

The Effect of High-Intensity Interval Training on Visceral Adipose Tissue in Type 2 Diabetes: A Systematic Review

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Abstract

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Visceral adipose tissue (VAT) is a significant contributor to insulin resistance in type 2 diabetes (T2D). The effectiveness of time-efficient high-intensity interval training (HIIT) in reducing VAT has not been reviewed. A systematic search conducted on PubMed, Embase, and SPORTDiscus up to April 2025 for randomized controlled trials that compared HIIT with non-exercise control and quantified VAT using imaging identified five trials (n = 138) that met inclusion criteria. Risk of bias was assessed using a nine-item modified PEDro scale. Four trials reported significant reductions in VAT after 8-12 weeks of thrice-weekly cycling HIIT sessions. Furthermore, all five HIIT interventions showed significant reductions in glycosylated hemoglobin compared to the control groups. Overall, supervised HIIT appears effective, resulting in clinically significant reductions in VAT and glycemic control. Nonetheless, these conclusions are limited by small sample sizes, protocol heterogeneity, and short follow-up durations. Larger trials that standardize interval structures, evaluate unsupervised adherence, and investigate mechanistic mediators are necessary to confirm the sustainability of outcomes and inform clinical applications of HIIT for patients with T2D.

Keywords: Sprint interval training, intra-abdominal fat, type II Diabetes Mellitus

Introduction

Type 2 diabetes (T2D) is a growing global health concern, with estimates indicating that over 537 million adults were living with diabetes in 2021, a figure projected to rise to 1.27 billion by 2050.¹ The increasing prevalence of T2D is largely due to sedentary lifestyles, high-calorie diets, and rising obesity rates.² These trends underscore the urgent need for effective interventions to mitigate the impacts of T2D and its complications.

A key contributor to the development and progression of T2D is excess visceral adipose tissue (VAT), which accumulates in the abdominal cavity around vital organs like the liver, pancreas, and intestines.³ Unlike subcutaneous fat, VAT is more metabolically active and is associated with chronic low-grade inflammation, insulin resistance, dyslipidemia, and heightened

cardiovascular risk.⁴ Reducing VAT is thus crucial for improving metabolic health and reducing morbidity and mortality in adults.⁵

Traditional interventions, such as caloric restriction and moderate-intensity continuous training, have shown some success in weight loss and metabolic health improvement.⁶ However, high-intensity interval training (HIIT) is emerging as a more time-efficient and potentially more effective alternative for reducing VAT and improving cardiometabolic risk factors.⁷ HIIT sessions involve short bursts of vigorous exercise followed by low-intensity recovery periods. These sessions can be completed more quickly than traditional exercise programs, which may help individuals who cite “lack of time” as a barrier to physical activity.⁸

Studies have increasingly examined HIIT's role in improving metabolic parameters in individuals with T2D.⁹⁻¹⁹ HIIT can enhance insulin sensitivity, glycemic control, and cardiorespiratory fitness in this population.²⁰ Emerging evidence also suggests that HIIT may be more effective in reducing VAT compared to moderate-intensity exercise, although results vary across studies.^{21,22} The extent of VAT reduction seems to be influenced by factors such as HIIT protocol specifics (e.g., work-to-rest ratio, intensity, duration), intervention length, baseline fitness level, and study population characteristics.²³

Given the potential effects of HIIT on VAT reduction and metabolic health, a review of the existing literature is appropriate. The objective of this review is to summarize findings from studies utilizing HIIT in populations with T2D. We hypothesize that HIIT interventions will result in greater reductions in VAT and improvements in glycemic control compared to non-exercise controls in adults with T2D. Additionally, this review aims to identify gaps in the literature that require further investigation and to provide a basis for future research and practical recommendations for exercise interventions in T2D management.

Methods

The present systematic review was conducted with the aim of determining the effects of HIIT exercise interventions on VAT in patients with T2D. This study was performed in accordance with the Preferred Reporting Items for Systematic Reviews and Meta-analysis (PRISMA) 2020 checklist.²⁴ This review was carried out in accordance to the ethical standards of the *International Journal of Exercise Science*.²⁵

Inclusion and Exclusion Criteria

The following inclusion criteria were applied: (1) English language articles; (2) studies of human participants with T2D; (3) studies where the experimental group underwent HIIT exercise intervention and was compared with a no-intervention control group; (4) randomized control studies; and (5) studies with assessments of visceral fat area (VFA).

Exclusion criteria included (1) studies written in a non-English language; (2) non-original and non-experimental research such as case-control studies, cross-sectional studies, study protocols, conference proceedings, abstracts, letters to the editor, and reviews. (3) animal studies; and (4) non-randomized quasi-experimental studies.

Search Strategy and Retrieval

Before conducting the electronic search, an initial review of the literature was carried out to identify relevant themes, refine keywords, and determine the most suitable databases for a comprehensive search strategy. A librarian assisted in developing and verifying the search strategy by providing guidance on where to locate relevant database subject headings, keywords were selected, and the search strategy was refined using sentinel studies for application across the selected databases. A comprehensive electronic database search was completed in Pubmed, Embase, and SPORTDiscus up to April 2025, using the following search strategy: ("visceral fat" OR "visceral adipose tissue" OR "intra-abdominal fat" OR "intra-abdominal adipose tissue" OR "retroperitoneal fat" OR "retroperitoneal adipose tissue") AND ("diabetes mellitus" OR "diabetes type 2" OR "diabetes type ii" OR "type ii diabetes" OR "type 2 diabetes") AND ("high-intensity interval training" OR "high-intensity interval exercise" OR "hiit" OR "sprint interval training" OR "sprint interval exercise" OR "high-intensity intermittent exercise" OR "high-intensity intermittent training"). The electronic search included articles in English and studies involving human participants, with no restrictions on publication dates. Records from the searches were imported into EndNote, and duplicates were removed. Two authors (I.D.D & J.C.D.) independently assessed titles, abstracts, and full texts for eligibility. Any disagreements were to be resolved through discussion or by consulting a third author (R.D.B). Data extraction was also performed independently by the same two reviewers, with disagreements resolved by a third reviewer. Reference lists of all identified studies were manually searched for potentially eligible papers.

Study Selection

Studies were included if the exercise intervention lasted 8 weeks or more. Both supervised and unsupervised HIIT trials were considered. Studies were included if VAT was measured using dual-energy X-ray absorptiometry (DEXA), magnetic resonance imaging (MRI), proton magnetic resonance spectroscopy (H-MRS), or computed tomography (CT). These imaging-based assessment provide precise and reproducible measurements of visceral fat, unlike indirect proxies such as waist circumference that cannot distinguish visceral from subcutaneous adiposity.

Quality Assessment

The risk of methodological bias was independently assessed following the guidelines of the Physiotherapy Evidence Database (PEDro) scale.²⁶ Two items concerning the non-blinding of participants and therapists were excluded from the original 11-item scale due to practical limitations associated with blinding exercise conditions in studies. Consequently, the quality of the studies was evaluated based on nine criteria: eligibility requirements, random allocation of participants, assessment of outcomes in at least 85% of participants, baseline comparison, allocation concealment, intention-to-treat analysis, reporting of statistical comparisons between groups, and provision of point estimates and variability statistics. Studies with a PEDro score of 6 or higher were included. We evaluated heterogeneity using both statistical and clinical criteria. The I^2 statistic was calculated from study-level effect sizes for VAT reduction, yielding $I^2 = 0\%$,

indicating negligible statistical heterogeneity. However, substantial clinical heterogeneity was evident across studies, including differences in HIIT protocols (interval length ranged from 8 seconds to 4 minutes), recovery duration, intensity targets, and energy expenditure control (only one study matched energy), and VAT measurement techniques (MRI, CT, DXA, H-MRS) each with distinct precision and interpretation. The differences identified impact the comparability and interpretation of pooled estimates. As a result, a meta-analysis was not conducted, and the findings are reported in narrative form.

Data Extraction

The collected data includes the following information: author name(s), publication year, participant characteristics (sample size, biological sex, health condition, age), study design parameters (exercise type, duration of exercise), measurement methodologies, and pre- and post-test data for the specified outcome variables. Means and standard deviations for all primary and secondary outcomes were extracted from each study for analysis.

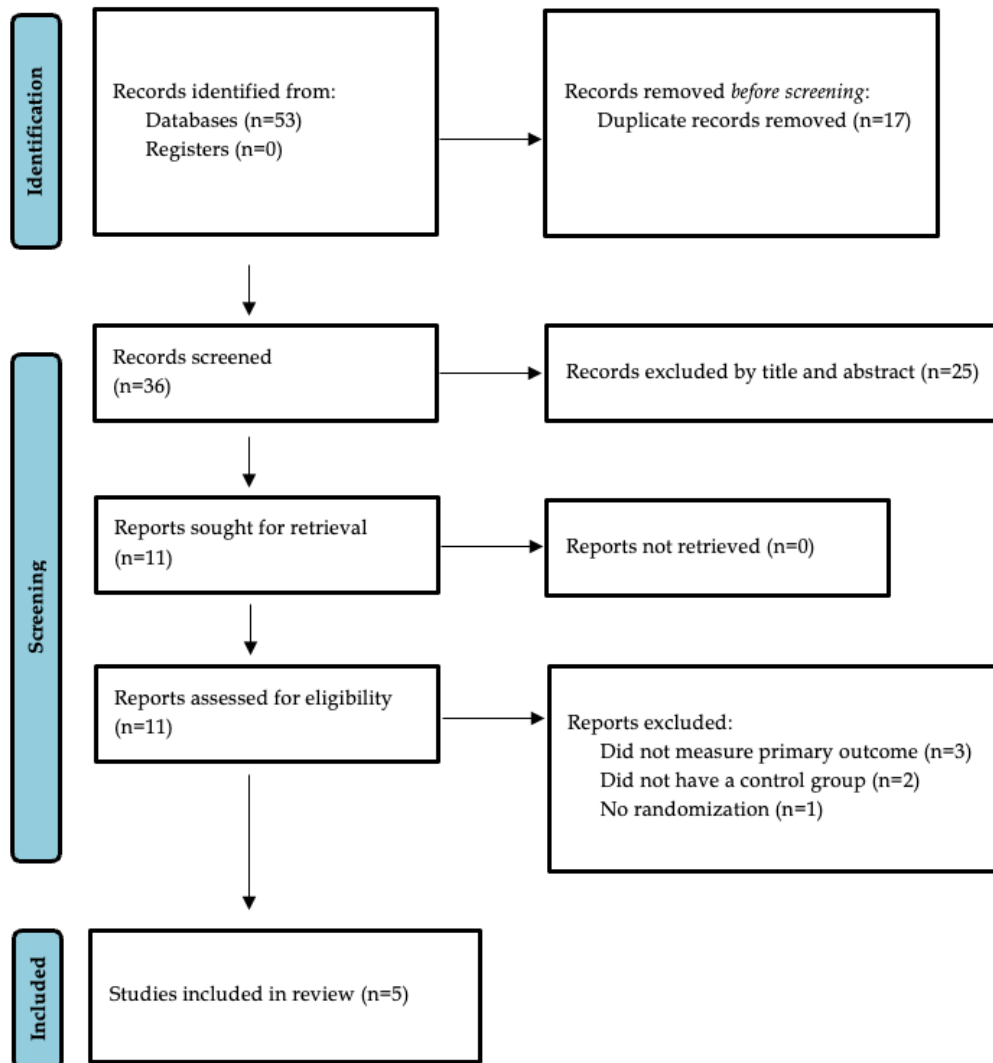


Figure 1. Flow diagram of systematic literature search.

Results

Included Studies

The initial search strategy identified 8 records from PubMed, 30 from Embase, and 15 from SPORTDiscus. After removing 17 duplicate records and screening the titles and abstracts (initial screening), 11 studies were retrieved for a detailed appraisal of the full texts (secondary screening). Six studies were excluded after reviewing the full text for the following reasons: (A) three did not measure primary outcomes; (B) two did not have a control group; (C) one was not a randomized study. Ultimately, five studies were included in this systematic review. A detailed flow diagram of the systematic literature search is presented in Figure 1.

Participant Characteristics

Table 1 presents the full details of participant characteristics. A total of 138 patients (72 males, 66 females) with T2D were included, with sample sizes ranging from 20¹³ to 40.¹¹ The mean ages of participants ranged from 52 to 62 years. Both males and females were included in the 5 studies selected. All patients with T2D were either overweight or had obesity according to their BMI (data not shown). Intervention durations ranged from 8 to 12 weeks, with 12-week durations in 3 of the 5 studies selected. In all 5 studies, exercise sessions were performed 3 times per week. The duration of each session of HIIT exercise ranged from 4 min¹² to 12 min.¹¹

Effects of HIIT on VAT Reduction

The primary goal of this study was to assess the impact of HIIT on reducing VAT in patients with T2D through a systematic literature review. Four of the five randomized control studies analyzed in this review found statistically significant reductions in VAT, providing strong evidence supporting HIIT as an effective intervention in T2D patients (Table 2)^{9,10,12,13}. Findikoglu et al.¹¹ found no significant reduction in VAT in the group compared to the control group when energy expenditure was matched between the groups. Additionally, Sabag et al.¹² and Winding et al.¹³ noted reductions in liver fat in adults with obesity and T2D. Further, Cassidy et al.¹⁰ found a 39% relative reduction in liver fat in T2D patients with cardiac dysfunction. These findings collectively indicate the effectiveness of HIIT in reducing ectopic abdominal adipose tissue, both VAT and liver fat, in T2D patients.

Effects of HIIT on Glycemic Control

Glycemic control was examined as a secondary outcome. Glycosylated hemoglobin (HbA1c), which reflects three months of glycemic control, was evaluated to determine the effects of HIIT compared to the control intervention. The five randomized control trials reviewed in this analysis all reported statistically significant reductions in HbA1c levels, providing strong evidence that supports HIIT as an effective intervention for glycemic control among patients with T2D (Table 3).

Table 1. Participant and intervention characteristics.

Study	Sample Size (Sex)	Age [Years] Mean $\pm$ SD	Exercise intervention	Follow up (Week)
Abdelbasset et al. ⁹	32 (21M; 11F)	Con: 55.2 $\pm$ 4.3 HIIT: 54.4 $\pm$ 5.8	5 min warm-up and 3 sets of 4 min cycling sessions at 80% to 85% of the VO ₂ max with 2 min intervals at 50% of the VO ₂ max between sets and 5 min cool-down $\times$ 3 d/w	8 weeks
Cassidy et al. ¹⁰	23 (18M; 5F)	Con: 59 $\pm$ 9 HIIT: 61 $\pm$ 9	Cycle ergometer at RPE 9–13 during 5 min warm-up, followed by 5 intervals at an RPE 16–17 with 3 min recovery periods between intervals. Interval duration started at 2 min and progressed to 3 min and 50 s by week 12 $\times$ 3 d/w	12 weeks
Findikoglu et al. ¹¹	40 (7M; 33F)	Con: 55.8 $\pm$ 8.6 HIIT: 57.5 $\pm$ 7.8	Cycling at HR corresponding to 90% of VO ₂ peak for 60s bouts and 30% of VO ₂ peak for 120s in low-intensity periods. Each exercise session started with 5 min of warming up and ended with 5 min of cooling down. Training sessions started with 8 cycles (weeks 1–4), continued with 12 cycles (weeks 5–8), ending with 16 cycles (weeks 9–12) $\times$ 3 d/w	12 weeks
Sabag et al. ¹²	23 (14M; 9F)	Con: 54.8 $\pm$ 8.3 HIIT: 51.9 $\pm$ 4.6	4 min of cycling at a 90% VO ₂ peak and a 10 min warm-up and 5 min cool-down at a 50% VO ₂ peak $\times$ 3 d/w	12 weeks
Winding et al. ¹³	20 (12M; 8F)	Con: 57 $\pm$ 7 HIIT: 54 $\pm$ 6	5 min warm-up, 20 min of cycling consisting of cycles of 1 min at 95% Wpeak and 1 min of active recovery (20% Wpeak) $\times$ 3d/w	11 weeks

Abbreviations: M: male; F: female; T2D: type 2 diabetes; Con: control; HIIT: high-intensity interval training; VFA: visceral fat area; kg: kilogram; RPE: rate of perceived exertion; VO₂peak: peak rate of oxygen consumption; Wpeak: peak power output; HR: heart rate.

Table 2. Effects of exercise training vs. control on VAT.

Study	Mode	Measure	Pre. Mean ($\pm$ SD)	Post. Mean ($\pm$ SD)
Abdelbasset et al. ⁹	Con: n = 16 HIIT: n = 16	VFA: MRI	Con: 179.8 $\pm$ 14.4 HIIT: 184.5 $\pm$ 12.3	Con: 177.2 $\pm$ 12.8 HIIT: 166.4 $\pm$ 11.6 †
Cassidy et al. ¹⁰	Con: n = 11 HIIT: n = 12	VFA: MRI	Con: 159 $\pm$ 58 HIIT: 201 $\pm$ 80	Con: 156 $\pm$ 49 HIIT: 181 $\pm$ 72 †
Findikoglu et al. ¹¹	Con: n = 20 HIIT: n = 20	VFA: CT	Con: 16.06 $\pm$ 5.63 HIIT: 17.7 $\pm$ 5.78	Con: 16.56 $\pm$ 5.23 HIIT: 16.65 $\pm$ 6.23
Sabag et al. ¹²	Con: n = 11 HIIT: n = 12	VFA: H-MRS	Con: 11.8 $\pm$ 2.3 HIIT: 9.7 $\pm$ 2.4	Con: 13.0 $\pm$ 2.7 HIIT: 8.0 $\pm$ 2.2 †
Winding et al. ¹³	Con: n = 7 HIIT: n = 13	VFA: DEXA	Con: 2.0 $\pm$ 0.6 HIIT: 1.7 $\pm$ 0.8	Con: 2.1 $\pm$ 0.6 HIIT: 1.5 $\pm$ 0.7 †

Abbreviations: n: number of subjects; Con: control; HIIT: high-intensity interval training; VFA: visceral fat area; H-MRS: proton magnetic resonance spectroscopy; CT: computed tomography; MRI: magnetic resonance imaging; DEXA: dual-energy X-ray absorptiometry; †: between group difference $p < 0.05$.

Table 3. Effects of exercise training vs. control on glycosylated hemoglobin.

Study	Control baseline HbA1c (%)	Control post HbA1c (%)	HIIT baseline HbA1c (%)	HIIT post HbA1c (%)
Abdelbasset et al. ⁹	6.7 ± 0.6	6.5 ± 0.5	6.6 ± 0.4	6.2 ± 0.3 †
Cassidy et al. ¹⁰	7.2 ± 0.5	7.4 ± 0.7	7.1 ± 1.0	6.8 ± 0.9 †
Findikoglu et al. ¹¹	6.99 ± 0.66	6.76 ± 0.66	6.9 ± 0.68	6.49 ± 0.49 †
Sabag et al. ¹²	7.6 ± 0.5	8.0 ± 0.5	7.3 ± 0.4	7.0 ± 0.3 †
Winding et al. ¹³	7.0 ± 1.15	6.9 ± 0.9	6.8 ± 0.8	6.5 ± 0.8 †

Abbreviations: HIIT: high-intensity interval training; HbA1c: glycosylated hemoglobin; †: between group difference $p < 0.05$.

Quality Assessment

The methodological quality of individual studies was evaluated using the PEDro scale, with scores ranging from 6 to 8 out of a maximum of 9 points (Table 4). Two studies had a score of 8,^{10,12} two scored 7,^{9,11} and one scored 6.¹³

Table 4. Risk of bias assessment (PEDro scale)

Criteria	Abdelbasset et al. ⁹	Cassidy et al. ¹⁰	Findikoglu et al. ¹¹	Sabag et al. ¹²	Winding et al. ¹³
Eligibility Criteria specified	Yes	Yes	Yes	Yes	Yes
Random allocation of participants	Yes	Yes	Yes	Yes	Yes
Allocation Concealed	No	No	No	No	No
Groups similar at baseline	Yes	Yes	Yes	Yes	Yes
Assessors blinded	Yes	Yes	Yes	Yes	No
Outcome measures assessed in 85% of participants	Yes	Yes	Yes	Yes	Yes
Intention to treat analysis	No	Yes	No	Yes	No
Reporting of between group statistical comparisons	Yes	Yes	Yes	Yes	Yes
Point measures and measures of variability reported for main effects.	Yes	Yes	Yes	Yes	Yes
Total=	7	8	7	8	6

Discussion

Obesity is a health condition characterized by an excessive accumulation of adipose tissue. The increase of adipose tissue in the abdominal area disrupts hormonal signaling pathways, which can contribute to metabolic disorders. Metabolic disease, also known as metabolic syndrome, is associated with low-grade inflammation caused by enlarged and dysfunctional adipocytes that release pro-inflammatory cytokines.²⁷ This inflammatory environment disrupts insulin signaling in peripheral tissues, leading to a cycle of insulin resistance and hyperglycemia. T2D results from insulin resistance and declining beta cell function and is a major consequence of metabolic dysfunction. Beyond mere weight gain, VAT plays a uniquely detrimental role in the pathogenesis of T2D. Unlike subcutaneous fat, VAT drains directly into the portal circulation, delivering free fatty acids and inflammatory mediators to the liver.⁴ This hepatic "first-pass" effect promotes gluconeogenesis, dyslipidemia, and further insulin resistance. Consequently, elevated VAT content is strongly associated with an increased risk of metabolic disease and overt T2D, highlighting the significance of targeting visceral fat reduction in therapeutic interventions.

This systematic review highlights that HIIT is a time-efficient approach for improving metabolic health in T2D patients. HIIT, which consists of brief periods of intense exercise ($>80\%$ VO_2 max) with recovery intervals, consistently outperformed moderate-intensity continuous training (MICT) in reducing visceral fat and controlling blood sugar. For instance, Maillard et al.¹⁵ observed a substantial decrease in visceral fat mass among HIIT participants, while those following MICT showed a slight increase. Additionally, Winding et al.¹³ found that HIIT led to marked improvements in key glycemic measures, whereas the MICT group experienced minimal changes, emphasizing the potential advantage of HIIT for this population. MICT is typically conducted at approximately 50–70% VO_2 max and includes activities like moderate jogging, swimming, or cycling at a sustained pace. The superior effects of HIIT on VAT reduction are likely attributable to greater post-exercise oxygen consumption (EPOC), increased mitochondrial biogenesis, and enhanced fat oxidation.²⁸ Collectively, these findings underscore the efficiency and effectiveness of HIIT, suggesting that it may offer advantages over MICT.¹⁵ However, further research is necessary to confirm the potential superiority of HIIT.

Several factors can affect the applicability and adherence to HIIT, including physiological, psychological, logistical, and behavioral elements. Physical limitations, fatigue, and health issues may influence retention. Psychological barriers like fear of injury, perceived intensity, and low self-efficacy can reduce motivation. Logistical barriers such as equipment access, cost, transportation, and time constraints also impede participation. Behavioral barriers, including difficulties with long-term exercise engagement and age-related cognitive decline, further hinder adherence.

Practical clinical application of HIIT in individuals with T2D and obesity is promising, as protocols across the reviewed studies were well tolerated and demonstrated high feasibility. Adherence rates averaged around 85%, with no significant adverse events such as cardiovascular or musculoskeletal complications reported, underscoring HIIT's safety when implemented with appropriate oversight. Most studies utilized supervised or partially

supervised settings, which likely contributed to high adherence and reduced dropout rates. For example, Cassidy et al.¹⁰ employed a hybrid approach where participants began with supervised sessions before transitioning to home-based training guided by pre-recorded instructions, demonstrating that HIIT can be adapted for minimally supervised environments. From a clinical standpoint, tailoring HIIT to the patient's age, fitness level, and comorbidities is essential, especially when considering unsupervised or home-based programs. For older or deconditioned individuals, gradual progression and initial supervision are recommended to minimize injury risk and ensure correct technique and intensity regulation. While those with prior training experience may self-administer HIIT, patients with limited exercise backgrounds or chronic health conditions may benefit from a preparatory phase of general aerobic and resistance training before advancing to high-intensity intervals. Practical strategies, such as hybrid models that integrate both supervised and home-based sessions, may be especially effective in enhancing feasibility, safety, and long-term adherence in real-world clinical practice. Overall, these findings suggest that with appropriate supervision, individualized progression, and flexible program formats, HIIT can be safely and effectively incorporated into the management of T2D and obesity across diverse patient profiles. Ongoing research should continue to explore the most effective ways to support patients in transitioning to independent HIIT and to identify protocols that maximize both safety and adherence outside of clinical settings.

One limitation of this review is the variability in HIIT protocols tested across the studies. While all five studies included in this review performed HIIT on cycle ergometry, the number of intervals, interval length, and level of exertion varied significantly. The most notable difference among the HIIT interventions was the length and number of intervals performed per session. Some studies employed short, repeated sprint protocols,^{10,12} while others utilized longer sustained intervals.^{9,11,13} Interval lengths among these studies ranged from 8-second sprints / 12-second recovery¹⁰ to 4-minute work intervals / 3-minute recovery.¹¹ This variation in interval structure creates challenges in comparing the effectiveness of HIIT across studies. Shorter, repeated sprint protocols rely more heavily on anaerobic metabolism and EPOC, whereas longer intervals incorporate a greater aerobic component and sustained fat oxidation during exercise. These differences influence total caloric expenditure, metabolic adaptations, and the degree of cardiovascular and muscular fatigue, all of which can impact VAT reduction and glycemic control. Furthermore, since Findikoglu et al.¹¹ was the only study to control for energy expenditure, it remains unclear whether the greater VAT reductions observed in other HIIT studies were due to inherent advantages of HIIT, higher total caloric expenditure, or the specific metabolic effects of different interval structures. Without standardization in energy expenditure and interval design, the relative contributions of intensity, duration, and total work performed to VAT reduction cannot be fully separated. Future studies should control for these factors to more accurately evaluate HIIT's metabolic benefits.

Another key limitation is the variability in individual responses to HIIT, which may depend on genetic, metabolic, and behavioral factors. While HIIT has demonstrated potential as a time-efficient intervention for VAT reduction and glycemic control, not all individuals respond to HIIT in the same way. Individuals with high insulin resistance or advanced T2D may exhibit slower metabolic adaptations to HIIT, as their impaired insulin signaling pathways take longer

to improve. These baseline metabolic differences suggest that individuals with more severe metabolic dysfunction may benefit from longer HIIT intervention durations, as well as a greater emphasis on increasing total caloric expenditure rather than focusing solely on exercise intensity. The findings of Findikoglu et al.¹¹ support this hypothesis, as they indicate that energy expenditure, rather than exercise modality, may be the key driver of VAT reduction. Future studies should stratify participants by metabolic health status to determine how disease progression influences individual responses to HIIT and whether modifications to interval structure, intensity, or session frequency could improve outcomes for those with severe insulin resistance.

Adherence to HIIT in free-living conditions also remains an open question. While all five studies included in this review were conducted in controlled environments, it is unclear whether HIIT protocols would be equally effective and maintain high adherence rates outside of a supervised setting. Future research should explore the feasibility of long-term, self-directed HIIT programs, particularly in older adults with T2D.

Finally, we recognize that our search strategy identified a relatively short number of studies for initial screening compared to systematic reviews in other areas. Although HIIT interventions have been employed by athletes and widely discussed within the exercise science literature for their time-efficient cardiovascular and metabolic benefits, it is predominantly over the past decade that HIIT has achieved broader recognition and uptake within mainstream fitness and academic research, particularly in randomized clinical trials. Furthermore, this review's specific emphasis on the effects of VAT reduction specifically in individuals with T2D may have further narrowed the pool of eligible studies.

This review examined the effectiveness of HIIT in reducing VAT and improving glycemic control in T2D. The results from randomized controlled trials indicate that HIIT significantly reduces VAT and enhances metabolism with limited time commitment compared to other exercise modalities.

Future research should aim to standardize HIIT protocols and control for total energy expenditure to better understand the effects of exercise intensity on VAT reduction and glycemic control. Individualized HIIT programs tailored to metabolic status, disease progression, and sex-specific responses should also be explored to enhance effectiveness. Additionally, investigating long-term adherence to HIIT outside supervised settings is crucial, as logistical and psychological barriers may impact its practicality in clinical and everyday contexts.

In conclusion, HIIT emerges as an effective strategy for reducing VAT and improving metabolic health in individuals with T2D. Further research is necessary to evaluate its long-term effectiveness, sustainability, and applicability across diverse populations. By refining exercise protocols and examining real-world adherence, HIIT can become a vital component of lifestyle interventions aimed at reducing metabolic disease risk and improving health outcomes in people with T2D.

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