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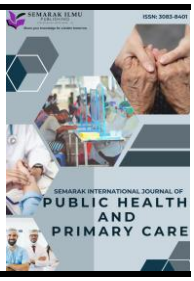

Integrating Exercise as Medicine in Public Health Strategies: A Multilevel Approach to Promoting Physical Activity

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ABSTRACT

The rising prevalence of non-communicable diseases (NCDs), physical inactivity, and declining mental health worldwide underscores the urgent need for effective and sustainable public health interventions. Exercise, once viewed primarily as a tool for fitness or recreation, is now gaining recognition as a vital component of preventive and therapeutic healthcare. This keynote article presents a comprehensive, multilevel framework for integrating "Exercise as Medicine" into public health strategies. The framework explores how multiple layers shape physical activity behaviours, including individual factors like motivation and health literacy, psychological drivers such as self-efficacy and behavioural intention, social influences, environmental design, and government policies. Drawing from an extensive body of recent research, this article highlights how interconnected these elements are. It emphasises that long-term exercise engagement rarely results from a single factor. Instead, sustained physical activity depends on a supportive ecosystem that enables individuals to act on their intentions and overcome personal or systemic barriers. Motivation, particularly intrinsic motivation, along with accessible infrastructure, social support, and clear policy direction, are presented as key levers for improving adherence to physical activity guidelines. Furthermore, the article stresses the importance of cross-sector collaboration, involving healthcare providers, educators, urban designers, and policymakers, to make physical activity an everyday norm rather than an optional lifestyle choice. Ultimately, this article offers practical recommendations for embedding exercise more deeply into healthcare systems and community planning, advocating for a shift in mindset that treats physical activity not as a luxury but as a fundamental health necessity.

1. Introduction

Non-communicable diseases (NCDs) such as heart disease, diabetes, and mental health conditions are now the top causes of death worldwide. These diseases are not only responsible for premature mortality, but they also significantly reduce quality of life and place an enormous burden on healthcare systems. Sedentary behaviour is a major contributor to this growing crisis, people are not moving enough. Despite widespread awareness of the benefits of physical activity, daily routines

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have become increasingly inactive due to modern lifestyles, urban environments, and technological convenience. In response, "Exercise as Medicine" has gained significant traction. This concept shifts the role of physical activity from a casual, recreational choice to a recognised preventive and therapeutic intervention. Just like medications are prescribed to manage health conditions, exercise can and should be prescribed to prevent and treat a wide range of physical and mental health issues. Scientific evidence shows that regular movement improves cardiovascular health, helps manage diabetes, reduces depression and anxiety, and enhances overall well-being. However, successfully incorporating physical activity into public health systems requires more than just telling people to exercise. It calls for a deeper, more structured approach considering the complex factors influencing behaviour. Why do some people stay active while others do not? What environmental and social conditions support an active lifestyle? How do policies, healthcare systems, and communities help or hinder efforts to promote movement? To answer these questions, this article presents a multilevel framework that looks at five key dimensions:

i. Individual-level factors (e.g., motivation and health literacy),
ii. Psychological components (e.g., self-efficacy and perceived barriers),
iii. Sociocultural influences (e.g., family support and community norms),
iv. Environmental conditions (e.g., access to facilities and walkability), and
v. Policy-level strategies (e.g., government investment and healthcare integration).

These layers provide a roadmap for meaningfully embedding physical activity into healthcare and public health strategies, turning movement into medicine for all.

2. Individual-Level Determinants of Physical Activity

Understanding why individuals choose or do not engage in physical activity requires close attention to personal factors, particularly motivation and health literacy. These two elements are foundational in shaping behaviour, sustaining exercise routines, and fostering long-term health outcomes.

2.1 Motivation

Motivation is the psychological engine that drives individuals to start and continue physical activity. It comes in two primary forms: extrinsic and intrinsic. Extrinsic motivation involves external rewards such as praise, incentives, or social recognition, which can be effective in getting people to initiate exercise [36]. However, intrinsic motivation, which includes internal drivers like enjoyment, personal challenge, self-fulfilment, or a desire to improve health, is much more powerful when maintaining regular physical activity over time [27]. Notably, intrinsic goals become especially important in the later stages of behaviour change. For example, individuals in the "maintenance" phase of the Transtheoretical Model are more likely to be driven by values aligned with personal health and well-being [22]. In addition, motivation does not operate in isolation. It works hand-in-hand with self-efficacy, the belief in one's ability to succeed, and strategic planning, which helps individuals stay on track despite obstacles [35].

2.2 Health Literacy

Health literacy is accessing, understanding, and using health-related information to make informed decisions. Physical activity involves knowing what type of exercise is beneficial, how much is required, and how to perform it safely [7]. People with higher health literacy are more confident in managing their health and more likely to engage in and sustain physical activity. Research shows that individuals with better health literacy are more likely to reach the action or maintenance stages of behaviour change [13]. Functional literacy, the basic ability to read and understand instructions, supports adherence to exercise programs [25]. However, critical health literacy, which involves deeper questioning and analysis, can sometimes lead to doubt or second-guessing medical advice, potentially reducing compliance [13]. Motivation and health literacy are crucial for initiating and sustaining physical activity. Programs that promote exercise at the individual level should prioritise nurturing intrinsic motivation and enhancing people's understanding of health information to empower informed, lasting participation in active lifestyles.

3. Psychological Factors

Psychological factors play a crucial role in determining how individuals engage with and sustain physical activity (PA). Understanding these mental and emotional components helps explain why some people maintain regular exercise habits while others struggle to begin or persist. Three key psychological elements stand out in the literature: self-efficacy, perceived barriers, and behavioural intention.

3.1 Self-Efficacy

Self-efficacy refers to a person's belief in their ability to successfully perform a specific behaviour, such as engaging in physical activity. It is widely regarded as one of the strongest predictors of long-term exercise participation [20,33]. Individuals with high self-efficacy are more likely to overcome challenges, stay motivated, and recover from setbacks. For example, someone who believes they can maintain a walking routine even during busy weeks is more likely to follow that plan. Self-efficacy also improves stress management, emotional regulation, and overall mental resilience. These psychological benefits reinforce consistent physical activity, creating a positive feedback loop [32].

3.2 Perceived Barriers

Perceived barriers are real or imagined obstacles that people believe prevent them from exercising. These can be practical, such as a lack of time, money, or childcare, or more global, like concerns about cultural expectations, personal safety, or body image [18,24]. The perception of these barriers significantly influences whether someone attempts to be active. Notably, individuals with strong motivation and high self-efficacy tend to view barriers as temporary or manageable, whereas those with lower confidence may perceive them as insurmountable [34]. This difference in perception often separates individuals who persist in physical activity from those who drop out or never begin.

3.3 Behavioural Intention and Mental Well-being

Behavioural intention refers to a person's conscious decision or plan to act. It is a direct precursor to behaviour and is shaped by self-efficacy and perceived barriers [17]. When individuals feel capable and do not perceive significant obstacles, their intention to exercise strengthens, and intention is a crucial first step toward action. Beyond physical benefits, regular PA supports mental health by boosting mood, reducing anxiety, and promoting psychological resilience [16]. When people believe they can exercise and feel supported, they are more likely to follow through and enjoy better mental well-being.

4. Sociocultural Factors

Sociocultural influences play a significant role in shaping how individuals approach physical activity, not only in deciding to start, but also in maintaining it over time. People are far more likely to stay active when they are surrounded by supportive social environments. For instance, participating in group workouts, exercising with friends or family, or receiving guidance from fitness professionals can significantly boost motivation and consistency [19]. These social contexts provide more than just companionship; they foster a sense of accountability, shared goals, and positive reinforcement that help sustain long-term habits. Family dynamics, peer expectations, and workplace culture can strongly influence one's commitment to physical activity. When physical activity is seen as a valued norm within a community or institution, individuals are more inclined to adopt and maintain those behaviours.

This is especially important for two key groups: young people and older adults. Peer influence and school culture can promote or discourage active lifestyles in youth. An older adult's sense of social connection and inclusion often determines whether they remain engaged in physical activity programs. Cultural background also shapes perceptions of exercise. In some societies, physical activity is closely tied to gender roles, religious beliefs, or traditional practices, which can encourage or inhibit participation. Understanding these sociocultural dimensions is crucial for designing effective, inclusive public health interventions that resonate with diverse populations.

5. Environmental Factors

Creating environments that support and encourage physical activity is crucial in promoting public health. Our urban or rural surroundings can either motivate or hinder regular movement. Two of the most impactful environmental factors influencing physical activity are access to exercise facilities and a community's walkability.

5.1 Access to Exercise Facilities

Access to safe, affordable, and well-maintained exercise spaces such as gyms, community centres, and parks significantly shapes people's physical activity habits. Interestingly, research indicates that communities with lower socioeconomic status (SES) tend to be closer to public spaces. However, the quality and availability of those facilities are often limited [9]. This inequality can contribute to lower participation rates in structured or vigorous physical activity. Moreover, studies have shown a positive association between proximity to exercise facilities and increased levels of moderate-to-vigorous physical activity (MVPA) [37]. However, urban areas that are overly saturated with facilities, especially when poorly planned, might experience a decline in walking or casual

activity. This may be due to reduced walkability, visual clutter, or dependence on indoor spaces, which reduces the natural incentive to walk or cycle [30]. Thus, balance in facility planning is essential.

5.2 Walkability and Urban Design

A walkable city is not only healthier but also more liveable. Cities designed with pedestrian-friendly infrastructure are associated with reduced pollution, lower rates of chronic illness, and greater community interaction [3]. Important features that enhance walkability include green spaces, shaded paths, street connectivity, and convenient access to public transportation [10]. These elements make walking a safe, pleasant, and practical choice. However, traditional walkability metrics often fail to account for critical aspects such as air quality, heat stress, and accessibility for vulnerable populations like the elderly or people with disabilities [5,28]. For cities to truly support physical activity, they must adopt inclusive urban design principles offering universal access, comfort, and safety for all individuals, regardless of age, ability, or income. In short, physical activity does not occur in a vacuum. It is deeply influenced by the environmental opportunities and barriers that surround us. Equitable access to exercise facilities and inclusive urban design must be central to any public health strategy to embed exercise as a daily, sustainable habit.

6. Policy Level

Effective public health policy is one of the most powerful tools for shaping healthier populations. Policy and investment are foundational when integrating "Exercise as Medicine" into healthcare systems and daily life. However, despite the strong evidence supporting physical activity as a preventive and therapeutic intervention, government commitment often falls short.

6.1 Public Health Policy and Investment

Policymakers play a crucial role in creating systems that promote regular physical activity. However, one significant barrier is the mismatch between political timelines and health outcomes. Many health benefits from physical activity, such as reduced disease rates and lower healthcare costs, are long-term results, which do not always align with short-term political goals or election cycles [38]. To overcome this, public health policies must be grounded in legitimacy, that is, they should be built upon solid scientific evidence, clear legislation, and effective administration [45]. Beyond that, communication is key. Policymakers should utilise engaging methods, such as storytelling, digital outreach, and public campaigns, to help people understand the value of these policies and foster public support. Change becomes more sustainable when the public sees physical activity as a shared social goal.

6.2 Implementation and Incentivization

Creating a good policy is only half the battle; implementing it effectively is just as critical. Challenges often include a lack of coordination between sectors, limited funding, and unclear responsibilities across institutions [33]. This is where structured frameworks like the Consolidated Framework for Implementation Research (CFIR) can help guide more organised and measurable approaches [15]. One proven strategy is to use financial rewards, certifications, or public recognition incentives for individuals, organisations, and even healthcare providers who meet physical activity goals or adhere to guidelines. Additionally, successful implementation relies on cross-sectoral

collaboration between health, education, urban planning, and community organisations to ensure that physical activity is integrated into everyday systems and services.

In conclusion, when backed by investment and well-planned implementation strategies, strong public policies can shift exercise from a personal responsibility to a collective societal standard. This requires bold leadership, public engagement, and inter-agency cooperation to make physical activity a central pillar of modern healthcare.

7. Health Outcomes

Physical activity does far more than build strength or burn calories; it is deeply connected to long-term health outcomes. Regular movement helps regulate weight, strengthens the cardiovascular system, supports mental health, and reduces inflammation, all of which are central to disease prevention and overall well-being. This section examines how lifestyle choices, particularly physical activity, directly impact key health indicators, including Body Mass Index (BMI), chronic stress, cardiovascular health, and mental resilience.

7.1 BMI, Cardiovascular Health, and Inflammation

The Body Mass Index (BMI) is one of the most widely used tools for assessing body weight in relation to height. While it offers a quick estimate of health risk, the relationship between BMI and health is more complex than it first appears. A high BMI is often associated with increased risk of cardiovascular diseases, such as coronary artery disease, stroke, and heart failure [39]. Studies have uncovered what is often called the "obesity paradox", a phenomenon where overweight or mildly obese individuals with pre-existing heart conditions sometimes experience better survival rates than their leaner counterparts [40]. This suggests that BMI alone does not tell the whole story; body composition, including fat distribution and lean muscle mass, plays a significant role in determining health outcomes. Additionally, obesity and inactivity are closely linked with chronic low-grade inflammation, a condition that significantly increases the risk of multiple diseases. Higher levels of BMI often lead to elevated inflammatory markers, such as high-sensitivity C-reactive protein (hsCRP), which are predictors of cardiovascular and metabolic complications [41,42]. These findings highlight the importance of regular physical activity for maintaining a healthy weight, managing inflammation, and protecting the cardiovascular system.

7.2 Chronic Stress and Mental Health

Chronic stress is another major health issue closely tied to physical activity, which has become increasingly common in today's fast-paced world. Long-term stress negatively affects the hypothalamic pituitary adrenal (HPA) axis, which manages the body's stress response. Chronic overstimulation of this axis leads to elevated cortisol levels, which, in turn, contribute to weight gain, high blood pressure, insulin resistance, and increased inflammation, all components of metabolic syndrome [1,43]. Importantly, regular physical activity acts as a natural stress reliever. It helps restore balance to the HPA axis and promotes the release of "feel-good" neurotransmitters like endorphins and serotonin, which improve mood and enhance emotional resilience [32]. Physically active people often report lower anxiety levels, better sleep quality, and greater life satisfaction. In this sense, exercise is not only medicine for the body, it is therapy for the mind.

8. Clinical and Community Integration

As the health benefits of physical activity become increasingly evident, there is a growing push to integrate exercise into healthcare systems and community frameworks. This means going beyond simply recommending movement and building the infrastructure, education, and policy systems that allow physical activity to become a routine part of daily life and healthcare delivery.

8.1 Exercise is Medicine (EIM) Models

One of the most impactful efforts to institutionalise exercise within clinical care is the Exercise is Medicine (EIM) Global Initiative. Spearheaded by the American College of Sports Medicine, EIM encourages healthcare providers to assess physical activity levels as a vital sign, like blood pressure or heart rate [30]. Clinicians are encouraged to "prescribe" exercise and refer patients to local, community-based programs that support healthy movement habits. Programs like EIM Greenville (EIMG) and EIM on Campus (EIM-OC) provide real-world examples of how clinical care can be successfully connected to accessible, community-led physical activity opportunities, especially in underserved or rural areas where barriers to exercise are often higher [14,44]. These models show measurable success in reducing sedentary behaviour and improving health outcomes.

8.2 Multidisciplinary and Educational Approaches

To fully embed physical activity into our health system, we must also address the training of healthcare professionals. Many physicians and nurses still receive little to no formal education on prescribing or advising on exercise. Experts who advocate for medical education reform have acknowledged this gap, recommending that structured, competency-based training be included in exercise prescription [2]. Beyond clinical settings, the challenge of promoting physical activity extends into the design of our communities and the systems that support public well-being. Urban planners, behavioural scientists, educators, and policy advocates must collaborate to build a movement-friendly society [4]. This includes designing walkable neighbourhoods, supporting active transportation, and integrating physical activity into school and workplace settings.

9. Conclusion

In today's world, where chronic diseases, mental health issues, and sedentary lifestyles are on the rise, exercise can no longer be seen as just a recreational activity. It must be understood and treated as essential medicine, a powerful, cost-effective tool for preventing and managing various health conditions. From reducing the risk of heart disease and obesity to improving mental well-being and cognitive function, the benefits of regular physical activity are well established and far-reaching. However, promoting exercise as medicine requires more than encouraging individuals to be active. It calls for a comprehensive, multilevel approach that addresses the many factors influencing behaviour and access. At the individual level, we must nurture motivation, self-efficacy, and health literacy so that people understand what to do and why it matters. On a psychological level, building resilience and reducing perceived barriers can help individuals stay consistent with their exercise routines, especially during stress or illness.

Beyond the individual, our environments must support movement, not restrict it. This means creating inclusive, walkable communities with accessible green spaces, safe infrastructure, and equitable access to quality exercise facilities. Urban design should enable all people, regardless of

age, ability, or income, to move freely and confidently in their daily lives. Perhaps most importantly, governments and health systems must treat physical activity as a public health priority. This involves crafting supportive policies, increasing investment, integrating physical activity into medical practice, and building cross-sector partnerships that unite healthcare providers, educators, planners, and communities under a shared mission.

In short, exercise should not be a luxury or a personal choice; it must become a standard part of everyday life and healthcare. By embracing this paradigm shift and collaborating across all levels of society, we can ensure that physical activity becomes a foundational pillar of a healthier future for everyone.

10. Recommendations

i. Enhance Health Literacy – Develop interventions targeting underserved populations to build PA-related knowledge and behaviour [13].
ii. Foster Intrinsic Motivation – Use autonomy-supportive, enjoyment-focused programs to reinforce long-term adherence [27].
iii. Promote Social Settings – Facilitate peer-based, inclusive activities for community support [19].
iv. Improve urban accessibility—Invest in walkable infrastructure that serves all demographics [28].
v. Scale Clinical PA Integration – Institutionalise EIM across health systems and train future clinicians [30].
vi. Reform Policy Incentives – Use implementation science to craft sustainable, evidence-driven health promotion frameworks [33].

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