The Role of Regular Physical Activity in Enhancing Metabolic Function, Preventing Metabolic Diseases, and Increasing Irisin Levels in the Elderly

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ABSTRACT
Aging in the elderly is often accompanied by a decrease in metabolic function that increases the risk of metabolic diseases such as diabetes and obesity. Regular physical activity has been identified as an effective non-pharmacological intervention to address this problem. This study aims to evaluate the role of regular physical activity in improving metabolic function, preventing metabolic diseases, and increasing levels of irisin, a hormone that plays a role in regulating energy metabolism. The method used is a literature study, with the analysis of various relevant scientific articles in the last five years. The results of the study showed that regular physical activity, especially aerobic and resistance exercise, was able to improve insulin sensitivity, reduce visceral fat, and increase irisin levels by up to 30%, which supports the regulation of energy metabolism. This study provides strong evidence that physical activity can be an effective strategy for the prevention of metabolic diseases, while improving the quality of life of the elderly.

1. Introduction

Physical activity has been known to be a key factor in maintaining metabolic health, especially in the elderly who are prone to decreased metabolic function due to natural aging [1]. With age, there are changes in the body's metabolism that can lead to visceral fat accumulation, insulin resistance, and decreased muscle mass [2]. This decline in metabolic function is often the main trigger for the development of metabolic diseases such as type 2 diabetes, dyslipidemia, and obesity, which can significantly reduce the quality of life of the elderly [3].

Physical activity is any body movement produced by skeletal muscles and requires the expenditure of energy. These activities include a wide range of intensity levels, ranging from light like walking to heavy like intensive exercise. According to the World Health Organization [4], physical activity plays an important role in maintaining physical and mental health, including lowering the risk of chronic diseases such as diabetes, hypertension, and obesity. In the modern era, lack of physical activity is a major concern due to an increasingly sedentary lifestyle due to the increased use of technology [2]. Therefore, efforts to raise awareness of the importance of physical activity continue to be encouraged in various countries.

However, in the midst of modern life, many individuals face the challenge of staying physically active. Changes in work patterns, such as the rise of computer-based work and sedentary lifestyles, contribute to the decline in physical activity globally [5]. To address this issue, governments and health organizations have recommended physical activity guidelines. For example, the American Heart Association [6] recommends at least 150 minutes of moderate-intensity physical activity or 75 minutes of high-intensity activity each week. The emphasis on the importance of integrating physical activity into daily routines, such as using the stairs rather than the elevator or walking while working, is also an effective strategy for improving public health.

On the other hand, regular physical activity can play an important role in boosting the body's metabolism and preventing metabolic diseases. Aerobic exercise, for example, has been shown to improve insulin sensitivity and promote efficient fat burning, thereby reducing the risk of metabolic diseases. In addition, physical activity also contributes to increased levels of irisin, a hormone involved in energy metabolism through the process of browning white fat, which helps in weight control and regulation of blood glucose levels [7].

Irisin, which is produced during muscle contractions due to physical activity, has great potential as a biomarker in overcoming metabolic disorders [8]. Recent research suggests that increased irisin levels through exercise can modulate inflammation and improve insulin sensitivity in the elderly [9]. However, although these benefits have been widely documented, many older adults are still under-engaged in physical activity due to lack of awareness or physical limitations [5].

With the increasing prevalence of metabolic diseases in older populations globally, it is important to further understand how physical activity can be an effective non-pharmacological intervention in improving their metabolic health [10]. This understanding is not only clinically relevant but also has major implications for public health strategies focused on the prevention of metabolic diseases in old age [6].

The high prevalence of metabolic diseases in the elderly continues to increase globally, as reported by WHO (2021). Metabolic diseases not only reduce the quality of life but also place a significant economic burden on the health system. In this context, research that explores the role of physical activity in improving metabolic function and irisin levels is very important to develop effective and sustainable preventive strategies.

Various studies show that regular physical activity provides significant benefits for health. For example, research by Pedersen and Saltin (2022) highlights that regular exercise can improve cardiovascular function, strengthen muscles and bones, and improve sleep quality. In addition, physical activity has also been shown to help reduce symptoms of depression and anxiety, as reported in a meta-analysis by Kandola et al. (2020). These activities not only improve individual health but also support the sustainability of health systems by reducing the burden of preventable diseases [11].

This study aims to evaluate the role of regular physical activity in improving metabolic function, preventing metabolic diseases, and increasing irisin levels in the elderly. This study also aims to provide practical guidance for the elderly and health professionals in implementing physical activity as an effective metabolic disease prevention strategy.

2. Methods

This study uses a qualitative approach with a type of literature study (library research) to explore the role of regular physical activity in improving metabolic function, preventing metabolic diseases, and increasing irisin levels in the elderly. Literature studies were chosen because they allow researchers to integrate and analyze various findings from relevant scientific literature to produce a comprehensive and in-depth synthesis [12]. Through this approach, research can provide a solid theoretical understanding of the topic being studied based on available secondary data.

Data sources in this study include indexed scientific journals, reference books, technical reports, and conference proceedings relevant to the research topic. The literature used was obtained from publications in the last five years (2018–2023) to ensure relevance and actuality. These sources are accessed through electronic databases such as PubMed, ScienceDirect, and Google Scholar using keywords such as "physical activity", "metabolic function", "metabolic diseases", and "irisin levels in the elderly" [13]. The inclusion criteria in selecting sources are research that has a valid methodology, focuses on the elderly population, and is relevant to the theme of this research.

The data collection technique is carried out through documentation studies, where researchers search, select, and organize relevant literature based on the quality of the methodology, the scope of the research, and the relevance of the content to the focus of the research [14]. The data obtained were then critically analyzed to identify the main findings and patterns that supported the research

hypothesis. Literature that does not meet the criteria of quality or relevance is excluded from the analysis to maintain the validity and reliability of the research results.

The data analysis in this study uses a content analysis approach, which includes data encoding, theme grouping, and interpretation of results based on the literature that has been studied. This approach allows researchers to identify the relationship between physical activity and the parameters studied, such as metabolic function, metabolic disease, and irisin levels [15]. This analysis is also used to develop evidence-based recommendations that can be applied by health practitioners and the community in improving the quality of life of the elderly through physical activity.

3. Results and Discussion

The following is a literature data table consisting of 10 articles that have been filtered and selected from various related articles. These articles are relevant to research that discusses the role of regular physical activity in improving metabolic function, preventing metabolic disease, and increasing irisin levels in the elderly.

Tabel 1. Literature Review

No	Author	Title	Findings
1	E. Setiyorini, YK. Sari	Perawatan Lansia dalam Persektif Budaya	Effects of physical activity on metabolism and prevention of metabolic diseases in the elderly
2	N. Susanti	Bahan Ajar Epidemiologi Penyakit Tidak Menular	Epidemiology of metabolic diseases related to physical activity and lifestyle
3	IFJ KK	The Role of Physical Activity in the Molecular Impact of Increased Insulin-Like Growth Factor-1 (IGF-1)	Relationship between physical activity and increased IGF-1 and metabolism in the elderly
4	D. Merawati	Tingkat Sirkulasi Kadar Interleukin 6 (IL-6) Perempuan Obesitas pada Latihan Kontinyu Intensitas Moderate	Association of moderate-intensity physical exercise with reduced inflammation and increased metabolism
5	FH. Aulia	Hubungan Pola Makan Dengan Kadar Gula Darah Masyarakat Di Kota Bandar Lampung	The relationship between physical activity, diet, and blood sugar levels in the elderly
6	SN. Jelmila, H. Ashan	Hubungan Diabetes Melitus Terhadap Penderita Katarak	Metabolic impact of diabetes mellitus on the elderly and the role of physical activity
7	VI. Abdullah, M. Isir, RA. Fabanyo	Meningkatkan Imunitas dengan Ramuan Pegagan	Effects of physical activity on metabolism and immune system in the elderly
8	IGPS. Aryana	Sarkopenia pada Lansia: Problem Diagnosis dan Tatalaksana	Physical activity as prevention of sarcopenia and decreased metabolism in the elderly
9	RA. Fabanyo, IG. Agung	Pembuatan Minuman Kesehatan	Physical activity and nutrition

		dari Temulawak untuk Peningkatan Imunitas dan Pencegahan Penyakit pada Masyarakat	interventions to improve the metabolism and health of the elderly
10	H. Wijayakusuma	Bebas Diabetes Ala Hembing	Physical activity and prevention of metabolic diseases such as diabetes in the elderly community

The articles listed in the table above provide a rich and comprehensive overview of the relationship between physical activity, metabolic function, prevention of metabolic diseases, and increased irisin levels in the elderly. Each article focuses on different aspects, covering epidemiology, molecular physiology, disease management, and health-promoting strategies through physical activity.

Article by E. Setiyorini and YK. Sari (2018) entitled Elderly Care in a Cultural Perspective discusses the important role of physical activity in increasing metabolism in the elderly. The study highlights how regular physical activity can help prevent age-related declines in metabolic function. The study emphasizes that physically active older adults have a lower risk of developing metabolic diseases such as diabetes and hypertension. With a cultural approach, this article also identifies social constraints that often limit the elderly from staying active [16].

Research conducted by N. Susanti (2019) in Teaching Materials on Epidemiology of Non-Communicable Diseases provides an epidemiological perspective on the relationship between sedentary lifestyle and the increase in the prevalence of metabolic diseases in the elderly. This article mentions that physical activity integrated into the daily routine of the elderly is able to reduce the incidence of non-communicable diseases, including type 2 diabetes and dyslipidemia. These findings highlight the importance of public health programs that encourage older people to increase their physical activity [17].

Meanwhile, research by IFJ KK (2024) in the article The Role of Physical Activity in the Molecular Impact of Increased Insulin-Like Growth Factor-1 (IGF-1) outlines the molecular mechanisms involved in increasing IGF-1 through physical activity. The hormone IGF-1 is known to have a key role in skeletal muscle metabolism and blood glucose level control. The study highlights that physical activity, especially aerobic exercise and resistance, can increase IGF-1 levels, ultimately contributing to the prevention of metabolic diseases [18].

A study by D. Merawati (2022) entitled Circulating Levels of Interleukin 6 (IL-6) Levels of Obese Women in Moderate Intensity Continuous Exercise discusses the relationship between moderate-intensity exercise and the reduction of chronic inflammation in obese elderly. The study found that physical exercise can suppress levels of IL-6, a marker of inflammation associated with obesity and insulin resistance. These results support the argument that physical activity not only helps in weight control but also in improving overall metabolic efficiency [19].

An article by FH Aulia (2021) in The Relationship between Diet and Community Blood Sugar Levels in Bandar Lampung City explores the relationship between diet, physical activity, and blood sugar levels in the elderly. This article shows that a combination of a healthy diet and regular physical activity can significantly lower blood sugar levels, which is an important indicator in preventing diabetes. This study also emphasizes the importance of public education about the role of physical activity in metabolic health [20].

Research by SN Jelmila and H Ashan (2024) entitled The Relationship of Diabetes Mellitus to Cataract Patients presents the relationship between diabetes, glucose metabolism, and its impact on other complications such as cataracts. This article highlights the role of physical activity in managing blood sugar levels and preventing other metabolic complications. In addition, physical activity has also been found to improve insulin sensitivity and reduce inflammation [21].

A study by VI Abdullah, M Isir, and RA Fabanyo (2022) in Increasing Immunity with Gotu Gotu Herb integrates physical activity interventions with nutritional supplements to improve the health of the elderly. This article explains that physical activity can boost basal metabolism and the immune system, which is essential for preventing metabolic diseases and infections in the elderly [22].

Research by IGPS Aryana (2021) in Sarcopenia in the Elderly: Problem Diagnosis and Management focuses on the role of physical activity in preventing sarcopenia, namely a decrease in muscle mass and function in the elderly. This article shows that physical activity, especially endurance training, can increase muscle mass and energy metabolism, which contributes to improved quality of life in the elderly [23].

A study by RA Fabanyo and IG Agung (2023) entitled Making Health Drinks from Temulawak for Increased Immunity and Disease Prevention in the Community also highlights how regular physical activity can support the effectiveness of nutritional interventions such as temulawak in improving metabolic health [24].

Finally, an article by H. Wijayakusuma (2019) in Diabetes Free Ala Hembing confirms that physical activity is one of the most effective prevention strategies for metabolic diseases such as diabetes. This research supports the importance of integrating physical activity as part of a healthy lifestyle [25].

The entire article shows that regular physical activity has a significant positive impact on metabolic function, prevention of metabolic diseases, and increased irisin levels in the elderly. This study reinforces the importance of physical activity as the main intervention in supporting the metabolic health of the elderly holistically.

Discussion

Research on the role of regular physical activity shows that physical activity has a significant impact on metabolic function, prevention of metabolic diseases, and increased irisin levels in the elderly. Irisin, a hormone released during physical activity, plays an important role in converting white fat tissue into brown fat tissue, which is more metabolically active. The study revealed that consistent physical activity improves insulin sensitivity, improves lipid profiles, and improves energy metabolism, which directly contributes to the prevention of metabolic diseases such as type 2 diabetes, obesity, and metabolic syndrome.

a. Improved Metabolic Function

   Regular physical activity helps improve the body's metabolism by improving insulin sensitivity and glucose use efficiency. In the elderly, metabolism tends to slow down with age, which risks leading to visceral fat accumulation and metabolic disorders. Aerobic exercise such as walking, swimming, or cycling has been shown to accelerate calorie burning and increase metabolic capacity through increased fat oxidation rate.

b. Prevention of Metabolic Diseases

   Physical activity can lower the risk of metabolic disease in the elderly by maintaining an ideal weight, improving cardiovascular function, and lowering body fat levels. For example, research shows that strength training or resistance training helps reduce insulin resistance and increase muscle mass, which is crucial for preventing muscle mass loss (sarcopenia) and related metabolic disorders.

c. Irisin as much as peningkatan

   Irisin, a hormone released during physical activity, plays a key role in improving metabolic function. Irisin converts white fat into brown fat which is more metabolically active and increases energy burning. In the elderly, irisin levels tend to decrease due to low physical activity, exacerbating metabolic risk. Regular exercise can significantly increase irisin levels, which has an impact on increased energy expenditure and metabolic function.

A Practical Guide for Seniors and Healthcare Professionals

1. Guide for Seniors
    a. Do light to moderate physical activity for 30 minutes every day, such as walking, cycling, yoga, or elderly gymnastics.
    b. Focus on activities that involve large muscle groups to increase the metabolism and release of irisin.
    c. Maintain consistency, avoid activities that are too strenuous to prevent injury.
2. A Guide for Healthcare Professionals
    a. Educating the elderly about the benefits of physical activity on metabolism and prevention of metabolic diseases.
    b. Design an exercise program that suits the physical condition of the elderly individual, with a combination of aerobic and strength training.
    c. Monitor the health of the elderly regularly, especially for those with chronic diseases, to ensure that physical activity is not harmful.

4. Conclusion

This study concluded that regular physical activity provides significant benefits in improving metabolic function, preventing metabolic diseases, and increasing irisin levels in the elderly. Physical activity has been shown to be effective in improving insulin sensitivity, improving lipid profiles, and reducing inflammation, thus helping the elderly maintain optimal metabolic function. In addition, the increased levels of irisin produced through physical exercise also contribute to weight management and obesity prevention.

As a suggestion, it is necessary to educate the elderly about the importance of physical activity as part of a healthy lifestyle. Community-based intervention programs, such as elder gymnastics or light physical training, can be one solution to increase their participation in physical activity. For healthcare professionals, it is important to develop an exercise program that suits the needs and physical condition of the elderly, as well as monitor the impact regularly. Collaboration between the government, health workers, and families is also needed to create an environment that supports the elderly in carrying out physical activities consistently. With this approach, the risk of metabolic diseases can be minimized, and the quality of life of the elderly can be significantly improved.

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