Published by SET Publisher

Journal of Pharmacy and Nutrition Sciences

ISSN (online): 1927-5951

Muscular Hypertrophic Effects of Oral Contraceptive Consumption in Women

João Augusto Recliski Pinheiro, Luiz Augusto da Silva*, Vinicius Muller Reis Weber, Carlos Ricardo Maneck Malfatti and Marcos Roberto Brasil

Uniguairacá Centro Universitário - R. XV de Novembro - Centro, Guarapuava - PR, Brazil

Article Info:

Keywords:
Contraceptive,
exercise,
hypertrophy.

Timeline:
Received: November 23, 2023
Accepted: December 09, 2023
Published: December 31, 2023

Citation: Pinheiro JAR, da Silva LA, Weber VMR, Malfatti CRM, Brasil MR. Muscular hypertrophic effects of oral contraceptive consumption in women. J Pharm Nutr Sci 2023; 13: 75-81.

DOI: https://doi.org/10.29169/1927-5951.2023.13.08

Abstract:

Hormones have several actions in the body; among their effects on effector organs, they can control the volume of skeletal muscle. The excess of hormones, in this case exogenous ones, could be altering the effects of physical exercise on skeletal muscle hypertrophy, especially after the consumption of contraceptives. Thus, we have a general objective in this work to evaluate the effects of contraceptive consumption on hypertrophy in women. We sought an integrative literature review with studies within 2001-2021, using the PubMed and Scielo databases. Seven articles were selected for a complete and coherent reading for the development of this review. Given the studies analyzed in the present study, it was possible to observe that the effects of oral contraceptives may indeed influence muscle hypertrophy. However, it can assist in preserving soft tissues, avoiding the looseness of the anterior cruciate ligament (ACL). For individuals aiming to enhance lean muscle mass, particularly in high-performance contexts, it is advisable to consider alternative contraceptive methods that do not disrupt the natural hormonal system. In conclusion, the OC user group did not obtain significant gains in lean mass, but their levels of dehydroepiandrosterone (DHEA), sex hormone agglobulinal ligand (SHBG), and insulin-like growth factor (IGF1) decreased, with increasing levels of only cortisol. Thinking of high performance to increase lean muscle mass, another means of contraceptives that do not affect the physiological hormonal system should be used.

*Corresponding Author
E-mail: lasilva7@hotmail.com

1. INTRODUCTION

The female endocrine system, inclusive of the reproductive segment, comprises a complex array of organs including two ovaries, fallopian tubes, a uterus, cervix, and vagina [1]. This intricate system plays a pivotal role in facilitating ovum fertilization and the ensuing process of pregnancy, underscoring the integral part it plays in the anatomical and functional aspects of female reproduction [2].

In order to inhibit this fertilization, there are contraceptive methods that seek to prevent unplanned pregnancies. As contraceptive means, we can highlight oral contraceptives that combine synthetic hormones and the Intrauterine Device (IUD), which consists of a plastic uterine device, in the shape of a T, which has chemical elements that prevent the fertilization of the egg [1].

The IUD is a preferred contraceptive among women in bodybuilding due to its dual role in hormonal regulation and contraception. In fitness environments, particularly in weight rooms, various training methodologies are employed [1]. These include strength training and muscle hypertrophy programs, designed to increase maximal strength and enhance lean muscle mass. This approach underscores the relationship between contraceptive choices and physical training goals, particularly in the context of high-intensity sports like bodybuilding [3].

Progesterone and estrogen, pivotal female hormones, are regulated by Follicle Stimulating Hormone (FSH) and Luteinizing Hormone (LH). Physical exercise is known to augment the secretion of these sex hormones [4]. Oral contraceptives, which typically contain progesterone and estrogen, can impact the hormone aromatization process. This effect is notable in the conversion of testosterone to estrogen via aromatases in women, potentially leading to reduced circulating testosterone levels and affecting muscle hypertrophy [5].

Presently, an estimated 78.5 million women worldwide use oral contraceptives. A significant portion of these women engage in hypertrophy training methods, with the objective of increasing their lean muscle mass. This statistic highlights the relevance of understanding the interplay between oral contraceptive use and physical training, particularly in the context of muscle development [6].

The relationship between oral contraceptive use and body composition extends beyond muscle hypertrophy. Weight gain, overweight, and obesity are potential concerns associated with hormonal contraceptives [7]. Additionally, women engaged in strength and hypertrophy training may experience muscle microlesions due to exercise, and contraceptive use could impact the muscle recovery process [8]. Side effects of contraceptives include weight gain, mood changes, fatigue, libido changes, skin issues, cholesterol level alterations, increased risk of Deep Venous Thrombosis (DVT), hormonal imbalances, and disruption of the hypothalamic-pituitary-gonadal axis, affecting natural hormone levels [8-10].

The proposed study aims to explore the relationship between contraceptive methods and their influence on strength training and muscle hypertrophy in women. It seeks to ascertain whether contraceptives play a beneficial or detrimental role in achieving fitness objectives. A significant focus will be on understanding the side effects caused by synthetic hormones in oral contraceptives. Furthermore, the study intends to analyze in-depth the specific effects of these contraceptives on muscle hypertrophy in women.

2. MATERIALS AND METHODS

The type of study chosen for this research was developed by an integrative literature review that relates to the presumed theme. Therefore, the organization of the literature review is an attachment to the main existing knowledge bases [11].

Articles published in the last 20 years were included in this research. Studies from the PubMed, Science Direct, and Scielo databases were used.

After searching for the articles, the research followed the stage of analysis for inclusion and exclusion of the selected materials. Firstly, the titles were analyzed, followed by the analysis of abstracts to verify which articles met the intention of studying the research. After that, the articles in full that had interconnection between the chosen keywords were analyzed. We used the keywords for the research: Contraceptive AND exercise AND muscle.

The analysis of the collected data was expressed in a discursive manner and illustrated by means of table and figures. The table contains the title, author's name, objectives, and conclusion of each article. A figure of the knowledge design acquired by schemes was

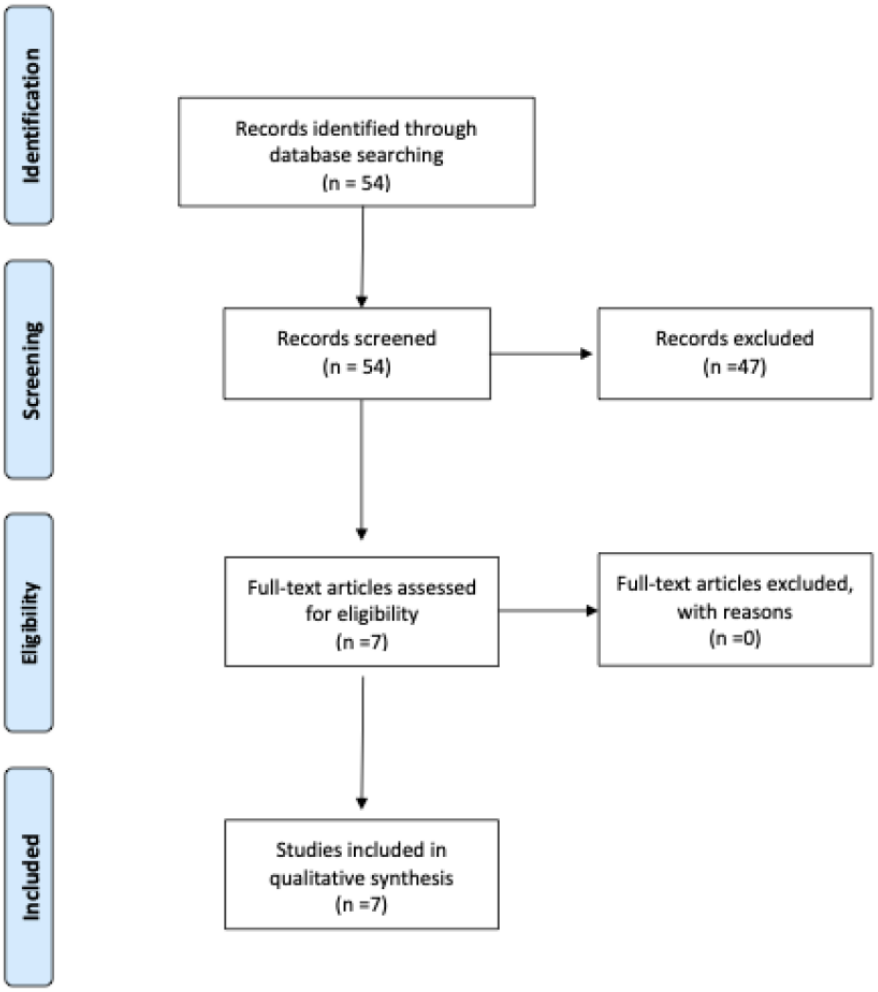

Figure 1: Methodological process of the literature review conducted in the study. It illustrates the steps taken for the selection and analysis of relevant articles, including the initial search, criteria for inclusion and exclusion of studies, and the final selection of articles used for the review.

organized in a summarized way and analyzed according to the theoretical framework.

3. RESULTS AND DISCUSSION

From the searches carried out in the referred databases, 54 articles were found described according to the keywords. According to the digitized titles, 9 articles were separated for reading the corresponding summary.

After reading the abstracts, two articles were discarded because they did not have a main coherence with the theme. Seven articles were selected for a complete and coherent reading for the development of this review.

Table **1** in the article presents a comprehensive list of seven distinct studies that have explored the influence of oral contraceptive consumption on muscle hypertrophy in women. Each study is meticulously analyzed, providing valuable insights into the varying hormonal responses and their subsequent impact on muscle development. The table serves as a critical resource for understanding the nuanced relationship between contraceptive use and physical adaptations in female physiology, especially in the context of athletic performance and muscle training.

The present study sought to analyze the effects of contraceptive consumption on hypertrophy in women. By analyzing the results of the studies compared above, it appears that oral contraceptives cause several hormonal disorders in women who use this medium as a method of contraception. Realizing that OC considered to be exogenous hormones can lower levels of free circulating testosterone and increase levels of the SHBG. This hormone binds with testosterone, then both testosterone for functions that the hormone sexual proposals, that is, the SHBG age

Table 1: Comparative Analysis of Hormonal Changes and Muscle Hypertrophy in Women Using Oral Contraceptives

Authors	Title	Methods	Results
Lee, Newman e Reichma [11]	Oral Contraceptives Blunt Women's Muscle Gain	2 groups of individuals aged 18 to 31 years (OC: n = 34, not OC: n = 39) were submitted to 10-week RET for the whole body (3x / week, 3 sets, 6-10 repetitions, at 75% of the maximum	↓Gain in lean mass (40%) ↓DHEA ng/mL (29%) ↓DHEAS ng/mL (34%) ↓IGF-1 ng/mL (32%) ↑Cortisol ng/mL (37%)
Hicks *et al*. [12]	Oral contraceptive pill use and the susceptibility to markers of exercise-induced muscle damage	9 OC users and 9 non-users. Dynamometry, electromyography, ultrasonography and the architectural properties of the vastus lateralis. Serum estrogen levels, creatine kinase and muscle pain were measured 48 hours before the damage, post-damage and 48, 96 and 168 hours after the damage.	↑Body mass (11%) ↓Serum estrogen (48%).
Dalgaard, Dalgas, Andersen [13]	Influence of Oral Contraceptive Use on Adaptations to Resistance Training	14 OC e 14 NOC. Anthropometric, DXA, $VO_{2máx}$/kg, serum hormones.	↑Serum albumin (g/L) (7,9%) ↓Testosterone (nmol/L) (50%) ↑SHBG (244%)
Martin e Elliotte-Sale [14]	A perspective on current research investigating the effects of hormonal contraceptives on determinants of female athlete performance	The study starts from an analysis of the perspective of other sources of studies on the same theme, highlighting ideas and hypotheses of the current subject.	↓Testosterone (61%) ↓VO2max (7%) ↑Fat mass (1.3% ate 17,3%) ↑Body mass (3% at 4.3%) ↓FSR (15%)
Romance *et al*. [15]	Oral Contraceptive Use does not Negatively Affect Body Composition and Strength Adaptations in Trained Women	Subjects performed an 8-week non-linear resistance-training program. Participants were assigned to either a group that consumed oral contraceptives (n=12, OC) or to a group that did not consume (n=11, NOC). Changes in body composition were measured by dual energy X-ray absorptiometry. Strength performance was assessed via the one maximum repetition (1RM) test in the squat and bench press, and muscular power was evaluated using the countermovement jump (CMJ) test.	↑Body mass (3%) ↑Fat free mass (3,2%)
Onambele *et al*. [16]	Oestrogen status in relation to the early training responses in human thumb adductor muscles	5-s contractions per day for 12 weeks were analysed size, strength, voluntary activation capacity and index of crossbridge force state, in the thumb adductor muscles of postmenopausal and seven premenopausal eumenorrhoeic women. The contralateral untrained muscle was used as a control.	↑Strength (28%) ↑Index of crossbridge force state (19%)
Peters and Burrows [17]	Androgenicity of the progestin in oral contraceptives does not affect maximal leg strength	Twelve participants who were using a monophasic pill containing 30 microg ethinylestradiol plus either 150 microg levonorgestrel (LEV) or 250 microg norgestimate (NOR) for at least the last 6 months were recruited . Three maximal isokinetic extension and flexion tests were performed on three occasions (Days 3-6, 11-14 and 18-21 of the pill cycle) to assess peak extension and peak flexion torque	No significant (p>.05) differences were found in the LEV and NOR groups in peak extension torque (F=0.719; p=.416) or peak flexion torque (F=0.291, p=.601) throughout the pill cycle and between groups.

Abbreviations: users of oral contraceptives (OC); non-users of oral contraceptives (NOC); Resistance exercise (RET); Sex hormone-binding globulin (SHBG); Dehydroepiandrosterone (DHEA); insulin-like growth factor (IGF1); creatine kinase (CK); maximal voluntary isometric knee extension (MVCKE), dual energy radiologic absorptometry (DXA); maximum oxygen consumption (VO2max); metabolic equivalent (MET); anterior cruciate ligament (ACL); myofibrillar protein fractional synthetic rate (FSR).

controlling the sex hormones available in the body. Then maintaining the balance in the processes related to sex hormones.

Muscle hypertrophy is related to the hormonal regulation, and testosterone has the function of muscle growth, being the main androgenic hormone. Testosterone is synthesized from cholesterol, producing about 5 to 10mg/day, and its degradation occurs in the liver. In its circulation, about 97% of testosterone is bound to protein albumin and SHBG, and the other 3% is found in free form, being the biologically active form. In women, testosterone is based on three hormones found in the pituitary (LH and FSH and prolactin); among the hormones, cortisol is the main inhibitor of testosterone, favoring catabolism (degradation) of muscle proteins [18].

When it comes to SHGB, it is not considered just an essential protein for transporting sex steroids. Relating to Ethinylestradiol (EE), depending on its dose interferes with high and low levels of SHBG, for example, oral contraceptives containing androgenic progestin such as levonorgestrel (LNG) induced lower levels of SHBG, while anti-androgen progestin concomitant as cyproterone acetate (CPA) induced the highest levels of SHBG [19,20].

Dalgaard, Dalgas, Andersen *et al*. [13] conducted a study relating the use of oral contraceptives in adaptations of resistance training. Adverse to the studies cited above, he pointed out that users of oral contraceptives showed a more significant increase in muscle mass and a significantly greater increase in the area of type I muscle fibers compared to the control group of non-users of supervised oral contraceptives over 10 years. Participants underwent several weeks of progressive resistance training to enhance their muscle strength and endurance. However, oral contraceptives did not influence the overall increase in muscle strength related to training.

Hicks *et al*. [15] presented a study comparing the use of the oral contraceptive pill and the susceptibility to markers of exercise-induced muscle damage, the results obtained were also contrary to other studies analyzed. Anthropometric measurements, estrogen levels and anatomical cross-sectional area of the vastus lateralis were analyzed. VL and anthropometric measurements, showed no significant differences between users and non-users of the oral contraceptive pill. Already, serum estrogen levels were significantly lower in OC users compared to non-users on the 14th day of the cycle (pill and menstrual). OC users are more susceptible to exercise-induced muscle damage. However, when it comes to creatine kinase (CK), after maximal eccentric contractions of the elbow flexors, there were no significant differences in CK in OC users and non-users. Therefore, differences in exercise protocols, muscle group exercises and different phases of the menstrual cycle and estrogen levels, make it difficult to determine the true role of OC in exercise-induced muscle damage.

Konopka, Hsue e Dragoo [10] proposed a study along the same lines of reasoning, based on the effects of oral contraceptives on the risk of soft tissue injury, soft tissue laxity and muscle strength. Presenting contradictory results based on the analyzed studies, only 10 studies presented high quality evidence relating the effects of oral contraceptives and soft tissues. Thus, it is determined that the use of oral contraceptives decreases the laxity of the anterior cruciate ligament (ACL), reducing the likelihood of its rupture.

Martin e Elliotte-Sale [14] analyzed a perspective in current research that investigates the effects of hormonal contraceptives on the performance determinants of female athletes. In one of the discussions in the study, it was the relationship between oral contraceptives and muscle mass, then linking the ideas mentioned above, where exogenous estrogen and progesterone affect the regulation of muscle anabolism and catabolism, thus directly or indirectly influencing hypertrophic adaptations and changing concentrations of anabolic hormones.

Lee, Newman e Riechman [11] presented a study where the use of oral contraceptives impaired muscle gains in young women, submitting groups of users and

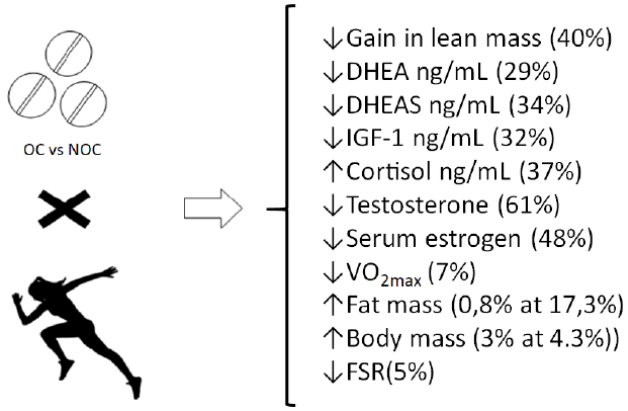

Figure 2: Effects of oral contraceptives on muscle hypertrophy.

non-users of OC in a 10-week training for the whole body exploring muscle strength. Body composition was determined by hydrostatic weighing. Blood samples were collected before/after training and analyzed for DHEA, DHEAS, cortisol and, IGF-1.

Muscle hypertrophy is related to micro-injuries, which are defined as structural micro ruptures of muscle fibers due to muscle contraction resulting from physical training, thus generating a significant increase in the volume of the muscles involved in this process [21,22]. The FITT-VP is the method of training prescription present in the guidelines of ACSM, in which it means frequency, intensity, time and type, volume, and the principles of progression. However, the FITT-VP must be carefully analyzed and may not be applied due to characteristics such as age, health status and physical capacity, not responding as expected due to the variability in the magnitude of certain exercises [23].

Relating between these gender differences, a study proposed men and women with eight weeks of weight training, analyzing the results of their muscle strength after eight weeks. After the 1-RM test pre- and post-training in men and women, they presented contradictory results with what they were expecting. Even though men have greater absolute strength than women in the analyzed exercises, the gains observed over time were greater in women [24].

Relating to all these consequences, the main factors that make it difficult for women to develop increased muscle mass through the actions of contraceptives and all hormonal changes are mainly the increase in the hormone SGBH, the inhibition of estradiol and the alteration of the anabolic cycle [13].

Women have lower testosterone production rates than men and, consequently, lower muscle mass gain. Women who use contraceptives, regardless of which contraceptive and hormone they contain, become a natural factor in preventing significant muscle hypertrophy [14].

When it comes to contraceptives, the hormones present in them, such as estrogen and progesterone considered exogenous, can influence the processes of muscle anabolism and catabolism [17]. The reduction in the levels of total testosterone (T) and free testosterone (FT) is due to the increase in SHBG related to the use of combined oral contraceptives [19].

It is therefore, agreed that testosterone is a potent anabolic hormone whose effect is linked to the increase in lean mass. A study conducted with women using combined oral contraceptives and a control group found significant changes in lean mass gain by non-users of oral contraceptives, with both groups practicing resistance training. Concluding the study authors mentioned that the significant changes in lean mass were linked to the group that did not use this means of contraception, whereas the group that used oral contraceptives suffered the changes due to the levels of androgenicity of the progesterone contained in the contraceptive [12].

4. CONCLUSIONS

In conclusion, this review elucidates the complex interplay between oral contraceptive usage and muscle hypertrophy in women. It highlights the modulatory effects of these contraceptives on key anabolic and catabolic hormones, which may consequentially alter lean muscle mass accretion. Additionally, the protective role of contraceptives in soft tissue integrity and injury prevention is noted. This synthesis underscores the imperative for targeted research to optimize contraceptive choices, balancing reproductive health needs with the physiological demands of women engaged in high-level athletic pursuits or muscle hypertrophy-oriented training regimens.

FUTURE DIRECTIONS

The study presents a direction in which it intends to inform about the issue of contraceptives and its relationship with muscle hypertrophy, whether it really affects the later in any way or not, influence strength training and muscle hypertrophy. Future research needs to aim to elucidate which contraceptive method would be most recommended for women (athletes) thinking about hormonal overload so that it does not directly affect the results of their training. Finally, it provides a basis for new experimental studies or bibliographic reviews to further deepen the knowledge on the suggested topic.

REFERENCES

[1] Mansour D, Inki P, Gemzell-Danielsson K. Efficacy of contraceptive methods: a review of the literature. The European Journal of Contraception & Reproductive Health Care 2010; 15(1): 4-16. https://doi.org/10.3109/13625180903427675

[2] Guyton. Guyton and Hall Textbook of Medical Physiology. Philadelphia, PA: Saunders Elsevier 2011.

[3] Morais R, Medeiros RR, Liberali R. Effectiveness of the supplementation of proteins in the training of force. Revista Brasileira de Nutrição Esportiva 2008; 2(10): 265-277.

[4] Shangold MM. Exercise and the AdultFemale: Hormonal and Endocrine Effects. Exerciseand Sport Sciences Reviews 1984; 12(1): 53-80. https://doi.org/10.1249/00003677-198401000-00005

[5] Carr S, Carmody D. Experiential learning in women's health: medical student reflections. Med Educ 2006; 40(8): 768-74. https://doi.org/10.1111/j.1365-2929.2006.02536.x

[6] Alkema L, Kantorova V, Menozzi C, Biddlecom A. National, regional, and global rates and trends in contraceptive prevalence and unmet need for family planning between 1990 and 2015: a systematic and comprehensive analysis. Lancet 2013; 381(9878): 1642-52. https://doi.org/10.1016/S0140-6736(12)62204-1

[7] Schwartz E, Holtorf K. Hormone replacement therapy in the geriatric patient: current state of the evidence and questions for the future. Estrogen, progesterone, testosterone, and thyroid hormone augmentation in geriatric clinical practice: part 1. Clinics in Geriatric Medicine 2011; 27(4): 541-559. https://doi.org/10.1016/j.cger.2011.07.013

[8] Godbole G, Joshi AR, Vaidya SM. Effect of female sex hormones on cardiorespiratory parameters. Journal of Family Medicine and Primary Care 2016; 5(4): 822. https://doi.org/10.4103/2249-4863.201148

[9] Guillebaud J. Drug interactions with hormonal contraception. The Journal of Family Planning and Reproductive Health Care 2005; 31(4): 335-6. https://doi.org/10.1783/147118905774480644

[10] Konopka JA, Hsue LJ, Dragoo JL. Effect of Oral Contraceptives on Soft Tissue Injury Risk, Soft Tissue Laxity, and Muscle Strength: A Systematic Review of the Literature. Orthop J Sports Med 2019; 7(3): 2325967119831061. https://doi.org/10.1177/2325967119831061

[11] Lee CW, Newman MA, Reichman SE. Oral contraceptive use impairs muscle gains in young women. FASEB Journal 2009; 23(1): 955-25. https://doi.org/10.1096/fasebj.23.1_supplement.955.25

[12] Hicks KM, Onambélé-Pearson G, Winwood K, Morse CI. Oral contraceptive pill use and the susceptibility to markers of exercise-induced muscle damage. Eur J Appl Physiol 2017; 117(7): 1393-1402. https://doi.org/10.1007/s00421-017-3629-6

[13] Dalgaard LB, Dalgas U, Andersen JL, Rossen NB, Møller AB, Stødkilde-Jørgensen H, Jørgensen JO, Kovanen V, Couppé C, Langberg H, Kjær M and Hansen M. Influence of Oral Contraceptive Use on Adaptations to Resistance Training. Front Physiol 2019; 10: 824. https://doi.org/10.3389/fphys.2019.00824

[14] Martin D, Elliott-sale K. A perspective on current research investigating the effects of hormonal contraceptives on determinants of female athlete performance. Revista Brasileira de Educação Física e Esporte 2016; 30(4): 1087-1096. https://doi.org/10.1590/1807-55092016000401087

[15] Romance R, Vargas S, Espinar S, Petro JL, Bonilla DA, Schöenfeld BJ, Kreider RB, Benítez-Porres J. Oral Contraceptive Use does not Negatively Affect Body Composition and Strength Adaptations in Trained Women. Int J Sports Med 2019; 40(13): 842-849. https://doi.org/10.1055/a-0985-4373

[16] Onambele GN, Bruce SA, Woledge RC. Oestrogen status in relation to the early training responses in human thumb adductor muscles. Acta Physiol (Oxf) 2006; 188(1): 41-52. https://doi.org/10.1111/j.1748-1716.2006.01597.x

[17] Peters C, Burrows M. Androgenicity of the progestin in oral contraceptives does not affect maximal leg strength. Contraception 2006; 74(6): 487-91. https://doi.org/10.1016/j.contraception.2006.08.005

[18] Badillo JJ, Ayestarán EG. Fundamentos do Treinamento de Força - Aplicação ao Alto Rendimento Desportivo. Porto Alegre: Artmed 2001.

[19] Zimmerman Y, Eijkemans MJ, Coelingh Bennink HJ, Blankenstein MA, Fauser BC. The effect of combined oral contraception on testosterone levels in healthy women: a systematic review and meta-analysis. Hum Reprod Update 2014; 20(1): 76-105. https://doi.org/10.1093/humupd/dmt038

[20] Bermon S, Garnier PY, Hirschberg AL, Robinson N, Giraud S, Nicoli R, Ritzen M. Serum androgen levels in elite female athletes. The Journal of Clinical Endocrinology Metabolism 2014; 99(11): 4328-4335. https://doi.org/10.1210/jc.2014-1391

[21] Glass DJ. Skeletal muscle hypertrophy and atrophy signaling pathways. Int J Biochem Cell Biol 2005; 37(10): 1974-84. https://doi.org/10.1016/j.biocel.2005.04.018

[22] Goldspink G. Gene expression in muscle in response to exercise. J Muscle Res Cell Motil 2003; 24(2-3): 121-6. https://doi.org/10.1023/A:1026041228041

[23] Ferguson B. ACSM's Guidelines for Exercise Testing and Prescription 9th Ed. 2014. J Can Chiropr Assoc 2014; 58(3): 328.

[24] Dias RMR, Cyrino ES, Salvador EP, Nakamura FY, Pina FLC, Oliveira AR. Impact of an eight-week weight training program on the muscular strength of men and women. Brazilian Journal of Sports Medicine 2005; 11(4): 224-228. https://doi.org/10.1590/S1517-86922005000400004