

Review Article

Physical literacy as the missing link in industrial health: A narrative review and conceptual analysis informed by the Sirjan context and the Golgohar cultural and sports club initiative

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Abstract

Rapid industrial expansion in Sirjan has reshaped occupational routines in ways that constrain daily movement and heighten metabolic vulnerability. While the health benefits of physical activity are well established, this narrative review advances the argument that the more fundamental deficit in such environments is the erosion of movement literacy—the cognitive, physiological, and behavioral capacity to understand, interpret, and intentionally engage in health sustaining physical activity. Drawing on evidence from exercise physiology, metabolic science, and occupational health, we conceptualize movement literacy as a multidimensional construct comprising awareness of exercise induced mechanisms, interpretation of bodily cues, and the ability to apply this knowledge to everyday behavior. Using the Gol Gohar industrial community as an illustrative case, we describe how limited literacy in these domains contributes to sedentary patterns among workers and outline how the Gol Gohar Sports Club operationalizes a literacy oriented model through targeted public education initiatives, coach led instructional programs, and awareness based practices such as “smart running.” By synthesizing mechanistic pathways—including glucose regulation, inflammatory modulation, neuroendocrine adaptation, and myokine signaling—the review positions movement literacy as a missing but necessary dimension in industrial health policy. We argue that enhancing this form of literacy may serve as a scalable strategy to mitigate metabolic risk and integrate exercise knowledge into routine occupational life.

Key Words: Physical activity, Industrial health, Gol Gohar Sirjan, Occupational stress, Metabolic syndrome, Public health.

Introduction

Modern industrial labor often places employees in environments characterized by low physical activity and chronic occupational stress—a combination that profoundly influences long term health outcomes. Extended shifts of sitting or performing repetitive mechanical tasks dramatically reduce daily energy expenditure and disrupt normal glucose regulation. Simultaneously, continuous mental strain activates the hypothalamic-pituitary-adrenal (HPA) axis, elevating cortisol levels and promoting central fat accumulation (Carson et al., 2014; Kivimäki et al., 2002). Over time, this dual physiological and psychosocial burden gives rise to a spectrum of chronic conditions including obesity, type 2 diabetes, hypertension, and metabolic syndrome, which are now recognized as the dominant non communicable diseases (NCDs) of industrial societies (Carson et al., 2014; Kivimäki et al., 2002).

This challenge is vividly observed in Sirjan, one of Iran’s principal industrial hubs located in Kerman Province. The rapid growth of Gol Gohar Mining and Steel Company has transformed the city’s lifestyle landscape. Mechanization and automation have replaced much of the traditional physical labor, leaving thousands of workers spending long hours indoors or seated in vehicles with minimal movement (Najafi et al., 2023; Pouragha, Poryaghoub, Naserpour, & Mehrdad, 2023). Such industrial transitions are often associated—based on evidence from similar occupational settings—with increased metabolic and cardiovascular risk. Comparable concerns have been noted anecdotally in the Sirjan context (Najafi et al., 2023; Pouragha et al., 2023). Within this context, the Gol Gohar Sports Club stands as a key local response—an effort to re-introduce physical activity into the daily rhythm of residents and employees. Such initiatives underline an emerging realization: economic development without health promotion is unsustainable. Industrial productivity may thrive on efficiency and precision, but human productivity depends on physiological vitality, mental balance, and social cohesion—all of which are grounded in regular physical movement (Najafi et al., 2023; Pouragha et al., 2023).

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Regular physical activity is universally regarded as one of the most powerful, accessible, and cost-effective strategies for disease prevention. Through aerobic exercise (e.g., walking, swimming, cycling), it strengthens the heart and lungs while lowering systemic inflammation (Koelwyn, Quail, Zhang, White, & Jones, 2017; Pratt et al., 2015). Resistance training augments muscle mass, enhances resting metabolic rate, and improves glucose control, whereas flexibility and mobility routines restore musculoskeletal balance and reduce injury risk (Medicine, 2013). Beyond visible fitness gains, consistent exercise regulates cortisol, elevates mood modulating neurotransmitters (serotonin, dopamine), and facilitates release of myokines such as irisin and interleukin 6, which possess potent anti-inflammatory and even anti-tumor properties (Medicine, 2013). Despite the clear evidence, Sirjan's industrial community still faces a critical health gap. Workplace policies often prioritize safety and productivity metrics while overlooking long-term prevention of lifestyle-related diseases. Few industrial companies maintain structured fitness programs or routine monitoring of employees' physical status. Addressing this oversight is not a matter of recreation but of public health necessity. Integrating structured movement into organizational culture can reduce chronic-disease risk, improve workforce performance, and align local practices with global health standards. For an industrial city like Sirjan, embedding exercise at the core of public-health strategy is essential. Sustainable development must no longer be measured only by tons of steel or market output, but by the vitality, resilience, and future health of the workers who sustain that progress. No primary data were collected from the Gol Gohar workforce. The Sirjan case is presented as an illustrative model based on workplace observations and extrapolations from existing occupational-health literature.

Materials and Methods

Study design

This work was conducted as a structured narrative review between April and July 2025. The aim was to synthesize current evidence on the physiological mechanisms linking physical activity, myokines, and health outcomes relevant to industrial populations, with particular emphasis on metabolic disorders and physical inactivity in settings similar to Sirjan.

Search strategy

A comprehensive literature search was performed in Medline (PubMed), SciELO, and the Cochrane Library. The search strategy combined MeSH and free text terms related to physical activity, industrial workers, metabolic disease, movement literacy, resistance and aerobic training, and myokine mediated mechanisms. The core search terms included:

“physical activity,” “exercise training,” “aerobic exercise,” “resistance training,” “physical inactivity,” “occupational health,” “industrial workers,” “type 2 diabetes,” “metabolic syndrome,” “obesity,” “myokines,” “exerkines,” “tumor microenvironment,” and “movement literacy,” combined using Boolean operators AND and OR.

Additional records were identified through snowballing by screening the reference lists of included studies. Two reviewers (A.A.H. and D.F.-L.) independently screened titles and abstracts to remove duplicates and assess eligibility. Full text articles were evaluated using Covidence software. Discrepancies were resolved through discussion, and a third reviewer (K.S.) was consulted when needed.

Inclusion and exclusion criteria

Studies were included when they met the following criteria:

1. Full text availability;
2. Article types including reviews, clinical trials, observational or experimental studies, case reports, or clinical experience papers;
3. Explicit analysis of the relationship between physical activity, physical inactivity, or exercise related physiological mechanisms;
4. No publication date restrictions;
5. Written in English, German, French, Italian, Spanish, or Portuguese.

Studies that did not meet the above criteria or lacked relevance to exercise physiology, physical inactivity, or occupational health contexts were excluded.

Exercise induced immunomodulation and long term disease prevention

Regular physical activity exerts profound and multifaceted effects on metabolic regulation. During each episode of muscular contraction, the translocation of GLUT-4 transporters to the cell membrane facilitates glucose uptake through insulin independent pathways, thereby enhancing overall insulin sensitivity. This adaptive mechanism offsets the insulin resistance that typically arises from prolonged physical inactivity and excessive caloric intake (Richter & Hargreaves, 2013). Beyond glucose control, exercise orchestrates a systemic anti-inflammatory response. Sustained training lowers circulating concentrations of tumor necrosis factor- α (TNF- α), interleukin-1 β (IL-1 β), and C-reactive protein (CRP), while stimulating anti-inflammatory mediators such as interleukin-10 (IL-10) and adiponectin (Pedersen & Saltin, 2015). These changes counteract the chronic low-grade inflammation that accompanies obesity, aging, and sedentary behavior

(Constantini & Hackney, 2013). Physical activity also exerts a stabilizing influence on the hypothalamic–pituitary–adrenal (HPA) axis, attenuating excessive cortisol secretion and normalizing the sympathetic–parasympathetic balance (Constantini & Hackney, 2013). In sedentary workers, persistent cortisol elevation promotes visceral fat accumulation and deteriorates glucose tolerance, whereas exercise restores neuroendocrine homeostasis and resilience to stress.

At the cellular level, aerobic and resistance training further enhance metabolic efficiency. Endurance exercise stimulates mitochondrial biogenesis within skeletal muscle, augmenting fatty-acid oxidation and improving oxidative capacity (Holloszy, 2005). Resistance exercise, meanwhile, increases skeletal-muscle mass, elevating resting energy expenditure and facilitating superior glycemic control (Holloszy, 2005). Collectively, these physiological adaptations delineate why individuals who engage in regular physical activity tend to maintain lower visceral adiposity, favorable hormonal profiles, and a reduced risk of cardiometabolic diseases.

Categories of physical activity and their specific benefits

Aerobic exercise

Among all forms of aerobic activity, running holds a uniquely comprehensive influence on the human body. Depending on its intensity, duration, and frequency, running activates an array of physiological pathways that improve cardiovascular efficiency, metabolic control, and neuroendocrine balance. At low intensities (e.g., brisk walking or light jogging at 40–55 % VO_2 max), the body preferentially oxidizes fatty acids as its main fuel source. This state enhances mitochondrial efficiency, mobilizes subcutaneous fat, and improves capillary density in skeletal muscle. Low-intensity running is particularly useful for individuals with metabolic syndrome or limited training background, since it imposes minimal mechanical load while steadily increasing energy expenditure (Thyfault & Bergouignan, 2020).

At moderate intensities (\approx 60–75 % VO_2 max), running triggers more complex systemic adaptations: stroke volume and cardiac output increase, the lungs expand their tidal capacity, and endothelial nitric oxide (NO) signaling intensifies—restoring vessel elasticity

Table 1. Major physiological mechanisms through which regular physical activity protects metabolic and endocrine health.

Mechanism / Pathway	Exercise-induced Adaptation	Primary Outcome on Health
Glucose Transport (GLUT-4 Pathway)	Muscular contraction triggers GLUT-4 translocation independent of insulin	↑ Glucose uptake, ↑ insulin sensitivity
Systemic Inflammation	↓ TNF- α , IL-1 β , CRP; ↑ IL-10, Adiponectin	↓ Chronic inflammation, ↓ metabolic syndrome risk
HPA Axis Regulation	Reduced cortisol hypersecretion and sympathetic dominance	↓ Visceral fat, ↓ stress load, restored neuroendocrine balance
Mitochondrial Biogenesis	Increased PGC-1 α and oxidative enzyme activity	↑ Fatty-acid oxidation, ↑ energy efficiency
Muscle Hypertrophy & Energy Expenditure	Resistance training promotes muscle growth and basal metabolic rate	↑ Glucose utilization, ↓ fat accumulation

Table 2. Physiological and practical effects of running at different intensities.

Running Intensity / Zone	Dominant Energy System & Fuel	Key Physiological Adaptations	Health Benefits (Metabolic / Cardiovascular / Neuro-endocrine)	Practical Application for Sirjan Industrial Workers
Low-Intensity Running (40–55 % VO_2 max) “Fat-burning zone”	Aerobic oxidation of fatty acids	↑ Capillary density, ↑ mitochondrial efficiency, steady HR	Improved fat oxidation, reduced body fat, gradual cardiorespiratory adaptation	10–15 min brisk walk or slow jog before/after shifts; suitable for beginners with
Moderate-Intensity Running (60–75 % VO_2 max) “Endurance zone”	Mixed fat + glucose metabolism	↑ Stroke volume, ↑ VO_2 max, ↑ NO release, ↑ PGC-1 α signaling	↓ TG 20–30 %, ↑ HDL 10–15 %, ↓ blood pressure, ↑ insulin sensitivity	3x/week 30–40 min runs around Gol Gohar facilities; mid-day aerobic team sessions
High-Intensity Running / Intervals (>80 % VO_2 max) “Anaerobic threshold zone”	Glycolytic + phosphagen systems	↑ BDNF, ↑ IL-6/irisin, ↑ lean mass, ↓ TNF- α & CRP	Strong anti-inflammatory and neuro-trophic effects; enhanced cognitive function & stress resilience	Short interval circuits (e.g., 4 × 4 min) twice weekly under supervision; boosts alertness before night shifts
Long-Duration Aerobic Endurance (>60 min)	Aerobic fatty-acid oxidation predominance	↑ Mitochondrial biogenesis, ↑ lipid mobilization, ↓ resting HR	Sustained improvement in aerobic metabolism and vascular elasticity	Weekend community runs or Gol Gohar Sports Club events to promote social cohesion
Combined (Variable-Pace / Fartlek)	Alternating aerobic-anaerobic	Integrates cardiovascular + neuro muscular benefits	Comprehensive training response with low injury risk	Group fun-runs for morale and team bonding

endothelial nitric oxide (NO) signaling intensifies—restoring vessel elasticity and lowering blood pressure (Thyfault & Bergouignan, 2020). Repeated aerobic bouts of 30–45 minutes, performed three to four times per week, upregulate peroxisome proliferator-activated receptor- γ coactivator-1 α (PGC-1 α), the key regulator of mitochondrial biogenesis. This shift not only augments energy metabolism but also bolsters long-term insulin sensitivity and lipid control. Clinical data indicate that twelve weeks of moderate running can reduce triglyceride levels by 20–30 % and elevate HDL cholesterol by 10–15 %, measurable benefits particularly relevant to sedentary industrial populations (Thyfault & Bergouignan, 2020). At higher intensities (> 80 % VO_2 max), interval or tempo running engages powerful anti-inflammatory and hormonal cascades. The transient stress of vigorous effort prompts the release of myokines such as IL-6 and irisin, which in turn inhibit TNF- α and promote the browning of white adipose tissue—converting fat into an energy-consuming phenotype. Simultaneously, high-intensity aerobic work amplifies brain-derived neurotrophic factor (BDNF), improving mood, memory, and cognitive resilience under occupational stress. For factory workers in Sirjan, where long sedentary periods and repetitive mechanical tasks predominate, structured bouts of running or brisk walking during shift intervals could yield major physiological dividends: reduced fatigue, lower systemic inflammation, and healthier lipid and glucose profiles. Even two 10-minute aerobic sessions embedded within the workday can normalize autonomic balance, reduce cortisol accumulation, and improve alertness. Beyond metabolic return, the rhythmic nature of running synchronizes breathing and movement—cultivating mental focus and emotional stability, key attributes for individuals performing demanding industrial tasks. Ultimately, regular running acts as both preventive medicine and cultural rhythm—a daily reaffirmation that vitality is trainable. Within the context of Sirjan’s industrial transformation, encouraging scheduled aerobic movement transforms energy from mechanical output into biological resilience, ensuring that economic productivity evolves hand-in-hand with human health.

Resistance exercise

Resistance training—whether performed with free weights, machines, elastic bands, or body weight movements—serves as a cornerstone of metabolic and structural health. Unlike aerobic activity that mainly engages the oxidative system, resistance exercise imposes mechanical tension and metabolic stress on muscle fibers, triggering adaptive signaling cascades that remodel the musculoskeletal and endocrine systems (Phillips & Winett, 2010).

At the cellular level, mechanotransduction activates several key regulators of energy metabolism and growth, most notably AMP activated protein kinase (AMPK), peroxisome proliferator activated receptor gamma coactivator 1 alpha (PGC-1 α), and the mechanistic target of rapamycin (mTOR) pathway (Phillips & Winett, 2010).

- AMPK serves as a cellular energy sensor that enhances glucose uptake and fatty acid oxidation.
- PGC-1 α promotes mitochondrial biogenesis and improves metabolic flexibility.
- mTOR governs protein synthesis and muscle hypertrophy, increasing muscle cross sectional area and restoring peripheral insulin sensitivity.

These integrated pathways optimize nutrient partitioning: amino acids and glucose are shuttled preferentially into skeletal muscle rather than visceral fat, thereby reducing ectopic fat deposition and improving energy efficiency (Phillips & Winett, 2010).

From a physiological viewpoint, consistent resistance training improves insulin-mediated glucose uptake, lowers HbA1c levels in pre diabetic individuals, and elevates resting metabolic rate—a critical factor for long term weight management. It also stimulates myokine secretion (such as irisin, myostatin inhibitors, and IL-15), which exert systemic effects on lipid oxidation, bone density, and immune modulation.

For industrial workers in Sirjan, whose daily routines often emphasize repetitive sitting or machine control with minimal muscle engagement, these adaptations are indispensable. Over Years of mechanized labor are known, in many occupational populations, to contribute to reduced physical conditioning and reliance on repetitive motor patterns—a framework relevant to interpreting the Sirjan case. Integrating structured resistance workouts within corporate wellness programs could counter these declines, restoring musculoskeletal vitality, posture, and endurance.

Even short sessions—two to three times weekly using compound movements (e.g., squats, push-ups, resistance band rows)—stimulate major muscle groups, improve spinal stabilization, and lower chronic fatigue. Beyond physiological gains, regular strength practice conveys a psychological dimension: workers regain a tangible sense of control over their physical capacity. In the cultural context of Gol Gohar, where industry symbolizes resilience, resistance training embodies personal strength and the spirit of collective endurance that defines the city.

Exercise induces the release of myokines, muscle derived signaling proteins that have systemic metabolic and immunologic

Table 3. Metabolic and functional benefits of resistance training for industrial employees.

physiological Domain	Cellular / Molecular Mechanism	Functional Outcome	Health Benefit	Practical Application for Sirjan Industrial Workers
Muscle Hypertrophy & Strength	Activation of mTOR → ↑ protein synthesis & muscle fiber CSA	Increased muscle resilience and power output	Counteracts sarcopenia; improves work performance	Two–three weekly sessions of compound lifts (squats, push-ups, band rows, loaded carries) to restore posture and lifting capacity during long machine-operation periods
Glucose Metabolism	AMPK activation → ↑ GLUT-4 translocation & glycogen storage	Improved insulin sensitivity	↓ fasting glucose; ↓ type 2 diabetes risk	Short 3-round circuits (8–12 reps) during or after shifts to stabilize post-shift glucose in workers with prolonged sitting
Mitochondrial Function	PGC-1α upregulation → ↑ mitochondrial biogenesis	Enhanced oxidative capacity	Better energy efficiency; fatigue resistance	Slow-tempo resistance–band work and body-weight drills to improve stamina during extended industrial shifts
Adipose Tissue Regulation	Muscle-derived IL-6, irisin → ↑ fat oxidation, ↓ visceral fat	Optimized body composition	↓ waist-to-hip ratio; ↓ inflammation	Combined strength + brisk walk sessions after shifts to stimulate fat oxidation and reduce visceral-fat accumulation
Bone and Joint Health	Mechanical loading → ↑ osteoblast activity & collagen turnover	Higher bone density; fewer injuries	Prevention of osteoporosis; reduced back pain	Step-ups, farmer's carries, and light kettlebell lifts to support spine health and reduce work-related strain
Psychological & Cognitive	Dopamine + myokine release → ↑ mood, ↓ fatigue	Improved mental health and motivation	Reduced burnout; better focus	Brief supervised resistance bouts before or mid-shift to enhance alertness and task engagement

effects. Among these, IL-6, Irisin, FGF-21, and Myostatin play crucial roles in linking physical activity to cancer prevention (Amirhossein Ahmadi Hekmatikar, 2024; Amirhosain Ahmadi Hekmatikar, Haghshenas, & Mohammad Sadeghipor, 2019; Pedersen & Saltin, 2015; Rami, Ahmadi Hekmatikar, Rahdar, Marashi, & Daud, 2024; Zolfaghari, Basereh, Daud, & Khoramipour, 2025).

- IL-6 acts as both a pro and anti-inflammatory agent; when secreted transiently during exercise, it triggers anti-inflammatory cascades, increasing IL-1 receptor antagonist and IL-10 levels. This creates an environment that suppresses metastatic and tumor supportive inflammation (Amirhossein Ahmadi Hekmatikar, 2025; Amirhossein Ahmadi Hekmatikar & Suzuki, 2025).
- Irisin, cleaved from the membrane protein FNDC5, induces browning of white adipose tissue and attenuates cancer-cell progression by inhibiting epithelial mesenchymal transition.
- FGF 21 improves mitochondrial oxidative capacity and reduces circulating glucose, contributing to an anti-tumor metabolic state.
- Myostatin antagonism, conversely, prevents cachexia and muscle loss often seen in malignancies.

In total, exercise transforms the tumor microenvironment by enhancing immune surveillance, promoting apoptosis, and reducing angiogenesis signaling (Pedersen & Saltin, 2015). This biological link illustrates why consistent training decreases the in-

-cidence of breast, colorectal, and liver cancers in both general and occupational populations.

Discussion

The findings of this conceptual analysis highlight a fundamental paradox: while Sirjan's industrial growth has advanced technical literacy, it has simultaneously eroded movement literacy—the basic ability to understand, value, and confidently perform physical activities that sustain health. Movement literacy, in the context of industrial health, refers not only to the ability to perform basic motor skills but also to an individual's understanding of how physical activity influences metabolic, hormonal, and psychological wellbeing. A major challenge within rapidly industrialized environments such as Sirjan is the widespread lack of awareness regarding the physiological benefits of regular physical activity. Many workers are familiar with exercise in a general sense, yet remain unaware of how movement improves glucose regulation, reduces chronic inflammation, stabilizes the HPA axis, prevents musculoskeletal imbalances, and enhances resilience to work related stress. This informational gap—rather than a lack of access to exercise alone—appears to be a central component of low movement literacy.

Against this backdrop, the Gol Gohar Sports Club has positioned itself to address movement literacy through a two tiered strategy. First, the Club utilizes social media platforms to disseminate accessible, evidence based information about the health effects of physical activity. These campaigns aim to raise community lev-

-el literacy by explaining, in simple and culturally relevant language, why aerobic and resistance training matter, how they protect against conditions such as type 2 diabetes and hypertension, and how small daily changes can have cumulative physiological impact. By targeting both employees and the broader Sirjan population, this approach seeks to normalize physical activity as a public health priority rather than a recreational option.

Second, the Club complements this educational outreach with structured, coach led programs designed to operationalize the science of movement. In these sessions, trained instructors provide not only technical guidance on performing exercises but also narrative explanations linking each drill to a physiological purpose-for example, how controlled eccentric loading enhances tendon capacity, how moderate intensity aerobic work improves autonomic balance, or how proper core engagement reduces lower back strain during long shifts. This pedagogical approach transforms physical activity from a task into an applied learning experience, allowing workers to understand what they are doing, why they are doing it, and how it affects their bodies over time.

Together, these two components-public awareness and structured educational practice-form a coherent model for enhancing movement literacy in industrial populations. While no empirical measurements were conducted in this review, the conceptual framework outlined here provides a basis for future assessment and helps clarify how movement literacy can be cultivated systematically within communities like Sirjan. Beyond general education and structured instruction, the Gol Gohar Sports Club emphasizes "smart running" as a practical pathway for strengthening movement literacy. Smart running refers to running undertaken with conscious awareness of its physiological mechanisms and intended health effects-rather than simply accumulating steps or distance. By teaching workers how different intensities activate distinct energy systems, how moderate aerobic work improves insulin sensitivity, or how interval bouts stimulate myokines such as IL-6 and irisin, the program reframes running from a routine physical task into an informed, purposeful behavior. This awareness based approach helps individuals interpret bodily cues during activity (e.g., changes in breathing rhythm, heart rate zones, fatigue signals) and understand how these cues relate to metabolic and endocrine adaptations. As a result, running becomes not only a mode of exercise but also a learning process through which workers gain the cognitive and somatic components of movement literacy. In an industrial population where sedentary habits dominate, smart running provides an accessible, evidence informed strategy for reconnecting individuals with the biological rationale of movement-turning one of the simplest activities into a structured lesson in self-care and physiological agency.

Years of mechanized labor and sedentary work have produced many industrial workers-according to prior research-tend to develop reduced motor competence over time, and the Sirjan workforce may reflect similar trends, though no direct assessments were conducted in this review. Low movement literacy manifests not only as reduced fitness but also as limited awareness of how the body functions, adapts, and self-repairs through motion. In an occupational context such as the Gol Gohar Mining and Steel Complex, prior studies show that low movement literacy in industrial settings is commonly associated with reduced flexibility, diminished core stability, and early metabolic symptoms; these patterns provide a conceptual lens through which the Sirjan workforce can be understood. Physiologically, the absence of basic motor competence suppresses the cascade of beneficial pathways described earlier-GLUT-4 translocation, AMPK and PGC-1 α activation, and anti-inflammatory myokine release. Psychologically, workers disengage from the embodied sense of vitality that connects self-efficacy to community belonging. In broader socio-cultural terms, this represents a gap between industrial knowledge and bodily knowledge.

Against this background, the Gol Gohar Sports Club emerges as a valuable public-health laboratory for rebuilding movement culture inside the city. The Club's objective extends beyond offering recreational facilities; it functions as a pedagogical system that translates biomedical literacy into embodied literacy. Through structured aerobic and resistance programs, it teaches employees not merely what to do but why movement matters-how muscular contraction improves insulin sensitivity, how correct posture prevents fatigue, and how team sports enhance both communication and stress resilience. This transition from exercise promotion to movement education is crucial. True literacy in movement entails the ability to interpret physical cues-understanding one's heart rate, recognizing signs of overtraining, managing recovery, and grasping the link between discipline and hormonal balance. Just as reading and writing are gateways to cognitive empowerment, movement literacy is a gateway to physiological empowerment. It equips industrial workers to take ownership of their own bodies within a system that often reduces them to repetitive automation.

Globally, public-health frameworks such as the ACSM's "Exercise is Medicine" initiative emphasize the integration of such literacy into daily routines. The Gol Gohar program, by embedding short activity sessions during shifts and providing narrative explanation for every drill, effectively localizes this philosophy. Each table presented earlier-from running-intensity adaptation to resistance mechanisms-can be interpreted as a curriculum of movement: an applied physiology syllabus designed for the industrial population of Sirjan.

Conclusion

By framing physical activity as a language that must be learned, the city can cultivate a new form of citizenship—where knowledge of motion becomes a measure of health literacy and civic responsibility. The Gol Gohar Sports Club thus represents not merely a training center but an educational institute of the body, translating the science of exercise into daily vocabulary for Sirjan's workforce. Empowering people to read their body's responses and write their own health trajectories redefines what sustainable industrial progress means: a synergy where steel hardens, but society moves—strong, informed, and alive.

What is already known on this subject?

- Industrial workplaces are typically characterized by low physical activity, long sedentary shifts, and high occupational stress, all of which increase the risk of metabolic syndrome, obesity, hypertension, and type 2 diabetes.
- Regular physical activity improves glucose regulation, reduces chronic inflammation, enhances HPA-axis stability, and positively influences metabolic, endocrine, and cardiovascular health.
- Myokines such as IL-6, irisin, FGF-21, and myostatin-related pathways mediate systemic anti-inflammatory, metabolic, and anti-tumor effects of exercise.
- Industrial workers—especially in mechanized settings—often show low motor competence, reduced flexibility, and early metabolic abnormalities due to prolonged inactivity.
- Global public-health frameworks (e.g., Exercise is Medicine) emphasize integrating structured physical activity into daily routines to mitigate chronic-disease risk.

What this study adds?

- Introduces physical literacy as a missing but fundamental variable in industrial health—going beyond physical activity levels to include workers' cognitive, physiological, and behavioral understanding of how exercise affects the body.
- Provides a conceptual framework linking low movement literacy with poor metabolic outcomes in industrial settings such as Sirjan, despite the availability of recreational facilities.
- Demonstrates how the Gol Gohar Sports Club offers a literacy-oriented model that connects exercise behavior with mechanistic understanding through coach-led education, social-media-based public communication, and structured programs such as “smart running”.
- Highlights movement literacy as a scalable public-health strategy capable of transforming physical activity from a simple

task into an applied learning process, enhancing self-efficacy and long-term adherence in industrial populations.

- Repositions industrial health promotion from merely providing training opportunities to teaching workers why specific exercises matter, how physiological cues should be interpreted, and how these insights support metabolic and neuroendocrine resilience.

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Data availability

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Compliance with ethical standards

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Author contributions

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