



Female Patient Representation Is Acceptable in Studies Regarding Hip Arthroscopy With Labral Repair Yet Deficient in Key Study Design and Sport-Specific Features

Benjamin M. Ose, M.P.H., Libby Frye, B.S., Dylan Wentzel, B.S., Richard McEntee, M.D., Ashley A. Herda, Ph.D., Scott M. Mullen, M.D., John P. Schroepel, M.D., Bryan G. Vopat, M.D., and Lisa M. Vopat, M.D.

Purpose: To systematically review and examine the current literature regarding the representation of female athletes in studies examining arthroscopic hip labral repair procedures. **Methods:** Studies regarding arthroscopic hip labral repair were identified in PubMed. We included human studies of all levels of evidence written in English that identified the biological sex of study participants and were conducted in the United States or non-US countries that offer the same treatment strategies available in the United States. Data regarding study population, athletic caliber, menstrual status, research theme, sample of males and females, journal impact factor, and paper Altmetric score were recorded and analyzed. **Results:** We screened 1,152 studies and identified 62 to be included in this audit. Females made up 55% of the population of participants. Female-only and male-only studies represented 4.8% and 14.5% of studies investigated, respectively. No studies investigated outcomes of female participants at the highest athletic caliber. Menstrual status was not considered or included as a variable in any study. Participants within athletic performance, indirect association, and health research theme had 32.8%, 61.1%, and 58.6% female representation, respectively. Median impact factor was similar among study population classifications. Study Altmetric score was highest among male-only studies and studies of the highest levels of athletic caliber. **Conclusions:** Overall, there was a similar prevalence of female-to-male participants in hip labral repair research, with a 55% to 45% female-to-male ratio in all studies included in this review. Despite this, there is a lack of female-only studies, inclusion of menstrual status, high-level female athletes, and female participants evaluated for performance outcomes. **Level of Evidence:** Level IV, systematic review of Level I to IV studies.

Sex-based inequality in sports science and sports medicine has been an ongoing topic of discussion. Efforts have been made to promote awareness of differences between female athletes and their male counterparts as well as minimize discrepancies in their wages and publicity. However, another critical

component is establishing evidence-based recommendations specific to female athletes. Smith et al.¹ indicated that sports science/sports medicine (SSSM) research has inadequately addressed the increase in sport participation by female athletes. In 2014, Costello et al.² studied the proportion of male versus female participants in published works of 3 major sports and exercise medicine journals. The authors evaluated over 1,382 articles consisting of 6,076,580 participants and found that only 39% of those participants were female, while 61% were male. This study revealed a long-standing disparity in the female SSSM sector. When considering why females have been excluded from SSSM research in the past, Smith et al.¹ suggested female SSSM research is more complex, is more time necessitating, and requires additional study expense. Overall rates of sports-related injuries are similar between sexes,³ while certain injuries pose greater risks to females compared to males, such as ankle sprain (1.4%

From the University of Kansas School of Medicine, Kansas City, Kansas, U.S.A. (B.M.O., L.F., D.W.); Department of Orthopedic Surgery and Sports Medicine, University of Kansas Medical Center, Kansas City, Kansas, U.S.A. (R.M., B.G.V., L.M.V.); and Exercise and Human Performance, University of Kansas, Overland Park, Kansas, U.S.A. (A.A.H.).

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Address correspondence to Benjamin M. Ose, M.P.H., University of Kansas Medical Center, MS 3017, 3901 Rainbow Blvd, Kansas City, KS 66160, U.S.A. E-mail: bose@kumc.edu

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vs 0.7%)⁴ and anterior cruciate ligament injury (3.5% vs 2.0%).⁵ Yet, females are often underrepresented in the sample population of studies despite a rise of female athlete participation in organized sport.²

Hip labral repair is an arthroscopic procedure used to repair the acetabular labrum following injury. Labral repairs preserve the function of the labrum and are associated with better postoperative patient-reported outcomes relative to labral debridement.⁶ For this reason, labral repair is a procedure that is increasing in incidence and is performed on many female patients. Zusmanovich et al.⁷ described an increase of 85% from 2011 to 2018 in total hip arthroscopy cases. Other studies have shown a higher incidence of hip arthroscopy for labral repair in females relative to males ranging from 54% to 71% of cases.⁸⁻¹¹ Despite this, it is currently unknown if women have been properly represented in current hip arthroscopy research focusing on outcomes following hip labral repair.

Some discrepancy exists in the literature regarding the gaps in outcomes between women and men following hip arthroscopy. Flores et al.¹² suggested that women and men experience equitable recovery, similar postoperative patient-reported outcome measures, and similar rates of reoperation following hip arthroscopy. However, past studies have suggested that women may experience worse preoperative hip function, worse patient-reported outcome scores, and higher rates of reoperation relative to men undergoing similar hip arthroscopy procedures.^{13,14} In another study, Beck et al.¹⁵ suggested that women may achieve higher postoperative values for modified Harris Hip Score (mHHS) following hip arthroscopy. The discrepancy in the literature regarding outcomes provides further rationale to examine the representation of females in current studies examining outcome following hip labral repair.

The purpose of this article is to systematically review and examine the current literature regarding the representation of female athletes in studies examining arthroscopic hip labral repair procedures.¹ We hypothesize that research data investigating hip labral repair will include fewer female participants compared to male participants overall and will be less likely to include females in the highest 2 levels of athletic caliber, and studies with female participants will be less likely to use performance-based outcome measurements.

Methods

This study was performed according to Preferred Reporting Items for Systematic Reviews and Meta-Analyses guidelines. Institutional review board approval was not required for this study. An electronic search was performed using PubMed to identify and collect articles describing hip labral repair. To capture

the relevant articles, the following search strategy was used, including terms specific to our area of interest as well as general terms provided by the Smith et al.¹ protocol:

(athlete OR sport OR healthy) AND (“hip labral repair” OR “acetabular labral repair” OR “arthroscopic labral repair” OR femoroacetabular impingement [mesh] OR “FAI” OR “cam impingement” or “pincer impingement” OR “hip arthroscopy” OR “hip dysplasia” OR “borderline hip dysplasia”) AND (exercise OR performance OR endurance OR aerobic OR strength OR power OR anaerobic OR speed OR skill OR tactics) NOT (“animals” [mesh] NOT “humans” [mesh]) NOT “nonoperative” NOT (“Review” [Publication Type] OR “Case Reports” [Publication Type])

Inclusion criteria were studies that focused on hip labral repair surgery, study participants who were identified as male or female, studies reported in the English language, human studies, all levels of evidence, and studies conducted in the United States or non-US countries that offer the same treatment strategies available in the United States. Exclusion criteria included editorials, animal studies, cadaver studies, narrative or systematic reviews, case reports, studies with populations with lifestyle diseases such as obesity or hypertension, studies in which hip labral repair is not the primary focus of the paper, studies that fail to explicitly state the sex of the participants, and studies looking at postmenopausal women or elderly populations.

Eligibility assessment of the studies was performed independently by 3 reviewers (B.M.O., L.F. and D.W.) using the Rayyan Systematic Review software, with discrepancies resolved by a senior author (R.M.) when necessary. Duplicate studies were removed, along with papers meeting exclusion criteria as outlined above. There is the potential for multiple published studies to utilize the same population data set.

The outcomes of interest included a classification of participant population, male and female participant counts, athletic caliber of participants, classification of menstrual status, study research theme, study Altmetric score, and journal impact factor. The characterization of the athletic caliber ranges from tier 0 (sedentary) to tier 5 (world class) with studies including a range of participants using the median tier.¹⁶ Characterization of menstrual status includes eumenorrhea, hormonal contraceptive use, menstrual irregularities, and mixed-population studies.¹ Research theme consisted of 3 categories: health, performance, and indirect measures. Patient-reported outcomes and measures such as mHHS were classified as health themes, while return to sport and sport assessments were performance measures. The standardized guidelines outlined by Smith et al.¹ were used for classification scenarios.

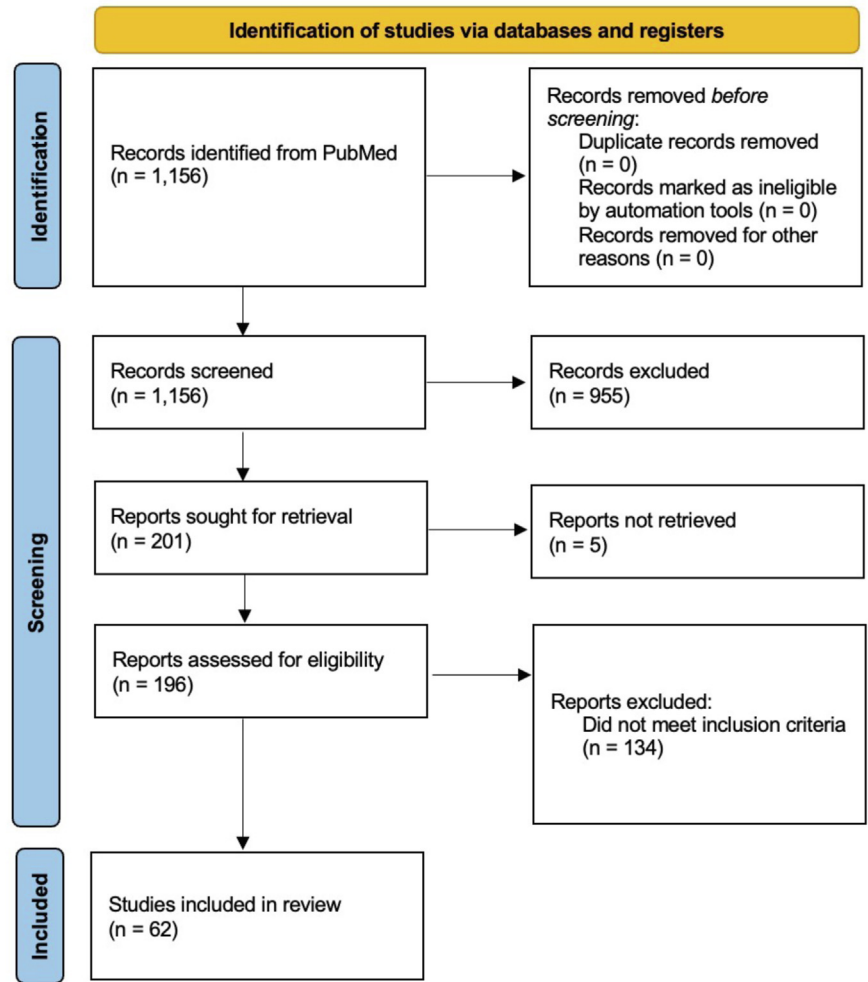


Fig 1. Study selection flow diagram.

Statistical Analysis

Data were compiled and frequency statistical analysis was conducted using Microsoft Excel spreadsheets (Microsoft Excel 2021). An assessment of bias using the Risk Of Bias In Non-Randomized Studies - of Interventions criteria was included for all studies.¹⁷

Results

Our database search resulted in 1,156 articles. Of this list, we identified 201 studies for full-text review and found that 62 articles met our inclusion criteria, which included a total of 11,461 participants (Fig 1). In total, 6,318 participants were female, making up 55% of the total population. Table 1 provides the breakdown of sample size, including total sample as well as male and female subsets, impact factor and Altmetric score by study population, athletic caliber, menstrual status, and research theme. A list of included studies can be found in Table 2.

Population and Sample Size

Analysis of these studies yielded only 3 of 62 (5%) papers that utilized a female-only population with a total

100 female participants making up 1% of the total participant population.^{24,43,73} This is compared to 9 of 62 (14%) male-only studies with 419 male participants making up 4% of the participant population.^{30,46,53,55,56,58,59,67,79} Additionally, there was 1 study of each male versus female subanalysis and male versus female design features classification, each with more males than females and together totaling 517 (5%) participants made up of 311 males and 206 females.^{47,68} The final 48 (77%) studies utilized a mixed-sex cohort with 6,012 female participants making up 58% of the total mixed-sex cohort sample size. Additionally, of the 48 mixed-sex cohort studies, 33 (67%) had larger female populations than male. The spread of study population classification compiled as both number of studies as well as number of participants can be seen in Figure 2. Figure 3 displays the spread of the study population classification by publication year, from 2010 until the present. This shows 3 or fewer studies being published each year before 2018 with an increase to 14 total studies investigating hip labral repair beginning in 2018 and a majority of these being mixed-sex cohort studies.

Table 1. Study Characteristics

Characteristic	Number (%) of Studies	Total Number (%)	Sample Size	Sample of Males, n (%)	Sample of Females, n (%)	Mean Impact Factor	Mean Altimetric Score
All studies	62 (100.0)	11,461	(100.0)	5,143 (44.9)	6,318 (55.1)	5.645	6.4
Population							
Mixed-sex cohort	48 (77.4)	10,425	(91.0)	4,413 (85.8)	6,012 (95.2)	5.588	5.5
Males only	9 (14.5)	419	(3.7)	419 (8.1)	—	5.711	11.1
Females only	3 (4.8)	100	(0.9)	—	100 (1.6)	5.461	5.0
Male vs female design features	1 (1.6)	96	(0.8)	54 (1.0)	42 (0.7)	7.010	2.0
Male vs female subanalysis	1 (1.6)	421	(3.7)	257 (5.0)	164 (2.6)	7.010	16.0
Athletic caliber							
Unclassified	38 (61.3)	9,609	(83.8)	4,030 (78.4)	5,579 (88.3)	5.584	5.4
Tier 0	—	—	—	—	—	—	—
Tier 1	7 (11.3)	357	(3.1)	90 (1.7)	267 (4.2)	5.414	6.1
Tier 2	3 (4.8)	105	(0.9)	68 (1.3)	37 (0.6)	4.916	1.0
Tier 3	5 (8.1)	736	(6.4)	437 (8.5)	299 (4.7)	5.000	5.0
Tier 4	6 (9.7)	527	(4.6)	391 (7.6)	136 (2.2)	6.527	10.5
Tier 5	3 (4.8)	127	(1.1)	127 (2.5)	—	7.010	18.7
Menstrual status							
Unclassified	62 (100.0)	11,461	(100.0)	5,143 (100.0)	6,318 (100.0)	5.645	6.4
Research theme							
Health	41 (66.1)	9,841	(85.9)	4,070 (79.1)	5,771 (91.3)	5.637	5.5
Indirect associations	2 (3.2)	54	(0.5)	21 (0.4)	33 (0.5)	2.877	1.0
Performance	19 (30.6)	1,566	(13.7)	1,052 (20.5)	514 (8.1)	5.956	8.9

The median number of participants per study population classification was calculated, with the male-only cohort having 33 participants, the female-only cohort having 36 participants, and the mixed-sex cohort having 42 males and 57 females. The classification of male versus female subanalysis and male versus female design features had only 1 study in each category, with 54 males and 42 females or 257 males and 165 females, respectively. These results can be seen in [Figure 4](#). The total number of participants under these classifications found that 4,413 males and 6,012 females were included in mixed-sex cohort studies. Male-only studies had 419 participants and female-only studies had 100.

Athletic Caliber

Overall, in 40 studies, athletic caliber was unable to be classified due to no athletic specifics being used in participant recruitment or analysis. Additionally, zero studies specified the population was sedentary, tier 0. There were subpopulations of sedentary participants in 2 studies, but these additionally included higher tier participants, leading to a median of tier 1 and tier 2 classification, respectively. [Figure 5](#) shows the total number of male and female participants found in each athletic caliber, excluding those in unclassified studies. The unclassified studies were made up of 4,030 (78%) males and 5,579 (88%) females. Tier 5 was only used in 3 male-only studies with a total of 127 (3%) male participants. These studies utilized participant populations of National Football League, Major League Baseball, and National Hockey League players.^{30,56,58} Tier 4 studies consisted of 391 (8%) males and 136 (2%) females.

Of the 1,113 males and 739 females in classified athletic caliber studies, [Figure 6](#) shows their spread among the athletic caliber tiering system. The largest groups of 437 of 1,113 males (39%) and 299 of 739 females (41%) were in studies of tier 3 or considered highly trained/national-level athletes. There were no female participants in either tier 0 or 5 athletic caliber studies. Of all participants, including those from unclassified studies, tiers 3 to 5 made up 18.6% of all males and 6.9% of all females.

In the comparison of study population classification to athletic caliber, all unclassified studies were from mixed-sex cohort designs. Male-only studies were classified into tiers 2 to 5, and female-only studies were classified as tier 1 or tier 3. The male versus female subanalysis and male versus female design feature comparison studies were classified as tier 3 and tier 4, respectively. These results can be seen in [Figure 7](#). Among unclassified athletic tier papers, all were a mixed-sex cohort, and nearly all had a health-based research theme. Additionally, of tier 3 to 5 studies, all had performance-based research themes focusing on outcomes related to sport.

Table 2. The 62 Studies Included in This Review

Author	Title	Year	Journal	Level of Evidence	Bias (ROBINS-I)
Beck et al. ¹⁸	Complete Capsular Closure Provides Higher Rates of Clinically Significant Outcome Improvement and Higher Survivorship Versus Partial Closure After Hip Arthroscopy at Minimum 5-Year Follow-Up	2021	<i>Arthroscopy</i>	III	Moderate
Beck et al. ¹⁹	Preoperative Hip Extension Strength Is an Independent Predictor of Achieving Clinically Significant Outcomes After Hip Arthroscopy for Femoroacetabular Impingement Syndrome	2020	<i>Sports Health</i>	IV	Serious
Bodendorfer et al. ²⁰	Multicenter Outcomes After Revision Hip Arthroscopy: Comparative Analysis of 2-Year Outcomes After Labral Repair Versus Labral Reconstruction	2021	<i>Am J Sports Med</i>	III	Low
Bodendorfer et al. ²¹	Multicenter Outcomes After Hip Arthroscopy: Comparative Analysis of Patients Undergoing Concomitant Labral Repair and Ligamentum Teres Debridement Versus Isolated Labral Repair	2021	<i>Orthop J Sports Med</i>	III	Moderate
Bodendorfer et al. ²²	Multicenter Outcomes After Primary Hip Arthroscopy: A Comparative Analysis of Two-Year Outcomes After Labral Repair, Segmental Labral Reconstruction, or Circumferential Labral Reconstruction	2022	<i>Arthroscopy</i>	III	Low
Byrd et al. ²³	Primary Repair of the Acetabular Labrum: Outcomes With 2 Years' Follow-Up	2014	<i>Arthroscopy</i>	IV	Moderate
Chaharbakhshi et al. ²⁴	Is Hip Arthroscopy Effective in Patients With Combined Excessive Femoral Anteversion and Borderline Dysplasia? A Match-Controlled Study	2019	<i>Am J Sports Med</i>	III	Low
Chahla et al. ²⁵	Influence of Acetabular Labral Tear Length on Outcomes After Hip Arthroscopy for Femoroacetabular Impingement Syndrome With Capsular Plication	2019	<i>Am J Sports Med</i>	III	Moderate
Chahla et al. ²⁶	Is There an Association Between Preoperative Expectations and Patient-Reported Outcome After Hip Arthroscopy for Femoroacetabular Impingement Syndrome?	2019	<i>Arthroscopy</i>	III	Moderate
Day et al. ²⁷	Hip Arthroscopy With Bone Marrow Aspirate Injection for Patients With Symptomatic Labral Tears and Early Degenerative Changes Shows Similar Improvement Compared With Patients Undergoing Hip Arthroscopy With Symptomatic Labral Tears Without Arthritis	2022	<i>Arthroscopy</i>	III	Serious
Di Benedetto et al. ²⁸	All-Suture Anchors in Arthroscopic Acetabular Labral Repair: Our Experience	2020	<i>Acta Biomed</i>	IV	Serious
Economopoulos et al. ²⁹	Prospective Randomized Comparison of Capsular Management Techniques During Hip Arthroscopy	2020	<i>Am J Sports Med</i>	II	Serious

(continued)

Table 2. Continued

Author	Title	Year	Journal	Level of Evidence	Bias (ROBINS-I)
Frangiamore et al. ³⁰	Career Length and Performance Among Professional Baseball Players Returning to Play After Hip Arthroscopy	2018	<i>Am J Sports Med</i>	IV	Moderate
Frank et al. ³¹	Improved Outcomes After Hip Arthroscopic Surgery in Patients Undergoing T-capsulotomy With Complete Repair Versus Partial Repair for Femoroacetabular Impingement: A Comparative Matched-Pair Analysis	2014	<i>Am J Sports Med</i>	III	Moderate
Frank et al. ³²	High Rate of Return to Yoga for Athletes After Hip Arthroscopy for Femoroacetabular Impingement Syndrome	2018	<i>Sports Health</i>	IV	Serious
Frank et al. ³³	High Rate of Return to Swimming After Hip Arthroscopy for Femoroacetabular Impingement	2018	<i>Arthroscopy</i>	IV	Serious
Freke et al. ³⁴	Acute and Subacute Changes in Hip Strength and Range of Movement After Arthroscopy to Address Chondrolabral Pathology	2019	<i>Am J Sports Med</i>	IV	Low
Glein et al. ³⁵	Patient-Reported Outcome Scores and Rate of Return to Sport After Hip Arthroscopic Surgery: A Sex-Based Comparison in Professional and Collegiate Athletes	2021	<i>Am J Sports Med</i>	III	Moderate
Hamula et al. ³⁶	Atypical Hip Pain in Femoroacetabular Impingement: A Comparison of Outcomes Based on Primary Hip Pain Location	2020	<i>Am J Sports Med</i>	II	Moderate
Hassebrock et al. ³⁷	Hip Arthroscopy in the High-Level Athlete: Does Capsular Closure Make a Difference?	2020	<i>Am J Sports Med</i>	III	Moderate
Hevesi et al. ³⁸	Multicenter Analysis of Midterm Clinical Outcomes of Arthroscopic Labral Repair in the Hip: Minimum 5-Year Follow-Up	2018	<i>Am J Sports Med</i>	III	Moderate
Horner et al. ³⁹	Results of Endoscopic Labral Repair With Concomitant Gluteus Medius and/or Minimus Repair Compared With Outcomes of Labral Repair Alone: A Matched Comparative Cohort Analysis at Minimum 2-Year Follow-up	2023	<i>Am J Sports Med</i>	III	Low
Jackson et al. ⁴⁰	Acetabular Labral Base Repair Versus Circumferential Suture Repair: A Matched-Paired Comparison of Clinical Outcomes	2015	<i>Arthroscopy</i>	III	Moderate
Jimenez et al. ⁴¹	Achieving Successful Outcomes in High-Level Athletes With Borderline Hip Dysplasia Undergoing Hip Arthroscopy With Capsular Plication and Labral Preservation: A Propensity-Matched Controlled Study	2021	<i>Am J Sports Med</i>	III	Moderate
Kaplan et al. ⁴²	Decreased Hip Labral Width Measured via Preoperative Magnetic Resonance Imaging Is Associated With Inferior Outcomes for Arthroscopic Labral Repair for Femoroacetabular Impingement	2021	<i>Arthroscopy</i>	IV	Low

(continued)

Table 2. Continued

Author	Title	Year	Journal	Level of Evidence	Bias (ROBINS-I)
Krych et al. ⁴³	Arthroscopic Labral Repair Versus Selective Labral Debridement in Female Patients With Femoroacetabular Impingement: A Prospective Randomized Study	2013	<i>Arthroscopy</i>	I	Moderate
Lee et al. ⁴⁴	Arthroscopic Repair of Acetabular Labral Tears Associated With Femoroacetabular Impingement: 7-10 Years of Long-Term Follow-Up Results	2019	<i>Clin Orthop Surg</i>	IV	Low
Lim et al. ⁴⁵	Outcomes After Arthroscopic Repair in Patients With Tears of Hypertrophic Versus Morphologically Normal Acetabular Labra	2020	<i>Am J Sports Med</i>	III	Moderate
Locks et al. ⁴⁶	Return to Play After Hip Arthroscopic Surgery for Femoroacetabular Impingement in Professional Soccer Players	2018	<i>Am J Sports Med</i>	IV	Serious
Marom et al. ⁴⁷	Characteristics of Soccer Players Undergoing Primary Hip Arthroscopy for Femoroacetabular Impingement: A Sex- and Competitive Level-Specific Analysis	2020	<i>Am J Sports Med</i>	III	Moderate
Martin et al. ⁴⁸	Minimal Clinically Important Difference and Substantial Clinical Benefit Values for a Pain Visual Analog Scale After Hip Arthroscopy	2019	<i>Arthroscopy</i>	III	Low
Martin et al. ⁴⁹	Functional Outcomes of Arthroscopic Acetabular Labral Repair With and Without Bone Marrow Aspirate Concentrate	2022	<i>J Bone Joint Surg Am</i>	III	Low
Mas Martinez et al. ⁵⁰	Significant Improvement After Hip Arthroscopy for Femoroacetabular Impingement in Women	2022	<i>Knee Surg Sports Traumatol Arthrosc</i>	IV	Moderate
Matsuda and Burchette ⁵¹	Arthroscopic Hip Labral Reconstruction With a Gracilis Autograft Versus Labral Refixation: 2-Year Minimum Outcomes	2013	<i>Am J Sports Med</i>	III	Moderate
May et al. ⁵²	Does Labral Repair Have a Clinical Benefit During Arthroscopic Treatment of Femoro-Acetabular Impingement? Prospective Multicentre Study With 2-Year Follow-Up	2020	<i>Orthop Traumatol Surg Res</i>	II	Low
McDonald et al. ⁵³	Performance Outcomes in Professional Hockey Players Following Arthroscopic Treatment of FAI and Microfracture of the Hip	2014	<i>Knee Surg Sports Traumatol Arthrosc</i>	IV	Serious
McGovern et al. ⁵⁴	Allocation of Anchors During Labral Repair: A Multicenter Cohort Analysis of Labral Treatment in Hip Arthroscopy	2021	<i>Orthop J Sports Med</i>	III	Moderate
Mullins et al. ⁵⁵	Arthroscopic Correction of Femoroacetabular Impingement Improves Athletic Performance in Male Athletes	2020	<i>Knee Surg Sports Traumatol Arthrosc</i>	II	Moderate
Nwachukwu et al. ⁵⁶	Characteristics and Outcomes of Arthroscopic Femoroacetabular Impingement Surgery in the National Football League	2018	<i>Am J Sports Med</i>	III	Serious

(continued)

Table 2. Continued

Author	Title	Year	Journal	Level of Evidence	Bias (ROBINS-I)
Parvaresh et al. ⁵⁷	Achievement of Meaningful Clinical Outcomes Is Unaffected by Capsulotomy Type During Arthroscopic Treatment of Femoroacetabular Impingement Syndrome: Results From the Multicenter Arthroscopic Study of the Hip (MASH) Study Group	2021	<i>Am J Sports Med</i>	III	Low
Philippon et al. ⁵⁸	Arthroscopic Labral Repair and Treatment of Femoroacetabular Impingement in Professional Hockey Players	2010	<i>Am J Sports Med</i>	IV	Serious
Ramos et al. ⁵⁹	Results of Hip Arthroscopy in Elite Level Water Polo Players With Femoroacetabular Impingement: Return to Play and Patient Satisfaction	2020	<i>J Hip Preserv Surg</i>	IV	Serious
Redmond et al. ⁶⁰	Arthroscopic Acetabuloplasty and Labral Refixation Without Labral Detachment	2015	<i>Am J Sports Med</i>	III	Moderate
Renouf et al. ⁶¹	The Outcome of Arthroscopic Repair of Acetabular Labral Tears Using the iHOT-33	2019	<i>BMC Musculoskelet Disord</i>	IV	Moderate
Riff et al. ⁶²	High Rate of Return to High-Intensity Interval Training After Arthroscopic Management of Femoroacetabular Impingement Syndrome	2018	<i>Am J Sports Med</i>	IV	Moderate
Saks et al. ⁶³	Equality in Hip Arthroscopy Outcomes Can Be Achieved Regardless of Patient Socioeconomic Status	2021	<i>Am J Sports Med</i>	III	Low
Salvo et al. ⁶⁴	Sex-Dependent Differences in Preoperative, Radiographic, and Intraoperative Characteristics of Patients Undergoing Hip Arthroscopy: Results From the Multicenter Arthroscopic Study of the Hip Group	2018	<i>Arthroscopy</i>	III	Low
Sawyer et al. ⁶⁵	Clinical Outcomes After Arthroscopic Hip Labral Repair Using Looped Versus Pierced Suture Techniques	2015	<i>Am J Sports Med</i>	III	Moderate
Scanaliato et al. ⁶⁶	Primary Circumferential Acetabular Labral Reconstruction: Achieving Outcomes Similar to Primary Labral Repair Despite More Challenging Patient Characteristics	2018	<i>Am J Sports Med</i>	III	Moderate
Schallmo et al. ⁶⁷	Return-to-Play and Performance Outcomes of Professional Athletes in North America After Hip Arthroscopy From 1999 to 2016	2018	<i>Am J Sports Med</i>	IV	Moderate
Shibata et al. ⁶⁸	Arthroscopic Hip Surgery in the Elite Athlete: Comparison of Female and Male Competitive Athletes	2017	<i>Am J Sports Med</i>	III	Moderate
Soriano et al. ⁶⁹	Treatment of Labral Calcification in the Setting of Femoroacetabular Impingement Syndrome With Arthroscopic Calcification Excision, Labral Repair, and Osteoplasty Improves Outcomes	2021	<i>Arthroscopy</i>	III	Moderate

(continued)

Table 2. Continued

Author	Title	Year	Journal	Level of Evidence	Bias (ROBINS-I)
Soriano et al. ⁷⁰	Hypermobile Patients With Femoroacetabular Impingement Syndrome Can Be Effectively Treated Utilizing Hip Arthroscopy With Periportal Capsulotomy Closure: A Matched Cohort Analysis Compared to Patients Without Joint Hypermobility	2023	<i>Arthroscopy</i>	III	Low
Sugarman et al. ⁷¹	Does Capsular Closure Affect Clinical Outcomes in Hip Arthroscopy? A Prospective Randomized Controlled Trial	2021	<i>Orthop J Sports Med</i>	I	Low
Uchida et al. ⁷²	Endoscopic Shelf Acetabuloplasty Concomitant With Labral Repair, Cam Osteoplasty, and Capsular Plication to Treat Acetabular Dysplasia in Artistic Athletes: A Case Series	2021	<i>Orthop J Sports Med</i>	IV	Serious
Uchida et al. ⁷³	Endoscopic Shelf Acetabuloplasty Can Improve Clinical Outcomes and Achieve Return to Sports-Related Activity in Active Patients With Hip Dysplasia	2018	<i>Knee Surg Sports Traumatol Arthrosc</i>	IV	Moderate
Vassalo et al. ⁷⁴	Clinical Outcomes of Arthroscopic Repair of Acetabular Labral Tears	2018	<i>BMJ Open Sport Exerc Med</i>	IV	Moderate
Ward et al. ⁷⁵	Arthroscopic Femoral and Acetabular Osteoplasties Alter the In-Vivo Hip Kinematics of Patients With Femoroacetabular Impingement	2022	<i>Arthrosc Sports Med Rehabil</i>	IV	Moderate
Waterman et al. ⁷⁶	Return to Golf After Arthroscopic Management of Femoroacetabular Impingement Syndrome	2018	<i>Arthroscopy</i>	IV	Serious
Winge et al. ⁷⁷	Arthroscopic Treatment for Femoroacetabular Impingement Syndrome (FAIS) in Adolescents—5-Year Follow-Up	2021	<i>J Hip Preserv Surg</i>	II	Serious
Yang et al. ⁷⁸	Patients With Unhealed or Partially Healed Anterior Capsules After Hip Arthroscopy for Borderline Developmental Dysplasia of the Hips Have Inferior Patient-Reported Outcome Measures	2023	<i>Arthroscopy</i>	III	Moderate
Yoo et al. ⁷⁹	Outcomes of Hip Arthroscopy in a Military Population Are Similar to Those in the Civilian Population: Matched Paired Analysis at 2 Years	2018	<i>Arthroscopy</i>	III	Moderate

iHOT, International Hip Outcome Tool; ROBINS-I, Risk Of Bias In Non-Randomized Studies - of Interventions.

Menstrual Status

No studies included menstrual status in their study design or mentioned that it was a variable considered within the study, either for testing during consistent menstrual phases or in the final analysis.

Research Theme

Of the 62 studies included, 41 (66%) were classified as having a health-related research theme, 2 (3%) utilized indirect associations to athletic performance, and 19 (31%) fit a performance-based research theme. Research theme outcomes included but were not limited to the following:

Health: Hip Outcome Score—Activities of Daily Living, Hip Outcome Score—Sports Subscale, mHHS, and International Hip Outcome Tool—12

Performance: Return to sport, acceleration (10-m sprint), change of direction speed, squatting depth, and reactive strength index

Indirect Associations: Lateral center-edge angle, internal rotation, internal rotation torque, lateral and proximal femoral head displacement

The distribution of males and females in each research theme was calculated. Among health and indirect association themed studies, 58.6% (5,771/9,841) and 61.1% (33/54) of participants were female, respectively, while

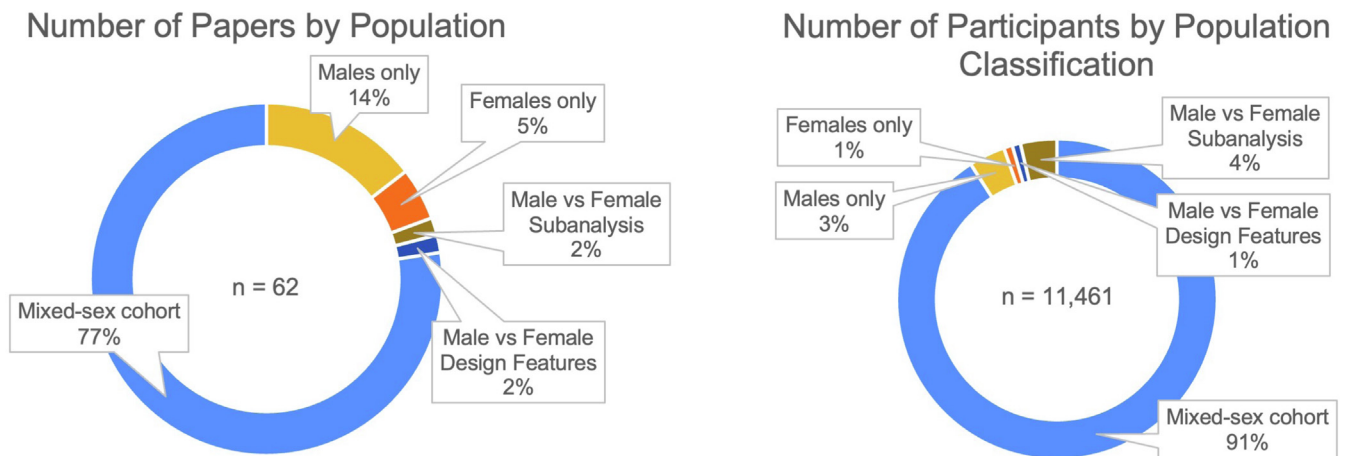


Fig 2. Distribution of the 62 included studies and participants separated between the 5 different study population classifications.

among performance themed studies, 32.8% (514/1,567) of participants were female.

Journal Impact Factor and Study Altmetric Score

Overall, the 62 studies included in this study had a mean impact factor of 5.645 and a mean Altmetric score of 6.4. The 2 highest Altmetric scores of 38 and 34 were seen in male-only studies, investigating professional soccer and professional football players, both classified as tier 5 athletic caliber.^{46,56} The highest Altmetric score found in a female-only study was 8 with a generalized health-related outcome among a tier 1 athletic caliber population.⁴³ The most prevalent journal in this study was the *American Journal of Sports Medicine* (AJSM) with 27 of the 62 papers featured. Additionally, AJSM also had the highest impact factor of any journal at 7.010. The 27 studies included 5 male-only, 1 female-only, and both the male versus female design and subanalysis studies. Of the 5 male-only studies in AJSM, the average Altmetric score was 19.4 compared to a score of 4 in the female-only study. Finally, the highest Altmetric score among mixed-sex cohort studies was 27 and focused on the health outcomes at the 5-year follow-up from arthroscopic labral repair.³⁸

Discussion

In this study, we found a lack of high-quality research surrounding elite female athletes or use of performance outcomes following hip labral repair, despite similar general representation compared to males. With a 55% versus 45% female-to-male ratio, demographics are similar to the roughly 54% to 57% female case distribution of acetabular labral repair found in other studies.⁸⁻¹⁰ As discussed in the Results section, even though females made up most of all subjects, males dominated research surrounding performance outcomes and higher-level athletes. Instead, most participants, specifically female research participants, in hip labral repair research were found in *health* themed studies. These are studies focusing on outcomes related to pain and activities of daily living rather than *performance* outcomes related to sport.

While these findings show that women at the highest level of athletics were not included in research, one possible explanation could be related to athletic opportunities in professional women's sports. Studies including men at the highest athletic level were investigating Major League Baseball, hockey, and football, sports with few comparable women's leagues. For

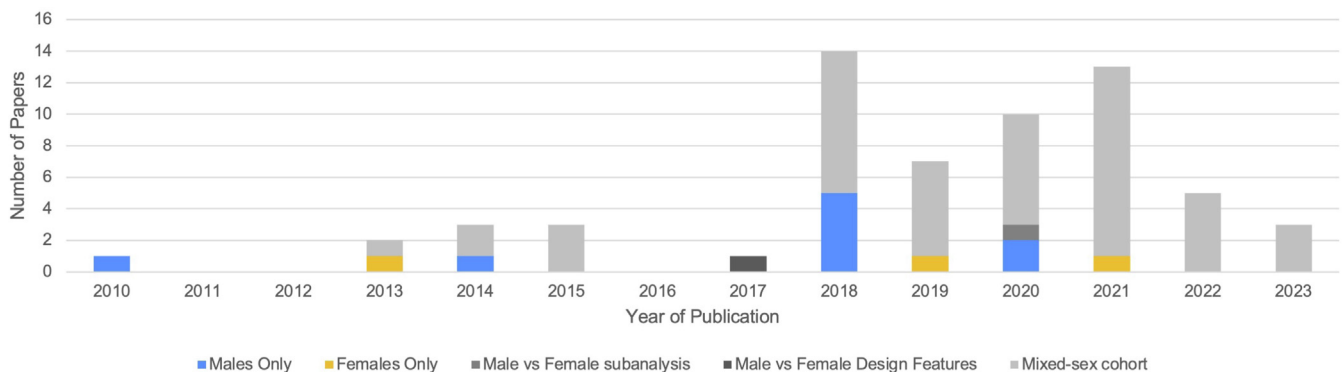
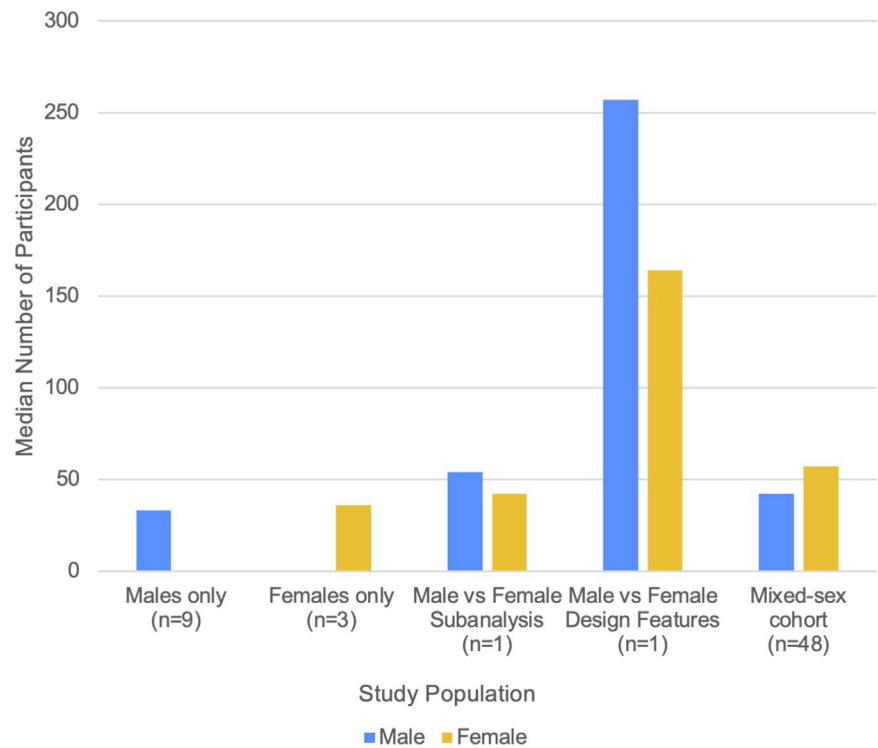


Fig 3. Number of studies and their population classification separated by year of publication.

Fig 4. Median number of study participants separated by sex for each population classification of study.



example, in the United States, the Professional Women's Hockey League and Professional Women's Fastpitch had their first seasons in 2023, only recently presenting opportunities for comparable populations to be investigated in these sports.

Another outcome of interest was the inclusion of menstrual status consideration among female participants. This could have been documenting participant use of hormonal contraceptives or the classification of natural menstrual cycles and performing a procedure or

Total Number of Participants by Athletic Caliber (Excluding Unclassified)

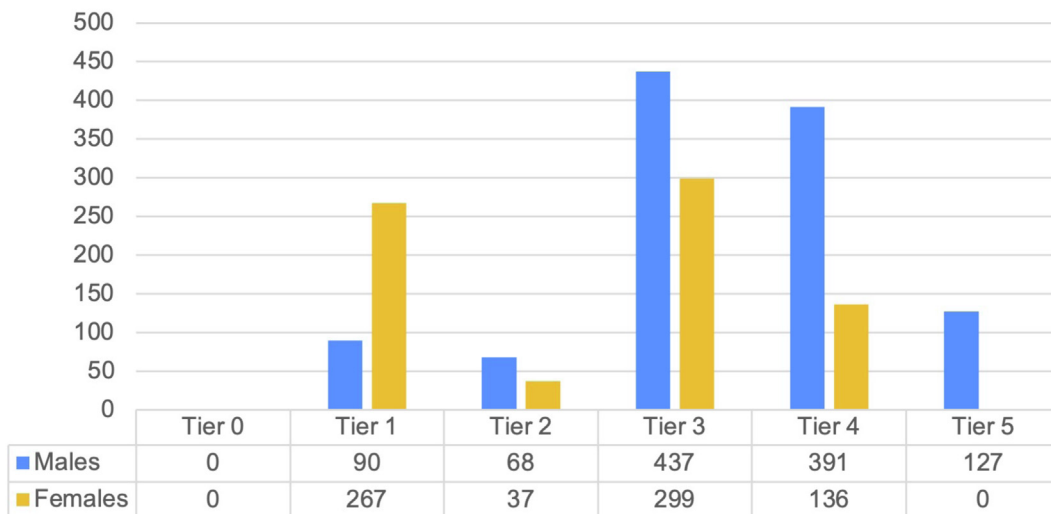
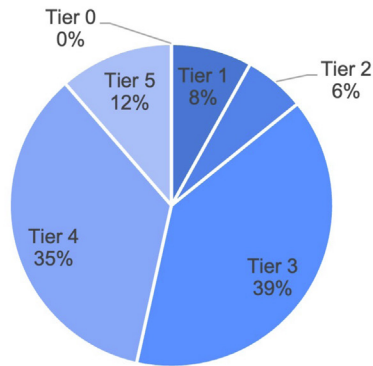


Fig 5. Total number of participants, separated by sex, by athletic caliber and excluding unclassified athletic caliber studies. Tier 0: sedentary; tier 1: recreationally active; tier 2: trained/developmental; tier 3: highly trained/national level; tier 4: elite/international level; tier 5: world class.

Athletic Caliber for All Males



Athletic Caliber for All Females

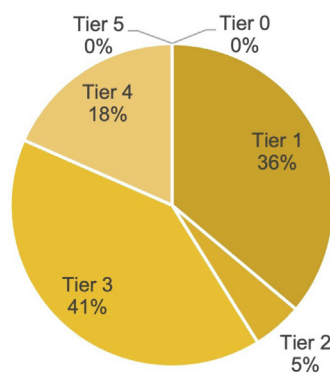


Fig 6. Athletic caliber classification by tier of all males and females. Tier 0: sedentary; tier 1: recreationally active; tier 2: trained/developmental; tier 3: highly trained/national level; tier 4: elite/international level; tier 5: world class.

testing outcomes during consistent phases. Interestingly, none of the 62 studies around hip labral repair included information on menstrual status, even with a 55% representation of female participants. This is significant in sports medicine research as the female menstrual cycle has been shown to affect aspects of athletic performance due to its impact on metabolism, as well as directly relate to the structure and function of muscles, tendons, and ligament.^{80,81} Menstrual cycle has also been known to affect wound healing in the setting of surgical reconstruction and therefore could play a role in the surgical recovery and outcomes following an orthopaedic procedure such as hip labral repair.⁸² Additionally, it has been shown that hormonal fluctuations throughout the menstrual cycle affect joint laxity, strength, and neuromuscular control.⁸³ These factors would likely impact postoperative return to sport and performance-based metrics following labral repair surgery. The absence of menstrual status data

could be attributed to the overall lack of female-only studies. With only 3 of 62 papers included in this study featuring a female-only population, comparison of females across different sports, athletic ability, age, menstrual status, and more remains difficult.

Finally, the quality of research as measured by journal impact factor and study Altmetric score pose an interesting discussion. In the body of literature analyzed regarding hip labral repair, median journal impact factors were similar among the different study populations ranging between 5 and 6 points. However, Altmetric score better represents media presence (social and commercial attention) and engagement, and male-only studies, along with studies of higher athletic caliber investigation, had consistently higher Altmetric scores. Mean male-only studies received over twice the attention and engagement score, according to the Altmetric measure, than either female-only or mixed-sex cohort studies. These were similar results to athletic

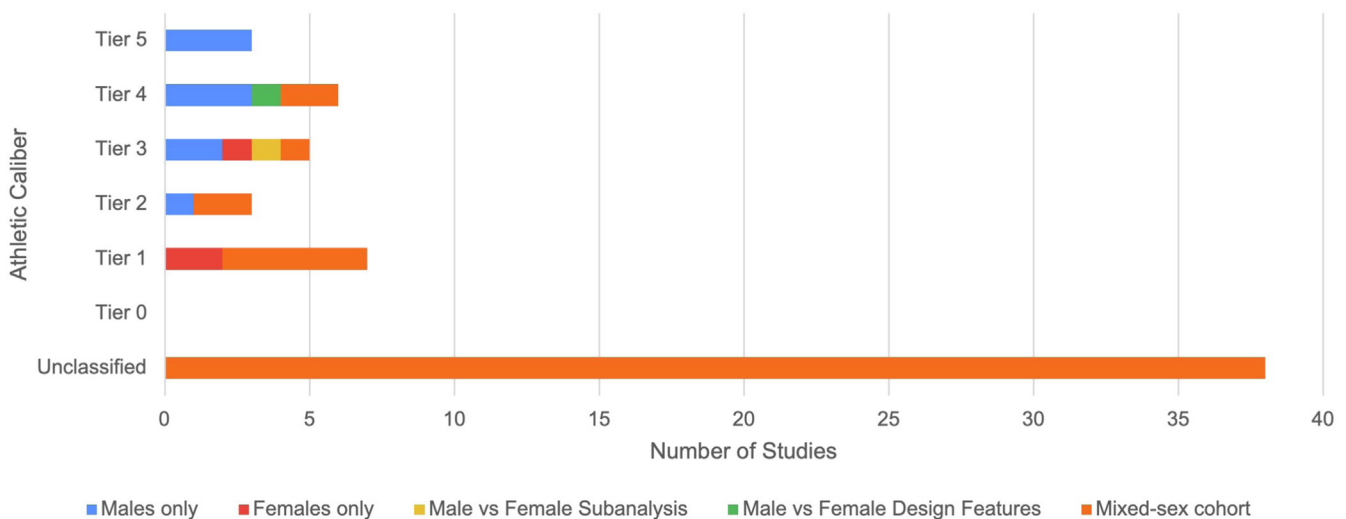


Fig 7. Number of studies by study population classification separated by athletic caliber. Tier 0: sedentary; tier 1: recreationally active; tier 2: trained/developmental; tier 3: highly trained/national level; tier 4: elite/international level; tier 5: world class.

caliber tier 4 and 5 studies, which lacked female representation, scoring on average 2 or 3 times as high as tier 3 or lower studies. It may be difficult to disentangle these measures within our data set as male-only studies often had a higher athletic caliber. Additionally, this may highlight a lack of female participation in the most discussed areas of sports medicine research and further supports the finding that while females were represented in hip labral repair studies, the most discussed research in this area revolved around male-only athletes or sports without professional women's leagues.

These results highlight some of the gaps that exist in the literature surrounding hip labral repair in female sports medicine research. More studies focused specifically on female-only populations would allow for a more focused and holistic view of the female athlete regarding hip labral repair surgery. Future studies surrounding this topic should focus on increasing the diversity of female participants to ensure the representation of athletes of the highest caliber in their various sports. Research focused on athletic performance outcomes would help to establish clinical practice guidelines and expectations that are better suited for the female athlete population. Additionally, research accounting for menstrual status presents an opportunity to fill a gap that has not been touched regarding hip labral repair in sports medicine. This may have an impact on both orthopaedic clinical practice or use of contraceptives.

Limitations

This study is not without limitations. One limitation of this article is the difficulty in distinguishing studies focusing specifically on labral repair among those examining other various procedures in hip arthroscopy, especially labral debridement for femoroacetabular impingement or hip dysplasia. While labral repair has become the norm for the treatment of femoroacetabular impingement, labral debridement has been a widely conducted surgical technique for the therapeutic treatment of impingement or dysplasia.⁸⁴ Papers that did not specifically state the intraoperative method for the treatment of FAI or dysplasia were excluded from the analysis due to the possible confounding of labral debridement as it has been established that patients undergoing labral debridement may have worse postoperative patient-reported outcome measures and have higher rates of conversion to total hip arthroplasty.^{85,86} Additionally, identifying the athletic caliber in the included studies presented difficulty as some studies did not specifically disclose the information necessary to make this determination. Additional information in some studies regarding the demographics of participants included would have helped to further clarify the proper athletic caliber of the study population and limit the number of articles

being distinguished as "unclassified." This would have allowed for more adequate reporting of this variable in this study.

Conclusions

Overall, there was a similar prevalence of female-to-male participants in hip labral repair research, with a 55% to 45% female-to-male ratio in all studies included in this review. Despite this, there is a lack of female-only studies, inclusion of menstrual status, high-level female athletes, and female participants evaluated for performance outcomes.

Disclosures

The authors declare the following financial interests/personal relationships which may be considered as potential competing interests: S.M.M. receives funding grants from Arthrex and Titan Surgical Group, receives speaking and lecture fees from Arthrex, receives travel reimbursement from Arthrex and Titan Surgical Group, and is a consultant or advisor for Stryker. J.P.S. receives funding grants from Titan Surgical Group and Arthrex; receives travel reimbursement from Titan Surgical Group, Arthrex, Vericel Corporation, and Zimmer Biomet Holdings; receives speaking and lecture fees from Arthrex, and is a consultant or advisor for Vericel Corporation. B.G.V. is a consultant or advisor for Artelon and Stryker; receives equity or stocks with Spinal Simplicity, Altior, and Carbon 22; and is a board member of the American Orthopaedic Foot and Ankle Society. All other authors (B.M.O., L.F., D.W., R.M., A.A.H., L.M.V.) declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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