



Received: 28-05-2024
Accepted: 08-07-2024

ISSN: 2583-049X

Effect of Moderate Intensity Interval Training and a High Calorie Diet on Endometrial Thickness in Obesity Cases: A Literature Review

¹ Nita Anggraini, ² Lilik Herawati, ³ Reny P'tishom, ⁴ Endyka Erye Frety

¹ Midwifery Study Program, Faculty of Medicine, Airlangga University, Indonesia

² Department of Physiology, Faculty of Medicine, Airlangga University, Indonesia

³ Department of Medical Biology, Faculty of Medicine, Airlangga University, Indonesia

⁴ Department of Midwifery, Faculty of Medicine, Airlangga University, Indonesia

Corresponding Author: **Nita Anggraini**

Abstract

Background: The number of calories eaten is greater than the energy used, so it can cause an imbalance in the body, which can cause problems such as obesity, which has an impact on the growth of the uterine lining. This literature review focuses on how to prevent an increase in uterine lining thickness by performing moderate-intensity interval training. The aim of this literature review was to assess the effect of MIIT on uterine lining thickness.

Subjects and Methods: The method used is to collect and analyze related research articles.

Results: Articles for 2015–2024 (10 years) discuss

moderate-intensity interval training using Indonesian and English.

Conclusion: Physical activity and obesity can increase FSH, resulting in a decrease in GnRH, which affects the production of LH and FSH, which causes ovarian stimulation to be disrupted and stops the production of estradiol. Estrogen causes cell proliferation and reshapes the endometrium after menstruation. Estrogen influences the basal epithelial layer of the endometrium to divide and proliferate to form the mucosal wall. Endometrial thickness can be reduced by moderate exercise.

Keywords: Moderate-intensity Interval Training, Endometrium, Obesity

Background

Obesity is a risk factor for health (Hales *et al.*, 2020). Obesity is the accumulation of excess fat due to an imbalance between energy intake and energy expended over a long period of time (WHO, 2021). Obesity in women causes disorders of sex hormone metabolism and disorders of the hypothalamus, pituitary, and ovary, which can increase pathological conditions such as ovulation disorders and estrogen hormone disorders, which can trigger breast cancer, endometrial cancer, and polycystic ovary syndrome. (Sidhu *et al.*, 2017). Obesity is closely related to an increased risk of cancer, including endometrial cancer and breast cancer (Onstad, 2016).

The prevalence of obesity almost tripled between 1975 and 2016. (WHO, 2021).

In 2016, the WHO stated that more than 1.9 billion adults aged 18 and over were overweight, and of this number, more than 650 million people were obese. (WHO, 2021). Based on Basic Health Research in 2018, the prevalence of obesity in the Indonesian population aged 18 years and over shows quite high figures, with a higher percentage in women, namely 44.40%, compared to the percentage of men, namely 26.60% (Badan Pusat Statistik, 2018).

Researchers have documented that women who meet criteria for obesity may have a longer follicular phase, a shorter luteal phase, and lower levels of follicle-stimulating hormone, luteinizing hormone, and progesterone compared with women who do not meet criteria for obesity. (Jungheim *et al.*, 2013; Klenov & Jungheim, 2014). Physical activity is useful for controlling body weight, reducing central adiposity, and managing adiposity well (Chin SH *et al.*, 2016). Recent key findings based on a meta-analysis of 117 studies show that physical activity is marginally effective for reducing total body weight, although less effective than a low-calorie diet, but has a greater impact on reducing central adiposity. (Verheggen *et al.*, 2016). Although a healthy lifestyle has always been associated with better health outcomes and can reduce the risk of preventable diseases, researchers suggest that weight loss combined with reduced calories and carbohydrates and increased physical activity can improve the regularity of women's menstrual cycles. (Holtzman & Ackerman, 2021b).

Research (Su *et al.*, 2019) proves that high intensity interval training can be used as a more effective method than continuous moderate intensity exercise to overcome overweight and obesity. High intensity interval training can reduce LDL significantly but this is not the case with continuous interval training. exercise at moderate intensity. Research (Lundgren *et al.*, 2021), stated that there were 195 participants who experienced weight loss after undergoing a low-calorie diet for eight weeks. However, the effect of moderate-intensity interval training as a preventive measure on endometrial thickness in subjects on a high-calorie diet is unknown. Therefore, it is necessary to carry out research aimed at analyzing the effect of moderate intensity interval training on endometrial thickness in female mice fed a high-calorie diet.

Moderate intensity exercise is an effective weight loss method. However, its effect on the endometrium and folliculogenesis is unknown. Therefore, it is necessary to review the literature regarding the effect of moderate intensity exercise on the endometrium and folliculogenesis.

Subjects and Method

The method used is to collect and analyze related research articles. There are several criteria for this literature review, including: 1) Type of participant: Human or animal 2) Type of intervention: Moderate interval intensity training (moderate intensity training) = 3) Type of outcome: Endometrial development. The databases used are Garuda and Google Scholar, with the keywords moderate exercise, endometrial development, and MIIT. All keywords are connected with a boolean "OR" to get as many citations as possible. and using "AND," which is used to increase the relevance and specificity of citations in the hope of finding published research, and using English to search for international journals. The articles reviewed are all articles from 2015–2024 (10 years) that discuss moderate exercise using Indonesian and English.

Results and Discussion

Moderate Exercise

Moderate exercise consists of several types of exercise, such as running and swimming. Running Moderate exercise is an activity that aims to maintain physical health in a planned, structured, and repeated manner. Recent research shows that light exercise can improve physical health but is influenced by several factors, namely intensity, duration, type and frequency (Caspersen *et al.*, 1985). Physical activity is the movement of skeletal muscles that can produce power and energy (Ministry of Health, 2017). (Gibala *et al.*, 2014). One of the characteristics of moderate training intervals is that there are alternating periods between training periods and rest periods (Sugiharto, 2014). Judging from the metabolic equivalent variable, moderate intensity exercise is physical activity that requires 3 to 6 metabolic equivalents, where one metabolic equivalent is equivalent to 3.5 ml of O₂/kg body weight per minute consumed by a person while resting and awake. Exercise is categorized as moderate intensity if VO₂ max reaches 40%-60%. Moderate intensity exercise levels have different effects (Awtry & Balady, 2010; Mandolesi *et al.*, 2018; Yang, 2019).

Endometrium

The endometrium is the deepest layer of epithelium that lines the uterine wall. The endometrium consists of a lamina

propria or stroma containing many blood vessels and a single layer of ciliated columnar epithelium. Morphologically, the endometrial layer consists of two zones, namely the functional layer and the basal layer. The functional layer is the thickest part of the endometrium and will experience necrosis and exfoliation at the end of each menstrual cycle, while the basal layer will remain there during the menstrual phase (Prawirohardjo, 2014). Endometrial tissue will experience proliferation during the menstrual cycle, the endometrium will thicken approximately 1 mm after menstruation to 6 mm during secretion (Peekham, 2014). The average thickness of the endometrium will thicken during the secretion phase of the cycle and will become thinner in the following phase (Tsuda *et al.*, 2017). The surface of the endometrium is lined with simple columnar epithelium lining the thick lamina propria. The lining epithelium extends downward into the connective tissue of the lamina propria and forms long, tubular uterine glands. In the proliferative phase, the uterine glands are usually straight in the superficial part of the endometrium but may show branching in deeper areas near the myometrium. The uterine wall consists of three layers: The inner endometrium, the middle layer of smooth muscle myometrium, and the outer serous membrane of the perimetrium.

The endometrium is further divided into two zones or layers: A narrow deep basal layer adjacent to the myometrium and a functional, broader superficial layer above the basal layer that extends into the lumen of the uterus. During the menstrual cycle, the endometrium exhibits morphological changes that are directly related to ovarian function. Cyclic changes in the non-pregnant uterus are divided into three distinct phases: The proliferative (follicular) phase, the secretory (luteal) phase, and the menstrual phase.

In the proliferative phase of the cycle and under the influence of ovarian estrogen, the thickness of the functional stratum increases, and the uterine glands elongate and follow a straight path to the surface. In addition, coiled (spiral) arteries (in cross section) are mainly visible in deeper areas of the endometrium. The lamina propria at the top of the endometrium is cellular and resembles mesenchymal tissue. The connective tissue in the basal layer is denser and appears darker in this illustration. The endometrium continues to grow during the proliferative phase as a result of increased levels of estrogen secreted by the developing ovarian follicles. The endometrium lies on top of the myometrium which consists of compact bundles of smooth muscle separated by thin strands of interstitial connective tissue with many blood vessels. As a result, muscle groups are visible in transverse, oblique and longitudinal sections. n

The thicker and brighter areas of the endometrium are called the functional stratum. The darker and deeper endometrium is the stratum basalis. The uterine glands during the secretory phase are circular (tortuous) and secrete glycogen-rich nutrients into their lumen. Surrounding the uterine glands is highly cellular connective tissue. Thin and empty spaces in the connective tissue layer are caused by increased edema in the endometrium. Below the stratum basalis is the smooth muscle layer of the myometrium of the uterine wall. If fertilization of the egg and implantation of the embryo does not occur, the uterus enters the menstrual phase, and many preparatory changes for implantation in the endometrium are lost. During the menstrual phase, the

endometrium in the functional layer experiences degeneration and exfoliation. The shed endometrium contains fragments of destroyed stroma, blood clots, and uterine glands. Some intact uterine glands are filled with blood. In the inner layer of the endometrium, the basal layer, the glandular base of the uterus remains intact during the shedding of the functional lining and menstrual flow. The endometrial stroma in most functional layers contains collections of erythrocytes that have been released from torn and damaged blood vessels. Additionally, the endometrial stroma shows infiltration of lymphocytes and neutrophils. The basal layer of the endometrium remains unaffected during this phase. The distal (superficial) portions of the coiled arteries become necrotic, while the deeper portions of these vessels remain intact (Eroschenko, 2017).

Effect of Moderate Intensity Interval Training on the Endometrium

Moderate intensity interval training is a type of moderate exercise that has rest sessions between training cycles. Moderate intensity interval training treatment can result in significant weight loss of 2% in line with the average amount of weight loss observed in most obesity programs. (Reljic, D., *et al*, 2021)^[12]. Therefore, MIIT is effective for weight loss in obese subjects. Weight loss provides positive feedback, namely increasing estrogen levels.

Excessive physical exercise can cause irregular menstruation and impaired fertility in female athletes (Ahrens *et al.*, 2014). GnRH pulsations have an important role in the reproductive system, stress and inadequate nutrition can inhibit the secretion of gonadotropin hormones. Excessive physical exercise in female athletes reduces GnRH, which can affect the production of FSH and LH. Disruption of this hormone can stop the production of estradiol, which results in impaired ovarian stimulation. (Orio *et al.*, 2013). Decreased estrogen levels can affect endometrial proliferation (Fritz and Speroff, 2011).

Conclusion

Moderate intensity interval training has a good impact on weight loss. However, in endometrial proliferation, moderate intensity interval training can reduce endometrial thickness.

References

1. Anwar R. Morfologi dan Fungsi Ovarium. Pustaka Unpad, 2005, 1-16. Available at: http://pustaka.unpad.ac.id/wp-content/uploads/2010/05/morfologi_dan_fungsi_ovarium.pdf.
2. Chang G. *et al*. Exercise Affect Blood Glucose Levels and Tissue Chromium Distribution in High-Fat-Diet-Fed C57BL6 Mice, 2020, 1-2.
3. Fisher G, Brown A, Brown M, Alcom A, Noles C, Winwood L, *et al*. High intensity-interval vs moderate intensity-training for improving cardiometabolic health in overweight or obese males: A Randomized controlled trial. PLoS ONE. 2015; 10(10):1-15. <https://pubmed.ncbi.nlm.nih.gov/26489022>.
4. Gershon E, Dekel N. Newly Identified Regulators of Ovarian Folliculogenesis and Ovulation. International Journal of Molecular Sciences. 2020; 21(12):1-18.
5. Haryanto P, Pangkahila A, Aman IGM, Dan Siswanto FM. Pengaruh Moderate exercise Intensitas Sedang

- terhadap Jumlah Reseptor Insulin di Jaringan Lemak Tikus Jantan Obesitas The Influence of Moderate Intensity Exercise to The Level of Insulin Receptors on Adipose Tissue of Obese Male Rats. 2019; 7(1):23-27.
6. Kiranmayee D, Praveena T, Himabindu Y, Sriharibabu M, Kavya K, Mahalakshmi M. Pengaruh Aktivitas Fisik Sedang pada Penanda Cadangan Ovarium pada Wanita Usia Reproduksi di Bawah dan Di Atas 30 Tahun. Journal of Human Reproductive Sciences. 2017; 10(1):44-48. Available at: <https://pubmed.ncbi.nlm.nih.gov/28479755/>.
7. Lutfi AR. Pengaruh Kombinasi Restriksi Kalori dan Latihan Kontinu Intensitas Sedang terhadap Kadar Free Fatty Acid (FFA) Serum dan Berat Lemak Visceral pada Mencit Betina yang dipapar Diet Tinggi Kalori. Tesis, 2020, 12-31.
8. Oroh P, Herlina W, Engka J. Moderate exercise Pada Pasien Obesitas. Jurnal Biomedik (Jbm). 2021; 13(1):34-43.
9. Pambudi D, Saadi A, Sudjarwo. Analisa Antimullerian Hormon (AMH) Di dalam Serum Pada Berbagai Kategori Indeks Masa Tubuh. Jurnal Surya Medika. 2019; 5(1).
10. Peckham M. Histology at a glance. 1 ed. Jakarta: Erlangga, 2014.
11. Rahayu FK, Dwiningsih SR, Saadi A, Herawati L. Effects of Different Intensities of Exercise on Folliculogenesis in Mice: Which is Better? Clinical and Experimental Reproductive Medicine. 2021; 48(1):43-49.
12. Reljic D, Frenk F, Herrmann HJ, Neurath MF, Zopf Y. Effects of very low volume high intensity versus moderate intensity interval training in obese metabolic syndrome patients: A randomized controlled study. Scientific Reports. 2021; 11(1):1-14.
13. Sarwono P. ILMU KEBIDANAN. Jakarta: PT Bina Pustaka, 2014.
14. Saadat H, Chaya V, Rai L, *et al*. Factor Influencing Endometrial Thickness In Postmenopausal Women. Annals of Medical and Health Sciences Research. 2014; 4(4):608-614. <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4160690>.
15. Seyed Saadat SN, Mohammadghasemi F, Ebrahimi H, Rafati Saje, Chatrnour G. Ovarian and Uterine Alterations Following Forced Swimming: An Immunohistochemical Study. Int J Reprod Biomed. 2016; 14:629-36.
16. Uadia PO, Nwokolo CC, Arainru AE, Agwubike EO, Akpata CB. Effect of physical and flexibility exercise on certain hormones and fasting blood sugar of some young Nigerian adults. Trop J Pharm Res. 2017; 16:245-250.
17. WHO. Obesity, 2019. Available at: https://www.who.int/health-topics/obesity#tab=tab_1.