovery (Moncion et al., 2024; Marzolini et al., 2023) and Parkinsons disease (Kathia et al., 2024) have gained significant emphasis, focusing on functional capacity and gait dysfunction. The RCTs on HIIT in cancer survivors are a trending frontier, assessing inflammatory markers and quality of life in breast cancer patients (Isanejad et al., 2023; Hiensch et al., 2021; Klavina et al., 2024) and the suppressive effects of exercise-induced myokines on cancer cell growth (Bettariga et al., 2025; Tsuji et al., 2021).

4. CONCLUSION

The bibliometric landscape of randomized controlled trials related to high-intensity interval training is characterised by rapid expansion, increasing international collaboration and a significant shift from athletic performance to clinical applications. Although cardiorespiratory and metabolic adaptations remain core research themes, the expansion of randomized controlled trials into oncology, neurology, and musculoskeletal indicates diverse applicability of high-intensity interval training in distinct populations, particularly emphasizing cancer and stroke patients. However, addressing identified methodological gaps through large-scale, standardized trials is important for ongoing evaluation and therapeutic integration of high-intensity interval training.

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AUTHOR CONTRIBUTIONS

Manish Acharjee: Manuscript Writing and Data Analysis.

Yashwant Gahlot: Methodology, Data Extraction.

Rahul Dev Choudhury: Data Screening and Data Analysis.

Sunita Arora: Supervision, Review & Editing.

Anek Goel: Methodology and Manuscript Preparation.

Sandeep Kumar Dwivedi: Data Screening and Manuscript Writing.

Om Prakash Mishra: Supervision, Methodology, and Final Review.

CONFLICT OF INTEREST

The authors declare that there is no conflict of interest.

ETHICS STATEMENT

Ethical approval was not required for this study.

DATA AVAILABILITY STATEMENT

The data supporting the findings of this study can be obtained from the corresponding author upon reasonable request. Access to the data is restricted and subject to the corresponding author's approval.

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