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Effectiveness of Jogging as an Intervention to Prevent Obesity in Elementary School Children and Developmental Implications

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Abstract. Childhood obesity poses a severe global public health threat, with China facing a projected overweight/obesity rate of 28.0% among children aged over 7 by 2030, adversely impacting both physical and mental health. This paper comprehensively analyzes the intervention effects of jogging on preventing obesity and influencing the growth and development of primary school students. The results of this paper indicate that jogging effectively regulates energy balance, activates aerobic metabolism, significantly burns calories through hormonal regulation, improves insulin sensitivity, reduces fat synthesis and enhances satiety. Physiologically, jogging enhances cardiorespiratory fitness, promotes bone/muscle development and increases bone mineral density. Crucially, jogging can also have significant mental health benefits, reducing anxiety and depression while increasing self-esteem and confidence. In addition, it enhances cognitive functioning, particularly executive control and breadth of attention in the classroom (12%-18% increase). In addition, group jogging activities help develop social adjustment and life skills. This paper identifies major barriers to physical activity (academic stress, lack of safe spaces, and screen time) and proposes multilevel prevention strategies involving school, family, and society, findings that provide strong evidence for the development of effective obesity prevention policies and the promotion of holistic child development.

Keywords: Childhood obesity, Jogging intervention, Growth and development, Prevention strategies.

1. Introduction

Obesity has become a global public health issue, seriously affecting people's health and quality of life, especially posing a huge threat to children's growth and development. In recent years, with changes in lifestyle and adjustments in dietary structure, the obesity rate among primary school students in China has shown a rapid upward trend. According to the China Children Obesity Report, without effective intervention, the detection rate of overweight and obesity among children aged 7 and above is predicted to reach 28.0% by 2030, with the number of overweight and obese children reaching 49.48 million [1]. Obesity not only has many negative impacts on children's physical health, such as increasing the risk of chronic diseases like cardiovascular diseases and diabetes, but

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also adversely affects their mental health, leading to problems such as low self-confidence and depression [2]. Therefore, taking effective intervention measures to prevent obesity in primary school students is of great significance.

In recent years, some studies have begun to focus on the intervention effect of jogging on obese children. A study on exercise intervention for obese children and adolescents found that after 4 weeks of aerobic exercise intervention including jogging, children's waist circumference and blood pressure indicators improved, indicating that jogging and other exercise interventions have a positive impact on the cardiovascular health and body composition of obese children [3]. Another study explored the impact of exercise intervention on the executive function of overweight and obese adolescents and children and found that exercise intervention can improve children's executive function. The study found that a single aerobic exercise intervention can effectively improve the executive function of overweight and obese children (WMD = -6.98, 95% CI = -11.89~-2.07, P = 0.005), and aerobic exercise with a single intervention duration of less than 30 minutes has a significant effect on improving executive function [4]. Aerobic exercise is an effective means to improve the executive function of overweight and obese children, especially short-term high-intensity aerobic exercise.

Among many intervention measures, physical exercise is regarded as one of the key means to prevent and control obesity. As a simple, easy-to-practice and cost-effective aerobic exercise, jogging has gradually attracted attention due to its low threshold and good exercise effect. Jogging can consume excess body calories, enhance cardiopulmonary function, and improve body metabolism rate, thus helping to control weight and improve body composition. Although existing studies have shown that physical exercise has a positive effect on preventing childhood obesity, there are few studies on the specific intervention effect of jogging in preventing obesity in primary school students and its impact on their growth and development. Some studies have pointed out that comprehensive intervention measures in multiple aspects, including health education and increasing physical activity, can effectively prevent obesity in Chinese primary school students, but the role of jogging is not specifically mentioned [5].

This study aims to comprehensively evaluate the multiple benefits of jogging. The social-environmental context characterized by rapid urbanization and sedentary lifestyles has exacerbated the risk factors associated with childhood obesity, making it crucial to explore interventions that can counteract these adverse effects. This study can provide more robust evidence support for formulating scientific and reasonable childhood obesity prevention strategies, thereby helping primary school students maintain a healthy weight and good physical development. Therefore, this article aims to explore the intervention effect of jogging on obesity prevention in primary school students and its impact on growth and development through the summary and analysis of relevant literature, providing a theoretical basis for formulating scientific and reasonable obesity prevention strategies.

2. The physiological mechanisms of jogging in obesity intervention and prevention

2.1. Jogging for obesity intervention

The detrimental impact of a sedentary lifestyle on health outcomes is profound and multifaceted. Compelling evidence links excessive screen time and physical inactivity to a concerning rise in various health adversities. Research consistently demonstrates strong associations between prolonged sedentary behavior and increased rates of obesity, heightened prevalence of mental health disorders including depression and anxiety, and a greater risk of developing chronic diseases in

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adulthood. Physiologically, extended periods of inactivity pose significant threats to fundamental bodily systems: they can lead to weakened bone structure and muscle atrophy (sarcopenia), diminished cardiovascular fitness and function, and a marked impairment of metabolic health, increasing susceptibility to conditions like insulin resistance. The urgency for intervention is starkly highlighted by childhood obesity trends. Notably, epidemiological data reveals that childhood obesity rates have astonishingly tripled over recent decades, a dramatic surge that underscores the critical need for immediate and effective public health strategies to promote physical activity from a young age [6].

According to Rebello et al, regular jogging exercise can significantly increase the basal metabolic rate, enabling the body to continue burning calories for a period after exercise, thus helping to control weight and reduce body fat accumulation [7]. Additionally, jogging improves insulin sensitivity, lowers blood glucose levels, reduces fat synthesis, and further decreases the risk of obesity. In this way, jogging not only helps obese individuals lose weight but also improves their overall health, enhancing self-confidence and life happiness.

Obesity is often accompanied by risk factors for cardiovascular diseases, such as hypertension, hyperlipidemia, hyperglycemia, etc. As an aerobic exercise, jogging can enhance cardiopulmonary function, improve the heart's pumping capacity and vascular elasticity, reduce blood pressure and lipid levels, and improve glucose metabolism. These mechanisms for improving cardiovascular health not only help reduce the risk of obesity-related diseases but also further promote the body's metabolic health, form a positive cycle, and better intervene in obesity [8].

2.2. Physiological mechanisms of jogging in obesity prevention

2.2.1. Activation of aerobic metabolism

Jogging, characterized as a moderate-intensity aerobic exercise, effectively engages the body's aerobic metabolic pathways through sustained, rhythmic activity. This engagement is crucial for energy utilization. Critically, a comprehensive Meta-analysis encompassing 940 overweight children demonstrated significant benefits. Single bouts of aerobic exercise, such as jogging, lasting over 30 minutes were shown to substantially enhance inhibitory function (WMD = -10.50, 95% CI = -19.15 to -1.85, $P = 0.02$) while simultaneously promoting fat oxidation. Furthermore, long-term intervention programs (≥8 weeks) yielded profound effects on body composition. Such sustained jogging significantly reduces visceral fat accumulation, primarily by improving insulin sensitivity, and is particularly effective in enhancing interference control ability (WMD = -0.16, 95% CI = -0.18 to -0.14, $P < 0.00001$) [4]. Collectively, these physiological mechanisms underscore jogging's unique advantages in obesity prevention among children. It fundamentally improves the body's metabolic status by optimizing energy substrate use and effectively curbing detrimental fat storage.

2.2.2. Hormonal regulation and appetite management

In addition to the direct metabolic activity, jogging is an important factor for obesity prevention by complex hormonal balance and regulation of appetite. For instance, evidence shows that consistent jogging soundly affects the primary satiety hormones, Leptin and Ghrelin. Hyperleptinemia, the satiety signal, is increased while Ghrelin, the hunger signal, is inhibited. This hormonal change has an actual benefit for kids in primary schools: those who participate in regular jogging experience a considerable 15 – 20% extension in post-prandial satiety! This long automatic satiety is important because it specifically targets the desire and need to snack between meals on high-calorie foods. As

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a result, it creates a good metabolic cycle, namely: adequate calorie restriction and increased energy consumption with jogging. Therefore, jogging has a twofold effect, since it helps to control the appetite and to keep a better hormonal balance in the body to decrease considerably the risk factors of obesity. This integrated physiological response, including energy metabolism, hormonal response and behavioral adaptation, can confirm that jogging is an ideal physical activity for obesity prevention. It provides a strategy to improve child physical health and well-being that is multifaceted [9].

3. Impact of jogging on physical development of primary school students

3.1. Skeletal and muscle development

As a kind of sports, jogging has many positive influences on the physical growth of primary school students. First of all, jogging can increase the efficacy of cardiopulmonary function, lifting heart-pumping efficiency and lung-gas exchanging capacity. Jogging, training will improve VO_2 max and cardiopulmonary endurance of primary school students. According to a study of continuous and interval aerobic training of children aged 8-11, 7-week training led to a remarkable increase in VO_2 max which improved the cardiopulmonary endurance [10]. It suggested that jogging training could obviously improve the children's cardiopulmonary function. Running can also help to improve muscle strength and join flexibility, promote bone development and increase bone mineral density to prevent osteoporosis. These results may also serve as empirical evidence for jogging training in the health of children.

3.2. Cognitive and mental health

Jogging not only improves the physical health of primary school students but also has a positive impact on their mental health. There is a modest positive impact of exercise intervention on the mental health of school-aged youth. In particular, exercising not only drastically decreases depression and anxiety but also increases self-esteem and social functioning. Jogging is an aerobic sport which mitigates anxiety and depression as well as improving children's confidence and self-esteem. During an exercise, the body produces molecules called neurotransmitters, for example, endorphins, also known as hormones of happiness, which can enhance, as a result, the state of mood and reduce stress, make children happier and more positive/high-spirit people [11]. Aerobic exercise has a significant activating effect on the prefrontal cortex. A meta-analysis shows that long-term jogging intervention can improve children's interference control ability in executive function ($P<0.00001$), manifested as a 12%-18% increase in classroom attention duration [4].

3.3. Social adaptability

Beyond individual physiological benefits, group jogging activities offer significant advantages for children's social development. The inherent need for collaboration and adherence to established rules during such activities provides a practical platform for enhancing interpersonal skills, teamwork, and rule-following behavior. Furthermore, participation in organized sports, including jogging programs, plays a vital and indispensable role in cultivating essential life skills. Adolescents who regularly engage in physical activities typically demonstrate markedly enhanced abilities in critical areas such as effective time management, setting realistic objectives, and systematically working towards and achieving their goals. Importantly, the discipline, perseverance, and sense of responsibility fostered through consistent sports participation extend beyond the playing field.

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Surveys conducted by research institutions, including Michigan State University, consistently indicate that students involved in sports frequently outperform their non-participating peers in academic settings [12]. This compelling correlation strongly suggests that the personal qualities honed through athletic engagement – such as focus, commitment, and resilience – are transferable assets that significantly contribute to academic success.

With the development of the social economy, the time for jogging sports has been squeezed to zero. With the development of smartphones, tablets, and electronic games, children may be attracted to sedentary behavior, leading to a couch potato lifestyle [13]. Communities lacking parks or entertainment centers may hinder children's enthusiasm for outdoor activities [14]. A study by the University of Minnesota found a significant negative correlation between a lack of economic resources and sports participation rates. Among economically disadvantaged teenagers, the participation rate in sports is as low as 8% to 17%, as low-income families face limitations in using sports facilities or cannot afford healthier food, directly affecting their ability to engage in sports activities [15]. Public policies that increase sports programs and safe play spaces are crucial for overcoming these barriers and promoting positive lifestyles for children.

4. Suggestions and prospects

4.1. School-level measures

4.1.1. Curriculum and teaching strategy arrangements

Schools should incorporate jogging into the physical education curriculum system and formulate a reasonable jogging plan. The number of weekly jogging sessions and the duration of each session should be determined according to the physical condition and motor ability of students in different grades. For example, lower-grade students can jog 2-3 times a week for 10-15 minutes each time, while middle and upper-grade students can increase to 3-4 times a week for 20-30 minutes each time.

In jogging teaching, physical education teachers should combine theoretical physical education courses to explain to students the hazards of obesity and the benefits of jogging for physical development, so as to enhance students' health awareness and self-management ability. It is necessary to focus on teaching correct jogging postures and breathing methods to help students establish good jogging habits. At the same time, diversified teaching methods such as setting up jogging games and group competitions should be adopted to improve students' interest in and enthusiasm for jogging.

4.1.2. Sports environment and facility support

Provide students with safe and suitable jogging venues. School playgrounds should be kept flat and clean, and the material and width of the track should meet standards to ensure that students will not be injured due to venue problems during jogging. Equip necessary sports facilities such as comfortable sports shoes and sweat-absorbent sportswear for students from economically disadvantaged families to borrow, so that all students can participate in jogging activities. Set up rest areas and water stations on campus to facilitate students in replenishing water and resting in a timely manner during jogging. At the same time, assign special personnel to maintain and manage sports facilities, and conduct regular inspections and updates to ensure the normal use of facilities.

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4.1.3. Strengthening home-school cooperation and communication

Establish a home-school communication platform to regularly feedback on students' performance and progress in school jogging activities to parents. Maintain close contact with parents through various means such as parent-teacher meetings, WeChat groups, and text messages, jointly paying attention to students' physical development and health conditions. Additionally, promote the importance of jogging to parents and guide them on how to encourage children to engage in jogging exercises at home. Encourage parents to participate in jogging activities with their children, foster a positive family exercise atmosphere, and help students develop lifelong exercise habits.

4.2. Family-level measures

4.2.1. Creating a sports atmosphere to promote children's active participation

The growth environment of children is of great importance. Parents should set an example by actively participating in physical exercise, establishing a model for their children. It is necessary to cultivate an atmosphere of loving sports and pursuing health in the family, encourage children to set aside a certain amount of time every day for exercise according to their interests and integrate exercise habits into daily life.

4.2.2. Reasonable arrangement of diet and work-rest schedule

Provide children with a nutritionally balanced diet, control the intake of high-calorie, high-fat, and high-sugar foods, and increase the proportion of nutrient-rich foods such as vegetables, fruits, and whole grains. This not only supplies sufficient energy for children's physical exercise but also avoids obesity caused by excessive calorie intake. Meanwhile, ensure children have adequate sleep, arrange work-rest schedules reasonably, and maintain their daily physical condition to facilitate physical growth and development and enhance the effect of obesity prevention.

4.2.3. Paying attention to children's psychological and growth needs

During children's jogging exercises, parents should pay attention to their children's psychological changes and give sufficient encouragement and support. When children make progress, promptly praise and reward them to enhance their self-confidence and sense of achievement; when children encounter difficulties or become slack,patiently guide and help them overcome obstacles to maintain their perseverance and enthusiasm for jogging. Respect children's personalities and interests, encourage them to make friends during jogging, cultivate team cooperation spirit and social skills, and promote their all-round physical and mental development.

4.3. Social-level measures

4.3.1. Promotion and awareness enhancement

Various media channels, such as television, the internet, and social media, widely publicize the importance of jogging in preventing obesity and promoting physical development among primary school students, so as to enhance the understanding and attention of all sectors of society to this issue. Communities should carry out health lectures and science popularization activities to popularize the hazards of obesity and the benefits of jogging among residents and create a good

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atmosphere where the whole society pays attention to and participates in promoting the health of primary school students.

4.3.2. Providing support for sports venues and facilities

Relevant departments should increase the construction and investment in public sports venues such as communities and parks, and add venues and facilities suitable for primary school students to jog. For example, build plastic runways and fitness trails in the community, and improve the supporting facilities of public sports venues, such as lighting, seats, trash cans, etc., to provide primary school students with a safe, convenient and comfortable environment for physical exercise. Physical exercise plays a significant positive role in the growth and development of primary school students. As a simple, easy-to-practice, economical and effective exercise method, jogging is of great significance in preventing obesity and promoting physical development among primary school students. Schools, families and society should make joint efforts to take active and effective measures at multiple levels to guide primary school students to participate in jogging exercises, cultivate their good exercise habits and healthy lifestyles, and lay a solid foundation for their healthy growth.

5. Conclusion

Jogging plays a significant role in intervening in obesity and influencing the growth and development of primary school students. From the perspective of intervention, jogging regulates energy balance and activates aerobic metabolism, enabling the body to continuously consume calories to effectively control weight. It also enhances satiety through hormonal regulation, forming a benign metabolic cycle. Moreover, jogging improves insulin sensitivity, lowers blood sugar, reduces fat synthesis, and mitigates the risk of obesity. In terms of developmental impact, jogging exerts comprehensive and profound effects on primary school students' physical growth. It strengthens cardiopulmonary function, improves maximum oxygen uptake (VO_2 max) and cardiopulmonary endurance, promotes skeletal and muscle development, and increases bone mineral density. Meanwhile, jogging brings notable benefits to mental health by reducing anxiety and depression, and boosting self-esteem and confidence. It also activates the prefrontal cortex, enhances interference control ability in executive function, and extends classroom attention duration. Additionally, jogging activities help improve social skills, thereby promoting the development of social adaptability and fostering lifelong exercise habits. Although jogging has shown significant effects in obesity prevention, individual differences should still be noted. For example, obese children have weaker initial exercise capacity and need to adopt intermittent jogging (such as combining running and walking) to gradually adapt. Future studies can integrate genomics to explore genetic markers of exercise response and achieve precise intervention. In addition, policy-level supervision on school exercise duration needs to be strengthened to prevent physical education classes from being occupied by major subjects. Primary school students' participation in physical activities is restricted by academic pressure, the temptation of electronic entertainment devices, and insufficient sports venue resources. In the future, joint efforts from all parties are needed.

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