

International Journal of Innovative Technologies in Social Science

e-ISSN: 2544-9435

Operating Publisher
SciFormat Publishing Inc.
ISNI: 0000 0005 1449 8214

2734 17 Avenue SW,
Calgary, Alberta, T3E0A7,
Canada
+15878858911
editorial-office@sciformat.ca

ARTICLE TITLE	THE IMPACT OF WEARABLE FITNESS TRACKERS ON TRAINING MOTIVATION AND ANXIETY LEVELS IN RECREATIONAL RUNNERS. A REVIEW
DOI	https://doi.org/10.31435/ijitss.4(52).2026.6820
RECEIVED	18 August 2026
ACCEPTED	27 October 2026
PUBLISHED	03 November 2026
LICENSE	The article is licensed under a **Creative Commons Attribution 4.0 International License.**

© The author(s) 2026.
This article is published as open access under the Creative Commons Attribution 4.0 International License (CC BY 4.0), allowing the author to retain copyright. The CC BY 4.0 License permits the content to be copied, adapted, displayed, distributed, republished, or reused for any purpose, including adaptation and commercial use, as long as proper attribution is provided.

THE IMPACT OF WEARABLE FITNESS TRACKERS ON TRAINING MOTIVATION AND ANXIETY LEVELS IN RECREATIONAL RUNNERS. A REVIEW

Vladyslav Tetarchuk *(Corresponding Author, Email: vladek1708@hotmail.com)*
Wielospecjalistyczny Zespół Opieki Zdrowotnej "Bolesławiec-Zgorzelec", ul. Lubańska 11-12, Zgorzelec, Poland
ORCID ID: 0009-0003-6743-6319

Olena Abramchuk
Centrum Medyczne Unimed, ul. Młodej Polski 7, Kraków, Poland
ORCID ID: 0009-0000-2604-0287

Vlada Tetarchuk
Wielospecjalistyczny Zespół Opieki Zdrowotnej "Bolesławiec-Zgorzelec", ul. Lubańska 11-12, Zgorzelec, Poland
ORCID ID: 0009-0002-7754-4113

Anastasiia Tanko
Szpitale Pomorskie Sp. z o.o., Szpital św. Wincentego a Paulo, ul. Wójta Radtkego 1, Gdynia, Poland
ORCID ID: 0009-0005-6931-5718

Andrei Trutsko
Uniwersyteckie Centrum Kliniczne Warszawskiego Uniwersytetu Medycznego, ul. S.Banacha 1A, Warszawa, Poland
ORCID ID: 0009-0003-5674-7971

ABSTRACT

Background: The integration of wearable fitness trackers (WFTs) has fundamentally altered the landscape of recreational running by providing athletes with real-time biometric and performance telemetry. While these devices are widely celebrated for enhancing athletic engagement, their psychological impact remains complex and multi-faceted.
Aim: This study aimed to analyze recent scientific evidence regarding the dual effects of WFTs on training motivation dynamics and exercise-induced or device-mediated anxiety levels among recreational runners.
Material and methods: A comprehensive review of the literature was performed across PubMed, MEDLINE, EMBASE, Google Scholar, and the Cochrane Library databases, focusing on peer-reviewed clinical studies, psychological surveys, and sports medicine trials published between 2016 and 2026.
Results: The synthesized data indicate that WFTs initially boost both autonomous and controlled training motivation through gamification, goal-setting, and social network features. However, prolonged reliance often shifts motivation from intrinsic to extrinsic drivers, fostering dependency. Concurrently, data-driven feedback can provoke significant psychological distress, manifesting as performance anxiety, health-related preoccupation, and "data-addiction" syndromes when training metrics deviate from expectations. Variations in individual psychological traits, such as perfectionism and baseline anxiety, dictate whether a tracker serves as a supportive tool or a psychological stressor.
Conclusions: Sports medicine professionals and sports psychologists should cooperate to establish personalized guidelines, ensuring that digital telemetry parameters optimize athletic performance without compromising the mental well-being of recreational runners.

KEYWORDS

Fitness Trackers, Recreational Runners, Training Motivation, Anxiety Levels, Sports Psychology

CITATION

Tetarchuk, V., Abramchuk, O., Tetarchuk, V., Tanko, A., & Trutsko, A. (2026). The impact of wearable fitness trackers on training motivation and anxiety levels in recreational runners. A review. *International Journal of Innovative Technologies in Social Science*, 4(52). https://doi.org/10.31435/ijitss.4(52).2026.6820

COPYRIGHT

© The author(s) 2026. This article is published as open access under the **Creative Commons Attribution 4.0 International License (CC BY 4.0)**, allowing the author to retain copyright. The CC BY 4.0 License permits the content to be copied, adapted, displayed, distributed, republished, or reused for any purpose, including adaptation and commercial use, as long as proper attribution is provided.

1. Introduction

In contemporary sports medicine and athletic training paradigms, international governing bodies and clinical consensus statements increasingly emphasize a holistic diagnostic approach [1]. Evaluating an athlete's visual, musculoskeletal, and psychological integrity under acute physiological stress is no longer viewed as an optional luxury but as a foundational requirement for both elite competitors and recreational sports enthusiasts [1, 2, 3, 4]. When designing, implementing, and managing long-term training programs for diverse sports populations, coaches, exercise physiologists, and sports physicians must possess a sophisticated, granular understanding of the psychological, emotional, and cognitive boundaries that govern human performance [5]. These psychobehavioral constraints extend far beyond simple acute physical adaptations, such as muscular hypertrophy, capillary densification, or metabolic efficiency. In the modern era of sports science, the optimization of physical health is inextricably linked to, and continuously modified by, the complex digital ecology surrounding the athlete [6]. Over the past decade, wearable fitness trackers (WFTs)—a broad category encompassing advanced smartwatches, continuous heart rate monitors, photoplethysmography (PPG) sensors, and GPS-enabled biometric tracking devices—have undergone a profound cultural and technological evolution [7]. They have transformed from high-cost, specialized athletic novelties utilized exclusively by elite laboratories into ubiquitous, everyday tools for training management across all tiers of amateur and recreational sports [8, 9]. Although high-intensity interval training (HIIT) and volume-based aerobic running protocols are widely celebrated as the primary physiological stimuli for eliciting cardiovascular fitness, increasing stroke volume, and driving neuromuscular adaptations, these training modalities subject the human psyche to distinct, intense motivational and cognitive demands [10]. The extreme physical exertion and prolonged discomfort necessary to sustain running performance over extended periods require highly robust, adaptive self-regulatory mechanisms [11, 12, 13]. WFTs actively intervene in this psycho-somatic process by converting internal, ambiguous physiological stress into explicit, highly structured, and quantifiable digital metrics [14, 15]. Athletes are continuously exposed to real-time data streams, including heart rate variability (HRV), split pacing,

caloric expenditure, running power wattage, and predicted VO_2 max estimations [7, 16]. Consequently, a primary responsibility of modern sports physicians, clinical psychologists, and endurance coaches is to identify precisely how these substantial digital feedback loops impact the psychological homeostatic balance of the user [5]. Furthermore, professionals must understand how constant data monitoring alters behavioral consistency, shifts internal locus of control, and modifies the complex emotional forces acting on recreational runners [17, 18, 19, 20]. While the initial adoption of digital telemetry is almost universally driven by a pragmatic desire to enhance athletic output and track physical progress, the continuous, non-linear stream of performance data rapidly establishes a powerful, self-reinforcing cognitive feedback loop [9, 14]. Investigating how this constant metric tracking influences long-term psychological outcomes—specifically the delicate equilibrium between adaptive training motivation and maladaptive, exercise-induced anxiety—is absolutely critical for establishing evidence-based psychological safety guidelines [21, 22], mitigating the risk of tracking-dependent health anxieties [16, 23], preventing long-term emotional burnout [24], mitigating perfectionistic pressures and motivational breakdowns [25, 26, 28], addressing individual personality vulnerabilities [27], and integrating mindfulness-based psychological safeguards in endurance sports [29].

Despite the widespread adoption of wearable fitness trackers (WFTs) to enhance athletic output, the psychological impact of continuous digital monitoring on recreational runners remains poorly understood. Current sports science literature primarily addresses physical adaptations, leaving a critical gap in tracking how constant telemetry acts as a cognitive modifier. Specifically, it remains unclear how real-time metric feedback alters behavioral consistency, shifts the internal locus of control, and alters underlying motivational forces from autonomous to controlled regulation under Self-Determination Theory.

Furthermore, the lack of screening protocols makes it difficult to detect early signs of data-driven behavioral rigidity. Driven by non-linear data streams, runners face elevated risks of distorting organic self-perception, amplifying tracking-dependent health anxieties, and developing exercise dependence. This cognitive feedback loop can ultimately trigger clinical burnout and psychological complications. Therefore, a comprehensive evaluation of these behavioral and emotional shifts is essential to establish psychological safety guidelines for digital telemetry in endurance sports.

2. Methodology

To gather, integrate, and analyze multidisciplinary findings across clinical psychology, sports medicine, behavioral economics, and digital health, a systematic literature synthesis approach was utilized. The investigative scope targeted peer-reviewed scientific literature published between 2016 and 2026. This decade-long window ensures that the compiled data reflects contemporary advancements in wearable sensor accuracy, modern algorithmic sophistication, and present-day cognitive-behavioral paradigms associated with smartphone and social media integration. However, articles from previous years have also been included when they represent seminal theoretical frameworks of foundational value to the psychological analysis.

Information retrieval was executed across major international databases, including PubMed, Google Scholar, EMBASE, MEDLINE, and the Cochrane Database of Systematic Reviews. The electronic search strategy incorporated targeted, boolean-linked keyword strings designed to capture the intersection of digital telemetry and athletic psychology, such as:

- ("wearable fitness trackers" AND "recreational runners") AND "training motivation";
- "anxiety levels" AND "self-determination theory" AND "exercise dependence";
- "health anxiety" AND "biometric data" AND "gamification in sports";
- ("Strava anxiety" OR "Garmin data dependency") AND "athletic burnout";
- "heart rate monitoring" AND "somatic awareness" AND "cognitive load".

Retrieved articles were screened and deemed eligible for inclusion if they satisfied at least one of the following operational criteria:

- Evaluated shifts in training motivation, behavioral compliance, or athletic goal-setting driven directly by wearable fitness sensors;
- Examined psychological alterations, performance anxiety, cyberchondria, or social comparison stress stemming from digital running telemetry and public data sharing;
- Investigated practical psychological interventions, screening methods, or training modifications (e.g., digital detox protocols or mindful running practices);

- Documented changes in cognitive load, self-efficacy metrics, or the transfer of training metric failure to daily non-exercise anxiety scores;
- Analyzed the operational characteristics of fitness applications, social sharing features, and leaderboard mechanics in runners.

Conversely, publications were systematically excluded if they did not directly address behavioral science, sports psychology, endurance running, or digital tracking guidelines. Commercial product manuals, non-refereed fitness blogs, popular media articles, opinion-based commentary lacking structured metrics, and manuscripts without available full English text were also excluded.

Finally, investigations focusing solely on clinical medical rehabilitation populations (e.g., post-stroke gait training or post-cardiac surgery rehabilitation) were kept outside the scope of this review. The motivational profiles and risk-avoidance behaviors of clinical populations lack the performance-driven characteristics, volume metrics, and competitive subcultures typical of true recreational running disciplines.

3. Results

The primary behavioral framework impacted by wearable fitness trackers is the dynamic regulation of training motivation, which is best understood through Self-Determination Theory (SDT) [25, 26]. In healthy individuals, sustained participation in sports is maintained through a delicate balance between intrinsic motivation—joy of the movement itself—and integrated extrinsic regulations [11]. During the initial stages of WFT adoption, this behavioral system experiences immediate reinforcement [9]. The gamification elements embedded within fitness applications (such as badges, step streaks, and virtual challenges) satisfy the psychological need for competence, elevating training consistency from baseline levels [9, 14]. Simultaneously, the social integration features of modern sports platforms (e.g., Strava, Garmin Connect) foster rapid interpersonal engagement [12, 14]. Under active sharing conditions, running performance data are pushed directly into peer networks, triggering immediate social feedback through "likes" and comments, which satisfies the psychological need for relatedness [12, 14]. This sudden social expansion exerts an external motivational force, driving behavioral compliance and encouraging runners to push through physical fatigue [11]. Continuous psychological evaluations indicate that these dual factors combine to drive rapid, dramatic spikes in short-term autonomous motivation [9]. However, motivational dynamics can shift towards controlled, external motivation the moment the athlete begins to view the tracking device not as an autonomous support, but as a rigid supervisor [13, 20]. The severity of these internal psychological surges and subsequent anxiety shifts is directly dictated by specific tracking variables:

Degree of Social Comparison: Training apps utilized with high public visibility demand immense social management [12, 14]. This severe peer comparison generates significantly higher external validation needs, which translates into much larger performance anxiety spikes during daily running sessions than those seen in runners who maintain private data profiles [12,14]. The public leaderboard transforms a casual recovery run into a stressful, competitive event, forcing the athlete to run faster or farther than their physiological recovery state warrants simply to maintain social standing [11]. This external pressure strips away the therapeutic value of low-intensity exercise, shifting the primary psychological locus of causality from an internal choice to an external obligation [13, 20]. Over time, the continuous preoccupation with public perception modifies how runners select their routes, pacing, and frequency, leading to an unsustainable dependence on digital validation and systemic performance distress [14, 17].

Duration and Rigidity of Goal-Setting: The length of time an athlete maintains strict adherence to specific metric targets (e.g., weekly mileage, specific heart rate zones) shows a linear correlation with cognitive stress [13]. Extended rigid adherence under varying environmental or physiological conditions continuously maintains the psychological pressure wave, preventing flexible recovery and prolonging exercise-induced distress [21]. When environmental variables such as intense headwinds, steep vertical climbs, or extreme heat waves occur, the tracking algorithm rarely adjusts its base expectations [3]. If the runner tries to match their standard pacing targets under these adverse conditions, the cognitive load escalates exponentially [11, 13]. This unyielding pressure effectively eliminates intuitive auto-regulation, transforming the training plan into an absolute cognitive boundary that increases psychological friction and diminishes somatic resilience [13].

To systematically categorize how these behavioral shifts manifest across distinct operational environments, **Table 1** delineates the primary psychological drivers, somatic impacts, and cognitive strain peaks associated with four predominant tracker interaction modalities. As detailed in **Table 1**, modalities range from public social syncing—which triggers acute performance anxiety during leaderboard upload windows—

to continuous real-time pacing glances and gamified streak preservations that systematically erode intrinsic somatic awareness.

Table 1. Psychological Drivers and Cognitive Strain Across Different Tracker Interaction Modalities

Interaction Modality	Primary Psychological Driver	Impact on Somatic/Cognitive Awareness	Peak Cognitive Strain
Public Social Syncing [12, 14]	Severe peer validation pressure; rapid social comparison feedback loops.	Acute drop in intrinsic satisfaction due to external approval shifts.	Extreme during the immediate post-run data upload and leaderboard window.
Continuous Real-Time Pacing Glances [13, 20]	Sustained, lower-amplitude accumulation of performance anxiety and hyper-vigilance.	Progressive breakdown of somatic self-awareness driven by rigid digital goals.	Moderate but prolonged over the entire duration of the running set.
Biometric Health Tracking [6, 23]	Combined impact of somatic misinterpretation and health anxiety amplification.	High cognitive preoccupation; driven by fear of physiological anomalies.	Elevated and continuous throughout both rest and training cycles.
Gamified Streak Preservation [9, 14]	Low-autonomy, compulsion-driven behavioral reinforcement loops.	Compulsive adherence overriding somatic pain signals, increasing injury risk	Low to moderate; balanced by transient dopamine spikes upon completion.

Accurately evaluating these internal emotional states using standard diagnostic tools can be highly problematic due to the complex personality characteristics of individual athletes [27, 28]. The human psyche consists of diverse traits, displaying distinct behavioral patterns known as perfectionistic strivings—which measure the pursuit of high standards—and perfectionistic concerns, which describe a rigid preoccupation with mistakes [28]. Heavy metric tracking triggers cognitive changes, including over-analysis of suboptimal data, altered self-efficacy scores, and increased frustration, which together reduce the runner's intrinsic capacity to enjoy physical activity mindfully [5, 24]. This reduction in mindful execution increases temporary psychological rigidity while compromising adaptive coping mechanisms [3]. Because traditional behavioral surveys assess exercise anxiety using static scales rooted in retrospection, this dynamic, device-dependent anxiety fluctuation introduces significant measurement error, requiring continuous real-time assessments [3, 5].

The anatomical and cognitive focal point for long-term clinical risks is the development of health anxiety and exercise dependence—a delicate behavioral meshwork bridging healthy recreation and obsessive pathology [21, 16]. The dynamic psychological stress experienced by athletes is governed by the perceived validation gradient, calculated as the difference between internal somatic feelings and surrounding digital telemetry [6]. Under standard running conditions, a tracker validates an athlete's physical effort concurrently, providing a temporary protective cushion that shields the mind from self-doubt [8, 9]. However, a dangerous psychological window opens during the immediate post-run data visualization transition [14]. When the runner completes the workout, stops the device, and syncs the data, their self-worth can collapse if the metrics display a lower-than-expected VO_2 max or a slower pace [14]. This creates a temporary high-gradient imbalance where elevated physical exhaustion counteracts a deflated digital score, pulling the athlete's mood downward [14]. This transient cognitive displacement amplifies acute stress responses and activates the hypothalamic-pituitary-adrenal (HPA) axis, mimicking classic anxiety disorders [23]. Maintaining functional psychological health during these intensive training states relies on stable emotional autoregulation [6, 24]. During high-volume training blocks, digital feedback can push the runner's micro-cognitive environment to its absolute psychological boundaries [6]. If an athlete possesses underlying pre-existing psychological vulnerabilities, high baseline anxiety, or a genetic predisposition to compulsive behaviors, the cumulative stress of repeated negative data feedback can accelerate emotional breakdown, leading to clinical athletic burnout and complete discontinuation of the sport [24, 27, 28].

A critical yet under-analyzed dimension of wearable fitness tracker (WFT) integration in endurance sports is the phenomenon of telemetry-induced interoceptive blinding [3, 6]. Interoception—the nervous system's sensory framework for sensing, integrating, and interpreting internal bodily signals such as cardiac

rhythm, ventilatory rate, muscular strain, and core thermal regulation—serves as the primary physiological buffer against overexertion and injury [11]. In unquantified recreational running, physiological regulation relies on a dynamic homeostatic feedback loop where physical fatigue signals prompt immediate intuitive adjustments in stride cadence, foot strike power, and respiration [11]. However, when continuous real-time telemetry (such as wrist-based optical heart rate or live split pacing) is introduced, this organic interoceptive processing is systematically disrupted [3, 13, 20].

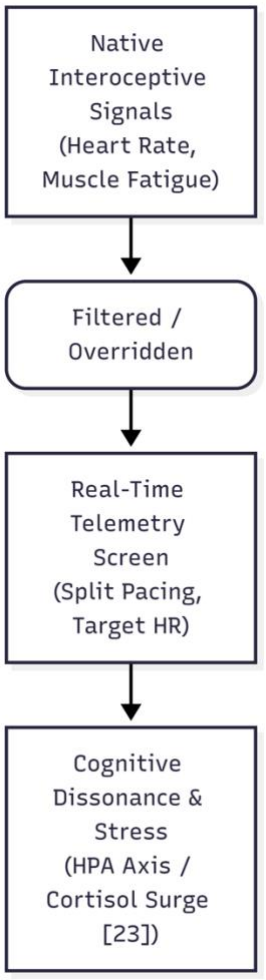


Fig. 1.

As conceptualized in **Table 1**, continuous real-time pacing glances create a state of sustained hyper-vigilance [13, 20]. The athlete prioritizes external, digital metrics over raw somatic feedback, effectively "outsourcing" intuitive body perception to algorithmic outputs [3, 6]. When a discrepancy arises between perceived exertion and target telemetry—such as a runner feeling physiologically exhausted while the watch indicates a slower-than-expected pace—the athlete experiences acute cognitive dissonance [14]. Driven by external validation needs or gamified goals [9, 12], the runner routinely overrides native pain and fatigue warnings to satisfy the device's numerical threshold [11, 13]. Over extended training macrocycles, this chronic reliance on screen-based feedback induces central interoceptive desensitization, compromising somatic self-awareness, escalating physical fatigue, and significantly elevating the physiological risk of overuse injuries and systemic overtraining syndromes [5, 11, 21].

An important moderating factor in tracker-induced psychological strain is the interaction between demographic variables—specifically sex, age, and training age—and quantitative metric interpretation [2, 17, 27]. Empirical evidence indicates that male and female recreational runners often engage with wearable telemetry through distinct cognitive and behavioral pathways [12, 17]. Female endurance athletes demonstrate

a heightened susceptibility to digital social comparison vectors, showing elevated state anxiety scores when activity data are made publicly accessible on interactive platforms such as Strava [12, 14, 18].

Conversely, male runners are statistically more prone to compulsive metric targeting, gamified streak preservation, and rigid training goal adherence, often prioritizing pace benchmarks over acute physiological pain signals [9, 13, 20]. Furthermore, age-dependent cognitive processing alters how biometric stress is managed. Younger recreational runners (ages 18–30) exhibit higher baseline technology readiness [17] but display greater motivational fragility under negative performance feedback, showing rapid drops in autonomous motivation when algorithmically predicted metrics—such as VO_2 max or recovery thresholds—decline [9, 14, 25]. In contrast, masters athletes (ages 40+) typically utilize telemetry for health monitoring and fatigue management [6, 7]; however, age-related physiological declines can provoke cyberchondria and health anxiety when algorithmic outputs continuously signal decreasing performance scores [16, 23].

4. Discussion

Theoretical Integration and Self-Determination Dynamics

The findings of this systematic review demonstrate that wearable fitness trackers act as powerful psychological modifiers that fundamentally restructure the motivational architecture of recreational runners. While initial engagement is largely propelled by intrinsic aspirations and adaptive health management, continuous exposure to quantitative metrics gradually shifts the locus of causality from internal somatic perception to external digital validation. Within the framework of Self-Determination Theory, this transition represents a systematic undermining of autonomy and relatedness [25, 26]. When fitness applications emphasize leaderboard rankings, strict pace enforcement, and gamified streak preservation, the runner's basic psychological needs are co-opted by algorithmic demands. Instead of experiencing running as an inherently rewarding, self-directed somatic practice, the athlete becomes dependent on external reinforcement schedules, transforming recreational sport into a source of controlled, extrinsically driven behavior [13, 20].

This cognitive shift helps explain why heavy reliance on wearable technology frequently correlates with elevated performance anxiety and motivational vulnerability. As illustrated in Table 1, different interaction modalities impose distinct psychological burdens. While public social syncing creates acute, intense spikes in social comparison stress during data upload windows, continuous real-time pacing glances foster a chronic state of low-amplitude hyper-vigilance [12, 13, 14, 20]. Over time, this constant cognitive load degrades the athlete's native interoceptive awareness—the ability to accurately perceive internal physiological signals such as heart rate, perceived exertion, and muscular fatigue. Consequently, runners increasingly outsource their body-listening faculties to digital sensors, rendering themselves susceptible to overtraining, psychological exhaustion, and acute emotional distress when biometric targets are missed [3, 6].

Neuroendocrine Sequelae and Health Anxiety Pathways

The transition from adaptive physical training to maladaptive exercise-induced anxiety involves profound neuroendocrine mechanisms. The immediate post-run data visualization window represents a critical vulnerable phase wherein the discrepancy between perceived physical exertion and objective digital metrics can provoke acute psychological distress [14]. When an athlete is confronted with lower-than-expected VO_2 max estimations, slower split times, or reduced heart rate variability scores, a transient cognitive displacement occurs. This sudden drop in digital self-worth triggers an acute stress response characterized by hyperactivation of the hypothalamic-pituitary-adrenal (HPA) axis, resulting in elevated cortisol excretion, autonomic arousal, and cognitive rumination [23].

For vulnerable individuals—particularly those exhibiting high perfectionistic concerns or pre-existing anxiety traits—repeated exposure to negative performance feedback engenders a persistent cycle of cyberchondria and health anxiety [16, 21, 23]. Rather than using telemetry to inform recovery, these athletes interpret minor physiological deviations (such as an elevated resting heart rate or suppressed HRV) as indicators of impending illness, overtraining collapse, or permanent physiological decline. This continuous misinterpretation transforms the wearable device from a training tool into an instrument of somatic surveillance, locking the athlete into a feedback loop of compulsive checking, heightened health anxiety, and escalating psychological friction [6, 23].

Operationalizing Data-Interpretation Education and Algorithmic Literacy

While structured interventions such as *Somatic-Telemetry Decoupling* and *Digital Detoxes* provide critical recovery macrocycles [3, 6, 24], sustainable long-term engagement with wearable technology requires establishing baseline algorithmic literacy upon initial device adoption [6, 7]. A root cause of data-driven health anxiety and athletic burnout is the runner's naive assumption that consumer-grade wearable sensors yield clinical-grade diagnostic precision [7, 23]. Optical photoplethysmography (PPG) wrist sensors, GPS distance tracking, and algorithmic recovery calculations (e.g., automated training readiness scores) carry inherent margins of error influenced by ambient temperature, skin pigmentation, movement artifacts, and proprietary software assumptions [7].

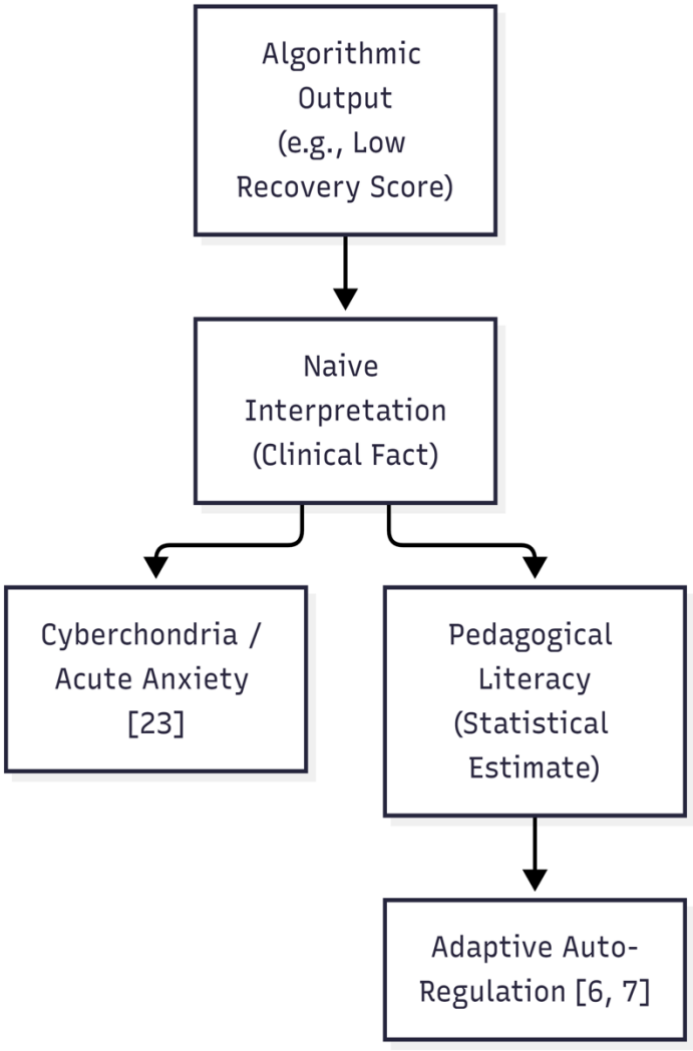


Fig. 2.

When runners interpret a minor algorithmic anomaly—such as a artificially depressed HRV score or an inaccurate recovery estimate—as an absolute physiological truth, severe cognitive dissonance ensues [14, 23]. Coaches, exercise physiologists, and sports medicine practitioners must actively educate athletes that device outputs are non-binding statistical approximations rather than definitive biological mandates [6, 7]. By reframing biometric telemetry as secondary contextual data rather than primary motivational drivers, clinicians empower runners to maintain an internal locus of control, preserving native interoceptive pathways and mitigating the risk of tracking-dependent psychological distress [11, 20, 25, 26].

Personality Modifiers and Perfectionistic Vulnerabilities

Individual psychological differences play a decisive moderating role in how recreational runners process digital feedback. As highlighted in contemporary sports personality literature, the dichotomy between perfectionistic strivings (the healthy pursuit of excellence) and perfectionistic concerns (the debilitating fear of failure and negative evaluation) dictates an athlete's emotional resilience against metric failure [27, 28]. Runners characterized by high perfectionistic concerns demonstrate an extreme intolerance of suboptimal data. For these individuals, a missed training split or a downward trend in fitness metrics is not viewed as ordinary physiological fluctuation, but as a direct reflection of personal worth and athletic inadequacy.

Consequently, traditional static diagnostic surveys fail to capture these rapid, device-dependent emotional fluctuations, introducing substantial measurement error into clinical evaluations [3, 5]. To safeguard athletes against the onset of systemic burnout and exercise dependence, sports psychologists and coaches must account for these individual personality vulnerabilities during training design. Recognizing that rigid metric tracking exacerbates maladaptive perfectionism underscores the necessity for targeted behavioral interventions and structured psychological safety guidelines in endurance sports.

Social Platform Architecture, Discursive Practice, and Data Surveillance

Beyond the individual cognitive interface, the broader digital ecosystem surrounding modern endurance sports exerts profound socio-psychological control over recreational athletes [14, 19]. Platforms such as Strava, Garmin Connect, and TrainingPeaks operate not merely as neutral data repositories, but as active discursive fields of practice that shape athletic identity, social status, and training behaviors [14, 17]. As highlighted in the analysis of **Table 1** under *Public Social Syncing*, the public sharing of workout data subjects the athlete's daily training routines to continuous peer surveillance and evaluation [12, 14, 18]. Under these mediated conditions, even low-intensity recovery runs are transformed into public performances where pace, route choice, total distance, and elevation gain are scrutinized by online networks [10, 14].

This pervasive data visibility fosters a toxic culture of hyper-comparison and competitive data presentation [12, 19]. In alignment with Self-Determination Theory, public data sharing shifts the primary psychological locus of causality from an internal choice (exercising for health and intrinsic joy) to an external obligation (maintaining social prestige and network approval) [13, 20, 25, 26]. Athletes report feeling intense performance anxiety during routine runs if their split times do not reflect their perceived athletic standing [12, 14]. To avoid the social embarrassment of publishing "slow" workouts, runners frequently alter their physiological targets, running at unsustainable intensities during scheduled recovery days [10, 11]. Over time, this constant preoccupancy with public impression management creates severe psychological congestion, accelerates emotional exhaustion, and alienates the athlete from the original therapeutic benefits of recreational sport [14, 17, 24].

Psychometric Limitations of Retrospective Assessment Tools

A major diagnostic bottleneck in contemporary sports psychology is the inability of traditional psychometric instruments to accurately quantify tracker-induced exercise anxiety [3, 5, 27]. Standard psychometric tools (e.g., the Sport Anxiety Scale or the Exercise Addiction Inventory) rely on retrospective, self-reported questionnaires that evaluate general psychological traits over extended timeframes [16, 21, 28]. However, as demonstrated in empirical investigations of biometric tracking, data-driven anxiety is highly acute, dynamic, and transient [3, 14, 15]. The peak surges of cognitive distress occur in micro-temporal windows—specifically during real-time target failure during a session or within the immediate post-run data upload phase [14].

Retrospective surveys systematically fail to capture these transient HPA-axis spikes, fluctuating cortisol responses, and momentary drops in self-efficacy, introducing substantial measurement error into clinical research [3, 5, 23]. To accurately evaluate how digital telemetry modifies athlete behavior, sports clinicians must transition toward Ecological Momentary Assessment (EMA) protocols and continuous neuro-ergonomic tracking (such as eye-tracking metrics, wearable HRV monitoring, and real-time stress sampling) [3, 6, 15]. Establishing precise, real-time psychometric evaluation tools is critical for differentiating between healthy training dedication, adaptive perfectionism, and early-stage exercise dependence triggered by digital tracking environments [16, 21, 27, 28].

Clinical Guidelines and Practical Interventions

To bridge the gap between empirical findings and practical coaching applications, structured clinical interventions must be implemented to protect the mental well-being of recreational runners. **Table 2** summarizes key practical recommendations, outlining their scientific rationales, primary behavioral outcomes, and prescribed frequencies.

Table 2. Summary of Practical Clinical Guidelines and Behavioral Prioritization for Runners

Clinical Guideline / Recommendation	Scientific & Physiological Rationale	Primary Behavioral Outcome	Prescribed Frequency
Somatic-Telemetry Decoupling [3, 6]	Reduces real-time visual cognitive load, mitigating acute anxiety spikes and preventing the degradation of native interoceptive signals.	Restores organic interoceptive awareness and re-establishes an internal locus of control.	1–2 sessions per training week.
Social Privacy Optimization [12, 14]	Avoids large public networks that add external comparison vectors, minimizing peer-driven performance distress.	Substantially reduces leaderboard-driven performance anxiety and social comparison stress.	Baseline setup configuration.
Baseline Psychological Screening [27, 28]	Assesses perfectionistic traits and baseline anxiety to identify pre-existing vulnerabilities to data obsession.	Identifies high-risk runners before dependency manifests.	Pre-season or annual screening.
Data-Interpretation Education [6, 7]	Teaches athletes that algorithmic metrics (VO_2 max, recovery hours) are estimates, reducing unwarranted health panic.	Mitigates cyberchondria and physiological over-analysis.	Upon initial tracker adoption.
High-Risk Stratification [16, 21]	Screens for histories of eating disorders, exercise addiction, and compulsive behaviors to protect vulnerable psychological structures.	Empowers coaches to mandate qualitative training styles.	Pre-program intake phase.
Structured "Digital Detox" Interventions [24]	Facilitates complete detachment from digital tracking for specific macrocycles to restore intrinsic motivation and rest the mind.	Prevents systemic clinical athletic burnout.	1 targeted training block per season.
Mindfulness-Based Training Integration [22, 29]	Promotes awareness of breath, muscle tension, and internal joy over rigid adherence to external screen-based variables.	Enhances somatic auto-regulation and running longevity.	Continuous throughout all cycles.

As detailed in Table 2, mitigating the psychological hazards of wearable technology requires a multi-tiered approach. Somatic-telemetry decoupling (running without screens 1–2 times per week) actively re-trains native interoceptive pathways and restores an internal locus of control [3, 6]. Concurrently, social privacy optimization removes the toxic exposure of public leaderboards, shielding the athlete from unnecessary social comparison stress [12, 14]. Furthermore, incorporating baseline psychological screenings and high-risk stratifications enables clinicians to identify runners predisposed to exercise dependence and compulsive tracking behaviors before pathological symptoms manifest [16, 21, 27, 28]. Finally, integrating structured digital detoxes and mindfulness-based training ensures that athletes can continue to leverage the physiological benefits of modern telemetry while preserving long-term emotional resilience and intrinsic running enjoyment [22, 24, 29].

Methodological Limitations and Future Research Directions

While this systematic review provides a comprehensive interdisciplinary synthesis of digital telemetry and athletic psychology, several methodological limitations must be acknowledged. First, the majority of existing literature relies on cross-sectional survey designs, which capture correlational relationships but limit definitive causal inferences regarding long-term digital dependency. Second, commercial tracking algorithms vary significantly across manufacturers (e.g., proprietary algorithms for recovery scores, training load, and VO_2 max estimations), introducing algorithmic opacity that complicates cross-study comparisons [7].

Future research should prioritize longitudinal, ecological momentary assessment (EMA) studies that track real-time emotional and physiological responses across varied training blocks. Investigating how specific demographic variables—such as age, gender, and baseline athletic experience—moderate vulnerability to digital anxiety will further refine clinical screening tools. Ultimately, advancing our understanding of the digital ecology surrounding endurance athletes will pave the way for sophisticated, technology-balanced training paradigms that prioritize both physical conditioning and psychological health.

Given these identified psychological risks, a paramount objective for contemporary sports psychology is to reimagine the human-technology interface within athletic environments. As excessive quantification systematically transforms physical activity from a source of intrinsic self-actualization into a vector for external validation, future interventions must focus on cultivating balanced digital ecosystems. These frameworks should proactively minimize destructive social comparison mechanics while fostering autonomous motivation in alignment with Self-Determination Theory [25, 26]. Ultimately, integrating non-intrusive telemetry with qualitative somatic self-awareness will enable recreational runners to leverage objective performance tracking without sacrificing emotional well-being or risking clinical athletic burnout [6, 24].

5. Conclusions

Wearable fitness trackers provide a highly effective framework for building training discipline, enhancing motivation, and tracking physical progress in recreational runners. However, they can expose the psychological architecture of the athlete to rapid, profound cognitive transitions. The temporary surges of exercise-induced anxiety observed during data evaluation are primarily driven by the rigid execution of metric-centric training and social comparison platforms, which result in acute psychological congestion and external dependency eroding the intrinsically flexible nature of recreational sport. The athlete's ability to safely buffer these transient cognitive loads is significantly dictated by their underlying personality traits, including perfectionism profiles and baseline emotional resilience. To preserve long-term mental well-being without compromising athletic gains, recreational runners should avoid prolonged, compulsive screen monitoring, optimize their privacy settings, and undergo comprehensive, sport-specific psychological screenings when signs of burnout appear. Innovative hybrid intervention models, combining digital tracking for objective loading with somatic mindfulness training, show immense clinical promise by allowing runners to harness the performance advantages of modern telemetry without falling victim to data-driven anxiety syndromes. Ultimately, the successful management of a recreational athlete requires a unified, interdisciplinary approach where the athlete's distinct cognitive anatomy, emotional profiles, training mechanisms, and specific sporting demands are systematically optimized together.

REFERENCES

1. Moe, M. C., Özmert, E., Baudouin, C., Binadra, A., Crafoord, S., Jo, Y., Kiratli, H., Moore, M., Pitsiladis, Y. P., Rolle, U., Tan, B., Yanik, Ö., Budgett, R., Erdener, U., Steffen, K., & Engebretsen, L. (2023). International Olympic Committee (IOC) consensus paper on sports-related ophthalmology issues in elite sports. *BMJ Open Sport & Exercise Medicine, 9*(3), Article e001644. https://doi.org/10.1136/bmjsem-2023-001644
2. Mangine, G. T., Stratton, M. T., Almeda, C. G., Roberts, M. D., Esmat, T. A., VanDusseldorp, T. A., & Feito, Y. (2020). Physiological differences between advanced CrossFit athletes, recreational CrossFit participants, and physically-active adults. *PLoS ONE, 15*(4), Article e0223548. https://doi.org/10.1371/journal.pone.0223548
3. Li, Y., Zheng, B., Grant, P., & Li, X. (2025). Assessing cognitive load through eye metrics in in-motion vs. stationary environments. *Applied Ergonomics, 129*, Article 104598. https://doi.org/10.1016/j.apergo.2025.104598
4. Zamani Sani, S. H., Fathirezaie, Z., Brand, S., Pühse, U., Holsboer-Trachsler, E., Gerber, M., & Talepasand, S. (2016). Physical activity and self-esteem: Testing direct and indirect relationships associated with psychological and physical mechanisms. *Neuropsychiatric Disease and Treatment, 12*, 2617–2625. https://doi.org/10.2147/NDT.S116811
5. Gu, H., Lei, Y., Yao, Y., Chen, C., & Liu, C. (2025). Physiological and psychological responses to acute stress: A meta-analysis of the 171 studies of Trier Social Stress Test including 8452 healthy adults. *Psychoneuroendocrinology, 180*, Article 107566. https://doi.org/10.1016/j.psyneuen.2025.107566
6. Chen, F., Zhao, L., Pang, L., Zhang, Y., Lu, L., Li, J., & Liu, C. (2025). Wearable physiological monitoring of physical exercise and mental health: A systematic review. *Intelligent Sports and Health, 1*(1), 11–21. https://doi.org/10.1016/j.ish.2024.12.006
7. Singh, B., Chastin, S., Miatke, A., Curtis, R., Dumuid, D., Brinsley, J., Ferguson, T., Szeto, K., Simpson, C., Eglitis, E., Willems, I., & Maher, C. (2024). Real-world accuracy of wearable activity trackers for detecting medical conditions: Systematic review and meta-analysis. *JMIR mHealth and uHealth, 12*, Article e56972. https://doi.org/10.2196/56972
8. Sullivan, A. N., & Lachman, M. E. (2017). Behavior change with fitness technology in sedentary adults: A review of the evidence for increasing physical activity. *Frontiers in Public Health, 4*, Article 289. https://doi.org/10.3389/fpubh.2016.00289
9. Park, S. J., Yang, H. J., Choi, C., & Bum, C. H. (2026). Effects of wearable technology on mental engagement and physical activity participation: Self-regulatory motivation, attitude, flow, and dropout in new sport participation. *Frontiers in Public Health, 14*, Article 1911509. https://doi.org/10.3389/fpubh.2026.1911509
10. Casado, A., Moreno-Pérez, D., Larrosa, M., & Renfree, A. (2019). Different psychophysiological responses to a high-intensity repetition session performed alone or in a group by elite middle-distance runners. *European Journal of Sport Science, 19*(8), 1045–1052. https://doi.org/10.1080/17461391.2019.1593510
11. Odriozola, A., Tirnauca, C., Corbi, F., González, A., & Álvarez-Herms, J. (2025). Physiological responder profiles and fatigue dynamics in prolonged cycling. *Journal of Functional Morphology and Kinesiology, 10*(4), 472. https://doi.org/10.3390/jfmk10040472
12. Wu, K., Li, Q., & Liu, Y. (2025). The code of sustainable success in fitness apps: Social comparison mechanism enabled by user facilitated supports. *Frontiers in Public Health, 13*, Article 1632598. https://doi.org/10.3389/fpubh.2025.1632598
13. Lin, T. Y., Liao, C. J., Chang, C., & Hung, T. M. (2026). Effect of goal setting, attentional focus, and feedback on resistance training: Stage 1 registered report of a factorial randomized controlled trial. *Psychology of Sport and Exercise, 84*, Article 103006. https://doi.org/10.1016/j.psychsport.2025.103006
14. Rivers, D. J. (2020). Strava as a discursive field of practice: Technological affordances and mediated cycling motivations. *Discourse, Context & Media, 34*, Article 100345. https://doi.org/10.1016/j.dcm.2019.100345
15. Elgendi, M., Markov, K., Liu, H., De Vos, M., Khalaf, K., Khandoker, A., Jelinek, H. F., Goswami, D., & Menon, C. (2026). Wearable devices for anxiety assessment: A systematic review. *Communications Medicine, 6*(1), Article 20. https://doi.org/10.1038/s43856-025-01234-6
16. Marques, A., Peralta, M., Sarmento, H., Loureiro, V., Gouveia, E., & Matos, M. (2019). Prevalence of risk for exercise dependence: A systematic review. *Sports Medicine, 49*(2), 319–330. https://doi.org/10.1007/s40279-018-1011-4
17. Galily, Y. (2025). From motivation to movement: How technology readiness and psychological profiles shape wearable tech use in students. *Societal Impacts, 6*, Article 100143. https://doi.org/10.1016/j.socimp.2025.100143
18. Connor, M., Hargreaves, E. A., Scanlon, O. K., & Harrison, O. K. (2023). The effect of acute exercise on state anxiety: A systematic review. *Sports, 11*(8), 145. https://doi.org/10.3390/sports11080145

19. Giddens, L., Gonzalez, E., & Leidner, D. (2016). I track, therefore I am: Exploring the impact of wearable fitness devices on employee identity and well-being. Deakin University. Conference contribution. https://hdl.handle.net/10536/DRO/DU:30165623
20. Etkin, J. (2016). The hidden cost of personal quantification. *Journal of Consumer Research, 42*(6), 967–984. https://doi.org/10.1093/jcr/ucv095
21. Psiuk, A. A. (2026). The phenomenon of exercise addiction: Diagnostic criteria, neurobiological underpinnings, and differential challenges at the interface of psychiatry and sports medicine. *Quality in Sport, 59*, Article 72682. https://doi.org/10.12775/QS.2026.59.72682
22. Gardner, F., & Moore, Z. (2012). Mindfulness and acceptance models in sport psychology: A decade of basic and applied scientific advancements. *Canadian Psychology / Psychologie Canadienne, 53*(4), 309–318. https://doi.org/10.1037/a0030220
23. Guthrie, A. J., Paredes-Echeverri, S., Bleier, C., Adams, C., Millstein, D. J., Ranford, J., & Perez, D. L. (2024). Mechanistic studies in pathological health anxiety: A systematic review and emerging conceptual framework. *Journal of Affective Disorders, 358*, 222–249. https://doi.org/10.1016/j.jad.2024.05.029
24. Gustafsson, H., DeFreese, J. D., & Madigan, D. J. (2017). Athlete burnout: Review and recommendations. *Current Opinion in Psychology, 16*, 109–113. https://doi.org/10.1016/j.copsyc.2017.05.002
25. Ryan, R. M., & Deci, E. L. (2017). *Self-determination theory: Basic psychological needs in motivation, development, and wellness*. The Guilford Press. https://doi.org/10.1521/978.14625/28806
26. Teixeira, P. J., Carraça, E. V., Markland, D., Silva, M. N., & Ryan, R. M. (2012). Exercise, physical activity, and self-determination theory: A systematic review. *International Journal of Behavioral Nutrition and Physical Activity, 9*, Article 78. https://doi.org/10.1186/1479-5868-9-78
27. Hsieh, A., Some, M., & Vanguri, P. (2025). Personality and performance amongst athletes: A systematic review. *Cureus, 17*(11), Article e96149. https://doi.org/10.7759/cureus.96149
28. Hill, A. P., Mallinson-Howard, S. H., Madigan, D. J., & Jowett, G. E. (2020). Perfectionism in sport, dance, and exercise. In G. Tenenbaum & R. C. Eklund (Eds.), *Handbook of sport psychology*. https://doi.org/10.1002/9781119568124.ch7
29. Birrer, D., Röthlin, P., & Morgan, G. (2012). Mindfulness to enhance athletic performance: Theoretical considerations and possible impact mechanisms. *Mindfulness, 3*(3), 235–246. https://doi.org/10.1007/s12671-012-0109-2