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RELATIONSHIP BETWEEN EXERCISE AND ANDROGENIC ALOPECIA

Frida Angelina[1*], Clorinda Chandra[1], Indira Vidiari Juhanna[2], I Putu Adiartha Griadhi[2]
[1] Biomedical Anti Aging Medicine Magister Program, Faculty of Medicine, Universitas Udayana, 80234, Denpasar, Indonesia
[2] Physiology Department, Faculty of Medicine, Universitas Udayana, 80234, Denpasar, Indonesia
Email: angelina.frida@gmail.com

ABSTRACT

Androgenic alopecia, a common etiology for hair thinning, exhibits a heightened prevalence with advancing age, while its incidence is influenced by genetic and non-genetic factors, including exercise, despite limited research in this area. Therefore, this literature review was organized to examine the relationship between androgenic alopecia and exercise in more detail. An article search was conducted in five electronic journal databases (Google Scholar, PubMed, ScienceDirect, MEDLINE, and EMBASE) to find scientific articles on the relationship between exercise and androgenic alopecia published within the last ten years (2013-2023), without language restrictions, with criteria inclusion as follows: 1) respondents with androgenic alopecia; 2) an explanation of the relationship between exercise and androgenic alopecia; and 3) description of the effect of intensity, frequency, and form of exercise on the incidence of androgenic alopecia. In total, there were five studies used in this literature review. The relationship between exercise and androgenic alopecia is complex and inconclusive, with some studies suggesting that exercise can delay hair loss. In contrast, others provide contradictory results, highlighting the need for more research with standardized protocols and diverse populations to establish a conclusive understanding. Thus, this literature review has answered that there is a relationship between exercise and the incidence of androgenic alopecia, which can increase or decrease the progression and symptoms depending on the type, intensity, duration, and frequency of exercise.

Keywords: aging; androgenic alopecia; exercise; progressivity

INTRODUCTION

Humans have an essential body part called hair, particularly hair on the head, which protects the body and adds to its aesthetic appeal. Anagen (growing phase), catagen (transition phase), and telogen (stationary phase) comprise the three phases of the hair growth cycle.[1] Hereditary, hormonal, metabolic, dietary, vascularization, inflammatory, and pharmacological factors are a few of the additional variables that may influence hair growth. Hair problems, such as receding hair, baldness, or overgrowth, may have physical and psychological consequences.[2,3] Alopecia, also known as baldness, can affect the entire head (alopecia totalis) or body (alopecia universalis).[4]

Androgenic alopecia is the most prevalent cause of hair thinning in humans. It is characterized by a significant reduction in hair follicle size and loss of hair shaft or follicular progenitor cells. Androgenic alopecia comprises nonscarring alopecia attributed to androgen hormone stimulation of predisposed hair follicles.[5,6] There are genetic and age-related factors that predispose men to androgenic alopecia. Both men

and women can experience thinning hair between the ages of 12 and 40 due to a polygenic pattern, namely male pattern hair loss in men and female pattern hair loss in women. Men have higher levels of 5α-reductase, accounting for the higher incidence rate in men than women. Five α-reductase levels contribute to converting testosterone to dihydrotestosterone (DHT). It then binds to androgen receptors on hair follicles to produce a hormone-receptor complex and activates genes responsible for the gradual transformation of large terminal follicles into smaller (miniaturized) follicles. This diminution of the hair follicle is a defining feature of androgenic alopecia.[2,7–9]

It is known that the prevalence of androgenic alopecia differs between sexes and ethnicities and that it affects between 0.2% and 2% of the world's population. The incidence and severity of androgenic alopecia increase with age in all racial and sex groups.[10] The prevalence of androgenic alopecia in Turkey is highest among men aged 70 and older (94%), followed by those aged 60 to 69 (92.9%), 50 to 59 (83.3%), 40 to 49 (77.2%), 30 to 39 (71.1%), and 17 to 29 (43.2%). Among women, the prevalence was highest between 60 and 69 (68.1%) and lowest between 17 and 29 (8.7%).[11] A recent observational cohort study in China found that early-onset androgenic alopecia occurs predominantly in males (72.7%), with an age range between 21 and 30 years (70.6%), and that familial androgenic alopecia predominates (72.8%).[12] While research conducted in Indonesia, to be precise at the Faculty of Medicine, Indonesian Muslim University, Ibnu Sina Makassar Hospital, and Menara Muslim Indonesia University, from 24 patients, the prevalence of androgenic alopecia without dandruff was 70.8%, and the prevalence of androgenic alopecia with dandruff was 29.2%.[13]

Exercise has been extensively researched and consistently proven to provide various health benefits across diverse populations. Regular physical activity contributes to weight management, cardiovascular health, and metabolic regulation, among other physiological adaptations. Furthermore, exercise has been associated with improved mental well-being, reduced stress, and improved overall quality of life. In the specific context of alopecia, the effects of exercise are multifaceted. Firstly, exercise promotes healthy blood circulation, potentially facilitating hair growth and follicular health by increasing the delivery of nutrients and oxygen to the hair follicles.[14] Additionally, exercise plays a role in hormonal regulation, including stress-related hormones like cortisol, directly impacting hair growth and preservation. Moreover, exercise-induced release of endorphins can positively influence psychological factors, such as self-esteem and body image, which is particularly relevant for individuals affected by alopecia. Engaging in physical activity also fosters a sense of empowerment and control over one's body, potentially alleviating the emotional distress associated with hair loss.[15–17]

While further research is necessary to fully understand the mechanisms underlying the relationship between exercise and alopecia, current evidence suggests that incorporating regular exercise into one's routine may complement traditional treatments, offering a holistic approach to managing alopecia and improving overall health. Although numerous studies have examined the connection between genetic and non-genetic factors and the occurrence and progression of androgenic alopecia, limited research exists on the association between androgenic alopecia and exercise. Thus, this literature review aims to delve deeper into the correlation between androgenic alopecia and exercise.

METHODS

We searched five electronic journal databases, including Google Scholar, PubMed, ScienceDirect, MEDLINE, and EMBASE, to locate scientific articles on the relationship or influence of exercise on the occurrence of androgenic alopecia. The criteria for scientific articles used as references in this literature review are those published within the last decade (2013-2023). There is no restriction on the language used; articles may be written in Indonesian, English, or even a language from another country if they contain excellent information pertinent to the theme of the literature review. The inclusion criteria were as follows: 1) respondents with androgenic alopecia; 2) an explanation of the relationship between exercise and androgenic alopecia; and 3) a description of the effect of intensity, frequency, and form of exercise on the incidence of androgenic alopecia.

RESULTS

A total of 1747 studies were identified through initial searches based on the specified keywords and their publication within the previous ten years. These studies underwent a rigorous screening process, applying predefined inclusion and exclusion criteria. Consequently, only five articles fulfilled the stipulated criteria and are thus deemed worthy of further evaluation: three cross-sectional studies, one combination cross-sectional and interventional prospective study, and one case-control study, as indicated in Table 1.

Table 1. Summary of the effect of exercise on androgenic alopecia in various studies

Authors	Design Study	Country	Sample	Age	Intervention	Outcome
Jiang et al., 2021	Cross-sectional study	China	592	≥18	1. Type of exercise (aerobic exercise, anaerobic exercises, stretching exercises, lifestyle exercises) 2. Duration of exercise (<30 minutes, 30-60 minutes, >60 minutes) 3. Frequency of exercise (0-2 times per week, 3-4 times per week, 5-7 times per week)	Types of aerobic exercise or other exercises (P<0.001), with a duration of >60 minutes (P=0.044), and a frequency of exercise 5-7 times per week (P=0.033) can help delay the progress of androgenic alopecia and improve symptoms.
Choi et al., 2017	Cross-sectional study	Korea	1182	18 – 94	1. Intensity of exercise (low-intensity, moderate-intensity, high-intensity) 2. Frequency of exercise (0-2 times per week, 3-4 times per week, 5-7 times per week)	The exercise frequency in the androgenic alopecia group with or without a family history of androgenic alopecia was higher than in the normal group in low-intensity exercise (P<0.001 and P=0.018, respectively). The study found that individuals with androgenic alopecia exercised more than those without androgenic alopecia, particularly within the low-intensity exercise group. Additionally, there was a tendency to increase androgenic alopecia patients in the low-intensity exercise group as exercise frequency increased, while no significant association was found between exercise

						and the types or severity of androgenic alopecia.
Kwak and Park, 2021	Case-control	Korea	36	>20	1. The exercise consists of stretching (10 minutes), resistance exercise (30 minutes), aerobic exercise/treadmill (30 minutes), and cool-down with stretching (10 minutes); for 12 weeks, three times a week, and 80 minutes a time. 2. The scalp care program consists of a scaling/mineral pack, manual technic, shampoo, and nutritional supply every 5 minutes; for 12 weeks, once a week for 20 minutes.	Combined exercise and scalp care programs did not significantly affect scalp oil content, water retention, TEWL (trans-epidermal water loss), and scalp surface temperature. However, an interaction effect was observed when it came to hair density and hair thickness. Specifically, the combined exercise and scalp care program positively affected hair density and thickness after completing the 12-week program, indicating its potential for early prevention and improvement of initial hair loss.
Khalil et al., 2022	Cross-sectional study and interventional prospective study	Egypt	300	≤ 20 and > 20	Exercise encompassed leisure time activities, transportation, occupational work, household chores, games, sports, planned exercise, and incorporated daily, family, and community activities, with a recommendation of engaging in activity for at least 10 minutes or around 1000 steps per bout, aiming for a minimum of 30 minutes of daily activity or a total of 10,000 steps per day on most days, while minimizing sedentary or sitting time. This program is combined with a diet program.	The prevalence of polycystic ovary syndrome among the studied group was 10.7%. After six months of the diet and exercise program, improvements were observed in menstrual cycle irregularities, BMI, waist circumference, total cholesterol, and low-density lipoprotein cholesterol levels. However, there was no significant effect on the degree of androgenic alopecia.
Gatherwright et al., 2013	Cross-sectional study	Ohio, United States	92	23 – 84	Increased exercise duration (in hours) but not specifically explained about the type, frequency, duration, or intensity of exercise.	Apart from abstaining from alcohol, consuming more than four alcoholic drinks per week, longer smoking duration, and increased stress duration, one of the contributing factors to a noticeable

	increase in vertex hair loss (P = 0.050) is the extension of exercise duration, measured in hours, but not specifically explained about the type, frequency, duration, or intensity of exercise.

DISCUSSION

Pathophysiology Androgenic Alopecia

Androgenic alopecia in men is characterized by a gradual decrease in terminal hair density and a gradual increase in vellus hair density. Despite the lack of clarity surrounding the mechanism of action, there are presently three accepted mechanisms.[7,18] The first mechanism is caused by the miniaturization of the scalp, which results in hair shortening and thinning. This miniaturization of hair can occur in one or multiple hair cycles and typically occurs during the anagen phase. Due to the shortened anagen phase, the hair is unable to differentiate.[19–21] The expansion of the telogen phase is responsible for the second mechanism. The third mechanism is due to the elongation of the kenogen phase (the phase between the telogen phase and the anagen phase), which causes a delay in the replacement of telogen hair by anagen hair.[7,18,22]

In the pathophysiology of androgenic alopecia, dihydrotestosterone (DHT), produced from testosterone by 5α-reductase types 1 and 2, is believed to play a role. Five α-reductase type 2 is more significant than type 1 in its role in androgenic alopecia. This is because type 2 is more prevalent in hair follicle dermal papillae and other androgen-dependent tissues, such as the prostate gland, and is responsible for two-thirds of circulating DHT. Type 1 is widespread in the epidermis, particularly in the sebaceous glands and hair follicles, and is responsible for one-third of the DHT in circulation.[19,20,23] Both men and women with androgenic alopecia have increased 5α-reductase and DHT activity in their hair follicles. Dihydrotestosterone binds to the androgen receptor and creates a hormone–receptor complex, which then activates genes involved in the gradual miniaturization of the terminal follicle into a vellus hair follicle. There is a decrease in the extent of the hair matrix and a shortening of the anagen phase, resulting in shorter and finer hair follicles.[24–26]

Males had higher levels of 5α-reductase type 1, type 2, and androgen receptors in their frontal hair follicles, according to a study of scalp biopsies from men and women. Moreover, women have higher cytochrome P-450 aromatase levels than males. The aromatase activity of cytochrome P-450 converts testosterone to estradiol. Due to high levels of 5α-reductase and low levels of cytochrome P-450 aromatase, more testosterone is converted to DHT than to estradiol in men, making androgenic alopecia in men more severe than in women. Therefore, the levels of 5α-reductase and DHT determine the characteristics of miniaturization of hair follicles in androgenic alopecia.[21,27,28] In addition to the miniaturization of hair follicles, environmental factors (diet, metabolic syndrome, smoking, and ultraviolet radiation) play a role in the pathogenesis of androgenic alopecia. Inflammation also plays a pathogenic role in androgenic alopecia, where a histological examination reveals inflammation in the upper third of the hair follicle's perifollicle.[29]

Androgenic alopecia in men has a pattern of inheritance that is not entirely understood. Several hypotheses assert that a single autosomal dominant gene, a single pair sex-linked factor, and polygenic inheritance all play a role. The absence of a family history does not entirely rule out the possibility of a diagnosis of androgenic alopecia. Although the presence of androgens and genetic susceptibility plays a significant role in androgenic alopecia in men, the pathophysiology of this condition is still poorly understood.[8,9,30]

Androgenic Alopecia and Aging Process

The introduction presents the most recent data on the epidemiology of androgenic alopecia and its association with advancing age. It is found that the prevalence of androgenic alopecia increases with age and the aging process.[10–12] Because the body's free radicals production increases with age, while endogenous defense mechanisms decline, oxidative stress can occur. This condition results from a mismatch between the systemic manifestations of reactive oxygen species (ROS) and the capacity of biological systems to restore the resulting damage or detoxify reactive intermediates.[31,32] Free radicals or reactive oxygen species (ROS) are highly reactive molecules that can harm lipids, proteins, and DNA. Numerous endogenous and environmental stresses generate free radicals, while the body has endogenous defenses. This imbalance results in progressive cellular injury and phenotypic senescence. Consequently, oxidative stress accompanied by advancing age will impact epidermis aging, including its effect on hair condition. The condition of the hair at issue is the quality of the hair fibers that emerge from the scalp; as this deteriorates, alopecia can develop.[33–35]

Alopecia Androgenic and Hormonal Factor

Developing androgenic alopecia is closely associated with hormonal factors, specifically androgens. Androgens, such as testosterone and its derivative dihydrotestosterone (DHT), significantly regulate hair growth and follicle cycling. In individuals with a genetic predisposition to androgenic alopecia, hair follicles become increasingly sensitive to the effects of DHT. When DHT interacts with susceptible hair follicles, it binds to androgen receptors located within the follicles. This binding triggers a cascade of events that leads to the miniaturization of the hair follicles, resulting in progressively thinner and shorter hair strands over time.[2,36]

The exact mechanism by which DHT affects hair follicles is not fully understood, but it is believed to involve a combination of genetic factors, androgen receptor activity, and interactions with other signaling pathways. DHT may influence the duration of the hair growth cycle, known as the anagen phase, and shorten it. This leads to a decreased duration of active hair growth and an increased resting period, known as the telogen phase. Consequently, affected hair follicles produce progressively smaller and thinner hairs until they eventually stop producing visible hair.[2,7,36] While androgens primarily drive androgenic alopecia, it is important to note that other factors, such as genetics, inflammation, and environmental influences, can also contribute to the condition. However, the precise interplay between these factors and androgens in the pathogenesis of androgenic alopecia is still an area of ongoing research.

Types of Exercise to Prevent Androgenic Alopecia

Physical activity is one way to slow the progression of androgenic alopecia indirectly. Training techniques can reduce stress, alleviate anxiety and depression, and enhance sleep quality.[37] Anxiety, depression, or stress can increase plasma cortisol levels and sebaceous gland secretions, resulting in dandruff and altering the environmental conditions for hair growth, eventually leading to alopecia. Appropriate exercise techniques will increase dopamine levels and alleviate anxiety and depression symptoms.[15–17] Consequently, it is crucial to select the appropriate training method, including the type, duration, and frequency of exercise, by considering the individual's condition comprehensively.

It is believed that the type, duration, and frequency of exercise influence the incidence of androgenic alopecia. Aerobic, anaerobic, stretching, and lifestyle exercises are all sports. Long-term aerobic exercise is believed to increase blood flow for circulation, oxygen saturation, hair growth, and other factors. If blood flow to the hair follicles on the scalp is adequate, the hair follicles will receive more nutrients, resulting in more significant hair growth.[38,39] Stretching exercises such as gymnastics and low-intensity yoga may not be sufficient to treat androgenic alopecia due to the high likelihood that they will not alter hormone levels in the body. However, this form of exercise will not worsen the resulting alopecia. If someone participates in high-intensity sports such as sprinting and weightlifting, their androgen levels will likely exceed what the body requires. Therefore, long-term high-intensity anaerobic sports are not recommended, and low-intensity, short-term/intermittent anaerobic, aerobic, or moderate-intensity stretching sports are preferred.[40–42]

Any exercise that lasts longer than 60 minutes is believed to inhibit the progression of androgenic alopecia. When performed routinely and consistently, the blood testosterone level will peak, then decrease in response to the body's requirements. In addition, an extended duration of exercise will accelerate blood circulation in the scalp, increasing oxygen intake to the scalp. This can ultimately enhance hair loss, local ischemia of hair follicles, and hypoxic conditions and prevent hair follicle atrophy. To prevent and slow the progression of alopecia, patients with normal cardiopulmonary function can be advised to engage in exercise lasting longer than 60 minutes.[40,41,43,44]

In five recent studies investigating the correlation between exercise and androgenic alopecia, a collective understanding emerges suggesting that the effects of exercise on this condition can be both positive and negative, contingent upon the type, intensity, duration, and frequency of physical activity. From these studies, it is evident that the findings are inconsistent and contradictory. Some studies suggest that certain types of exercise, longer duration, and higher frequency are associated with delaying the progress of androgenic alopecia, while others do not find a significant association or provide contradictory results.[40,41,45–47] These contradictions may be due to several factors, including differences in study design, sample sizes, populations studied, measurement methods, and variations in exercise protocols. Other factors such as genetics, hormonal influences, and individual variations could also contribute to the conflicting results. Further research would be necessary to establish a more conclusive understanding of the relationship between exercise and androgenic alopecia, including large-scale, controlled studies with standardized protocols and diverse populations.

Certain sports and exercise activities can inhibit the occurrence of androgenic alopecia through multiple mechanisms. Firstly, exercise promotes improved blood circulation throughout the body, including the scalp, delivering essential nutrients and oxygen to the hair follicles, supporting their growth and overall health. Additionally, exercise reduces stress levels by triggering the release of endorphins, natural mood-lifting chemicals, which is significant as high-stress levels have been associated with hair loss. Individuals can help prevent or reduce hair loss by managing stress through exercise. Moreover, regular exercise contributes to overall health and well-being, indirectly benefiting hair health. Exercise supports a healthy immune system and helps maintain proper hormonal balance, both crucial for healthy hair growth.[20,41] However, it is important to note that the effectiveness of exercise in inhibiting alopecia can vary depending on the underlying cause of hair loss, and other factors such as genetics, hormonal imbalances, and specific medical conditions may also influence hair loss, potentially requiring additional treatments or interventions.

Exercise can potentially induce androgenic alopecia through two mechanisms: androgen release and oxidative stress. In individuals with a genetic predisposition to androgenic alopecia, exercise can increase the release of androgens, such as testosterone, contributing to hair follicle miniaturization and eventual hair loss.[22] Additionally, exercise generates oxidative stress, resulting from an imbalance between harmful free radicals and the body's ability to neutralize them. This oxidative stress can damage hair follicles and contribute to hair loss. Strenuous exercise, in particular, increases the production of reactive oxygen species (ROS) and exacerbates oxidative stress. This increased oxidative stress leads to an elevation in dihydrotestosterone (DHT) entry into dermal papillary cells, facilitated by ROS and their impact on the concentration and activity of 5α-reductase. Consequently, individuals with androgenic alopecia experience hair loss due to the amplified entrance of DHT into dermal papillary cells caused by increased androgen release. However, a study by Kruk et al. suggests that moderate to vigorous exercise may protect against oxidative stress by enhancing the body's endogenous antioxidant defense mechanisms. On the other hand, infrequent exercise with excessive duration or intensity, coupled with a lack of exercise frequency, can induce oxidative stress and contribute to skin carcinogenesis.[48]

Despite the potential benefits of exercise with androgenic alopecia, there are several limitations to consider in the existing research. Firstly, the number of studies exploring the relationship between exercise and androgenic alopecia is limited, indicating a research gap. Additionally, the available studies vary in design, sample size, and methodology, making it difficult to draw definitive conclusions. Moreover, most studies rely on self-reported exercise data, which may introduce recall bias and inaccuracies. Furthermore, the specific characteristics of exercise, such as type, intensity, duration, and frequency, are not consistently defined and standardized across studies, making it challenging to compare and generalize the findings.

Lastly, the existing research predominantly focuses on male participants, limiting the generalizability of the results to females. Overall, while the available evidence suggests a potential relationship between exercise and androgenic alopecia, further well-designed studies are needed to overcome these limitations and provide a more comprehensive understanding of this association.

CONCLUSION

It can be concluded that there is a relationship between exercise and the incidence of androgenic alopecia, which can increase or decrease the progression and symptoms depending on the type, intensity, duration, and frequency of exercise. While research on the relationship between androgenic alopecia and exercise is limited, current evidence suggests that regular exercise can benefit hair growth and overall well-being. Exercise promotes healthy blood circulation, hormonal regulation, and psychological well-being, which may contribute to improved hair health. Several studies in this literature review indicate that specific types, duration, and exercise frequency may help delay the progression of androgenic alopecia and improve symptoms. However, further research is needed to understand the mechanisms better and optimize exercise interventions for managing androgenic alopecia effectively. Incorporating exercise into a holistic approach to treating androgenic alopecia may provide additional benefits to traditional treatments and improve overall health and well-being.

CONFLICT OF INTEREST

The authors declare no conflict of interest.

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