RELATIONSHIP OF FEMALE BREASTS TO PHYSICAL ACTIVITY, EXERCISE AND SPORT – PART 2

RELAÇÃO DAS MAMAS FEMININAS COM A ATIVIDADE FÍSICA, EXERCÍCIO E ESPORTE – PARTE 2

RELACIÓN DE LAS MAMAS FEMENINAS CON LA ACTIVIDAD FÍSICA, EJERCICIO Y DEPORTE – PARTE 2

Article Review
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Artículo de Revisión

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ABSTRACT

Women are increasingly seeking to be physically active or even choose sports as their professional activity as in the years, the number of Summer Olympic athletes has equaled that of men. Due to this growing female participation in sports, the study of female and male differences has become increasingly relevant in the involvement of the academic world. Several anthropometric and physiological differences have been established; however, the volume and shape of female breasts are peculiar and still little studied. The specificity of female breasts are conditions that can exert sports performance and contribute to distancing women from physical activity practice. Possible conditions of female breasts in sports are exercise-induced mastalgia, breast injury, nipple injury, pregnancy, and many others. A review on this subject, stimulating more research, and making knowledge reach more women is a major objective of this literature review. We understand that more studies are needed to understand pathophysiology, prevention, and treatment. ***Level of Evidence II; Retrospective Narrative Review.***

Keywords: Athletes; Women; Exercise; Breast; Wounds and Injuries.

RESUMO

As mulheres buscam cada vez mais serem fisicamente ativas ou até mesmo escolhem o esporte como sua atividade profissional, visto que nos últimos anos, o número de atletas Olímpicas tem se igualado ao dos homens. Devido essa crescente participação feminina no esporte, o estudo das diferenças entre mulheres e homens tem se tornado cada vez mais relevante no meio acadêmico. Existem diversas diferenças antropométricas e fisiológicas já bem estabelecidas, porém o formato e volume da mama feminina é uma peculiaridade, mas ainda pouco estudada. As especificidades da mama feminina são condições que podem comprometer o rendimento no esporte e até mesmo contribuir para que a mulher se distancie da prática de exercício físico. Podemos citar como possíveis condições das mamas femininas no esporte: Mastalgia induzida pelo exercício físico, lesão das mamas, lesão dos mamilos, problemas das mamas relacionados ao período da gestação e puerpério, mastalgia relacionada ao ciclo menstrual, entre outras. Revisar sobre o assunto, estimulando mais pesquisas sobre o tema e fazendo que o conhecimento alcance mais mulheres é um grande objetivo dessa revisão da literatura. Entendemos que mais estudos são necessários para compreender a fisiopatologia, formas de prevenção e o tratamento dessas complicações. ***Nível de Evidência II; Revisão Narrativa Retrospectiva.***

Descritores: *Atletas; Mulheres; Exercício Físico; Mama; Ferimentos e Lesões.*

RESUMEN

Introducción: Las mujeres buscan cada vez más la actividad física o eligen el deporte como actividad profesional, ya que en los últimos anos el número de atletas olímpicas de verano ha casi igualado al de hombres. Debido a esta creciente participación femenina en el deporte, el estudio de las diferencias entre mujeres y hombres se ha vuelto cada vez más relevante en el ámbito académico. Existen varias diferencias antropométricas y fisiológicas bien establecidas, pero la forma y el volumen de la mama femenina es una peculiaridad, pero aun poco estudiada. Las especificidades de la mama femenina son condiciones que pueden comprometer el rendimiento deportivo y contribuir para que las mujeres se alejen del ejercicio físico. Podemos citar como posibles afecciones de las mamas femeninas en el deporte: mastalgia inducida por el ejercicio, lesión de las mamas, lesión del pezón, periodo de embarazo, entre otras. Revisar el tema, estimular más investigaciones sobre el tema y hacer que el conocimiento llegue a más mujeres es un objetivo principal de esta revisión bibliográfica. Entendemos que se necesitan más estudios para comprender la fisiopatología, prevención y tratamiento. ***Nivel de Evidencia II; Revisión Narrativa Retrospectiva.***

Descriptores: *Atletas; Mujeres; Ejercicio Físico; Mama; Heridas y Lesiones.*

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INTRODUCTION

This is the second part of the article that continues the discussion on the relationship between women's breasts and physical activity, exercise, and sport, as we have identified topics that have not been covered but are no less important. We strongly encourage you to read part one previously published in the magazine, as they are complementary.

PRESENTATION AND DISCUSSION

Due to the complexity and the wider literature available, the authors believe that breast cancer and physical activity, exercise, and sport deserve exclusive attention for all the benefits already known in other publications, and chose not to address this topic. The other topics covered below in the second part of the publication follow the assertion in the first part that public strategies are needed to encourage better levels of physically active women and, therefore, breast problems deserve attention.

Breast injury

Some anatomical structures are exclusive to women, and the injuries inflicted on these structures.[1] Due to their location in the anterior thorax, limited anatomical support, and lack of musculoskeletal protection, women's breasts are vulnerable to direct trauma against the breasts[2,3] during sports, resulting in contusion, abrasion, hematoma or laceration,[4] particularly contact/collision sports. The long-term impact of these injuries, if any, needs to be identified.

The prevalence of breast lesions is generally not reported in lesion questionnaires because this information is rarely asked for in anamnesis questions[5] and reports from older studies described it only as a "minor nuisance", appearing at the bottom of the list of lesions.[6]

Out of 504 elite athletes from 46 different sports, 29% reported having had a breast injury due to contact, whether this was direct contact with another athlete, against equipment, or on the ground. Of these, 21% reported a negative impact on their performance as a result of the injury.[2] As expected, trauma from kicks and elbows[3,4] are some of the direct contact gestures described.

There is still no accepted medical classification for breast injury during sport, which excludes breast injury from being recorded.[2] With a medical classification and incorporating breast injury into the anamnesis of physically active women, more data on the subject will emerge and consequently a specific approach will be targeted.

Athletes, coaches, and medical professionals who work with women should be alert to the possibility of breast injuries, given their potential to negatively impact performance. In one sample, only 10% reported[2] the injury to a health professional, and it may be even less reported in adolescents,[1] showing that female athletes are reluctant to report this injury, particularly to male staff.

Athletes should be encouraged to report these injuries and, when necessary, receive appropriate treatment.[2] As marathon runners' high pain threshold and pain tolerance have already been reported,[7] and are described in articles on injuries in athletes, this educational role takes on even more importance to bring the discussion into everyday life, preventing breast injuries from being an under-reported topic.

Contusion is typically mild and caused by superficial capillary rupture resulting in edema and ecchymosis.[4] Hematoma can occur if, with trauma, a deep vein bleeds[5] and turns into fatty necrosis with hardening of the tissue, scarring, and even calcification over many years, and may require surgical aspiration in some cases.

Breast trauma can also lead to mastitis or a painful breast abscess,[3,4] in some cases requiring drainage.[6] The described management of contusions is to apply ice every 15-20 minutes, usually resolving within 21 days.[3,4] Lacerations can bleed profusely due to the rich blood supply in the area,[6] but most cases are controlled with pressure to stop excessive bleeding, as well as suturing and the use of antibiotics when necessary.[4]

The discontinuity of the skin should require strict cleaning control to avoid secondary infection.[6] An integration of sports physicians, gynecologists, and mastologists can guide the effectiveness of the measures and establish protocols for prevention and management since contact/fighting/collision sports will always present the risk of breast injury.

Another detail concerning breast lesions that could occur is indirect lesions. Sports require a wide variety of gestures, such as jumping, landing, and the impact of the breasts[5] against the chest wall with considerable force.[6]

In horseback riding, the shock to the breasts transmitted by the vertical movement of the horse with the inclination of the body seems to lead to higher levels of breast pain.[8] A possible hypothesis could be that there is a mechanism of indirect, non-contact injury from the shock of the breasts against the rib cage, and within this hypothesis, imagine that this could be related to exercise-induced mastalgia, which is described more by the swaying of the breasts, and the shock to the breasts could also be one of the contributing factors.

Adequate protection[4,5] is a measure that is adopted in the context of breast injury, even if not exclusively. Appropriate padding to prevent trauma to the breasts, such as abrasion, laceration, and bruising that can lead to hematoma formation, may be indicated,[1] with prevention being a form of treatment.[6]

More than 1 in 3 athletes have had a breast injury during competition or training, among all sports, 43% reported not having strategies for breast injury, and only 3% used protection, these being sports that encourage mandatory use such as fencing and boxing, and the strategies described were modifying movement to prevent injury 9%, avoiding gestures that result in injury 6% and placing hands 6%.[2]

The right material can also help prevent complications such as abscesses.[3] The change in gesture as a measure to avoid trauma can have an impact on performance and protective materials may not be viable in certain disciplines.

There is a gap in the literature on breast injuries that requires more data to be collected in order to provide better guidance on this topic and an initial measure of dissemination on the subject for physically active women to report the injury and receive appropriate treatment.

Nipples

The nipples are prominent and a common site of involvement,[1,4] among women who run,[9] particularly long distances,[10] and should be included in the inflammatory dermatoses associated with sport.[11] Although the condition is not exclusive to women, it is important to discuss it below.

Friction, abrasion, and repetitive irritation caused by contact between the nipple and the shirt lead to nipple eczema, nicknamed "runner's nipple",[6,9,11,12] a condition that can be acute or even chronic.[3,4]

Generally, the involvement is bilateral and presents with erythema and edema, depending on its evolution, exudation, and crusting.[12] Painful erosions of the areolas and nipples can fissure and result in bleeding,[1,4,10] and blisters have already been described in association with this condition in one publication.[6]

Some associated factors identified were wet t-shirts, atopy,[12] and running without a bra,[9,10] as well as larger breasts,[2] described as frictional nipple injury in various sports other than running, highlighting the need for better research into prevalence and association so as not to make a possible mistake of associating the condition strictly with running and verifying a real general prevalence in physically active women at various levels of practice and sports.

In a sample of 319 women runners, 9% experienced painful nipples.[13] Another publication with 76 participants, with 39% women, determined a cutoff of 64km or more weekly in which runners' nipples were significantly more frequent, 35.7% of the sample presenting runners' nipples above this cutoff.[11] On race day in different marathons, the prevalence found was between 2-16.3%.[10] 20% of 504 athletes reported frictional injuries from 46 different sports.[2]

One possibility is that the lesion is interpreted as not bothersome enough to seek medical attention or that almost all cases resolve spontaneously, which also explains the few records in the scientific literature. Regardless of the severity, frictional nipple injuries have been reported in the literature and their impact on sports participation should be included in discussions.

The prevention measures described are the use of a protective bandage[2] and adhesive tape, wearing a T-shirt with suitable material, lubricating the nipples with Vaseline[1,12] and a sports bra,[2,4] although there are no studies that have tested the effectiveness of these measures.

Fissures can develop into secondary infections, and good hygiene and the use of antibiotics[3,4,10] should be considered. Topical corticosteroids for short periods are often the suggested initial treatment for skin lesions, but the nipple and areola areas are especially susceptible to the widely known adverse effects of topical corticosteroids.[12]

The first report of the condition recommended talc,[9] but within a short space of time, a publication recommended against its use due to its potential harm.[14] If future trauma is avoided, runners' nipple is self-limiting, but refractory cases can be difficult to manage clinically.[12] The approach and management, probably due to the limited data, can be directed with more data from studies on patients who need medical attention.

A brief highlight is the detection of the need for data related to personal choices such as piercing, the nipple(s) being known to be a place of choice, whether for physically active recreational/amateur women or high-performance athletes, being a starting point for capturing general information on epidemiology in this population, primary and secondary prevention and finally, conducts related mainly to trauma, since there is still no literature on this subject with this direction.

Finally, another condition similar to the runner's nipple has been described, but unlike the friction injury, this one is associated with cold,[15] called the cyclist's nipple. Usually, the cyclist is out in the cold for a while, and the clothing gets wet from perspiration and 6 evaporation, and wind chill lowers nipple temperatures.

As the nipples cool down, they become painful and can last for days with sensitivity to touch and temperature changes, even after cycling has finished. Cycling again in the same conditions can be uncomfortable. Treatment is expectant and thermal stress should be avoided while sensitivity is altered. Prevention consists of "windbreaker" material avoiding cold exposure to the anterior chest.[15]

Just like runners' nipples, it is necessary to identify possible thermal injuries that may occur in other sports, so as not to restrict them to cycling. With the evolution of sports equipment and wider access, it is possible that this condition is even rare today, so understanding the current prevalence would be important, especially in regions with lower temperatures.

Variation in breast volume and composition

Some publications have reported a possible relationship between variations in breast volume and exercise and sport. Elite athletes[16] and marathon runners[17] had smaller breasts compared to the general population.

Training with a very high weekly volume[13] and intensity[4] represents a high-calorie expenditure and can lead to a loss of body fat, where breast fat is a factor. There is a theory that girls who exercise more during and before puberty will have smaller fat deposits at menarche and therefore smaller breasts later in life.[3,5]

This association of variation in breast volume in relation to exercise requires causal studies to understand the levels and magnitudes at which this occurs.

This topic may be particularly important in the scenario of women practicing physical exercise and sport in relation to the condition of low energy availability, described by the International Olympic Committee as Relative Energy Deficiency in Sports[18] and by the American College of Sports Medicine as the Triad of the female athlete.[19]

The hypoestrogenic state can lead to breast atrophy,[20] with the condition of low energy availability being one of the causes of hypoestrogenism. Breast atrophy could therefore be included in the context of diagnostic investigation as a possible sign in a patient's clinical history with this hypothesis, ideally with a long-term longitudinal physical examination, and at the very least included in the anamnesis.

Weight loss alone,[3] already alters breast volume, even without low energy availability. Other conditions that may be linked to physically active women who exercise, such as diets[5] and eating disorders[21] have also described breast atrophy.

The population that uses anabolic steroids is generally physically active and breast reduction may be one of the results of changes in the reproductive system caused by suppression of the hypothalamus-pituitary-gonadal axis, although it has been described as a reversible adverse effect,[22] unlike other adverse effects of anabolic steroid use in women.

In one publication, out of 13 women, 3 had reduced breast size due to the use of anabolic steroids.[23] Although all these points described above only indirectly relate the breasts to physical activity, exercise, and sport, special attention is required to better associate the breasts with these topics in the population of physically active women.

Different volumes at different stages of life, such as adolescence, and pregnancy, among others, and differences in volumes between physically active women and athletes can even help provide insight into mastalgia's etiology.[7]

The nipple and areola area are especially susceptible to the widely known adverse effects of topical corticosteroids and may be a differential diagnosis as a cause of breast atrophy due to subcutaneous absorption in patients who develop nipple runners[12] when treated with this class of medication.

In addition to volume, another discussion is in relation to composition, based on the hypothesis that repeated stretching of the breast support could cause irreversible damage over time and consequently sagging[14] and ptosis of the breasts.[13,24]

One article started from the opposite line of reasoning: upper body exercises could prevent breast ptosis.[25] However, exercise is unlikely to change breast size by altering muscle tissue, as there is only a small amount of muscle in the areolar zone and none in the rest of the breast structure, and even if the appearance of the breasts changes, these are due to changes in the overlying pectoralis.[3,4]

The subdermal structures of the breast with the overlying skin representing relatively loose ligaments next to the pectoralis major muscle was described in an article with the phrase "Breasts are more likely to fall with the skin than rise with the muscles".[25]

It is unlikely that sports participation leads to sagging breasts, but regardless of whether it causes sagging and ptosis of the breasts due to stretching of the ligaments or increases in size with physical training, it is necessary to determine whether this is a factor that can deter women from participating in physical activities,[26] in the possible belief that exercise and sport can have these outcomes.

Further research with causal studies is needed to specify this topic effectively.

Pregnancy

There is a line of research in the scientific literature linking pregnancy and/or breastfeeding with exercise. It is necessary to include the relationship of the breasts in this association as a third item with what is available in the literature. Breast growth occurs during pregnancy[6] and breast congestion contributes to changing the center of gravity,[27] justifying greater alertness and caution in relation to the breasts with exercise. There is also a physiological prominence of the nipples, which may represent a greater risk of injury.[4]

With the numerous reported benefits of physical exercise during pregnancy, which is not only recommended but also safe,[27-29] the breasts in this context deserve future studies to gain a comprehensive understanding of physically active pregnant women, such as breast lesions and mastalgia-induced by physical exercise during pregnancy, but not just limited to these topics.

Many athletes modify their distance running training behavior in order to breastfeed, but in competitive athletes, 84.1% continued running while breastfeeding, with the majority citing no effect of running on their ability to breastfeed.[28]

Breasts weigh approximately 400-500g when breastfeeding,[5] so breastfeeding before exercise to avoid engorged breasts during exercise, by emptying the breasts, can bring greater comfort to exercise if the breasts are not full.[29]

After giving birth, the breasts reach their differential state. This may explain reports of a lower prevalence of mastalgia in breastfeeding women. In a sample of 46% of women who were already mothers, 88% breastfed and mastalgia was significantly related to parity, with more nulliparous women experiencing mastalgia than mothers.[7] There was also a significantly higher proportion of breastfeeding in marathon runners (94.1%) compared to physically active women in the general population (79.8%).

The prevalence of breast pain was significantly higher in nulliparous women in both cohorts. 51.4% of nulliparous marathon runners experienced breast pain compared to 31.1% of those who had already given birth. In women from the general population, 36.4% of nulliparous women experienced breast pain compared to 21.7% of those who had already given birth.[17]

Including the breasts in scientific research into physical exercise, sport and breastfeeding, and replicating this positive data, will bring new aspects and directions not only for improving mastalgia, but also for other beneficial points.

Miscellaneous

The literature shows that there are still more topics, no less important, to be debated about the breasts and the relationship with physical training and they could be covered in more depth in other articles and will be mentioned briefly.

Breast reduction is a surgical intervention that has shown positive outcomes such as increased levels of exercise[30-32] in some publications. Although physical activity, exercise, and sport in most of these articles are not the main focus related to this topic, breast reduction deserves to be included in the context of breast size and physical training, as our article has shown.

Our article focused on discussing clinical aspects, but as the topics discussed in our publication are unraveled and better studied, surgical interventions with positive outcomes, such as reduction mammoplasty, will be welcomed as a therapeutic option in this scenario.

To our surprise, and to our knowledge, there is no specific publication on the relationship between breast implants and physical activity, exercise and sports, either for clinical or aesthetic indications. This is a completely open field to be explored, and the authors of this article strongly suggest studies specifically on this topic to obtain data and information for a full understanding and thus also to direct future discussions on this topic, as was done in our article.

One of the symptoms of premenstrual syndrome is pain and/or tenderness in the breasts. Our article discussed that exercise can be a non-drug therapeutic tool depending on the etiology of mastalgia, and premenstrual syndrome[33-35] and cyclical mastalgia seem to be examples.

Exercise in the management of premenstrual syndrome symptomatology is an increasingly promising field and the benefit in relation to breast symptomatology could help provide answers to the concomitant association when the patient suffers from exercise-induced mastalgia with other etiologies of mastalgia, even though the compound effect has been refuted as discussed in this article.

There is a diagnosis related to physical exercise and trauma called Mondor's disease[36] caused by thrombophlebitis of the superficial thoracic veins. It is characterized by sudden onset pain, with edema and hyperemia of the breasts. It is self-limiting and evolves into a palpable fibrous band that disappears after recanalization of the affected vein,[37] so doctors working with physically active patients who have this clinical presentation associated with a history of vigorous training or weaving against the breasts should remember this diagnosis.

Although it is rare, and the pathophysiology is not exclusively physical exercise and trauma, it is prudent to encourage registries of Mondor's disease so that, with an increase in the number of publications of case series, there can be concrete documentation and understanding of the relationship between exercise and trauma to the breasts and the pathology.

CONCLUSION

The existence and extent of the subject are evident in the various topics on the relationship between women's breasts and physical activity, exercise, and sport, covered in two parts by the authors.

The detected topics published here show that there are still large scientific gaps to be researched on what has been covered, as well as the likelihood of the existence of topics that have not yet been detected/poorly covered/neglected.

Research into physical training and women's health should be increasingly encouraged, and women's breasts should be included in this context, because being physically active brings many benefits to human beings, and in cases of need for health care, we can make sure that the female sex can enjoy these benefits.

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REFERENCES

1. Loud KJ, Micheli LJ. Common athletic injuries in adolescent girls. Curr Opin Pediatr. 2001;13(4):317-22. doi:10.1097/00008480-200108000-00005.
2. Brisbine B, Steele J, Phillips E, Mcghee D. Elite female athletes experience breast injuries that affect their performance. J Sci Med Sport. 2019;22(Suppl 2):S67-8. doi:10.1016/j.jsams.2019.08.274.
3. Patel DR, Greydanus DE, Hatim AO. The Female Athlete. Pediatrics Faculty Publications. 2018:260. [Accessed in January 8 2022]. Available at: https://uknowledge.uky.edu/pediatrics_facpub/260.
4. Greydanus DE, Omar H, Pratt HD. The adolescent female athlete: current concepts and conundrums. Pediatr Clin North Am. 2010;57(3):697-718. doi:10.1016/j.pcl.2010.02.005.

5. Gehlsen S, Stoner LJ. The female breast in sports and exercise. Med Sport Sci. 1987;24:13-22.
6. Haycock CE. How I Manage Breast Problems in Athletes. Phys Sportsmed. 1987;15(3):89-95. doi:10.1080/00913847.1987.11709304.
7. Brown N, White J, Brasher A, Scurr J. The experience of breast pain (mastalgia) in female runners of the 2012 London Marathon and its effect on exercise behaviour. Br J Sports Med. 2014;48(4):320-5. doi:10.1136/bjsports-2013-092175.
8. Burbage J, Cameron L. An investigation into the prevalence and impact of breast pain, bra issues and breast size on female horse riders. J Sports Sci. 2017;35(11):1091-7. doi:10.1080/02640414.2016.1210818.
9. Levit F. Jogger's nipples. N Engl J Med. 1977;297(20):1127. doi:10.1056/NEJM197711172972018.
10. Mailler EA, Adams BB. The wear and tear of 26.2: dermatological injuries reported on marathon day. Br J Sports Med. 2004;38(4):498-501. doi:10.1136/bjsm.2004.011874.
11. Purim KS, Leite N. Sports-related dermatoses among road runners in Southern Brazil. An Bras Dermatol. 2014;89(4):587-92. doi:10.1590/abd1806-4841.20142792.
12. Tomi NS, Altmeyer P, Kreuter A. Tacrolimus ointment for 'jogger's nipples'. Clin Exp Dermatol. 2007;32(1):106-7. doi:10.1111/j.1365- 2230.2006.02251.x.
13. Estok PJ, Rudy EB. Intensity of jogging. Relationship with menstrual/reproductive variables. JOGN Nurs. 1984;13(6):390-5. doi:10.1111/j.1552-6909.1984.tb02188.x.
14. Nequin ND. More on jogger's ailments. N Engl J Med. 1978;298(7):405-6. doi:10.1056/nejm197802162980721.
15. Powell B. Bicyclist's nipples. J Am Med Assoc. 1983;249(18):2457.
16. Brisbine BR, Steele JR, Phillips EJ, McGhee DE. Breast pain affects the performance of elite female athletes. J Sports Sci. 2020;38(5):528-33. doi:10.1080/02640414.2020.1712016.
17. Brown N, Burnett E, Scurr J. Is Breast Pain Greater in Active Females Compared to the General Population in the UK?. Breast J. 2016;22(2):194-201. doi:10.1111/tbj.12547.
18. Mountjoy M, Sundgot-Borgen J, Burke L, Carter S, Constantine N, Lebrun C, et al. The IOC consensus statement: beyond the Female Athlete Triad—Relative Energy Deficiency in Sport (RED-S). Br J Sports Med. 2014;48(7):491-7. doi:10.1136/bjsports-2014-093502.
19. Nattiv A, Loucks AB, Manore MM, Sanborn CF, Sundgot-Borgen J, Warren MP; American College of Sports Medicine. American College of Sports Medicine position stand. The female athlete triad. Med Sci Sports Exerc. 2007;39(10):1867-82. doi:10.1249/mss.0b013e318149f111.
20. Huhmann K. Menses Requires Energy: A Review of How Disordered Eating, Excessive Exercise, and High Stress Lead to Menstrual Irregularities. Clin Ther. 2020;42(3):401-7. doi:10.1016/j.clinthera.2020.01.016.
21. ACOG Committee Opinion No. 740: Gynecologic Care for Adolescents and Young Women with Eating Disorders. Obstet Gynecol. 2018;131(6):e205-13. doi:10.1097/AOG.0000000000002652.
22. Nieschlag E, Vorona E. MECHANISMS IN ENDOCRINOLOGY: Medical consequences of doping with anabolic androgenic steroids: effects on reproductive functions. Eur J Endocrinol. 2015;173(2):R47-58. doi:10.1530/EJE-15-0080.
23. Korkia P, Stimson GV. Indications of prevalence, practice and effects of anabolic steroid use in Great Britain. Int J Sports Med. 1997;18(7):557-62. doi:10.1055/s-2007-972681.
24. Scurr J, Brown N, Smith J, Brasher A, Risius D, Marczyk A. The Influence of the Breast on Sport and Exercise Participation in School Girls in the United Kingdom. J Adolesc Health. 2016;58(2):167-73. doi:10.1016/j.jadohealth.2015.10.005.-
25. Rinker B, Veneracion M, Walsh CP. Breast ptosis: causes and cure. Ann Plast Surg. 2010;64(5):579-84. doi:10.1097/SAP.0b013e3181c39377.
26. Burnett E, White J, Scurr J. The Influence of the Breast on Physical Activity Participation in Females. J Phys Act Health. 2015;12(4):588-94. doi:10.1123/jpah.2013-0236.
27. Bø K, Artal R, Barakat R, Brown W, Davies GAL, Dooley M, et al. Exercise and pregnancy in recreational and elite athletes: 2016 evidence summary from the IOC expert group meeting, Lausanne. Part 1—exercise in women planning pregnancy and those who are pregnant. Br J Sports Med. 2016;50(10):571-89. doi:10.1136/bjsports-2016-096218.
28. Bø K, Artal R, Barakat R, Brown WJ, Davies GAL, Dooley M, et al. Exercise and pregnancy in recreational and elite athletes: 2016/17 evidence summary from the IOC Expert Group Meeting, Lausanne. Part 3-exercise in the postpartum period. Br J Sports Med. 2017;51(21):1516-25. doi:10.1136/bjsports-2017-097964.
29. Bø K, Artal R, Barakat R, Brown WJ, Davies GAL, Dooley M, et al. Exercise and pregnancy in recreational and elite athletes: 2016/17 evidence summary from the IOC Expert Group Meeting, Lausanne. Part 5. Recommendations for health professionals and active women. Br J Sports Med. 2018;52(17):1080-5. doi:10.1136/bjsports-2018-099351.
30. Knox JA, Nelson DA, Latham KP, Kurina LM. Objective Effects of Breast Reduction Surgery on Physical Fitness. Ann Plast Surg. 2018;80(1):14-7. doi:10.1097/SAP.0000000000001167.
31. Brown JR, Holton LH 3rd, Chung TL, Slezak S. Breast-feeding, self-exam, and exercise practices before and after reduction mammoplasty. Ann Plast Surg. 2008;61(4):375-9. doi:10.1097/SAP.0b013e318160223f.
32. Strong B, Hall-Findlay EJ. How Does Volume of Resection Relate to Symptom Relief for Reduction Mammaplasty Patients?. Ann Plast Surg. 2015;75(4):376-82. doi:10.1097/SAP.0000000000000190.
33. Yesildere Saglam H, Orsal O. Effect of exercise on premenstrual symptoms: A systematic review. Complement Ther Med. 2020;48:102272. doi:10.1016/j.ctim.2019.102272.
34. Maged AM, Abbassy AH, Sakr HRS, Elsawah H, Wagih H, Ogila AI, et al. Effect of swimming exercise on premenstrual syndrome. Arch Gynecol Obstet. 2018;297(4):951-9. doi:10.1007/s00404-018-4664-1.
35. Dennerstein L, Lehert P, Heinemann K. Global study of women's experiences of premenstrual symptoms and their effects on daily life. Menopause Int. 2011;17(3):88-95. doi:10.1258/mi.2011.011027.
36. Ben Hamida K, Ghalleb M, Triki A, Jebir I, Makhlouf R, Touinsi H. Mondor's disease of the breast: a case series. J Med Case Rep. 2021;15(1):188. doi:10.1186/s13256-021-02708-6.
37. Obradovic K, Adzic N, Pavlovic Stankovic D, Petkovic I, Urban V, Milosevic Z. Superficial Thrombophlebitis of the Breast (Mondor's Disease): An Uncommon Localization of Common Disease. Clin Med Insights Case Rep. 2020;13:1179547620972414.