

Where are all the female participants in Sports and Exercise Medicine research? A decade later.

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Disclosures of Interest

- Bryan Vopat reports a relationship with The University of Kansas Medical Center that includes: Altior: Stock or stock Options; American Orthopaedic Foot and Ankle Society: Board or committee member; Artelon: Paid consultant; Carbon 22: Stock or stock Options; Spinal Simplicity: Stock or stock Options.
- Lisa Vopat reports a relationship with The University of Kansas Medical Center that includes: Altior: Stock or stock Options; American Orthopaedic Foot and Ankle Society: Board or committee member; Artelon: Paid consultant; Carbon 22: Stock or stock Options; Ortho Bullets: Stock or stock Options; Spinal Simplicity: Stock or stock Options.

Objective

- In 2014 Costello et al.¹ published a sentinel paper spotlighting the large disparity of female versus male representation within sports science and sports medicine (SSSM) research
- From January 2011 through August of 2013 the authors evaluated 1,382 articles
 - This included 6,076,580 participants showing a 39% female representation
 - Highlighted a longstanding disparity in female representation within the SSSM sector
- Other studies have shown similar results ²
- We aimed to revisit this a decade later to assess improvements to participant representation within the field

Methods: Paper Selection

Journals Investigated

- Medicine and Science in Sports and Exercise (MSSE); British Journal of Sports Medicine (BJSM); American Journal of Sports Medicine (AJSM)

Inclusion Criteria

- All original research and epidemiological studies with live human participants
- Published between January 2021 - August 2023

Exclusion Criteria

- Editorials, special communications, methodological advances, reviews, meta-analyses, letters to the editor, animal studies, cadaver studies, other in vitro laboratory research
- Studies that did not report their study population by sex or did not report participation in number of people.

Methods: Data Extraction

Included studies were assessed for:

- Total number of participants
- Number of male and female participants

Inclusion of menstrual status in study design

- Following the audit protocol by Smith et al.¹ and the current opinion by Elliott-Sale et al.³
- This utilized a tiered ranking system to assess studies based on both;
 - a. The classification of female participants according to menstrual status (menstrual cycle, hormonal contraceptives, menstrual irregularities, mixed menstrual status, unclassified)
 - b. The standardization of methodical control relating to ovarian hormonal profiles (Gold, Silver, Bronze, Ungraded, and Unclassified).

Key Findings

	2021		2022		2023*		Total	
	n	(%)	n	(%)	n	(%)	n	(%)
Total								
Number of papers	582		520		339		1,441	
Total Participants	35,629,562		3,265,368		1,257,930		40,152,860	
Males	20,409,778 (57.28%)		1,507,629 (46.17%)		586,944 (46.66%)		22,504,351 (56.05%)	
Females	15,219,784 (42.72%)		1,757,739 (53.83%)		670,986 (53.34%)		17,648,509 (43.95%)	
Mean % Female	39.62%		40.39%		41.00%		40.22%	
Female only studies	43 (7.39%)		41 (7.88%)		19 (5.60%)		103 (7.15%)	
Male only studies	127 (21.82%)		92 (17.69%)		49 (14.45%)		268 (18.60%)	
Both females and males	412 (70.79%)		387 (74.42%)		271 (79.94%)		1070 (74.25%)	

- 1,441 studies included with 40,504,351 total participants
- 17,648,509 (43.95%) Female participants
- 22,504,351 (56.05%) Male participants
- Female-only and male-only studies included 7.15% and 18.60% of all studies, respectively
- Mean percent female of investigated study populations was 40.22%

Key Findings

- MSSE had the greatest female population of 56.19% of total
- Mean percent female was consistent across the three journals ranging from 39.92% - 40.44%

	2021		2022		2023*		Total	
	n	(%)	n	(%)	n	(%)	n	(%)
BJSM								
Number of papers	67		81		38		186	
Total Participants	29,122,412		1,869,500		747,105		31,739,017	
Males	16,487,675	(56.62%)	821,198	(43.93%)	348,295	(46.62%)	17,657,168	(55.63%)
Females	12,634,737	(43.38%)	1,048,302	(56.07%)	398,810	(53.38%)	14,081,849	(44.37%)
Mean % Female	40.51%		37.36%		44.35%		39.92%	
Female only studies	7	(10.45%)	6	(7.41%)	2	(5.26%)	15	(8.06%)
Male only studies	17	(25.37%)	15	(18.52%)	6	(15.79%)	38	(20.43%)
Both females and males	43	(64.18%)	60	(74.07%)	30	(78.95%)	133	(71.51%)
AJSM								
Number of papers	267		249		171		687	
Total Participants	5,344,342		463,058		308,966		6,116,366	
Males	3,346,299	(62.61%)	321,081	(69.34%)	173,260	(56.08%)	3,840,640	(62.79%)
Females	1,998,043	(37.39%)	141,977	(30.66%)	135,706	(43.92%)	2,275,726	(37.21%)
Mean % Female	40.08%		40.37%		41.10%		40.44%	
Female only studies	9	(3.37%)	8	(3.21%)	2	(1.17%)	19	(2.77%)
Male only studies	37	(13.86%)	29	(11.65%)	9	(5.26%)	75	(10.92%)
Both females and males	221	(82.77%)	212	(85.14%)	160	(93.57%)	593	(86.32%)
MSSE								
Number of papers	248		190		130		568	
Total Participants	1,162,808		932,810		201,859		2,297,477	
Males	575,804	(49.52%)	365,350	(39.17%)	65,389	(32.39%)	1,006,543	(43.81%)
Females	587,004	(50.48%)	567,460	(60.83%)	136,470	(67.61%)	1,290,934	(56.19%)
Mean % Female	38.88%		41.70%		39.88%		40.05%	
Female only studies	27	(10.89%)	27	(14.21%)	15	(11.54%)	69	(12.15%)
Male only studies	73	(29.44%)	48	(25.26%)	34	(26.15%)	155	(27.29%)
Both females and males	148	(59.68%)	115	(60.53%)	81	(62.31%)	344	(60.56%)

Key Findings

Comparison to January 2011 – August 2013: Female Representation

- Costello et al. reported 39% of total participants between 2011-2013* were female. We found this increased to 44% between 2021-2023*.¹
- With the removal of two large epidemiologic studies (34 million participants) the representation of females increased even further to 53%
- The mean proportion of female participants per study is a more standardized measure of comparison. Our analysis of 2021-2023* showed this mean ranged from 39.92% to 40.44% between journals. In comparison, from 2011-2013*, these same journal's mean proportion of female participants per study ranged from 35% to 37%.¹

Key Findings

Comparison to January 2011 – August 2013: Study cohort

- Female-only cohorts remained relatively stable
- Male-only cohorts decreased in use
- Mixed-sex cohorts increased in use

	BJSJ			AJSJ			MSSE		
	Female-only	Male-only	Both	Female-only	Male-only	Both	Female-only	Male-only	Both
2011-2013*	17 (7.5%)	68 (30.1%)	141 (62.4%)	19 (3.9%)	90 (18.3%)	384 (77.9%)	85 (12.8%)	228 (34.4%)	350 (52.8%)
2021-2023*	15 (8.1%)	38 (20.4%)	133 (71.5%)	19 (2.8%)	75 (10.9%)	593 (86.3%)	69 (12.1%)	155 (27.3%)	344 (60.6%)

Key Findings

Menstrual Status Inclusion

- Only 66 (5.6%) studies included menstrual status in their study design
- 14 studies ranked in the highest quality classification tiers
 - 8 silver studies, 6 gold studies
- MSSE published the most papers that took menstrual status into consideration

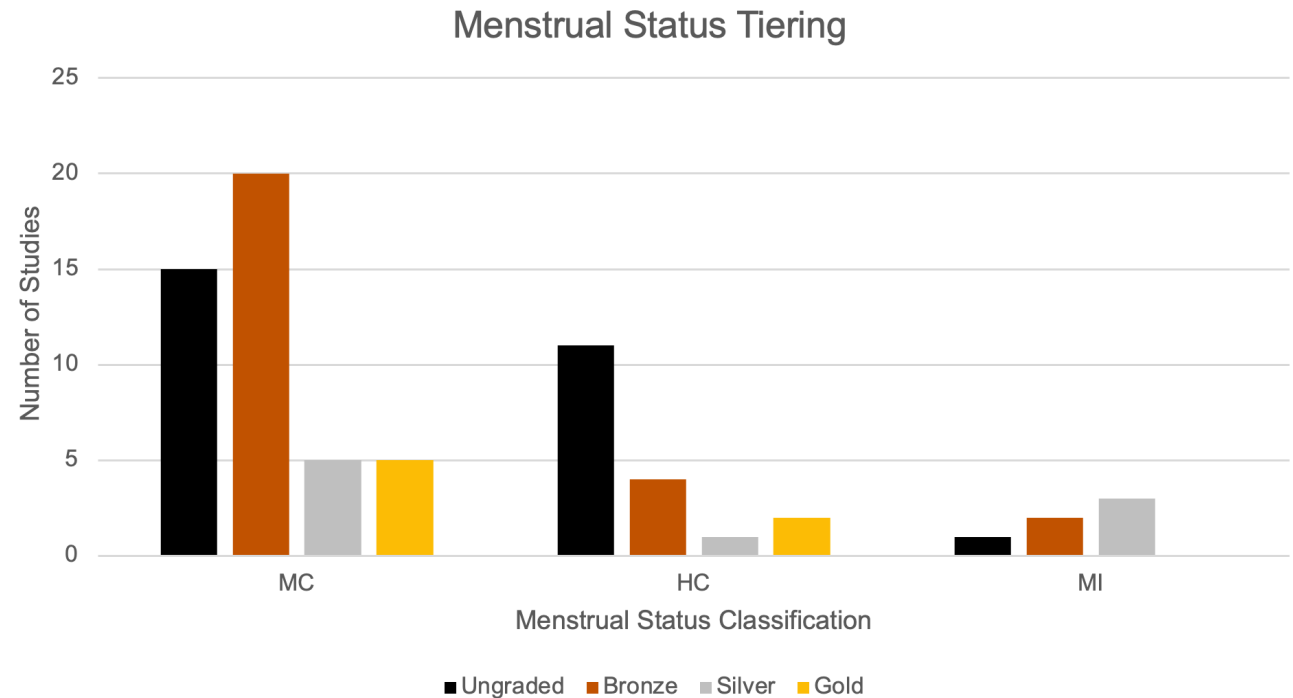


Figure 1. Tiering results for populations of natural menstrual cycle (MC), use of hormonal contraceptives (HC), and menstrual irregularities (MI)

Conclusions

The present study revealed an increase in female participation within SSSM research over the past decade from 39% to nearly 44%. While the overall number of female participants has risen in recent years, there remains a significant disparity in female representation compared to male participants as seen in the average percent female within cohorts of 40% and female-only studies make up 7% of studies, compared to male-only studies making up 19%.

The inclusion of menstrual status in study designs continues to be limited, with few studies considering this crucial variable. The higher inclusion observed in MSSE, suggest a growing awareness of the impact of hormonal fluctuations on research outcomes in exercise science.

Significance and Future

While this study may be the first to show improvement, it still highlights the need for continued efforts to address female disparities in sports medicine research and emphasizes the importance of incorporating menstrual status in study designs to better inform care for female athletes.

Additionally, the Smith et al. protocol outlined means for assessing athletic caliber and research theme with regards to use of health, performance or indirect association outcomes which should be considered in future research.

References

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