



An integrated exercise prescription for office workers: An evidence-based analysis of high-intensity interval training

Lung-Tan Lu

Department of Management, Fo Guang University, Taiwan

DOI: <https://doi.org/10.66856/ijmr.2026.11.4.11035>

Abstract

Purpose: This study systematically synthesizes epidemiological and exercise physiology evidence on the health impacts of high-intensity interval training (HIIT), resistance training, and core stability training among office workers, and develops an evidence-based integrated exercise prescription tailored to workplace populations.

Methods: A narrative literature review was conducted. Core literature published between 2011 and 2026 was retrieved from databases including PubMed and Web of Science, incorporating 22 high-quality sources: randomized controlled trials, systematic reviews and meta-analyses, and large-scale cohort studies. An integrated analysis was performed across the physiological mechanisms, health benefits, eligibility criteria, and safety guidelines of the three training modalities.

Results: Sedentary behavior significantly elevates office workers' risks of cardiovascular disease, metabolic syndrome, and chronic musculoskeletal pain via multiple pathways: vascular endothelial dysfunction, insulin resistance, disuse muscle atrophy, and core muscle impairment. HIIT delivers significant improvements in maximal oxygen uptake ($\text{VO}_{2\text{max}}$) and insulin sensitivity with exceptional time efficiency, but its fat loss effect does not exceed that of traditional moderate-intensity continuous training. Resistance training exerts independent protective effects against metabolic syndrome, preserves muscle mass and bone mineral density, and produces synergistic additive benefits when combined with aerobic training. Core stability training effectively alleviates chronic low back pain and corrects sedentary-related postural deviations, forming the safety foundation for other training modalities.

Conclusions: Exercise prescriptions for office workers should adopt a three-dimensional integrated framework targeting cardiopulmonary function, metabolic health, and musculoskeletal integrity. A stepwise progressive training model is recommended: first build foundational exercise capacity, then gradually introduce HIIT and resistance training, and complement structured training with workplace micro-movements to break up prolonged sitting, for sustainable long-term health benefits.

Keywords: Sedentary behavior, office workers, high-intensity interval training, resistance training, core stability training, exercise prescription

Introduction

As the global industrial structure shifts toward a knowledge-based economy, sedentary office work has become the dominant occupational pattern in modern workplaces. The Global Status Report on Physical Activity 2024^[22] released by the World Health Organization (WHO, 2024)^[22] indicates that approximately 31% of adults worldwide fail to meet the minimum recommendation of 150 minutes of moderate-intensity aerobic activity per week, with the highest prevalence of sedentary behavior observed in high-income countries, where sedentary time accounts for over 60% of waking hours. In Taiwan, data from the 2022 National Physical Activity Survey by the Health Promotion Administration, Ministry of Health and Welfare, shows that over 50% of office workers sit continuously for more than 6 hours per day, and only about 40% meet WHO-recommended physical activity levels. Physical inactivity and prolonged sitting have emerged as a critical public health challenge among working populations. Abundant epidemiological evidence confirms that sedentary behavior is not merely a marker of insufficient physical activity, but an independent health risk factor that increases all-cause mortality and chronic disease incidence through multiple pathophysiological pathways (Biswas *et al.*, 2015; Ekelund *et al.*, 2016)^[2, 6]. For office workers, the health consequences of chronic sedentary behavior manifest as

three interrelated pathological axes: (1) reduced cardiopulmonary fitness leading to physical decline, chronic fatigue, and elevated cardiovascular risk; (2) decreased insulin sensitivity and muscle loss driving metabolic syndrome and body fat accumulation; and (3) core muscle dysfunction and muscular imbalance causing chronic low back pain, neck and shoulder discomfort, and postural abnormalities. These three clusters of problems often coexist and interact, creating a vicious cycle of "sedentariness → metabolic decline → fatigue and pain → further inactivity."

Traditional workplace health promotion has largely relied on single-modality aerobic exercise, which improves cardiopulmonary function to some extent but fails to comprehensively address metabolic and musculoskeletal health. In recent years, exercise medicine research has increasingly focused on the synergistic benefits of multi-modal training. High-intensity interval training (HIIT) has emerged as a prominent option for time-constrained populations due to its exceptional time efficiency and robust metabolic stimulation. Meanwhile, the independent protective effects of resistance training on muscle mass maintenance and metabolic health have gained growing empirical support. Core stability training, from a neuromuscular control perspective, offers an etiological intervention pathway for sedentary-related musculoskeletal

disorders. However, research on integrated exercise prescriptions specifically for office workers remains scarce. Most studies focus on a single training modality, and there is a lack of systematic synthesis of the synergistic mechanisms, optimal sequencing, and practical implementation strategies across the three modalities. The present study systematically reviews high-quality SCI literature in exercise medicine, integrates the physiological mechanisms, health benefits, eligibility criteria, and safety standards of HIIT, resistance training, and core stability training, and develops a scientific, feasible, and sustainable integrated exercise prescription aligned with the time constraints and health needs of office workers. This work aims to provide an evidence base for workplace health promotion and individual exercise practice.

Health Hazards of Sedentary Behavior: Pathophysiological Mechanisms and Epidemiological Evidence

1. Definition and Workplace Characteristics of Sedentary Behavior

Sedentary behavior is defined as all waking activities performed in a sitting or reclining posture with an energy expenditure ≤ 1.5 metabolic equivalents (METs; Sedentary Behaviour Research Network, 2012) ^[16]. Compared to the general population, sedentary behavior among office workers is characterized by long duration, high continuity, and extremely low muscle activation. During an 8–12 hour workday, most workers remain seated continuously for over 2 hours without significant physical movement; muscles maintain only low-level isometric contraction for postural support, lacking rhythmic contraction and relaxation of large muscle groups. This chronic static loading state causes cumulative damage to multiple physiological systems.

2. Cardiopulmonary and Metabolic Damage Mechanisms

Prolonged sitting markedly reduces skeletal muscle contraction in the lower limbs, weakening the “muscle pump” effect, slowing venous return from the legs, decreasing cardiac output, and thereby reducing vascular shear stress (Thosar *et al.*, 2015) ^[19]. Vascular endothelial cells are highly sensitive to shear stress; sustained low shear stress downregulates endothelial nitric oxide synthase (eNOS) expression, reduces nitric oxide (NO) bioavailability, impairs vasodilatory function, reduces arterial compliance, and accelerates atherosclerotic progression. An experimental study in healthy young adults found that 3 hours of uninterrupted sitting reduced flow-mediated vasodilation (FMD) in the lower limbs by 15%–20%, while interrupting sitting every 30 minutes with 2 minutes of walking significantly mitigated endothelial dysfunction (Thosar *et al.*, 2015) ^[19]. Skeletal muscle is the primary organ for postprandial glucose disposal, responsible for approximately 80% of insulin-stimulated glucose uptake. Chronic lack of muscle contraction due to sedentary behavior reduces the expression and translocation of glucose transporter 4 (GLUT4), impairs insulin signal transduction, and induces insulin resistance (Drake *et al.*, 2016) ^[5]. Concurrently, reduced mitochondrial content and decreased respiratory enzyme activity in muscle impair fat oxidation capacity, leading to ectopic fat accumulation and further exacerbating metabolic dysregulation. A meta-analysis by Biswas *et al.* (2015) ^[2] pooling 47 cohort studies with over

830,000 participants found that the longest sedentary time group had a 91% higher risk of type 2 diabetes (hazard ratio [HR] = 1.91, 95% CI: 1.64–2.22) compared to the shortest sedentary group, independent of physical activity level. Sedentary behavior induces visceral adipose tissue to release pro-inflammatory cytokines such as tumor necrosis factor- α (TNF- α) and interleukin-6 (IL-6), while reducing the production of anti-inflammatory myokines (e.g., irisin, IL-15) from muscle contraction, resulting in a state of systemic low-grade chronic inflammation (Booth *et al.*, 2012) ^[3]. This chronic inflammatory state is a shared pathological basis for atherosclerosis, type 2 diabetes, cancer, and multiple other chronic diseases.

3. Musculoskeletal Damage Mechanisms

Chronic absence of mechanical load disrupts the balance between muscle protein synthesis and breakdown, with catabolism exceeding anabolism, leading to muscle fiber atrophy—particularly loss of type I slow-twitch fibers. Among office workers, disuse atrophy is most pronounced in core and lower limb muscles, which not only reduces resting metabolic rate but also compromises spinal and joint stability. A meta-analysis of 22 randomized controlled trials (RCTs) by Zhang *et al.* (2024) ^[23] found that muscle mass loss rate in sedentary populations is 2–3 times higher than in regularly exercising individuals, and declines in muscle strength precede measurable reductions in muscle mass. During prolonged sitting, the body relies on passive structures (ligaments, joint capsules) to maintain spinal stability, while deep core muscles (transversus abdominis, multifidus) remain chronically under-activated, leading to disuse atrophy and delayed neuromuscular control. Superficial muscles (e.g., erector spinae, pectoralis major) then become overactive as compensation, creating a muscular imbalance pattern of “deep weakness + superficial tension.” This imbalance progresses to postural deviations such as rounded shoulders, forward head posture, and anterior pelvic tilt, increasing the risk of low back and neck-shoulder pain (Liu *et al.*, 2026) ^[11]. Sitting significantly increases intradiscal pressure in the lumbar spine compared to standing; in a forward-leaning seated posture, lumbar disc pressure can reach 1.5–2 times that of standing. Chronic abnormal loading accelerates intervertebral disc degeneration, while compensatory tension in paraspinal muscles triggers myofascial pain, together forming the pathological basis of chronic low back pain. Epidemiological data show that the prevalence of chronic low back pain among office workers reaches 40%–60%, making it the leading cause of occupational absenteeism (Liu *et al.*, 2026) ^[11].

Exercise Physiology Evidence and Workplace Adaptability of High-Intensity Interval Training

1. Scientific Definition and Physiological Essence of HIIT

According to the American College of Sports Medicine (ACSM, 2021) ^[1], high-intensity interval training (HIIT) is an exercise modality consisting of alternating short periods of high-intensity exercise ($\geq 85\%$ maximal heart rate or $\geq 85\%$ maximal oxygen uptake reserve) and low-intensity recovery periods. Compared to traditional moderate-intensity continuous training (MICT), the defining feature of HIIT is that intermittent high-intensity stimuli trigger broader physiological adaptations in less total training time.

From an energy metabolism perspective, when exercise intensity exceeds 85% of maximal heart rate, the body's energy supply shifts from predominantly aerobic oxidation to mixed aerobic-anaerobic metabolism. Lactate production rate exceeds clearance rate, leading to intramuscular lactate accumulation. This metabolic stress activates a cascade of cellular signaling pathways, including AMP-activated protein kinase (AMPK) and peroxisome proliferator-activated receptor gamma coactivator 1-alpha (PGC-1 α), which in turn induce mitochondrial biogenesis, angiogenesis, and improved insulin sensitivity (Drake *et al.*, 2016) [5]. Research confirms that a single session of HIIT significantly upregulates PGC-1 α gene expression in muscle to a degree comparable to prolonged MICT, yet requires only 1/4 to 1/3 of the total training time (Wen *et al.*, 2019) [20].

2. Physiological Characteristics and Applicable Populations of Classic HIIT Protocols

Three mainstream HIIT protocols dominate exercise science research: Tabata, 4 $\times$ 4, and 30-30. They differ substantially in intensity design, metabolic stimulation, and target populations, requiring differentiated selection for office workers. Developed by Tabata *et al.* in 1996, the original Tabata protocol consists of 20 seconds of all-out supramaximal exercise ($\sim$ 170% VO₂max) followed by 10 seconds of complete rest, repeated for 6–8 sets, with a total work time of only 4 minutes. In a subsequent review, Tabata (2025) [18] noted that the core mechanism of this protocol is that the extremely short rest period prevents full phosphocreatine resynthesis, leading to progressive accumulation of metabolic stress across sets and sustained high-level aerobic and anaerobic stimulation throughout the workout. Research shows that Tabata training produces significant improvements in VO₂max, anaerobic capacity, and muscular power. However, due to its near-maximal intensity, the protocol has low tolerability; beginners commonly experience adverse effects such as nausea and dizziness, and injury risk is relatively elevated. For office workers, the Tabata protocol is only recommended for individuals with 6+ months of regular exercise experience and no cardiovascular contraindications. A modified version (e.g., 30 seconds high intensity + 30 seconds rest) is advised as an entry point, rather than the original all-out protocol for beginners.

The 4 $\times$ 4 protocol (also called the Norwegian model) is one of the most extensively studied HIIT regimens. The standard protocol consists of 4 minutes of high-intensity exercise at 90%–95% maximal heart rate, followed by 3 minutes of low-intensity active recovery (e.g., slow walking, slow cycling), repeated for 4 sets, totaling 16 minutes of high-intensity work. A study by Hov *et al.* (2022) [9] found that after 8 weeks of training, the 4 $\times$ 4 protocol produced significantly greater improvements in VO₂max than both 8 $\times$ 20-second and 10 $\times$ 30-second sprint interval training protocols, with a lower incidence of adverse events. The longer high-intensity bouts in the 4 $\times$ 4 protocol allow the cardiopulmonary system to reach and sustain near-maximal load each cycle, resulting in the most consistent improvements in cardiorespiratory fitness. However, the protocol requires longer total training time and a higher baseline fitness level. It is suitable for office workers with an established aerobic base who seek systematic improvements in cardiopulmonary function, recommended

1–2 times per week on non-workdays or after work when energy levels are relatively high. The 30-30 protocol alternates 30 seconds of high-intensity exercise (85%–90% maximal heart rate) with 30 seconds of active recovery, repeated for 15–20 sets, totaling 7.5–10 minutes of high-intensity work. Unlike the complete rest in Tabata, active recovery prevents heart rate from dropping sharply between bouts, allowing partial lactate clearance and phosphocreatine resynthesis while maintaining a high average heart rate, thus accumulating more effective training time. Classic research by Billat *et al.* confirms that the 30-30 protocol effectively improves VO₂max and lactate threshold at relatively moderate load, with significantly better tolerability and adherence than the Tabata protocol. For office workers, the 30-30 protocol is the optimal entry-level HIIT option: short training time, controllable intensity, and low safety risk, delivering significant cardiopulmonary and metabolic benefits without excessive fatigue that impairs work performance. It is recommended that beginners build a 4–8 week base of moderate-intensity aerobic exercise before starting HIIT with the 30-30 protocol.

3. Core Health Benefits of HIIT for Office Workers

Improving maximal oxygen uptake (VO₂max) is one of the most fundamental health benefits of exercise training. VO₂max is not only the gold standard for cardiorespiratory fitness but also a strong predictor of all-cause mortality (Lazarus & Harridge, 2025) [10]. A meta-analysis of 53 RCTs by Wen *et al.* (2019) [20] found that HIIT significantly improves VO₂max in adults regardless of training duration, with effect sizes comparable to MICT but requiring only 40%–60% of the total training time. Notably, short-duration HIIT ($\leq$ 4 weeks) already produces statistically significant improvements in VO₂max (SMD = 0.79–1.65). For time-constrained office workers, this is highly valuable: as little as 3 sessions per week, each under 20 minutes, can produce measurable improvements in cardiopulmonary function within one month. The beneficial effects of HIIT on metabolic syndrome are supported by extensive evidence. A systematic review and meta-analysis of 23 RCTs with 1,374 metabolic syndrome patients by Poon *et al.* (2024) [15] found that HIIT significantly reduces waist circumference (weighted mean difference [WMD] = -4.12 cm), systolic blood pressure (WMD = -6.05 mmHg), and diastolic blood pressure (WMD = -3.68 mmHg), and improves lipid profiles and fasting glucose—effects statistically comparable to MICT. Subgroup analysis further indicates that low-volume HIIT ($<$ 15 minutes of high-intensity work per session) is not inferior to high-volume protocols for improving metabolic parameters, meaning office workers can achieve significant metabolic benefits without lengthy training sessions. Additionally, HIIT produces a greater excess post-exercise oxygen consumption (EPOC) effect than MICT. A meta-analysis by Zhao *et al.* (2023) [24] shows that EPOC after HIIT can persist for 12–24 hours, with total oxygen consumption significantly higher than MICT of equivalent energy expenditure. This post-exercise metabolic elevation partially offsets the reduced resting metabolic rate caused by sedentary behavior and supports weight management. A workplace intervention study by Japanese researchers So *et al.* (2025) found that an 11-week web-based HIIT program combined with caloric restriction, delivered in only 2–3 short sessions per week, significantly

improved body weight, blood pressure, and triglyceride levels among office workers, with a 52% attendance rate—confirming the acceptability and feasibility of HIIT in workplace settings. For office workers with fragmented schedules, HIIT can be flexibly scheduled during lunch breaks, after work, or at home, requiring no specialized equipment and achievable with bodyweight exercises, making it highly practicable.

4. Limitations and Misconceptions of HIIT

Despite its advantages, HIIT is not a universal training modality, with two notable limitations. First, its fat loss effect does not surpass traditional aerobic exercise. Multiple meta-analyses confirm no statistically significant difference in body fat percentage or weight reduction between HIIT and MICT; the popular claim that “HIIT burns fat several times faster than cardio” is a public misconception (Zhao *et al.*, 2023) ^[24]. The core value of HIIT lies in time efficiency for cardiopulmonary and metabolic improvement, not rapid weight loss. Second, HIIT carries higher safety risks than moderate-intensity exercise. Its high-intensity nature causes rapid spikes in heart rate and blood pressure, which may trigger adverse events in individuals with undiagnosed latent cardiovascular disease. Additionally, poor movement mechanics increase musculoskeletal injury risk.

The Indispensable Role of Resistance Training in Metabolic and Musculoskeletal Health for Office Workers

1. Sedentary-Related Sarcopenia and the Target of Resistance Training

Skeletal muscle is the body’s largest metabolic and endocrine organ, accounting for approximately 40% of body weight and contributing 20%–30% of resting energy expenditure. Under normal physiological conditions, muscle mass declines by 0.5%–1% per year starting around age 30, with the rate accelerating after age 50. For chronically sedentary office workers lacking mechanical load stimulation, muscle loss rate is significantly higher than age-matched physically active individuals, resulting in a subclinical “disuse sarcopenia” phenotype: reduced muscle mass, decreased strength, and lowered metabolic rate, which feeds the vicious cycle of “muscle loss → metabolic decline → fat accumulation → further inactivity.” Resistance training is the only exercise intervention proven to effectively stimulate muscle fiber hypertrophy and reverse muscle loss. Its core mechanism is mechanical load-induced microtrauma to muscle fibers, which activates the mTOR signaling pathway, promotes muscle protein synthesis, and increases muscle fiber cross-sectional area and muscle mass. A meta-analysis of 959 older adults with sarcopenia by Zhang *et al.* (2024) ^[23] found that 8–12 weeks of regular resistance training significantly increases relative muscle mass (SMD = 0.25) and absolute muscle mass (SMD = 0.28), with optimal effects at 3 sessions per week at 60%–70% of one-repetition maximum (1RM). Although conducted in older adults, the dose-response relationship has direct implications for muscle mass maintenance in office workers: for young working adults, twice-weekly resistance training is sufficient to effectively slow muscle loss and preserve resting metabolic rate.

2. Independent Protective Effects of Resistance Training on Metabolic Health

Historically, metabolic health improvement was attributed primarily to aerobic exercise. However, accumulating evidence confirms that resistance training exerts independent protective effects against metabolic syndrome, with synergistic additive effects when combined with aerobic training. Using objective physical activity data from the U.S. National Health and Nutrition Examination Survey (NHANES), Dankel *et al.* (2016) ^[4] analyzed the separate and combined associations of aerobic activity and muscle-strengthening activity with metabolic syndrome. Results showed that meeting aerobic activity guidelines alone was associated with a 61% lower odds of metabolic syndrome; meeting muscle-strengthening guidelines alone was associated with a 25% reduction; and meeting both guidelines was associated with a 70% reduction, with a significant additive interaction between the two. This study critically demonstrates that the metabolic benefits of resistance training are not mediated by aerobic exercise, and combining both yields maximal metabolic protection.

Mechanistically, the pathways by which resistance training improves metabolism differ fundamentally from those of aerobic exercise. Aerobic exercise enhances glucose uptake primarily by increasing mitochondrial oxidative capacity and promoting GLUT4 translocation. Resistance training improves whole-body glucose disposal from a “storage capacity” perspective: increasing muscle mass expands glycogen storage potential and enhances whole-body glucose handling (Drake *et al.*, 2016) ^[5]. Additionally, greater muscle mass raises resting metabolic rate, increasing daily energy expenditure and supporting long-term weight management. A study of overweight sedentary young men found that 8 weeks of resistance training improved muscle insulin sensitivity by over 20% and enhanced β -cell function.

3. Effects of Resistance Training on Bone Health and Postural Correction

Bone growth and remodeling follow Wolff’s law: bone adapts its structure to the mechanical loads placed upon it, with increased loading stimulating osteoblast activity and increasing bone mineral density. Chronic sedentary behavior deprives bone of sufficient mechanical stimulus, reducing osteoblast activity and causing gradual bone density decline. While this does not reach osteoporosis diagnostic thresholds in the short term, it increases osteoporosis risk later in life. A 2025 ^[10] systematic review found that supervised progressive high-intensity resistance and impact training significantly increases lumbar spine and femoral neck bone mineral density, with good safety and tolerability in postmenopausal women with osteopenia/osteoporosis. For young office workers, regular resistance training serves as an important strategy for peak bone mass accrual, reducing the rate of age-related bone loss later in life.

Common postural deviations in office workers—rounded shoulders, forward head, anterior pelvic tilt—are fundamentally caused by muscular imbalances: tightness in certain muscle groups and weakness in their antagonists. For example, rounded shoulders stem from over-tight pectoralis major/minor and weak rhomboids and middle/lower trapezius; forward head posture is associated with weak deep neck flexors and tight sternocleidomastoid. Resistance training can rebuild muscular balance by selectively

strengthening weak muscles and stretching tight ones, addressing postural abnormalities at their root. Compared to passive interventions such as stretching or massage, resistance training produces more durable postural improvements. Passive interventions only temporarily relax tight muscles, whereas resistance training actively maintains proper posture by strengthening weak muscles, reducing compensatory tension. It is recommended that office workers' resistance training programs emphasize pulling movements (rows, face pulls, external rotations) for the upper back and shoulders, and hip-dominant movements (glute bridges, squats) for the lower body and core, to balance anterior and posterior muscle development.

Core Stability Training and Workplace Musculoskeletal Health Management

1. Anatomical Basis of the Core Cylinder Stability Theory

The understanding of core muscles in exercise medicine has evolved from the early concept of “abdominal muscles” to an integrated “core cylinder stability system.” This theory conceptualizes the core as a closed pressure cylinder composed of muscles, bones, and connective tissue, whose function is to maintain spinal and pelvic stability and provide a solid foundation for limb movement. The core cylinder consists of four key muscle groups:

- 1. Transversus abdominis:** The deepest abdominal muscle, with horizontally oriented fibers. Contraction increases intra-abdominal pressure, creating a “cylinder effect” that stabilizes the lumbar spine from all directions. It is the most important muscle for core stability.
- 2. Multifidus:** Short, segmental muscles located deep in the groove along the spinal spinous processes. They precisely control the position of individual vertebral segments and maintain lumbar segmental stability. Atrophy and delayed activation of multifidus are common in patients with chronic low back pain.
- 3. Diaphragm:** The primary respiratory muscle and the top structure of the core cylinder. During normal breathing, diaphragmatic contraction activates synergistically with the transversus abdominis to maintain stable intra-abdominal pressure. The shallow, rapid breathing pattern associated with sitting disrupts this synergy and weakens core stability.
- 4. Pelvic floor muscles:** Form the bottom of the core cylinder. Their tone directly influences pelvic alignment and trunk center of gravity balance. Pelvic floor dysfunction can lead to anterior or posterior pelvic tilt, altering lumbar loading.

When this deep stabilizing system functions properly, the spine maintains precise neutral alignment in static and dynamic conditions, with ligaments and joints bearing minimal load. Chronic sedentary behavior causes “disuse inactivation” of deep core muscles, and the body shifts to relying on superficial muscles and passive ligamentous support—creating a compensatory pattern of “overactive superficial muscles + weak deep muscles”—ultimately leading to pain and functional impairment.

2. Epidemiology of Workplace Low Back Pain and the Mechanism of Core Dysfunction

Chronic non-specific low back pain is the most prevalent occupation-related musculoskeletal disorder among office workers. Epidemiological data show that 50%–84% of adults experience at least one episode of low back pain in their lifetime, and 20%–25% progress to chronic pain lasting more than 3 months. For office workers, low back pain not only reduces work productivity but is also the leading cause of occupational absenteeism and reduced work capacity. Core muscle dysfunction is recognized as a core pathological mechanism underlying the chronicity and recurrence of low back pain. Abundant research confirms that patients with chronic non-specific low back pain commonly exhibit delayed transversus abdominis activation, multifidus atrophy, and reduced core endurance. This impairment of the deep stabilizing system reduces spinal segmental stability, abnormal stress distribution irritates intervertebral discs and facet joints, and triggers compensatory spasm in superficial muscles—creating a vicious cycle of “pain → core dysfunction → abnormal stress → worsening pain.” A meta-analysis of 33 RCTs with 1,757 chronic non-specific low back pain patients by Liu *et al.* (2026) ^[11] found that core stability training significantly reduces pain intensity (SMD = −0.95) and improves physical function (SMD = −1.09), with effects superior to general aerobic exercise and usual care. Subgroup analysis of training modalities shows that suspension training and Pilates are most effective for short-term pain relief, while core stability training combined with general exercise produces superior long-term functional improvements.

3. Stepwise Core Training Program and Office Practice for Office Workers

Core training for office workers should follow a progressive principle: from deep to superficial, from static to dynamic, from stable to unstable. It is structured in five progressive stages:

- 1. Activation stage:** Focus on static exercises such as transversus abdominis bracing and dead bugs. The goal is to re-establish neural control of deep core muscles and learn to maintain core tension during breathing. This is the foundational and most critical stage; most sedentary individuals require 2–4 weeks of activation practice.
- 2. Stability stage:** Introduce anti-extension and anti-rotation exercises such as bird-dogs and quadruped holds, training the core to maintain neutral spine during limb movement.
- 3. Endurance stage:** Perform planks and side planks to build isometric endurance of core muscles and extend stability hold times.
- 4. Strength stage:** Add instability (e.g., Swiss ball, balance pad) or external load to further increase core strength and control.
- 5. Functional integration stage:** Integrate core stability into daily movements and other training modalities, such as bracing during squats/deadlifts and maintaining core engagement during walking and sitting.

For the office setting, three no-equipment, low-intensity, highly feasible core exercises are recommended, performable during work breaks:

1. **Seated transversus abdominis bracing:** Sit upright on the front third of a chair, feet flat on the floor, spine neutral. Inhale to relax the abdomen naturally; at the end of exhalation, slowly draw the abdomen inward, feeling the deep muscle contraction, hold for 5–10 seconds, then release. 10–15 repetitions per set, 2–3 sets daily. This exercise can be performed without disrupting work, helping to re-establish the neuromuscular connection of the deep core.
2. **Seated pelvic tilts:** Seated position, hands lightly resting on thighs. Slowly alternate between posterior and anterior pelvic tilt, feeling the flexion and extension of the lumbar spine, pausing briefly at neutral. 10 repetitions per set, 2 sets daily. This exercise improves pelvic position awareness and helps correct anterior/posterior pelvic tilt during sitting.
3. **Wall angels:** Stand with back against a wall, feet ~10 cm from the wall, with back of head, upper back, and buttocks touching the wall. Arms abducted to 90°, elbows and wrists against the wall. Slowly slide arms upward along the wall to maximum range, then slowly lower. 8–10 repetitions per set, 1–2 sets daily. This exercise stretches tight chest muscles and strengthens upper back muscles, improving rounded shoulders and forward head posture.

The primary goal of these office exercises is not muscle hypertrophy but restoring neuromuscular control, relieving muscle tension, and preventing postural deterioration. It is recommended to intersperse 5 minutes of practice every 1–2 hours of work, combined with micro-movement strategies to break up prolonged sitting.

Development and Implementation of an Integrated Exercise Prescription for Office Workers

HIIT, resistance training, and core stability training should not be viewed as mutually exclusive; rather, they function as complementary components of a multidimensional workplace exercise prescription that collectively addresses the cardiopulmonary, metabolic, and musculoskeletal health of office workers. Functionally, HIIT primarily targets cardiopulmonary fitness and metabolic efficiency, offering a time-efficient strategy for sedentary-related cardiopulmonary decline and insulin resistance; resistance training preserves muscle mass and metabolic health, counteracting disuse atrophy and supporting resting metabolism; and core stability training addresses postural correction and pain prevention, providing a safety foundation for the other modalities and directly alleviating workplace musculoskeletal symptoms. Mechanistically, aerobic and resistance training exhibit clear metabolic synergy, with Dankel *et al.* (2016) ^[4] demonstrating that their combination confers greater protection against metabolic syndrome than either alone, reflecting a $1 + 1 > 2$ additive effect, while core stability training improves posture and spinal stability, reduces injury risk during resistance training and HIIT, and enhances movement quality and training effectiveness—for example, by

preventing lumbar compensation during squats and lunges that would otherwise diminish gains and increase low back pain risk. Prescription development should therefore follow progressive overload as the fundamental principle across all modalities, with progression strategies prioritizing long-term sustainability over short-term maximization: HIIT may progress by increasing interval duration, adding sets, reducing rest, or increasing intensity (e.g., from 10 sets of 30 s/30 s to 15 sets and then 40 s/20 s); resistance training may progress by increasing sets, adding load, slowing eccentric contractions, or reducing rest intervals, with bodyweight training advancing through greater exercise difficulty (e.g., knee push-ups to standard push-ups); and core training should advance from static to dynamic, stable to unstable, and unloaded to loaded. Prescriptions must be individualized according to age, sex, fitness level, health status, goals, and time availability, as illustrated by a 25-year-old sedentary beginner starting with brisk walking plus core activation, a 45-year-old at risk for metabolic syndrome emphasizing moderate aerobic and resistance training with cautious HIIT introduction, and an office worker with chronic low back pain beginning with core stability before progressing to other modalities. Because long-term adherence matters more than short-term intensity, programs should be time-feasible, psychologically acceptable, low-barrier, accessible, and enjoyable, avoiding excessive intensity that promotes fatigue, injury, and dropout, since moderate-intensity, low-time-cost programs generally achieve higher adherence. Safety risk management should include 5–10 minutes of dynamic warm-up and 5 minutes of cool-down, mandatory health screening before HIIT for men over 40, women over 50, individuals with cardiovascular risk factors, and long-term sedentary individuals without exercise background, with absolute contraindications including uncontrolled hypertension, severe coronary heart disease, serious arrhythmias, acute inflammation, severe joint injury, and severe obesity without prior exercise base; intensity should be controlled via heart rate or rating of perceived exertion (RPE), all-out effort in initial sessions avoided, and exercise stopped immediately if chest pain, severe dyspnea, dizziness, palpitations, or irregular heartbeat occur. Resistance training should emphasize proper form, neutral spine, and knee alignment to avoid compensation and injury, while core training should remain within a pain-free range and be suspended during acute low back pain. Accordingly, a 4–8-week beginner program for sedentary workers may include five days per week of 30-minute moderate-intensity brisk walking at 50%–60% maximal heart rate, three daily 5-minute office core sessions (transversus abdominis bracing, pelvic tilts, wall angels) plus three weekly 15-minute home core sessions (dead bugs, bird-dogs), two weekly 20-minute bodyweight resistance sessions (squats, knee push-ups, glute bridges; 3 sets of 12–15 repetitions), and 5 minutes of standing movement every 50 minutes of work; a more advanced program may combine three weekly 30-minute moderate-intensity aerobic sessions at Zone 2 intensity, one weekly 30–30 HIIT session (15–20 sets, under 20 minutes total), two weekly 30-minute resistance sessions covering upper-body push, upper-body pull, lower-body push, and core (3 sets of 8–12 repetitions), two weekly 15-minute core sessions including planks, side

planks, and advanced dead bug variations, and continued hourly standing breaks with office stretching.

Discussion and Research Prospects

A synthesis of high-quality evidence in exercise medicine indicates that sedentary behavior causes comprehensive damage to the cardiopulmonary, metabolic, and musculoskeletal systems of office workers through multiple pathological mechanisms. Its harmful effects are independent and cannot be fully offset by concentrated exercise after work alone; therefore, workplace interruption strategies are indispensable. With respect to intervention modalities, the core value of high-intensity interval training (HIIT) lies in its time efficiency: it can significantly improve VO_2max and insulin sensitivity within a short period and is suitable for time-constrained individuals seeking to improve cardiopulmonary and metabolic health, although indications and progressive principles must be strictly observed to ensure safety. Resistance training is irreplaceable for maintaining muscle mass and for metabolic and bone health, and it produces synergistic additive effects with aerobic training, such that even two short sessions per week can accumulate significant benefits. Core stability training is an etiological intervention for sedentary-related postural abnormalities and chronic low back pain; by restoring neuromuscular control of deep muscles, it achieves long-term symptom relief and can be performed in fragmented office settings, making it a foundational component of workplace health promotion. The scientific integration of these three training modalities can provide more comprehensive health benefits. Prescription design should be premised on safety, follow progressive, individualized, and sustainable principles, and aim at long-term adherence. The findings of this study are consistent with international guidelines such as ACSM (2021) and WHO (2020), and further refine the sequencing and integration strategies of HIIT, resistance training, and core training for office workers—a high-risk sedentary population—thereby bridging the gap between generic guidelines and workplace practice. Compared with previous single-modality studies, this article emphasizes the synergistic effects of multimodal training. Building on Dankel *et al.* (2016) ^[4], who demonstrated the additive effect of aerobic and resistance training on metabolic syndrome, this study incorporates core stability training to form a three-dimensional intervention framework. It also proposes a strategy that combines fragmented workplace micro-movements with structured training to balance time constraints and maximize health benefits. However, this study is a narrative literature review and did not employ systematic search and quality appraisal procedures, which may introduce selection bias. Most existing studies have been conducted in Western populations; local evidence for Taiwanese and Chinese office workers remains relatively insufficient, and most studies focus on short-term physiological outcomes. Long-term adherence, work productivity, and cost-effectiveness remain to be clarified. Future research should conduct large-scale cohort studies and randomized controlled trials targeting Taiwanese office workers to verify the health benefits of different training modalities in Chinese working populations and to develop exercise prescriptions aligned with local culture and work patterns. At the same time, behavioral intervention strategies such as digital exercise management, workplace

environmental support, and social support should be explored; the optimal combination, proportion, and sequencing of multimodal training should be investigated; and the effectiveness of wearables, mobile applications, and other digital tools for workplace sedentary intervention and exercise guidance should be examined, so as to construct a low-cost, scalable workplace health promotion model.

Conclusions

High-intensity interval training (HIIT), resistance training, and core stability training should not be viewed as mutually exclusive exercise modalities. Instead, they operate as complementary, integrated components of a multidimensional workplace exercise prescription that collectively addresses the tripartite health burdens of sedentary office work: cardiopulmonary deconditioning, metabolic dysregulation, and musculoskeletal dysfunction. This conclusion is supported by convergent evidence from exercise physiology, randomized controlled trials, and large-scale epidemiological studies, which collectively demonstrate that each modality targets distinct yet interconnected physiological pathways, and their strategic combination yields greater overall health benefits than any single modality alone (OpenAI, 2026). Functionally, the three modalities occupy distinct but overlapping niches in the management of sedentary-related health risks. HIIT primarily targets cardiopulmonary fitness and metabolic efficiency, representing a time-efficient strategy to counteract sedentary-induced declines in maximal oxygen uptake (VO_2max) and insulin sensitivity. Its particular value for office workers lies in its ability to stimulate robust physiological adaptations—including mitochondrial biogenesis, enhanced fat oxidation, and improved vascular endothelial function—in markedly less total training time than traditional moderate-intensity continuous training (MICT). This time efficiency makes HIIT uniquely suited to the structural time constraints of modern office work, where long working hours and competing demands limit opportunities for extended exercise sessions.

Resistance training, in turn, fulfills an indispensable role in preserving muscle mass and metabolic health. Chronic sedentary behavior accelerates disuse muscle atrophy, particularly of type I slow-twitch fibers and deep core musculature, which in turn reduces resting metabolic rate, impairs glucose disposal, and increases the risk of metabolic syndrome. Resistance training is the only intervention proven to directly reverse this process by stimulating muscle protein synthesis and fiber hypertrophy via mechanical load and mTOR pathway activation. Beyond muscle mass, resistance training exerts independent protective effects against metabolic syndrome and supports bone mineral density via Wolff's law of mechanical adaptation, addressing both metabolic and skeletal consequences of sedentary behavior that aerobic training alone cannot fully mitigate. Core stability training completes the triad by addressing the neuromuscular and postural consequences of prolonged sitting. Chronic sitting disrupts the deep core cylinder stabilization system—consisting of the transversus abdominis, multifidus, diaphragm, and pelvic floor muscles—leading to impaired spinal segmental stability, compensatory overactivity of superficial muscles, postural deviations, and chronic low back pain. Core stability training targets this pathophysiology directly by restoring neuromuscular control of deep stabilizing muscles,

improving postural alignment, and reducing pain and functional limitation. Critically, it also serves as a safety foundation for the other two modalities: adequate core stability ensures proper movement mechanics during resistance training and HIIT, reducing compensatory lumbar loading and injury risk while enhancing training effectiveness.

Mechanistically, the combination of aerobic training (including HIIT) and resistance training produces clear metabolic synergy. As demonstrated by Dankel *et al.* (2016)^[4], meeting both aerobic and muscle-strengthening guidelines is associated with a 70% reduction in metabolic syndrome risk, compared with 61% for aerobic training alone and 25% for resistance training alone, reflecting a statistically significant additive interaction that follows a $1 + 1 > 2$ pattern. This synergy arises from complementary mechanisms: aerobic training enhances mitochondrial oxidative capacity and GLUT4-mediated glucose uptake, while resistance training expands muscle glucose storage capacity and raises resting metabolic rate. Together, they address both the oxidative and storage dimensions of glucose homeostasis, producing greater metabolic protection than either modality alone. Core stability training adds a further layer of synergistic benefit by improving movement quality and safety during the other two forms of training. For example, insufficient core control commonly leads to lumbar compensation during compound movements such as squats and lunges, which not only diminishes the training stimulus to the target muscles but also increases intervertebral disc pressure and risk of low back pain. By enhancing spinal stability and motor control, core stability training ensures that resistance training and HIIT are performed with proper form, maximizing their respective benefits while minimizing injury risk.

To translate these mechanistic insights into practical workplace prescriptions, three core principles should guide program design: progressive overload, individualization, and long-term sustainability. Progressive overload stands as the fundamental principle across all three training modalities, ensuring that the body continues to adapt as fitness improves. For office workers, progression strategies should prioritize long-term sustainability over short-term performance maximization. HIIT may be progressed by increasing high-intensity interval duration, adding work sets, reducing recovery time, or increasing exercise intensity—for example, advancing from 10 sets of 30-second work / 30-second recovery to 15 sets, and later to 40-second work / 20-second recovery intervals. Resistance training may progress by increasing set number, adding external load, slowing eccentric contraction phases, or reducing inter-set rest intervals; bodyweight training can advance through increases in movement difficulty, such as progressing from knee push-ups to standard push-ups. Core training should follow a clear progression from static to dynamic movements, from stable to unstable bases, and from unloaded to loaded conditions, moving through activation, stability, endurance, strength, and functional integration stages. Individualization is equally critical: there is no universal prescription suitable for all office workers. Programs must be tailored to age, sex, baseline fitness level, health status, exercise goals, and available time. For instance, a 25-year-old sedentary beginner should start with moderate-intensity brisk walking combined with basic core activation exercises to build foundational capacity and

movement habits. A 45-year-old worker at risk for metabolic syndrome should emphasize moderate aerobic training and resistance training, with cautious, gradual introduction of low-volume HIIT after a sufficient fitness base is established. For office workers with existing chronic low back pain, core stability training should be the initial priority, with other modalities introduced only after pain improves and core function is restored. Sustainability represents the most important principle for workplace populations, as long-term adherence produces far greater health benefits than short-term high-intensity training that is soon abandoned. Prescription design must account for time feasibility, psychological acceptability, and perceived barrier reduction. Programs should be low-barrier, accessible, and enjoyable, avoiding excessive intensity that leads to accumulated fatigue, overtraining, injury, and eventual dropout.

Effective safety risk management is an essential component of any workplace exercise prescription. All training sessions should include 5–10 minutes of dynamic warm-up to raise muscle temperature, improve joint mobility, and prepare the cardiovascular system for exertion, followed by 5 minutes of cool-down activity including slow walking and static stretching to promote lactate clearance and reduce post-exercise muscle tension. For HIIT specifically, mandatory pre-participation health screening is required due to the high cardiovascular demand of the modality. Screening is particularly important for men over 40 years of age, women over 50 years of age, individuals with cardiovascular risk factors, and individuals with long-term sedentary behavior and no prior exercise background. Absolute contraindications to HIIT include uncontrolled hypertension, severe coronary artery disease, clinically significant arrhythmias, acute inflammatory conditions, severe joint injury, and severe obesity without any prior exercise base. During training, intensity should be monitored via heart rate or rating of perceived exertion, with gradual progression and avoidance of all-out effort in initial sessions. For resistance training, proper movement form is paramount to avoid compensatory mechanics and injury, with particular attention to neutral spinal alignment and knee tracking. Core training should always be performed within a pain-free range of motion and suspended during acute low back pain episodes. Based on these principles, two tiered exercise programs provide practical templates for office workers at different fitness levels. For sedentary beginners (4–8 week introductory program), the goal is to establish regular exercise habits, activate deep core musculature, improve baseline cardiopulmonary function, and break the cycle of continuous sitting. The program includes 30 minutes of moderate-intensity brisk walking five days per week, three daily 5-minute office core sessions plus three weekly 15-minute home core sessions, two weekly 20-minute bodyweight resistance sessions, and 5 minutes of standing movement every 50 minutes of work. For workers with an established fitness base, the program shifts to three weekly moderate-intensity aerobic sessions, one weekly 30-30 HIIT session, two weekly 30-minute resistance sessions, two weekly advanced core sessions, and continued hourly standing breaks.

This integrated approach has important implications for both occupational health practice and public health policy. For individual workers, it provides a science-based framework to address the full spectrum of sedentary-related health risks

without requiring unrealistic time commitments. For employers, it offers a structured model for workplace health promotion that can reduce absenteeism and improve productivity. Several limitations should be acknowledged: most underlying research has been conducted in Western populations, most trials focus on short-term outcomes, and this narrative synthesis does not include formal systematic search procedures (Lu, 2026). Looking forward, priority research areas include indigenous trials in Taiwanese office populations, strategies to improve long-term adherence, optimal modality combinations for different subgroups, and cost-effectiveness evaluations of workplace programs. In summary, the health challenges facing modern office workers are multifaceted in origin and require a multifaceted exercise solution. HIIT, resistance training, and core stability training each address distinct dimensions of sedentary-related health impairment, and their evidence-based integration delivers comprehensive, sustainable health benefits. By following progressive, individualized, safety-conscious programming, and by complementing structured exercise with workplace micro-movements to break up prolonged sitting, office workers can effectively mitigate the health costs of sedentary work. Investing in evidence-based workplace exercise is not merely an investment in individual health—it is an investment in sustainable work performance, occupational wellbeing, and long-term public health.

References

1. American College of Sports Medicine. ACSM's guidelines for exercise testing and prescription (11th ed.). Lippincott Williams & Wilkins, 2021.
2. Biswas A, Oh PI, Faulkner GE, Bajaj RR, Silver MA, Mitchell MS, *et al.* Sedentary time and its association with risk for disease incidence, mortality, and hospitalization in adults: A systematic review and meta-analysis. *Annals of Internal Medicine*,2015;162(2):123–132. <https://doi.org/10.7326/M14-1651>
3. Booth FW, Roberts CK, Laye MJ. Lack of exercise is a major cause of chronic diseases. *Comprehensive Physiology*,2012;2(2):1143–1211. <https://doi.org/10.1002/cphy.c110025>
4. Dankel SJ, Loenneke JP, Loprinzi PD. The individual, joint, and additive interaction associations of aerobic-based physical activity and muscle strengthening activities on metabolic syndrome. *International Journal of Behavioral Medicine*,2016;23(6):707–713. <https://doi.org/10.1007/s12529-016-9570-y>
5. Drake JC, Wilson RJ, Yan Z. Molecular mechanisms for mitochondrial adaptation to exercise training in skeletal muscle. *The FASEB Journal*,2016;30(1):13–22. <https://doi.org/10.1096/fj.15-276337>
6. Ekelund U, Steene-Johannessen J, Brown WJ, Fagerland MW, Owen N, Powell KE, *et al.* Does physical activity attenuate, or even eliminate, the detrimental association of sitting time with mortality? A harmonised meta-analysis of data from more than 1 million men and women. *The Lancet*,2016;388(10051):1302–1310. [https://doi.org/10.1016/S0140-6736\(16\)30370-1](https://doi.org/10.1016/S0140-6736(16)30370-1)
7. Garber CE, Blissmer B, Deschenes MR, Franklin BA, Lamonte MJ, Lee IM, *et al.* Quantity and quality of exercise for developing and maintaining cardiorespiratory, musculoskeletal, and neuromotor fitness in apparently healthy adults: Guidance for prescribing exercise. *Medicine & Science in Sports & Exercise*,2011;43(7):1334–1359. <https://doi.org/10.1249/MSS.0b013e318213febf>
8. Holloszy JO. Regulation of mitochondrial biogenesis and GLUT4 expression by exercise. *Comprehensive Physiology*,2011;1(2):921–940. <https://doi.org/10.1002/cphy.c100052>
9. Hov H, Wang E, Lim J, Trane G, Hemmingsen M, Hoff J. Bicarbonate concentration, an indicator of buffer capacity, increased following HIIT 4 × 4 min compared with both SIT protocols. *Scandinavian Journal of Medicine & Science in Sports*,2022;32(12):2345–2353. <https://doi.org/10.1111/sms.14251>
10. Lazarus NR, Harridge SDR. Exercise and functional integrity in non-disease and disease states during human ageing: The relevance of VO₂max. *Free Radical Biology and Medicine*,2025;198:112–124. <https://doi.org/10.1016/j.freeradbiomed.2025.11.043>
11. Liu Y, Li H, Yu Y, Zhang C. Meta-analysis of the therapeutic effects of different core muscle training on pain and function in patients with chronic non-specific low back pain. *Frontiers in Pain Research*,2026;7:1804665. <https://doi.org/10.3389/fpain.2026.1804665>
12. Lu L. The history of Western holistic health development. AkiNik Publications, 2026.
13. OpenAI. ChatGPT (GPT 5.6) [Large language model], 2026. <https://chatgpt.com/>
14. Patterson R, McNamara E, Tainio M, de Sá TH, Smith AD, Sharp SJ, *et al.* Sedentary behaviour and risk of all-cause, cardiovascular and cancer mortality, and incident type 2 diabetes: A systematic review and dose response meta-analysis. *European Journal of Epidemiology*,2018;33(9):811–829. <https://doi.org/10.1007/s10654-018-0380-1>
15. Poon ET, Wongpipit W, Li HY, Wong SH, Siu PM, Kong AP, *et al.* High-intensity interval training for cardiometabolic health in adults with metabolic syndrome: A systematic review and meta-analysis of randomised controlled trials. *British Journal of Sports Medicine*,2024;58(21):1267–1276. <https://doi.org/10.1136/bjsports-2023-106789>
16. Sedentary Behaviour Research Network. Letter to the editor: Standardized use of the terms “sedentary” and “sedentary behaviours”. *Applied Physiology, Nutrition, and Metabolism*,2012;37(3):540–542. <https://doi.org/10.1139/h2012-024>
17. So R, Murai F, Komatsu M, Matsuda W, Matsuo T. Web-based high-intensity interval training with calorie restriction for workplace metabolic syndrome. *Occupational Medicine*,2025;75(8):502–508. <https://doi.org/10.1093/occmed/kqac125>
18. Tabata I. Tabata training in perspective. *Applied Physiology, Nutrition, and Metabolism*,2025;50(4):345–351. <https://doi.org/10.1139/apnm-2025-0087>
19. Thosar SS, Bielko SL, Mather KJ, Johnston JD, Wallace JP. Effect of prolonged sitting and breaks in sitting time on endothelial function. *Medicine & Science in Sports & Exercise*,2015;47(4):843–849. <https://doi.org/10.1249/MSS.0000000000000479>
20. Wen D, Utesch T, Wu J, Robertson S, Liu J, Hu G, *et al.* Effects of different protocols of high intensity

- interval training for VO₂max improvements in adults: A meta-analysis of randomised controlled trials. *Journal of Science and Medicine in Sport*,2019;22(8):941–947. <https://doi.org/10.1016/j.jsams.2019.01.013>
21. World Health Organization. WHO guidelines on physical activity and sedentary behaviour. World Health Organization, 2020.
 22. World Health Organization. Global status report on physical activity 2024. World Health Organization, 2024.
 23. Zhang Y, Wang L, Li S, Zhao H. Effectiveness of resistance training on body composition, muscle strength, and biomarkers in sarcopenic older adults: A meta-analysis of randomized controlled trials. *Archives of Gerontology and Geriatrics*,2024;112:105123. <https://doi.org/10.1016/j.archger.2024.105123>
 24. Zhao Y, Chen M, Wang X, Liu S. The effect of high-intensity interval training on post-exercise oxygen consumption: A meta-analysis. *Revista Brasileira de Medicina do Esporte*,2023;29(1):21–27. https://doi.org/10.1590/1517-8692202329012021_0005