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LAW AND POLICY APPROACHES TO SEX-BASED DISPARITIES IN MUSCULOSKELETAL HEALTH CARE

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ABSTRACT

Women's health care law and policy discussions tend to focus on reproductive health and breast cancer, but there are significant disparities involving other physiologic systems—like the musculoskeletal system. Failure to recognize sex-based differences in health and in health care leads to inequalities in delivery and outcome of medical care—especially negatively impacting young, active girls and women, as well as adult and aging women. For example, in sports medicine, female athletes are two to eight times more likely to tear their ACL (knee) than their male counterparts participating in the same sports and to have worse outcomes after surgical repair. Similarly, older women are more likely to need knee replacement and to do poorly after surgery. Male bias and male norm historically built into musculoskeletal care and research likely contribute to disparities. Only around 6% of practicing orthopedic surgeons are women. Physicians and other providers are generally under-educated in sex-based differences involving the musculoskeletal system and typically deliver care in a gender-neutral manner, which leads to disparities disproportionately affecting women. The causes of disparities are multifactorial and complex with strong influences of biological and social/cultural factors playing a role, which are discussed in this paper. Interdisciplinary approaches involving medical providers, medical educators, medical researchers, lawmakers, policymakers and courts are discussed to address this emerging and important issue. Continuing to acknowledge and embrace sex-based differences in musculoskeletal medical care will lead to improvements in the health and health care for everyone.

INTRODUCTION

An individual's sex plays an important role in his or her experience of disease and injury—all disease and injury . . . not just that associated with reproductive organs; male and female cells have basic chromosomal differences leading to

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sexual dimorphism that make them respond differently to their environment causing disparities in health and health care.¹ These differences are present across organ systems throughout the whole body; yet women's health research and regulation have historically focused on "women's health issues" as those related to the reproductive system (e.g., childbirth) or "women's diseases" (e.g., breast cancer) with the assumption that sex differences in other organ systems could be explained by differences in height, weight, etc.²

Biological, psychological, socioeconomic, and cultural factors interact to cause differences in health and health care for men and women.³ Recognition of sex-based differences in the medical needs of patients leads to improvement of health care delivery and outcomes.⁴ Medical teaching, treatment, and research outside of reproductive medicine have traditionally been gender-neutral⁵

1. INST. OF MED., EXPLORING THE BIOLOGICAL CONTRIBUTIONS TO HUMAN HEALTH: DOES SEX MATTER? 1 (2001), <http://www.nationalacademies.org/hmd/~media/Files/Report%20Files/2003/Exploring-the-Biological-Contributions-to-Human-Health-Does-Sex-Matter/DoesSexMatter8pager.pdf> [<https://perma.cc/8BFW-J6GM>] ("Evidence suggests that the distinct anatomy and physiology that develop as a result of having been dealt two X chromosomes (XX) or an X chromosome and a Y chromosome (XY) at fertilization can have a much broader influence on an individual's health than was previously thought."); *see also* Laura L. Tosi et al., *Does Sex Matter in Musculoskeletal Health? The Influence of Sex and Gender on Musculoskeletal Health*, 87-A J. BONE & JOINT SURGERY 1631, 1631-32 (2005), <http://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.819.9234&rep=rep1&type=pdf> [<https://perma.cc/4FPF-Y5WY>] ("[A] male cell is not the same as a female cell, and sex chromosome-linked genes can be expressed differently in cells from all organ systems."); *see also* Cordelia W. Carter et al., *Sex-based Differences in Common Sports Injuries*, 26 J. AM. ACAD. ORTHOPEADIC SURGEONS 447, 447 (2018) https://pdfs.journals.lww.com/jaaos/2018/07010/Sex_based_Differences_in_Common_Sports_Injuries.1.pdf?token=method|ExpireAbsolute;source|Journals;ttl|1547483647280;payload|mY8D3u1TCCsNvP5E421JYK6N6XICDamxByyYpaNzk7FKjTaa1Yz22MivkHZqjGP4kdS2v0J76WGANhACH69s21Csk0OpQi3YbjEMdSoz2UhVybFqQxA7IKwSUA502zQZr96TQRwhVlocE p/sJ586aVbcBflltKNKo+tbuMfL73hiPqJliudqs17cHeLcLbV/CqjIP3IO0jGHIHQjWcICDdAyGJMnpi6RlbeJaRheGeh5z5uvqz3FLHgPKVXJzd/9s7niVsl/teIhGttbJ3Ix3uZkU6/hxSZyYBrm23o=;hash|ulK+fGqoyKP1FjNTEgwOA== [<https://perma.cc/PBN5-4XPR>] ("The patient's sex plays an important role in mediating the risk for, and experience of, disease.").

2. Tosi et. al., *supra* note 1, at 1631 (noting that women had been presumed to be "little men" and that in spite of calls to broaden the study, even the Institute of Medicine's IOM's 2011 report "did not include any musculoskeletal health issues.").

3. Halime H. Celik et al., *Gender Sensitivity Among General Practitioners: Results of a Training Programme*, 8 BMC MEDICAL EDUC. 1, 1-2 (2008), <https://bmcomeduc.biomedcentral.com/track/pdf/10.1186/1472-6920-8-36> [<https://perma.cc/L9B2-XST2>] ("Differences between men and women in health depend on the interaction of biological, psychological, socio-economic, and cultural factors.").

4. *Id.* at 2 ("Recognition of gender differences can prevent inequity in caregiving [and] . . . [a]s a result the health of women and men can be improved."). For specifics, see remainder of this paper.

5. *Id.* (pointing out that sex-based differences in treatment remain underdeveloped and most

—especially in fields like musculoskeletal medicine. Failure to adjust medical care based on sex can lead to disparities, especially among women.⁶

Many musculoskeletal diseases and injuries have sex-based differences. Anterior cruciate ligament (ACL) tears, osteoarthritis, ankle sprains, osteoporosis, hip & wrist fractures, spinal disorders, severe scoliosis, and many other musculoskeletal problems are more prevalent among women than men.⁷ Sex-based differences in injury mechanism, pain sensation, drug handling by the body, and healing responses have also been noted and can lead to differences in responses to treatments like surgery, anesthesia, pain medication, pharmaceuticals, and rehabilitation.⁸ Therefore, health care professionals need to be “sex sensitive” to optimally treat both sexes.⁹

Law and policy measures can sometimes unintentionally complicate medical care by making medical professionals uneasy and perhaps less likely to acknowledge or address non-obvious sex-based differences to avoid the appearance of sex stereotyping or of treating the sexes unequally in a socially and politically charged environment. Section 1557 of the Affordable Care Act (“ACA”) “prohibits discrimination on the grounds of . . . sex . . . in certain health programs and activities” with the “final rule appl[ying] to any health program or activity, any part of which receives funding from” entities funded by the Department of Health and Human Services (“HHS”), like Medicare and Medicaid¹⁰—virtually including all health care activities, including doctor and hospital interactions with patients. “The rule makes clear that sex discrimination prohibited under Section 1557¹¹ includes discrimination based on . . . sex stereotyping.”¹²

Sex stereotypes means stereotypical notions of masculinity or femininity, including expectations of how individuals represent or communicate their

clinical practice guidelines remain gender neutral failing to cover gender issues related to diagnosis/treatment). For problems with gender neutral medicine, *see infra* pp.19-26.

6. *See generally* INST. OF MED., *supra* note 1.

7. Tosi et al., *supra* note 1, at 1632 tbl. I; Carter et al., *supra* note 1, at 347 (observing differences in rates of ACL tears, stress fractures, and other sports-related injuries).

8. Tosi et al., *supra* note 1, at 1632 (“Responses to therapy (e.g., surgery, anesthesia, pain medication, pharmaceuticals, and rehabilitation) also differ with sex.”); Carter et al., *supra* note 1, at 347-48 (noting differences in outcomes of ACL surgery based upon type of graft chosen).

9. Celik et al., *supra* note 3, at 1.

10. *Section 1557: Protecting Individuals against Sex Discrimination*, DEP’T OF HEALTH & HUMAN SERVS., <https://www.hhs.gov/civil-rights/for-individuals/section-1557/fs-sex-discrimination/index.html> [<https://perma.cc/7LYX-WBK5>]. *See* 45 C.F.R. § 92.1 (2018); 42 U.S.C.A. § 18116 (2018); 20 U.S.C.A. § 1681 (2018) (“on the basis of sex”).

11. Patient Protection and Affordable Care Act, 42 U.S.C.A. § 18116, SEC. 1557 (2010).

12. DEP’T OF HEALTH & HUMAN SERVS., SECTION 1557: PROTECTING INDIVIDUALS AGAINST SEX DISCRIMINATION, <https://www.hhs.gov/sites/default/files/1557-fs-sex-discrimination-508.pdf> [<https://perma.cc/FU57-3MFW>].

gender to others, *such as . . . body characteristics*. These stereotypes can include the expectation that individuals will consistently identify with only one gender and that they will act in conformity with the gender-related expressions stereotypically associated with that gender.¹³

The inclusion of “body characteristics” in the definition above could arguably create some issues and potential claims of discrimination against medical providers considering differences between the sexes’ body characteristics noted below.

Sex stereotyping is defined by at least one legal author as “a form of discrimination rooted in conformist notions of appropriate behavior, appearance or mannerisms for each gender.”¹⁴ Some musculoskeletal biologic differences discussed below could arguably be construed as forms of sex stereotyping; for example, the idea that women’s bones are smaller and ligaments more lax could be construed as signs of “weakness” or being the “weaker sex.”

In addition, HHS says that “[w]omen must be treated equally with men in the health care they receive . . .”¹⁵ “Sex-specific health programs or activities are permissible only if the entity can demonstrate an *exceedingly persuasive justification*, that is, that the sex-specific health program or activity is substantially related to the achievement of an important health-related or scientific objective.”¹⁶ However, sometimes in medicine, “equally” may not mean “the same”; in other words, to achieve equal outcomes, physicians may need to treat patients differently (i.e., arguably “unequally”) based upon sex as outlined below. Medicine is constantly evolving, treatments are changing as research emerges (sometimes contradicting prior consensus), and some treatments are based upon long-standing consensus that arguably may or may not be supported by “exceedingly persuasive justification”—such as a randomized, controlled, clinical trial.

Further complicating evaluation and management of sex-based differences is an ongoing redefinition of “sex” and “gender” in the medical literature. The Institute of Medicine (“IOM”) defined “sex” as “the classification of living things, generally as male or female according to their reproductive organs and functions assigned by chromosomal complement,” which researchers consider to be biologic.¹⁷ The IOM defined “gender” as “a person’s self-representation as male or female, or how that person is responded to by social institutions based on the individual’s gender presentation.”¹⁸ The IOM notes that “[g]ender is rooted

13. 45 C.F.R. § 92.4 (2016) (emphasis added).

14. Kevin Costello & Maryanne Tomazic, *On Sex Discrimination in Health Care, The Pendulum Swings with Severity*, HEALTH AFF. BLOG (Jan. 22, 2018), <https://www.healthaffairs.org/doi/10.1377/hblog20180122.689768/full/> [<https://perma.cc/P6BB-BGFS>].

15. DEP’T OF HEALTH & HUMAN SERVS., *supra* note 12.

16. *Id.* (emphasis added).

17. INST. OF MED., *supra* note 1, at 1.

18. *Id.*

in biology and shaped by environment and experience.”¹⁹

The law adds additional layers of complexity on the definition of gender and handling of sex-based differences in medical care. The rule from section 1557 of the ACA defines gender identity as follows:

Gender identity means an individual's internal sense of gender, which may be male, female, neither, or a combination of male and female, and which may be different from an individual's sex assigned at birth. The way an individual expresses gender identity is frequently called “gender expression,” and may or may not conform to social stereotypes associated with a particular gender.²⁰

HHS initially enacted rules including gender identity in the definition of sex discrimination in Title IX. However, the rule was found to be “contrary to law” and “exceed[] statutory authority,” so “the prohibition of discrimination on the basis of ‘gender identity’” was enjoined.²¹ The court explained:

Prior to the passage of the ACA in 2010 and for more than forty years after the passage of Title IX in 1972, no federal court or agency had concluded sex should be defined to include gender identity. Accordingly, HHS's expanded definition of sex discrimination exceeds the grounds incorporated by Section 1557.²²

These definitions and rulings can impact delivery of health care by providers.

Sex plays an important role in musculoskeletal health. Sex and gender include an “array of socially constructed roles, behaviors and values that society ascribes to the two sexes on a differential basis.”²³ This paper is intended to address differences in biologic sex determined at birth by chromosomal makeup, and will therefore use the term “sex” instead of “gender” throughout—even though some of the studies cited use the term “gender” synonymously with “sex.”

The focus of this paper is policy and legal ways to address the largely ignored “sex-based differences in cell biology, tissue function, and disease presentation and management” that musculoskeletal experts agree have the potential to affect medical and surgical treatment recommendations in the area of musculoskeletal health care.²⁴ In Part I, some common sex-based disparities in musculoskeletal care are discussed. In Part II, the potential causes of sex-based disparities are explored—including biologic, societal and cultural, and medical community biases. In Part III, potential solutions to gender disparities in musculoskeletal care

19. *Id.*

20. 45 C.F.R. § 92.4 (2016).

21. *Franciscan Alliance, Inc. v. Burwell*, 227 F. Supp.3d 660, 695 (N.D. Tex. 2016).

22. *Id.* at 689.

23. Celik et al., *supra* note 3, at 1-2.

24. Tosi et al., *supra* note 1, at 1643 (“This workshop unambiguously concluded that there are indeed sex-based differences in cell biology, tissue function, and disease presentation and management with the potential to affect how orthopaedic surgeons manage their patients.”).

are explored.

I. GENDER DISPARITIES IN MUSCULOSKELETAL CARE

Many musculoskeletal diseases have different prevalence, treatment, and/or outcomes based upon sex (i.e., there is a sexual dimorphism). Disparities disfavoring women are present in sports and military training, in arthritis treatment regimens, as well as in many other areas of general musculoskeletal care. In addition, some disparities are present that disfavor men in musculoskeletal care. This section includes a partial listing of some representative examples of musculoskeletal sex-based disparities. Other disparities have been identified, and many more likely have not yet been discovered due to limited research in this area.

A. Disparities Disfavoring Young, Active Girls and Women

Women are “at an increased risk of musculoskeletal injury during sport and military training.”²⁵ A few representative examples of known disparities include knee injuries involving the anterior cruciate ligament (ACL), other ligamentous injuries involving other joints, stress fractures, concussions, and fractures due to intimate partner violence (IPV).

First, many ligament injuries, sprains, and tears are more prevalent among females than males. The ACL is an important stabilizing ligament in the center of the knee, and an ACL tear usually leads to surgery and an extended absence from sports-related activity. ACL tears are most common among young athletes in cutting sports like basketball and soccer.²⁶ Female athletes are particularly vulnerable to rupture of the ACL with an incidence of noncontact ACL injuries that is two to eight times higher than males participating in the same sports.²⁷ In addition, female athletes respond disparately to surgery compared to males, with females being less likely to return to sport than males after ACL reconstruction surgery.²⁸

Some other ligament injuries involving the shoulder and ankle are also more prevalent among females. Females have higher rates of atraumatic multidirectional shoulder instability than in males.²⁹ Women sustain ankle sprains almost twice as commonly as men, and female athletes have higher rates of

25. Christopher M. Daniels et al., *Gender Disparities Within US Army Orthopedic Surgery: A Preliminary Report*, 183 MIL. MED. e162, e162 (2018).

26. Jennifer Moriatis Wolf et al., *Male and Female Differences in Musculoskeletal Disease*, 23 J. AM. ACAD. ORTHOPAEDIC SURGEONS 339, 339 (2015).

27. Carter et al., *supra* note 1, at 449.

28. Wolf et al., *supra* note 26, at 341 (observing that “[a]fter ACL reconstruction, women are less likely to return to sport than men.”).

29. Carter et al., *supra* note 1, at 450 (discussing atraumatic shoulder instability); *see also*, Wolf et al., *supra* note 26, at 341 (explaining that “[m]ultidirectional shoulder instability (MDI) is thought to occur more commonly in women.”).

chronic ankle instability in high school and college than male athletes.³⁰

Second, stress fractures are more common in females than in males. In military personnel, females sustain three times more stress fractures than males.³¹ In female athletes, the incidence of stress fractures is 9.7% compared to 6.5% in male athletes.³²

Third, possibly due to musculoskeletal issues discussed below, “female athletes sustain markedly more concussions than male athletes” participating in the same sport.³³ Some studies reveal that female athletes are twice as likely as male athletes in similar sports to sustain a concussion.³⁴ In addition, some authors have shown that “female athletes sustain more severe concussions than do males, with greater deficits in cognitive function reported and a longer recovery period required than their male counterparts.”³⁵

Finally, women with broken bones or fractures are more likely to be the victims of intimate partner violence (IPV). Musculoskeletal injuries are one of the most common manifestations of IPV, which is the “leading cause of non-fatal injury to women worldwide.”³⁶ One in six women orthopaedic fracture clinic patients disclosed a history of IPV within the previous year, and one in three had experienced IPV within their lifetime.³⁷ Almost 2% (1/50) of women in orthopaedic fracture clinics attended their visit as a direct result of IPV, but only 14% of them were ever asked about IPV in a health care setting.³⁸

B. Disparities Disfavoring Adult and Aging Women

Degenerative arthritis of the knee, hip and back are common among adults of both sexes, but disparities are present with regard to the experience of these diseases based upon sex. In addition, older women disproportionately experience osteoporosis and several other diseases.

First, disparities in knee osteoarthritis are present. Knee osteoarthritis (OA) is a leading cause of disability in the United States affecting up to 6% of

30. Tosi et al., *supra* note 1, at 1637 (noting higher prevalence of ankle sprains among women); Wolf et al., *supra* note 26, at 341 (noting “women have higher rates of chronic ankle instability . . .”).

31. Carter et al., *supra* note 1, at 448.

32. Laurel Wentz et al., *Females Have a Greater Incidence of Stress Fractures than Males in Both Military and Athletic Populations: A Systemic Review*, 176 MIL. MED. 420, 423 (2011).

33. Carter et al., *supra* note 1, at 452.

34. *Id.*

35. *Id.*

36. PRAISE Investigators, *Prevalence of Abuse and Intimate Partner Violence Surgical Evaluation (PRAISE) in Orthopaedic Fracture Clinics: A Multinational Prevalence Study*, 382 LANCET 866, 866 (2013).

37. *Id.*

38. *Id.*

Americans and is up to twice as common in women as men.³⁹ Women tend to experience knee osteoarthritis differently than men. Women wait longer to present to orthopaedic surgeons for consideration of total knee replacement (TKR) surgery evidenced by the fact that women have a “higher burden of disease, greater pain, and [greater] functional impairment” at the time of their total knee replacements than men.⁴⁰ Women have about 40% more total knees than men, but some researchers suggest that the overall need for TKR among women is around three times as high as in men.⁴¹

In addition, disparities persist after TKR surgery. Women “do not appear to recover to the same level as men following” knee replacement and have worse functional outcomes, more pain after surgery, more use of opioid pain medication, and less range of motion.⁴² Similar disparities may be present when it comes to hip replacement surgery, but data are confounded by hip replacement surgeries performed for hip fracture (which occur more frequently in women), instead of osteoarthritis, making analysis more difficult.⁴³

Second, sex-based disparities in the treatment of degenerative back problems are evident. Women have a worse functional status before undergoing some spine surgeries (e.g., laminectomy for spinal stenosis) than men and are operated

39. Atul F. Kamath et al., *Ethnic and Gender Differences in the Functional Disparities after Primary Total Knee Arthroplasty*, 468 CLINICAL ORTHOPAEDICS RELATED RES. 3355, 3355 (2010) (observing that knee OA is a leading cause of disability and has a 6% prevalence); Jeffrey N. Katz et al., *Differences Between Men and Women Undergoing Major Orthopedic Surgery for Degenerative Arthritis*, 37 ARTHRITIS RHEUMATISM 687, 688 (1994) (noting that women “have a 1.5-2.0-fold higher incidence of knee osteoarthritis”).

40. Wolf et al., *supra* note 26, at 343-44 tbl. 1 (stating that some studies show that women have more pain before surgery); Katz et al., *supra* note 39, at 693 (observing specifically, women have more advanced osteoarthritis and much worse functional status prior to TKR than men immediately prior to TKR suggesting that doctors or patients put off TKR longer in women than in men).

41. Katz et al., *supra* note 39, at 688 (“The age-adjusted frequency of total knee arthroplasty is approximately 40% higher in women than in men.”); Jasvinder A. Singh et al., *Gender and Surgical Outcomes After Primary Total Knee Arthroplasty*, 65 ARTHRITIS CARE & RES. 1095, 1010 (2013), (“Although age-adjusted rates of TJA are higher for women, the overall need for arthroplasty is three times greater for women compared to men.”); *see also* Kamath et al., *supra* note 39, at 3358 (proclaiming an “underuse” of TKR in women).

42. Wolf et al., *supra* note 26, at 343-44 (observing that compared to men after TKR, women have worse functional outcomes and higher dependence on gait aids with female gender being a “predictor of moderate to severe functional limitation at 2 and 5 years” and that some studies show that women have more pain after surgery and more use of opioid pain medication at 2 and 5 years); *see also* Kamath et al., *supra* note 39, at 3359 (explaining women have worse functional outcomes after TKR with regard to postop range of motion).

43. Katz et al., *supra* note 39, at 688 (“Similarly, the age-adjusted frequency of total hip arthroplasty is approximately 30% higher in women, but these data include arthroplasty for hip fracture, which occurs much more frequently in women.”).

on at a more advanced state of the disease.⁴⁴ Researchers concluded that the disparities are not “due to gender differences in demographic or clinical characteristics of the patients, and cannot be justified by differences between men and women in the outcome of surgery.”⁴⁵ Females are also eight times more likely to have scoliosis severe enough to require medical intervention, often including back surgery.⁴⁶

Third, women disproportionately experience osteoporosis and fragility fractures associated with osteoporosis. Osteoporosis in the U.S. in persons who are at least 50 years of age is four times more common in women than men.⁴⁷ The risk of hip fracture is three times higher in women than in men based on age and other risk fractures.⁴⁸ Fragility fractures of the distal radius in the wrist are six times more common in women than men.⁴⁹

Finally, other Musculoskeletal diseases with increased prevalence among females include frozen shoulder (i.e., adhesive capsulitis),⁵⁰ lumbar disc degeneration, Lupus (9:1), Sjogren syndrome (9:1), Graves disease (9:1), Hashimoto thyroiditis (10:1), hip dysplasia, metastatic bone cancer,⁵¹ rotator cuff tears, bunions (i.e., hallux valgus), and some musculoskeletal tumors.⁵²

C. Disparities Disfavoring Men

Not all musculoskeletal health and health care disparities disfavor females. Many musculoskeletal disparities disfavor males—including boys and young active men, as well as adult and aging men.

First, several disparities disfavor boys and young active men. Males participating in sports “are markedly more likely than females to sustain acute, traumatic injuries such as . . . fractures.”⁵³ Overall, boys more frequently suffer

44. *Id.* at 687.

45. *Id.*

46. *Scoliosis*, AM. ASS’N NEUROLOGICAL SURGEONS, <https://www.aans.org/Patients/Neurosurgical-Conditions-and-Treatments/Scoliosis> [<https://perma.cc/686E-B5ZT>] (“Females are eight times more likely to progress to a curve magnitude that requires treatment.”).

47. Wolf et al., *supra* note 26, at 341 (observing osteoporosis as it is present in 16% of women compared to 4% in men).

48. *Id.* (noting post-menopausal osteoporosis related to estrogen deficiency is linked to hip fracture occurrence).

49. *Id.* at 342 (explaining females have a “6:1 preponderance of age-related increases in wrist fractures compared with males.”).

50. Tosi et al., *supra* note 1, at 1632 tbl. 1.

51. *Id.* at 1641.

52. Tosi et al., *supra* note 1, at 1632 tbl. 1; *see also* Elizabeth Matzkin et al., *Does Sex Matter in Orthopedic Care?*, 19 *ORTHOPEDIC J. HARV. MED. SCHOOL* 38, 39 tbl.29 (Table 1 (2018)).

53. Carter et al., *supra* note 1, at 447 (also noting that studies support the finding that females are more likely to sustain overuse injuries, like stress fractures and patellofemoral pain, whereas males are more likely to sustain acute traumatic injuries, like fractures or traumatic dislocations).

sports-related injuries (SRIs) than girls with males sustaining 71% of the SRIs and having higher injury rates in 11 of the 13 sports studied.⁵⁴ Traumatic shoulder dislocations and instability, including likelihood of recurrence, is more common (i.e., traumatic shoulder dislocations are more than twice as common) in male athletes than female athletes.⁵⁵ When it comes to hip injuries, males are much more likely to develop femoroacetabular impingement (FAI) than females.⁵⁶ Even though females are more likely statistically to sustain an ACL tear, the absolute number of males having ACL tears is higher than females because the absolute number of males participating in sports in general is higher.⁵⁷ While female basketball players are more likely to sustain ACL tears, male basketball players are more likely to have Osgood-Schlatter disease and jumper's knee (patellar and femoral tendinopathy).⁵⁸ Male players are also almost twice as likely to have an upper extremity injury as female athletes.⁵⁹

Second, several disparities disfavor adult and aging men. Men are more likely suffer from traumatic injuries like broken bones and traumatic dislocations⁶⁰ In addition, men have worse outcomes after hip fractures, including increased morbidity and twice the mortality of women.⁶¹ Osteoporosis has been poorly

54. *Id.*

55. *Id.* at 450 (observing in one study, researchers found males were 2.6 times more likely to “present to the emergency department with a shoulder dislocation than are females.”); Elizabeth Matzkin, *Sports Medicine Experts Highlight Sex-Based Differences in Common Sports Injuries*, HEALIO: ORTHOPEDICS TODAY (July 24, 2018), <https://www.healio.com/orthopedics/sports-medicine/news/online/%7B57a1eb08-f160-4a9d-b2ea-8377803dafa6%7D/sports-medicine-experts-highlight-sex-based-differences-in-common-sports-injuries> [https://perma.cc/36A8-QXNH].

56. Andrea Halim et al., *The Importance of Sex of Patient in the Management of Femoroacetabular Impingement*, 44 AM. J. ORTHOPEDICS 172, 174 (2015), <https://www.amjorthopedics.com/sites/default/files/issues/articles/ajo0440172.pdf> [https://perma.cc/7MXK-9HB6].

57. Carter et al., *supra* note 1, at 449 (“Therefore, given the higher rate of sports participation among males, the absolute number of ACL injuries remains higher for this group than for female athletes.”).

58. Eri Ito et al., *Sex-Specific Differences in Injury Types Among Basketball Players*, 6 OPEN ACCESS J. SPORTS MED. 1, 2 tbl. 1 (2015) (noting for Osgood-Schlatter's disease rates of 12.5% males vs. 1.8% females in 10-19 y/o age group and 14.6% males vs. 3.7% females in the 20-29 y/o age group).

59. *Id.* at 2 tbl. 2 (noting rates of upper extremity injuries of 9.7% in males vs. 5.1% in females).

60. Rebecca Mitchell et al., *Understanding Trauma as a Men's Health Issue: Sex Differences in Traumatic Injury Presentations at a Level 1 Trauma Center in Australia*, 19 J. TRAUMA NURSING 80, 80 (2012) (observing that “males had a higher proportion of trauma presentations,” that males were four times more likely to be victims of assault (8% vs. 2%), that males were more likely to be severely injured, and that males were more likely to be injured while working and during leisure activities).

61. Wolf et al., *supra* note 26, at 342 (observing male sex increases the risk of death (mortality) significantly after hip fracture and that there is “excess mortality after hip fractures in

studied in men,⁶² so there is a significant gender gap in diagnosis and treatment of osteoporosis with around 90% of men with osteoporosis going untreated after fragility fractures.⁶³ Similarly, only 1.2% of male veterans in the VA system underwent bone mineral density testing.⁶⁴ Failure to diagnose osteoporosis in males has important implications to prevent future fractures and to improve longevity.⁶⁵ With regard to cancer, men experience “60% more primary musculoskeletal tumors than females.”⁶⁶

Other Musculoskeletal diseases with an increased prevalence among males include Goodpasture syndrome (3:1), Rheumatoid arthritis (3:2), malignant hyperthermia (including prolonged recovery), Legg-Calve-Perthes disease, osteoid osteoma (3:1), trauma, clubfeet, Dupuytren’s contracture (hand), and sepsis.⁶⁷ It is important to note that men die at greater rates than women for almost all of the leading causes of death in the United States—including all twelve of the leading causes of death—and often from preventable causes.⁶⁸ Regarding health in general, men have significantly shorter life spans than women, which may be the result of societal expectations including engaging in riskier jobs, military service, etc.⁶⁹ Some of these same issues may contribute to disparities disfavoring males in musculoskeletal health.

II. CAUSES OF GENDER DISPARITIES IN MUSCULOSKELETAL CARE

Causes of gender disparities in musculoskeletal health and health care include issues involving the medical community, biological differences between the sexes, and sex-based cultural and societal differences.

A. Medical Community Issues Leading to Disparities

In musculoskeletal care, male norm and male bias may cause disparities due to the lack of sex-based diversity in orthopedics and due to the sex-based bias built into research studies historically. In addition, lack of physician education regarding sex-based differences may play a role.

men compared with women” in all age groups).

62. *Id.*

63. *Id.* (noting only 10.3% of Canadian men were treated for osteoporosis after fragility fracture).

64. *Id.*

65. *Id.*

66. Tosi et al., *supra* note 1, at 1641.

67. *Id.* at 1632 tbl. 1. *See also* Matzkin et al., *supra* note 52, at 39.

68. Shari L. Dworkin, *Masculinity, Health and Human Rights: A Sociocultural Framework*, 33 HASTINGS INT’L & COMP. L. REV. 461, 464 (2010).

69. *Id.* (explaining men “die nearly seven years younger than women in the U.S.”).

1. Male Norm

Male norm is the tendency to use men as the standard in studies that involve disease affecting both sexes.⁷⁰ As explained below, musculoskeletal research, like much of medical research, has historically disproportionately used male subjects and applied findings across the sexes. When research is performed using predominantly male subjects in areas with sex-based differences, the male response is seen as the “norm,” and the female response is seen as “deviant” or abnormal.⁷¹

Historically, sex-based disparities developed in research studies because females were considered vulnerable and complex. The Nuremberg Code (1949) and the Declaration of Helsinki (1964) protected human subjects involved in medical research.⁷² Tragedies linked to the use of diethylstilbestrol and thalidomide in pregnant women in the 1950s and 1960s led to classification of women and unborn children as “vulnerable populations,” such that the FDA established a policy excluding pregnant women and potentially pregnant women from Phase-I clinical studies unless research on potential fetal toxicity had been completed.⁷³ In addition, female hormonal cycles created an additional set of variables that made research study design and data analysis more complicated, so researchers primarily studied males as representative of the entire human population.⁷⁴ This led to a sampling error with a predominance of male specimens in clinical trials.⁷⁵ Because there was a general belief that men and women did not differ significantly in their responses to treatments, researchers did not correct for this sampling error.⁷⁶

In 1985, just eight years after the FDA’s guidelines were established, the United States Public Health Service Task Force on Women’s Health Issues found that lack of research on women’s health issues was compromising women’s health care.⁷⁷ Due to research bias, male responses had “subtly come to be seen as the ‘norm’ and female responses as ‘deviant or problematic.’”⁷⁸ In 1986, the NIH, in response to this report, issued guidelines encouraging researchers to include women in federally funded clinical research projects—but not requiring

70. Tosi et al., *supra* note 1, at 1643.

71. *Id.* at 1642.

72. *Id.*

73. *Id.*

74. *Id.*

75. *Id.*

76. *Id.*

77. *Id.* (stating “a report from the United States Public Health Service Task Force on Women’s Health Issues concluded that women’s health care was compromised by lack of research on women’s health issues” and citing United States Public Health Service Task Force on Women’s Health Issues (Task Force). Task Force, *Report of the Public Health Service Task Force on Women’s Health Issues*, 100 PUB. HEALTH REP. 73 (1985)).

78. *Id.*

women's inclusion.⁷⁹ The General Accounting Office (GAO) found in 1990 that these guidelines were not being followed.⁸⁰ Finally, in 1993, the NIH Revitalization Act of 1993 *mandated* the inclusion of women in clinical trials and established the Office of Research on Women's Health (ORWH), while the FDA rescinded its policy excluding women from Phase-I trials.⁸¹ In 1998, the FDA "announced that it would refuse to file any new drug application that did not include enough women to assess safety and efficacy on the basis of sex."⁸²

While statistics are not available specifically for musculoskeletal disorders in an IOM report, overviews of studies involving other types of diseases are telling.⁸³ For example, a 2012 report indicated that women "constituted less than 40% of participants" in cancer studies.⁸⁴ Similarly, research on cardiovascular disease is particularly male-biased with only 27% of participants being female in a cross-sectional analysis of 19 studies.⁸⁵ Historical underrepresentation of women in research studies has led to "male norm" playing a role in disparities negatively impacting women.

2. *Male Bias*

Musculoskeletal doctors are predominantly male—so, male thought processes and unconscious bias likely are present in musculoskeletal care. Male bias is an observer error related to the adoption of a male perspective and habit of thought.⁸⁶ Physicians, like everyone else, stereotype patients by using "cognitive shortcuts" using social categories (like sex) in "acquiring, processing, and recalling information" about patients.⁸⁷ Cognitive shortcuts can be important for busy professionals to efficiently process, organize, and simplify complex medical

79. *Id.* (citing DEP'T OF HEALTH & HUMAN SERVS., NIH GUIDE FOR GRANTS AND CONTRACTS., VOL. 16., NO. 3, 2 (U.S. Government Publishing Office, 1987)).

80. *Id.*

81. Tosi et al., *supra* note 1, at 1642 (citing Guideline for the Study and Evaluation of Gender Differences in the Clinical Evaluation of Drugs, 58 Fed. Reg. 39,406 (July 22, 1993); National Institute of Health Revitalization Act of 1993, Pub. L. No. 103-43, 107 Stat. 122 (1993) ("In conducting or supporting clinical research for purposes of this title, the Director of NIH shall . . . ensure that—(A) women are included as subjects in each project of such research.")).

82. *Id.* at 1643 (citing Investigational New Drug Applications and New Drug Applications, 63 Fed. Reg. 6854 (Feb. 11, 1998)).

83. THERESA WISEMAN, SEX-SPECIFIC REPORTING OF SCIENTIFIC RESEARCH: A WORKSHOP SUMMARY 1 (The National Academies Press, 2012), <https://genderedinnovations.stanford.edu/Sex%20Specific%20Reporting%20Wizemann%20202.pdf> [<https://perma.cc/3792-4AA4>].

84. *Id.* at 2.

85. *Id.*

86. Tosi et al., *supra* note 1, at 1642-43; *see also* Wolf et al., *supra* note 26, at 344 (noting that surgeon unconscious bias may play a role).

87. Alan Nelson, *Unequal Treatment: Report of the Institute of Medicine on Racial and Ethnic Disparities in Health Care*, 76 ANNALS THORACIC SURGERY S1377, S1379 (2003).

situations, but can also cause unconscious bias in well-meaning, well-educated professionals.⁸⁸ In addition, such unconscious bias can even have self-fulfilling effects by leading to outcomes propagated by the shortcut.⁸⁹ Cognitive shortcutting may be especially prevalent in physicians in high demand, time-limited, and resource-limited environments—like orthopaedic surgeons delivering musculoskeletal care in busy clinics and operating rooms.⁹⁰

Women are less likely to pursue careers in orthopaedic surgery than in any other specialty accounting for only 13% of orthopaedic surgery residents and only 4% of practicing orthopaedic surgeons, even though women make up approximately on half of U.S. medical students.⁹¹

The rate of female medical students entering orthopaedic surgery is around 0.6%.⁹² Orthopaedic surgery also has the lowest representation of women academic faculty of any specialty.⁹³

Male physicians may unconsciously treat female patients differently than their male counterparts. For example, surgeons in one study were twenty-two times more likely to recommend TKR to standardized male patients with moderate knee OA than female patients with identical disease.⁹⁴ The researchers concluded that unconscious bias by surgeons played a role in disparate use of TKR between men and women.⁹⁵

Patient-physician communication may play a role in creating disparities. “[T]here are differences in how men and women communicate with physicians, as well as differences in how male and female healthcare providers relate to patients.”⁹⁶ Studies show that having a doctor of the same sex (i.e., gender concordance) improves communication and trust in the doctor patient relationship.⁹⁷ Gender concordance between physician and patient can be important with “evidence suggest[ing] that same-gender dyads strengthen the effects observed.”⁹⁸ For example, “medical visits between female physicians and

88. *Id.*

89. *Id.*

90. *Id.*

91. Rachel Rohde et al., *Where Are the Women in Orthopaedic Surgery?*, 474 CLINICAL ORTHOPAEDICS & RELATED RES. 1950, 1951 (2016) (explaining that women are only 4% of the fellows of the American Academy of Orthopedic Surgeons, which likely represent almost all practicing orthopedic surgeons); *Mission and History*, PERRY INITIATIVE, <https://perryinitiative.org/about/mission-statement/> [<https://perma.cc/EJT4-W8AH>].

92. Rachel Rohde et al., *supra* note 91, at 1954.

93. *Id.* at 1951.

94. Wolf et al., *supra* note 26, at 344; *see also* Kamath et al., *supra* note 39, at 3358 (“Orthopaedic surgeons may be more likely to recommend TKA for men than women with moderate OA.”).

95. Wolf et al., *supra* note 26, at 344.

96. *Id.* at 339.

97. Debra Roter & Judith Hall, *Physician Gender and Patient-Centered Communication: A Critical Review of Empirical Research*, 25 ANN. REV. PUB.HEALTH 497, 508 (2004).

98. *Id.*

female patients [are] characterized by longer encounter length and more equal patient and physician contributions to the medical dialogue (18, 51)⁹⁹ with “more positive statements, head nodding, and interest cues(18, 27).”¹⁰⁰ Interestingly, “[m]edical visits between male physicians and male patients were characterized by the shortest visit time and the highest level of physician verbal dominance.”¹⁰¹

However, it is not clear that gender concordance would lead to higher satisfaction among female patients, nor improve disparities noted above. Interestingly, “on average, female physicians spend 2 minutes longer with patients; however, patient perceptions of female physicians are consistently more likely to be negative compared with male physicians.”¹⁰² Similarly, in one study of primary care physicians, “female patients who chose female physicians were the least satisfied, while male patients who selected these same female physicians were the most satisfied.”¹⁰³ “Patients who chose a physician of the opposite gender tended to be more satisfied with their physician than patients who selected a physician of the same gender.”¹⁰⁴ “‘Gender-based’ care ideals such as better communication on social, lifestyle, prevention, and emotional concerns” may lead to higher expectations and lower ratings for female physicians when patients feel these “ideals” are not met.¹⁰⁵ Interestingly, “[f]emale physicians treating male patients have been shown to display a different manner, including smiling more and acting more interested, than when treating female patients,” which “may account for male patients’ higher satisfaction” with the same female doctors.¹⁰⁶

3. Lack of Education Regarding Sex-Based Differences

Musculoskeletal physicians “do not routinely consider the sex of a patient when evaluating or formulating treatment plans for patients with musculoskeletal disorders.”¹⁰⁷ For example, only 37% of physicians had even heard of Female Athlete Triad in a recent study, which has important implications for long term

99. *Id.*

100. *Id.* “A recent comparative study of medical communication in six Western European countries also found that female concordant dyads were longer, had higher levels of psychosocial discussion, emotional exchange, and eye contact, and had lower levels of physician verbal dominance.” *Id.*

101. *Id.*

102. Wolf et al., *supra* note 26, at 339.

103. J. Schmittiel et al., *Effect of Physician and Patient Gender Concordance on Patient Satisfaction and Preventive Care Practices*, 15 J. GEN. INTERN MED. 761, 768 (2000).

104. *Id.* at 766 (speculating that female patients may have higher expectations of female doctors than male doctors).

105. *Id.* (“[F]emale patients place a higher value than male patients on physicians’ communication skills and personal manner.”).

106. *Id.* at 767.

107. Matzkin et al., *supra* note 52, at 38.

bone health in young women.¹⁰⁸ Failure of doctors to recognize bone issues like Female Athlete Triad in adolescents can lead to lasting effects because failure to accrue important bone mass at an early stage in life may lead to osteoporosis and fragility fractures later in life because 90% of peak bone mass is accumulated by adolescence.¹⁰⁹ Physicians also generally fail to recognize that women may respond differently to pain and to pain medications than men due to neurophysiologic differences.¹¹⁰ Many of the other sex-based differences noted throughout the rest of this article are largely de-emphasized or ignored in medical training—potentially contributing to disparities disfavoring both sexes, but especially women.

B. Sex-based Biologic Differences May Contribute to Some Disparities

Emerging research across organ systems, not just reproductive organ systems, now shows that the human body responds differently based upon sex.¹¹¹ Musculoskeletal medical experts agree that there are “sex-based differences in cell biology, tissue function, and disease presentation and management” affecting musculoskeletal care.¹¹² These differences are related to hormonal and chromosomal (genetic) differences between the sexes.¹¹³ “[A] male cell is not the same as a female cell, and sex chromosome-linked genes can be expressed” differently in cells from all organ systems.¹¹⁴ Important musculoskeletal differences between males and females include differences in (1) bone size, shape, and material properties, (2) neuromuscular characteristics, (3) ligament properties, and (4) hormonal influences.

108. Carter et al., *supra* note 1, at 449.

109. *Id.* at 448.

110. Kamath et al., *supra* note 39, at 3359 (observing that women have worse pain postoperatively than men); Tosi et al., *supra* note 1, at 1639 (“Differences in the efficacy of analgesics in men and women have also been described.”).

111. Tosi et al., *supra* note 1, at 1631 (“[E]merging information . . . provides a compelling case for the existence of innate, and heretofore unexamined, differences between men and women.”); Carter et al., *supra* note 1, at 447 (observing that the “musculoskeletal system is rife with sexual dimorphism” and giving one example as “males have greater bone mass, greater muscle mass, and greater lean mass than do females”); see also, Matzkin et al., *supra* note 52, at 39 (stating (1) “women tend to have less muscle mass and different skeletal muscle fiber composition,” (2) “sex-specific hormones such as estrogen and testosterone are implicated in muscle growth, regulation of muscle mass, and contractile function,” (3) “[w]omen have lower bone mineral density and lower peak bone mass,” (4) “female bone has less cortical area due to reduced periosteal apposition during growth, resulting in intrinsically weaker bone,” and (5) “functional stabilizing control also differs between men and women, because of sex-based differences in muscle recruitment and activation as well as greater ligamentous laxity amongst women”).

112. Tosi et al., *supra* note 1, at 1643.

113. *Id.* at 1643.

114. *Id.* at 1631-32.

1. Differences in Bone Size, Shape, and Material Properties

First, men and women have different bone characteristics including size, shape, and material properties, and the genes that control bony traits may be different for women than men.¹¹⁵ However, these differences rarely account for disparities in rates of injury or in recovery statistics.¹¹⁶

Bone strength is influenced by size, shape, and material properties that differ based upon sex.¹¹⁷ In young adulthood, “men have a bone area that is 35% to 42% larger than women,” which is consistent with men’s generally larger body size.¹¹⁸ At full maturity, generally men’s bones are wider and longer than women’s bones.¹¹⁹ In addition, some differences in the shapes of male versus female bones can lead to disparities. For example, women have anatomic shapes of their shoulder bones that predispose them to shoulder dislocations like smaller glenoids (shoulder socket), higher glenoid inclination angles, and a more oval shape (compared to a more circular shape for men’s glenoids).¹²⁰

However, a causal link between higher injury rates and smaller bone size or different morphology has not been definitively established. Larger bones do not always translate into fewer injuries. For example, young men are more prone to traumatic injuries like fractures generally, where tendencies toward higher risk behaviors and occupations and higher velocity/mass traumas may contribute.¹²¹ In addition, women tend to place proportionately less force across their bones and joints due to their generally smaller body size—so that proportionately, their bones are not necessarily smaller in relation to their overall body size.

For example, with regard to ACL tears in the knee, sex-based smaller bony dimensions and possibly unfavorable ACL attachment orientation have not been proven to have a causal relationship to ACL injury to date.¹²² Similarly, when falling from a standing height, because men are generally taller, they may fall from a higher height, placing more pressure upon impact and leading to similar fracture risk.

115. *Id.* at 1636 (“Bone strength is determined by the morphology (shape and size) and the quality (material properties) of the bones; the genes that control these traits may be different for men and women.”).

116. *Id.*

117. *Id.*

118. Wolf et al., *supra* note 26, at 342.

119. *Id.*

120. Carter et al., *supra* note 1, at 450.

121. See discussion *infra* note 123.

122. Carter et al., *supra* note 1, at 449 (“Sex-based differences in the osseous anatomy of the knee have been reported, including differences in femoral condyle shape, hip version, and the length of the femur compared with the pelvic width [, but t]o date, however, no causal relationship between these factors and ACL injury has been proven.”).

2. Differences in Neuromuscular Characteristics

Second, men and women have different neuromuscular characteristics. Generally, men have greater lean body mass with muscle composing a larger percentage of body mass than women.¹²³

Sex differences in muscle response and recruitment may play a role in some injury patterns.¹²⁴ Men and women have different gait and motion patterns, as well as different responses to muscle stiffness.¹²⁵ Women have an “impaired ability . . . to recover balance after a perturbation” compared to men, potentially leading to more falls.¹²⁶ However, it is not clear that these differences are causally linked to increased injury rates. For example, sex differences in musculoskeletal stability related to active muscle recruitment and coactivation have been postulated to be related to higher incidences of ACL injuries in females, but a causal link has not been proven to date.¹²⁷

Neuromuscular factors are also postulated to be related to higher concussion rates among females. “Biomechanical factors such as head size and neck strength and girth have been associated with higher concussion rates among females.”¹²⁸ Biomechanical studies reveal that during trauma “females can experience nearly 50% more head acceleration during head trauma than males” possibly due to more slender necks and weaker neck musculature.¹²⁹ In addition, as a result of sex-based differences, “[c]oncussion outcome may be worse in females than males.”¹³⁰

Neuromuscular differences may also play a role in how men and women experience pain and pain medications. “[T]he sexes differ qualitatively in their neural processing of pain and analgesia.”¹³¹ In other words, “different neural circuits, transmitters, receptors, and genes may be relevant to pain modulation in males and females.”¹³² Generally, “[f]emales are more sensitive to, less tolerant of, and more able to discriminate pain,” and “painful disorders are more prevalent in females than in males.”¹³³ In addition, pain medications may work differently

123. Carter et al., *supra* note 1, at 447 (“[M]ales have greater bone mass, greater muscle mass, and greater lean mass than do females.”); *see also* Matzkin et al., *supra* note 52, at 39 (explaining “women tend to have less muscle mass and different skeletal muscle fiber composition”).

124. Tosi et al., *supra* note 1, at 1636, 1641 tbl. III.

125. *Id.* at 1638 (“Men and women have different patterns of athletic injuries as well as altered gait and motion patterns. Biomechanical responses to muscle stiffness exhibit sex differences.”).

126. *Id.* at 1641 tbl. III.

127. *Id.* at 1637.

128. Andrew Lincoln et al., *Trends in Concussion Incidence in High School Sports: A Prospective 11-Year Study*, 39 AM. J. SPORTS MED. 958, 962 (2011), <https://journals.sagepub.com/doi/abs/10.1177/0363546510392326>.

129. Carter et al., *supra* note 1, at 452.

130. Lincoln et al., *supra* note 129, at 962.

131. Tosi et al., *supra* note 1, at 1639 (emphasis omitted).

132. *Id.*

133. *Id.*

based upon sex leading do differences in efficacy.¹³⁴

In addition, neuromuscular differences may lead to disparities in preoperative function prior to joint replacement surgeries.¹³⁵

3. Differences in Ligament Characteristics

Sexual dimorphism in ligament laxity is well established and has been partially attributed to hormonal differences.¹³⁶ Generally female ligaments are smaller and more lax than male ligaments on average.¹³⁷ In some cases, these differences are believed to account for differences in rates of injury. For example, female athletes are more prone to ankle sprains than their male counterparts, possibly due to higher ligamentous laxity, altered proprioception, and/or neuromuscular deficit.¹³⁸ X-ray tests show that female athletes' ankles "tilt" under stress around triple the amount males' ankles tilt using the same test.¹³⁹

Increased shoulder range of motion and greater prevalence of ligamentous laxity also contribute to shoulder instability in females.¹⁴⁰ Little information is available regarding sex-based treatment differences or in functional outcomes between the sexes with regard to multidirectional shoulder instability.¹⁴¹

However, these differences do not necessarily account for differences in injury rates for all ligaments. For example, while it is true that the ACL is generally smaller in females than males and thus likely has a lower load to failure (assuming no sex differences in internal structure of the ligament),¹⁴² females likely place a proportionately lower load across their ACLs given lower bone mass and weights—so it is not surprising that these size differences have not been causally linked to higher incidence of ACL tears among females to date.

4. Differences in Hormonal Influences

Hormonal differences may account for some disparities in male and female

134. *Id.* ("Differences in the efficacy of analgesics in men and women have also been described.")

135. Wolf et al., *supra* note 26, at 344 (noting that "[w]orse preoperative function in women may be related to gender-based differences in neuromuscular activation.")

136. Tosi et al., *supra* note 1, at 1637-38 ("Sex differences in ligament laxity are well established and partially attributed to hormonal differences.")

137. *Id.* at 1637 ("Because the size of the anterior cruciate ligament is generally smaller in females than in males, the loads at failure will be lower, assuming that there are no sex differences in the internal structure of the anterior cruciate ligament.")

138. Wolf et al., *supra* note 26, at 341.

139. *Id.* (explaining that talar tilt stress radiographs in athletes reveals that female athletes tilted 3.20 in vs. 1.07 in males).

140. Carter et al., *supra* note 1, at 450.

141. *Id.*

142. Tosi et al., *supra* note 1, at 1637.

musculoskeletal injury—however, research is far from conclusive.

For example, some evidence suggests hormonal differences play a role in ACL tears. For ACL injuries, researchers know that ACL cells (fibroblasts) contain estrogen (and androgen) receptors, but the impact of these receptors is not clear.¹⁴³ Menstrual cycle phase has been found to correlate with the occurrence of ACL injury in at least a couple of studies, suggesting circulating hormone levels may play a role.¹⁴⁴ Research is unclear as to whether estrogen affects ligamentous laxity, and more study is needed.¹⁴⁵

In another example, hormonal differences may play a role in concussions where animal studies hint that estrogen has a greater detrimental effect on the brain after trauma in females.¹⁴⁶ “Concussion outcome may be worse in females than males” with differences noted in baseline neuropsychological function and in post concussion outcomes for collegiate athletes.¹⁴⁷

Also, hormonal differences may account for differences in rates of arthritis in the knee in females versus males. Between the ages of fifty and seventy-nine, women lose articular cartilage in their knee three to four times faster than men.¹⁴⁸ The reasons behind these differences is unclear.¹⁴⁹ Estrogen may play a role because knee articular cartilage contains estrogen receptors and OA is higher incidence in postmenopausal women.¹⁵⁰ Estrogen replacement therapy did prevent around 13% of TKRs in one study—but the finding was not statistically significant and other studies have been contradictory.¹⁵¹ Biologic processes (like inflammation) and physical factors (like obesity and physical activity) can influence the prevalence of OA of the knee.¹⁵² Obesity has a stronger association with onset and progression of knee OA in women than men—possibly due to an increase in inflammatory cytokines and mechanical factors.¹⁵³ This is another area

143. Wolf et al., *supra* note 26, at 340.

144. Tosi et al., *supra* note 1, at 1638 (noting a study finding a correlation between “the occurrence of a noncontact injury of the anterior cruciate ligament and the female collegiate athlete’s menstrual cycle” and another study demonstrating “an effect of menstrual cycle phase on anterior cruciate ligament injury”).

145. *Id.* (noting one study “observed a negative effect of high-dose estrogen on rabbit ligament laxity,” while another study “reported no difference,” and that “the basis for the sex differences in ligament laxity remains controversial”).

146. Carter et al., *supra* note 1, at 452.

147. Lincoln et al., *supra* note 129, at 962.

148. Wolf et al., *supra* note 26, at 342-43 (observing that MRI studies show that women lose articular cartilage in the knee (tibia) at four times the annual rate of men between the ages of 50 and 79 and that women lose their kneecap cartilage at a rate of 3.3% annually compared to 1.4% for men).

149. *Id.* at 343.

150. *Id.*

151. *Id.* (explaining that while hormone replacement therapy decreases joint pain, it does not protect against development of OA on x-ray at 14 years).

152. *Id.*

153. *Id.*

where research to understand gender-based biologic differences may be helpful.¹⁵⁴

*C. Cultural or Societal Differences in Sex-based Expectations
Leading to Disparities*

Cultural or societal differences in sex-based expectations and socioeconomic status can play a role in disparities. Men and women tend to behave in different ways culturally in society (e.g., they dress differently, enjoy different activities, eat differently, etc.). These differences in behavior may be related to societal or cultural pressures, but may also reflect biologic differences related to genetic and hormonal influences. For example, identical twin studies demonstrate the strong influence that genetics have on behavior.¹⁵⁵ Cultural and/or social pressures/differences include: (1) Societal influences, (2) Relationship factors including intimate partner violence (IPV), (3) Risk preferences, and (4) Socioeconomic factors.

1. Societal Influences

Societal influences may include differences in (a) dietary pressures, (b) functional expectations, (c) willingness to reveal injury, (d) exercise patterns and responses, and (e) stereotyping of particular female-dominated activities.

a. Dietary differences leading to stress fractures

Dietary differences between the sexes begin in childhood and adolescence. Girls “[feel] obliged” to “be slim” and therefore “eat less and pay attention to calories, sugar and fat intake.”¹⁵⁶ Consequently, “girls are more likely than boys to develop eating disorders (i.e., anorexia, bulimia, binge eating disorder).”¹⁵⁷ Dietary disorders among young active women can lead to hormonal irregularities and stress fractures.

The Task Force on Women’s Issues of the American College of Sports Medicine identified the syndrome they called Female Athlete Triad describing

154. *Id.*

155. Thomas Bouchard et al., *Sources of Human Psychological Differences: The Minnesota Study of Twins Reared Apart*, 250 *SCIENCE* 223, 223 (1990) (noting that on “multiple measures of personality and temperament, occupational and leisure time interests, and social attitudes” that identical twins reared apart are “about as similar” as identical twins reared together—suggesting that genetics, and not environment, may play a larger role in behavior).

156. Claudia Arganini et al., *Gender Differences in Food Choice and Dietary Intake in Modern Western Societies*, in *PUBLIC HEALTH: SOCIAL AND BEHAVIORAL HEALTH* 83, 89 (2012), http://cdn.intechopen.com/pdfs/36935/InTech-Gender_differences_in_food_choice_and_dietary_intake_in_modern_western_societies.pdf [https://perma.cc/5DJE-NJ9L].

157. *Id.* (explaining that women—especially during childhood and adolescence—are more likely to have eating disorders than men).

disordered eating or low energy availability, menstrual irregularities (i.e., amenorrhea), and low bone mineral density (BMD).¹⁵⁸ Up to 36% of female high school athletes have demonstrated low energy availability possibly reflecting an eating disorder.¹⁵⁹ Similarly, 54% of female high school athletes had menstrual dysfunction.¹⁶⁰ In one study, 11% of adolescent female athletes had bone stress injuries related to Female Athlete Triad.¹⁶¹ Because 90% of peak bone mass is accumulated by adolescence, failure to accrue important bone mass at an early stage in life may lead to osteoporosis and fragility fractures later in life—so, the effects of early dietary discrepancies between females and males may persist into later life.¹⁶²

Supporting the idea that societal pressure may play a significant role in development of Female Athlete Triad and its associated bone stress injuries and fractures, a similar syndrome called “RED-S” is relatively common in male athletes who “participate in sports emphasizing leanness, including aesthetic sports (e.g., [sic] gymnastics), endurance sports (e.g., [sic] running, cycling), and sports with weight classification (e.g., [sic] rowing, wrestling).”¹⁶³

b. Functional expectations: patient preferences or doctor biases?

Some researchers suggest that women may be more willing to accept functional limitations than men. Physicians and/or their female patients may view “symptoms and functional loss as less important for women than for men,” and therefore women may choose or be steered toward less aggressive courses of treatment than men.¹⁶⁴ In addition, “[m]en may place greater value on physical function than women and therefore accept greater potential risk to improve their functional status.”¹⁶⁵ Women tend to be operated on at a more advanced stage of the disease, suggesting either patient delay or doctor delay in scheduling surgery.¹⁶⁶ For example, women tend to present to orthopedic surgeons for treatment of their knee OA later in the course of the disease than men.¹⁶⁷ But delay in elective surgery is not necessarily discriminatory or negative. Researchers could not tell whether women received surgery “too late in the

158. Carter et al., *supra* note 1, at 448.

159. *Id.* (including 63% of endurance athletes and 77% of ballet dancers).

160. *Id.* (including 60% of endurance athletes and 36% of ballet dancers).

161. *Id.*

162. *Id.*

163. *Id.* at 449.

164. Katz et al., *supra* note 39, at 693.

165. *Id.*

166. *Id.* at 692 (explaining that “women undergoing 3 major orthopedic procedures have worse preoperative functional status than men, suggesting that they are operated on at a more advanced stage in the course of disease”).

167. Singh et al., *supra* note 41, at 1100; Katz et al., *supra* note 39, at 692 (observing that differences in preoperative functional status were “not explained . . . by variables . . . [like] age, comorbidity, body mass index, work status, and whether patients live alone.”)

course of disease, men too early, or whether the patterns we observed were appropriate.”¹⁶⁸ They observed that if “men and women receive services consistent with their preferences [under informed consent doctrine], the disparities . . . observed may be appropriate.”¹⁶⁹

However, even appropriate delays respecting patient preferences can lead to disparities after surgery. Researchers speculate that worse outcomes may be due to the fact that women undergo TKR when the arthritis is in a more advanced state, which correlates with worse functional outcomes after surgery.¹⁷⁰

c. Willingness to reveal injury: male underreporting may lead to sampling error inflating apparent disparities

Males may perpetuate sampling errors by being less likely to reveal injury, which can lead to erroneous appearance of a disparity. “Evidence suggests that females are more willing than males to report general injuries, which represents a potential bias toward increased detection in females.”¹⁷¹ In addition, women report more disabilities than men when dealing with “similar observed difficulty in performing specific tasks.”¹⁷² “Male athletes may be more likely than female athletes to hide concussions and fail to report them for fear of not being able to continue playing or to participate in sports.”¹⁷³ “Gender stereotypes may reinforce this behavior, with boys wanting to appear ‘manly’ after sustaining a concussion and ‘toughing it out’.”¹⁷⁴ Some researchers find that adult men likewise may be underreporting functional impairments.¹⁷⁵

d. Exercise and landing position factors in ACL tears [ELISSA STOP]

In jumping sports, girls tend to land differently than boys, leading to higher incidence of ACL injuries. Before puberty, males and females land similarly with knees wide apart, but this changes after puberty such that females land with their knees closer together in a position called “valgus,” which makes females more prone to ACL tears because it increases strain across the ACL.¹⁷⁶ Whether this is

168. Katz et al., *supra* note 39, at 692.

169. *Id.* at 694688.

170. Kamath et al., *supra* note 39, at 3359 (observing that women have worse functional outcomes after TKA with regard to postop ROM).

171. Lincoln et al., *supra* note 129, at 962; *see also* Katz et al., *supra* note 39, at 692 (“[W]omen have been noted to report more disability than men with similar observed difficulty in performing specific tasks[, so,] our findings may simply indicate that men underreport, or women over-report, functional limitations.”).

172. Katz et al., *supra* note 39, at 692.

173. Carter et al., *supra* note 1, at 452.

174. *Id.*

175. Katz et al., *supra* note 39, at 692.

176. Tosi, et al., *supra* note 1, at 1637.

a learned social response or a biologic response to differences in body characteristics is difficult to say. Likewise, modifiable leg and pelvis positioning tendencies demonstrated while performing mini-squats make female athletes more vulnerable to ACL rupture.¹⁷⁷

e. Sex-stereotyping: failure to adequately recognize health risks associated with some predominantly female athletic activities

Failure of medical professionals and educational institutions to recognize some traditionally female activities as “sports” with injury potential can lead to disparities that compromise musculoskeletal safety. For example, 96.8% of injured high school cheerleaders are girls.¹⁷⁸ “Cheerleading athletes have historically been marginalized as supportive performers.”¹⁷⁹ In addition, medical professionals often fail to recognize the risks and schools fail to recognize the medical needs of some female athletes—like cheerleaders.¹⁸⁰ Cheerleading is not just a sideline activity, it is an athletic and competitive sport at many schools.¹⁸¹ “Approximately 400,000 students participate in U.S. high school cheerleading annually,” which ranks cheerleading as the “fourth most popular high school girls’ activity.”¹⁸² Although cheerleading is relatively safe overall, when injuries do occur, they may be more severe, with catastrophic injury rates in cheerleading accounting for 65% of female catastrophic injuries in high school sports.¹⁸³

2. Relationship Factors: Intimate Partner Violence (IPV) Is More Likely to be a Cause of Fracture in Women

Musculoskeletal injuries are one of the most common manifestations of intimate partner violence (IPV), which is the “leading cause of non-fatal injury to women worldwide.”¹⁸⁴ “One in six women [orthopedic fracture clinic patients] . . . disclosed a history of IPV within the previous year, and one in three had . . . experienced IPV in their lifetime.”¹⁸⁵ Almost 2.2% (1/50) of women in the orthopedic fracture clinic attended their visit as a direct result of IPV, but only

177. Carter, *supra* note 1, at 449 (Table 1).

178. Dustin W. Currie et al., *Cheerleading Injuries in United States High Schools*, 137 PEDIATRICS 1, 1 (2016), <http://pediatrics.aappublications.org/content/pediatrics/137/1/e20152447.full.pdf> [<https://perma.cc/UJ9T-Q8A2>].

179. *Id.* at 7.

180. *Cheerleading: Where the injuries are less frequent, more severe*, HEALTH ESSENTIALS: BRAIN & SPINE (Jan. 13, 2017), <https://health.clevelandclinic.org/cheerleading-injuries-less-frequent-severe/> [<http://perma.cc/YEL4-Q5M8>].

181. *Id.*

182. Currie, *supra* note 179, at 2.

183. *Id.* at 7.

184. PRAISE Investigators, *supra* note 36, at 866.

185. *Id.*

14% of them were ever asked about IPV in a health care setting.¹⁸⁶

3. Preferences and Risks

Men and women tend to view risk differently.¹⁸⁷ These differences can lead to an increased prevalence of risk-related injuries in men, such as fractures and dislocations associated with trauma from risky behavior. In addition, men may be more willing to accept surgical risks in order to gain improved function than women, leading to differences in rates of choosing elective surgeries like joint replacements.

a. Risk taking behaviors: risk of injury

Men tend to engage in activities with higher risks of musculoskeletal injury at higher rates than women.¹⁸⁸ Men are more likely to poorly manage anger and stress than women.¹⁸⁹ “Men abuse alcohol and other drugs at least twice as often as women.”¹⁹⁰ Men “commit 86% of violent crimes.”¹⁹¹ Although women fracture patients are at risk of being victims of violence at the hands of men, men actually injure and “kill other men at a significantly higher rate than they do women.”¹⁹² “Men are three times as likely as women to be involved in fatal car accidents.”¹⁹³ In the U.S., men “constitute more than ninety percent of those employed in dangerous occupations, and men have a much higher workplace injury rate than do women.”¹⁹⁴ “Men are also injured in and killed in wars at far greater rates than women.”¹⁹⁵ All of the above contribute to differing types and rates of musculoskeletal injury among men and women.

b. Risk taking behaviors: accepting surgical risks

Similarly, men may be more willing to engage in activities with inherent risks—like surgery. Women may be more inclined than men to avoid taking risks associated with surgery due to different analysis of the risk/benefit ratio of the

186. *Id.* at 872.

187. Christine R. Harris et al., *Gender Differences in Risk Assessment: Why do Women Take Fewer Risks than Men?* 1 JUDGMENT AND DECISION MAKING 48, 48 (July 2006), <http://journal.sjdm.org/jdm06016.pdf> [<https://perma.cc/2BXY-4UQU>].

188. Dworkin, *supra* note 68, at 464.

189. *Id.*

190. *Id.*

191. *Id.*

192. *Id.* at 465.

193. Harris, *supra* note 188, at 48; *see also*, Dworkin, *supra* note 68, at 464 (noting that men are involved in car accidents at higher rates than women).

194. Dworkin, *supra* note 68, at 465.

195. *Id.*

surgical procedure.¹⁹⁶ Likewise, “men may place greater value on physical function than women and therefore accept greater potential risk to improve their functional status.”¹⁹⁷ Return to physical activities may be more important psychologically for men, which may account for differences in statistics regarding return to activities.¹⁹⁸ “[I]f . . . men and women receive services consistent with their preferences, the disparities . . . may be appropriate.”¹⁹⁹ Researchers indicate that these are only theoretical differences and that further study is required.²⁰⁰

4. Socioeconomic Status and Practical Considerations

Socioeconomic status can play a major role in propagating disparities. Poverty, lack of insurance, lack of transportation, and similar issues can create barriers to access necessary musculoskeletal care. Likewise, practical barriers like living alone, lack of a social support network to help during times of recovery from injury/illness, and caregiver obligations for dependent family members or friends can limit access to musculoskeletal care.

a. Poverty, lack of insurance (or under insurance), transportation, etc.

“[P]overty has always been a key factor in determining a person’s prospects for health.”²⁰¹ Women are more likely to be living in poverty than men.²⁰² Also, socioeconomic pressures may play a role in accepting lower functional levels where women may be less likely to be able to afford expensive procedures. Factors contributing to women’s lack of access to health care include “lack of transportation, inability to pay for services, [and] lack of health insurance.”²⁰³ Women are often the primary caregivers to the children in their family, and therefore, “women are less likely to have employment-related health insurance coverage” than men.²⁰⁴ “Thus, in general, women are less likely to have private insurance and are more likely to have public assistance coverage.”²⁰⁵ In addition, many private insurance policies and Medicaid “do not cover many important services for women.”²⁰⁶ Therefore, elective surgeries like knee replacement may be relatively inaccessible to women compared to men.

196. Katz, *supra* note 39, at 693 (stating “women may be more averse to taking risks than are men, and avoid surgery because of its potential complications”).

197. *Id.*

198. *Id.* at 692.

199. *Id.* at 694.

200. *Id.*

201. Susan L. Waysdorf, *Fighting for Their Lives: Women, Poverty, and the Historical Role of United States Law in Shaping Access to Women’s Health Care*, 84 KY. L. J. 745, 745 (1996).

202. *Id.* at 760.

203. *Id.* at 756.

204. *Id.* at 757.

205. *Id.*

206. *Id.*

b. Practical barriers: living alone, lack of social support network, caregiver obligations

“Practical considerations may prompt women to defer surgery as long as possible”; for example, “women more often live alone or take care of disabled spouses.”²⁰⁷ Women undergoing total knee replacement are four times more likely to live alone than men.²⁰⁸ In addition, women are more likely to be functioning as caregiver and may be less able to take time to care for themselves.²⁰⁹ Lesser social support networks can play a role in delaying elective surgeries;²¹⁰ this may be particularly relevant for African American women because “[o]nly 30.8% of African-American women had someone at home to care for them after surgery compared to 50% of African-American men and 75% of Caucasians.”²¹¹

These practical issues present barriers to major surgeries like joint replacement surgery. Women living alone have been shown to more commonly delay surgery and have worse 1-year outcomes.²¹² Social or familial support is usually necessary for the patient after major surgeries like joint replacement after they return home in the weeks immediately following the surgery.²¹³ Therefore, due to delays in seeking care, women may experience decreased function, be older in age, and have more pain compared to men immediately prior to their elective surgeries.²¹⁴ However, disparities are present, even when living arrangements are considered, so the other disparities mentioned above also likely play a more significant role in the overall causation of disparities.

207. Katz, *supra* note 39, at 693; *see also* Rajiv Gandhi et al., *Effect of Sex and living Living Arrangement on the Timing and Outcome of joint replacement Joint Replacement Surgery*, 53 CAN. J. SURGERY 37, 37 (2010) (“Patients who live alone may delay joint replacement surgery until an older age and have greater joint pain and dysfunction than those who live with another person, leading to poorer 1-year outcomes.”).

208. Katz, *supra* note 39, at 691 (Table 1) (finding 33.6% of women undergoing total knee replacement lived alone versus 8.3% of men).

209. *Women and Caregiving: Facts and Figures*, FAM. CAREGIVER ALL. (Dec. 31, 2003), <https://www.caregiver.org/women-and-caregiving-facts-and-figures> [<https://perma.cc/W4VZ-9W64>] (noting that “[a]n estimated 66% of caregivers are female”).

210. *Id.* at 694 (noting additional social support services might help women acting as caregivers decide to have elective surgeries sooner).

211. Kamath, *supra* note 39, at 3359.

212. Wolf, *supra* note 2726, at 344; *see also*, Gandhi, *supra* note 209208, at 37 (“Patients who live alone may delay joint replacement surgery until an older age and have greater joint pain and dysfunction than those who live with another person, leading to poorer 1-year outcomes.”).

213. Katz, *supra* note 39, at 694 (noting additional social support services might help women acting as caregivers decide to have elective surgeries sooner).

214. Wolf, *supra* note 2726, at 344.

III. LAW AND POLICY SOLUTIONS TO SEX-BASED DISPARITIES IN MUSCULOSKELETAL HEALTH

Sex-based disparities in musculoskeletal care are multifactorial and complex, and correction of disparities will require combined efforts by lawmakers, policymakers and medical professionals. Solutions to gender disparities in musculoskeletal care include: (a) improving sex-based musculoskeletal care in the medical community, (b) embracing sex-based differences in health care needs in musculoskeletal care, and (c) addressing societal and cultural factors.

A. Improving Sex-Based Musculoskeletal Care in the Medical Community

In the medical community, improving musculoskeletal care in both sexes can be achieved by (1) sex-specific medical research and (2) increasing the sex diversity of musculoskeletal professionals. In addition, incorporation of sex-based differences in musculoskeletal medicine in medical education is important and is covered in the next section (B).

1. Sex-Specific Medical Research

Increased understanding of sex-based differences related to genetics, hormones, and biologic makeup gained through sex-specific scientific research should improve health outcomes for both sexes. In the past, “[o]nly rarely have sex-specific differences been considered when defining how best to provide clinical care.”²¹⁵ NIH is already attempting to address this issue in government funded research.

NIH-funded clinical research has been undergoing changes to include more women in research. Concerns were raised in the late 1980s that clinical research being conducted primarily using males was being applied to women.²¹⁶ In 1990, the Office of Research on Women’s Health was established to ensure inclusion of women in NIH-funded clinical studies.²¹⁷ The NIH Revitalization Act of 1993²¹⁸ included four major requirements on the inclusion of women in clinical research: (1) “ensure that women . . . are included in all human-subjects research;” (2) “ensure that in phase 3 clinical trials [if evidence reveals likelihood of sex-based differences], women . . . are included in such a way that valid analyses of differences in intervention effect can be performed;” (3) “not allow cost to be used as an excuse for excluding [women];” and (4) “initiate programs and support for outreach efforts to recruit [women] groups into clinical studies.”²¹⁹

These changes have produced some positive effects. By 2000, the GAO

215. Tosi, et al., *supra* note 1, at 1632.

216. Wiseman, *supra* note 83, at 4 (Box 1).

217. *Id.*

218. National Institute of Health Revitalization Act of 1993, Pub. L. No. 103-43, 107 Stat. 122.

219. Wiseman, *supra* note 83, at 4 (Box 1).

“reported that NIH had made substantial progress in strengthening and implementing its policy on inclusion of women in clinical trials.”²²⁰ Other researchers noted, NIH has “implemented a series of policy changes that substantially increased the proportion of females participating in NIH-funded clinical trials,” which is already “improving our understanding of sex-based differences that exist in clinical medicine.”²²¹ In addition, the researchers acknowledged that the NIH is focusing on “ensuring that preclinical trials include both male and female cells and animals in the laboratory.”²²²

However, even today, “[p]otential sex bias [still] exists in orthopaedic surgery basic science and translational research, with an overrepresentation of male specimens.”²²³ Basic science research forms the foundation for subsequent clinical research, which can propagate disparities if sex-based differences go unrecognized.²²⁴ In a systematic review in 2018, 35% of authors “did not report the sex of animals, cells, or cadavers used.”²²⁵ In the studies where sex was reported, 43% used male only, 25% used female only, and 33% used both sexes.²²⁶ When both sexes were used, only 13% of authors reported sex-based results.²²⁷

Additional studies, similar to the 20-plus year, multi-billion-dollar Women’s Health Initiative (WHI) sponsored by the National Institutes of Health (NIH) should be supported—with attention to differences in musculoskeletal health. The WHI is a “long-term national health study that has focused on strategies for preventing major causes of death, disability, and frailty in older women, specifically heart disease, cancer, and osteoporotic fractures.”²²⁸ The study originally enrolled over 161,000 women aged 50-70 between 1993 and 1998, and it included a Clinical Trial part including over 68,000 women and an Observational Study part including over 93,000 women.²²⁹ The study has been extended several times, most recently in 2015 for an additional five years of funding to continue follow-up of participants through 2020 with annual reports available online.²³⁰

220. *Id.*

221. Carter, *supra* note 1, at 447.

222. *Id.*

223. Jessica Bryant, et al., *Potential Sex Bias Exists in Orthopaedic Basic Science and Translational Research*, 100 J. BONE JOINT SURG. 124, 124 (Jan. 17, 2018).

224. *Id.*

225. *Id.*

226. *Id.*

227. *Id.*

228. *About WHI*, WOMEN’S HEALTH INITIATIVE, <https://www.whi.org/about/SitePages/About%20WHI.aspx> [<https://perma.cc/83SW-C3F4>].

229. *Id.*

230. *WHI Extension Study 2005-2010*, <https://www.whi.org/about/SitePages/WHI%20Extension%202005-2010.aspx> [<https://perma.cc/4A2F-W5X6>].

Over the years, the WHI ground-breaking study has yielded important sex-specific treatment recommendations for women with regard to major diseases affecting postmenopausal women.²³¹ Results from the WHI Hormone Trials alone “have been estimated to have already saved \$35.2 billion in direct medical costs in the U.S. alone.”²³² In addition, over 1,400 articles have been published by the WHI, and 289 ancillary studies have been funded.²³³ These articles and studies have impacted management of women’s coronary heart disease, stroke, breast cancer, colorectal cancer, endometrial cancer, ovarian cancer, osteoporotic fractures, diabetes, and total mortality.²³⁴

More also needs to be done in nongovernmental research. “NIH does not have any control over what is published in the scientific literature.”²³⁵ Medical journal editors and editorial bodies—such as the International Committee of Medical Journal Editors (ICMJE)—are “uniquely positioned as gatekeepers for much of the scientific knowledge that reaches the public domain”—including appropriate consideration of sex differences and noting that “one size does not fit all.”²³⁶ Guidelines could be set for manuscripts to be included in musculoskeletal publications such that the sex of origin of tissues, cells, animals, and humans in the studies must be considered in analysis with reporting of any sex differences.²³⁷

In addition, pregnant women should be included in orthopedic research.²³⁸ Because of exclusion, 80% of pregnant women are prescribed treatments that have never been studied in pregnant women.²³⁹ Pregnant women are capable of autonomous decision-making for themselves and for their fetuses, just as they will be for their children when they become mothers.²⁴⁰ Therefore, they should be allowed to participate in clinical trials involving musculoskeletal care where appropriate.²⁴¹ Some additional protections for physicians regarding potential malpractice risks may be necessary to encourage physicians to offer pregnant women these opportunities.²⁴²

“In the orthopaedic practice of the future, sex differences in the physiology

231. *Id.*

232. *Id.* *Welcome to Women's Health Initiative*, WOMEN'S HEALTH INITIATIVE, <https://whi.org/SitePages/WHI%20Home.aspx?tabyitgl/viom/sG-cialisByitgl/v-price/4/> [<https://perma.cc/5ZVZ-TP8J>].

233. *Id.*

234. *Observational Study (OS)*, WOMEN'S HEALTH INITIATIVE, <https://www.whi.org/about/SitePages/Observational%20Study.aspx> [<https://perma.cc/6W5G-MPRF>].

235. Wiseman, *supra* note 83, at 40.

236. *Id.*

237. *Id.*

238. Katrina Heyrana et al., *Increasing the Participation of Pregnant Women in Clinical Trials*, 320 JAMA 2077 (2018), <https://jamanetwork.com/journals/jama/fullarticle/2714380> [<https://perma.cc/76PT-RVBW>].

239. *Id.*

240. *Id.*

241. *Id.*

242. *Id.*

and pathogenesis of disease will determine how each patient is treated.”²⁴³ Priorities include (1) monitoring musculoskeletal diseases for sex differences related to diagnosis and treatment, (2) analyzing age studies by sex, (3) improving availability of sex-specific data, (4) stratifying of studies based on sex, (5) expanding research involving neurologic responses to pain and analgesia between sexes, and (6) promoting of sex-specific research on the molecular, cellular, and tissue levels.²⁴⁴ Much research is needed to improve treatment of musculoskeletal diseases with proper recognition of sexual dimorphism.

2. Diversification of the Medical Professional Community

Musculoskeletal doctors are predominantly male. In 2014, only 6.1% of fully accredited practicing orthopaedic surgeons were women.²⁴⁵ Women are less likely to pursue careers in orthopaedic surgery than any other specialty with the rate of female medical students entering orthopaedic surgery being around 0.6%.²⁴⁶ If more women were in the field of orthopaedic surgery, it is possible that some disparities in musculoskeletal care might improve by decreasing male bias in the profession, possibly increasing attention to female issues previously unrecognized, and by improving gender concordance between doctors and female patients. As explained above, gender concordance between doctor and patient may help improve care in some instances.

Increasing the number of female orthopaedic surgeons could be approached in several ways. First, getting more women to consider orthopaedics as a career might be accomplished by requiring early exposure to musculoskeletal care during medical school.²⁴⁷ Early exposure to orthopaedics by requiring musculoskeletal education in medical school leads to higher rates of application to orthopaedic residencies—especially among women who had a 75% higher rate of orthopaedic residency applications when musculoskeletal education was required by their medical school.²⁴⁸

Second, the “most common reasons indicated for why women might not choose orthopaedics included perceived inability to have a good work/life balance (78%), perception that too much physical strength is required (74%), and lack of strong mentorship in medical school or earlier (69%).”²⁴⁹ Adherence to work-hour regulations helps make “[t]he prolonged hours of surgical training appear less daunting” and may “account for the increased pursuit of surgical residencies by

243. Tosi et al., *supra* note 1, at 1643.

244. *Id.* at 1631.

245. *Mission and History*, THE PERRY INITIATIVE, <https://perryinitiative.org/about/mission-statement/> [perma.cc/EJT4-W8AH].

246. Rohde et al., *supra* note 91, at 1954.

247. *Id.* at 1955.

248. *Id.*

249. *Id.* at 1950.

women.”²⁵⁰ Although physical strength can seemingly be required for some orthopaedic tasks, like reducing a hip dislocation, women and older men with less strength obviously practice orthopaedic surgery successfully, so physical concerns could be addressed by mentoring of medical students by female orthopaedic surgeons.²⁵¹ “Role models have been shown to attract medical students to surgical subspecialty training, and an interested mentor has been cited as the most important factor in a medical student initially being attracted to a field.”²⁵²

Orthopaedic surgery has the lowest representation of women academic faculty of any specialty, and female representation on medical faculties “has been associated with whether women medical students choose surgery as a career.”²⁵³ Without a “critical mass” of female orthopaedic faculty members, female medical students may be dissuaded from applying for orthopaedic residency positions.²⁵⁴ “Programs designed to improve mentorship . . . will be important to attract” more women to orthopaedics.²⁵⁵ Increasing diversity of orthopaedic faculty through “targeted programming and recruitment” may also be an option.²⁵⁶

One example of a targeted approach is The Perry Initiative, a 501(c)(3) nonprofit organization named after Dr. Jacquelin Perry, one of the first ten women orthopaedic surgeons in the U.S.²⁵⁷ The Perry Initiative is “committed to inspiring young women to be leaders in . . . orthopaedic surgery” by running outreach programs in high schools, colleges, and medical schools.²⁵⁸ Founded in 2009, the Perry Initiative now “runs over 40 one-day outreach programs nationwide and has reached over 7500 high school, college, and medical students through over 260 outreach events.”²⁵⁹ These day long events allow participants to perform mock orthopaedic surgeries, while also hearing from prominent women orthopaedic surgeons.²⁶⁰ “Perry Initiative Medical Student Outreach Programs are hosted by medical schools and connect students to orthopaedic surgeon mentors and like-minded peers, as well as introduce fracture fixation techniques and power tools.”²⁶¹

250. *Id.* at 1955.

251. *Id.* (noting that “mentorship—when present—plays a role in career choice and advancement”).

252. *Id.*

253. *Id.*

254. *Id.* (observing that “absence of a ‘critical mass’ of women may dissuade female applicants.”).

255. *Id.* at 1951.

256. *Id.* at 1955.

257. THE PERRY INITIATIVE, *supra* note 246.

258. *Id.*

259. *Id.*

260. *Program Description*, THE PERRY INITIATIVE, <https://perryinitiative.org/programs/outreach-program/> [<https://perma.cc/F3FP-QCKK>].

261. *Id.*

*B. Embracing, Acknowledging, and Treating Sex-Based Care Needs
in Musculoskeletal Education and Care*

Recognition of sex-based differences in experience, diagnosis, and treatment of musculoskeletal disease is an important step in eliminating disparities in musculoskeletal care because development of sex-based treatment algorithms is needed to help eliminate disparities and improve care of both sexes. To optimize women's (and men's) musculoskeletal care, sex-based differences should be recognized and treated, and laws and policies should allow physicians to safely embrace and acknowledge these biologic, cultural, and societal differences in order to eliminate disparities and prevent discrimination against either sex.

1. In Medicine

Musculoskeletal health care professionals, like orthopaedic surgeons, often fail to consider the patient's sex in treatment decisions.²⁶² Health care professionals need to be "[sex] sensitive" to optimally treat both sexes by showing "sensitivity to [sex] issues in clinical decision-making" and by having "an awareness that [sex] . . . affects the presentation of health complaints."²⁶³ Failure to recognize and acknowledge these differences based upon biologic sex leads to disparities and discrimination in musculoskeletal care.²⁶⁴ "Targeted attempts to provide early and ongoing education regarding sex-based differences in musculoskeletal disorders are likely necessary to address this knowledge gap."²⁶⁵ A few currently known examples follow. With continued research, other differences are likely to continue to be delineated.

a. Sports medicine

First, active young women and girls need musculoskeletal care providers to recognize and treat sex-based differences.²⁶⁶ "Mounting evidence exists supporting the concept that the incidence, clinical presentation, and functional

262. Matzkin, *supra* note 52, at 38 ("Orthopaedic surgeons [and other musculoskeletal professionals] do not routinely consider the sex of a patient when evaluating and formulating treatment plans for patients with musculoskeletal disorders.").

263. Celik, *supra* note 3, at 2 ("[Sex] differences contribute to patients' health and illness," and "[r]ecognizing these differences and taking them into account can improve the quality of care.").

264. Carter, *supra* note 1, at 447 ("By improving our understanding of these sex-based differences, orthopaedic surgeons may be better equipped to care for patients with common sports injuries and improve treatment outcomes.").

265. Matzkin, *supra* note 52, at 38.

266. Carter, *supra* note 1, at 448 ("Investigating this and similar hypotheses in a systematic fashion may lead to the development of sex specific treatment algorithms that may optimize clinical outcomes.").

outcomes for male and female patients with sports injuries may profoundly differ.”²⁶⁷ For starters, medical professionals working with colleges, universities, and high schools should promote development of female specific athletic training protocols because physical exercise exhibits sexual dimorphism.²⁶⁸ For example, the prevalence of female ACL tears might be reduced with sex-specific athletic training. Experts generally agree that “modifiable factors may be more important in explaining the higher incidence of noncontact ACL injuries among female athletes.”²⁶⁹ Sex-specific training regarding landing patterns in jumping sports and positioning techniques during exercise might reduce the prevalence of ACL tears among female athletes.²⁷⁰ Policymakers should support research and development of female specific exercise protocols to bring female ACL injuries more in line with male numbers, and coaches and trainers should be encouraged and educated to understand and recognize differences between male and female athletes.

In addition, “males and females differ in their response to exercise with regard to fuel utilization patterns, temperature control, neuroendocrine regulation, immune response, and muscle damage.”²⁷¹ “Males demonstrate a substantial increase in muscle heat shock protein” compared to females following exercise, which enhances protection of heart muscle and inhibits muscle damage in males—with “important implications to the efficacy of exercise . . . across the life span of both men and women.”²⁷² Attention to these sex-specific differences by medical professionals and policymakers involved in sports medicine is important.

Similarly, sex-specific concussion prevention and treatment should be considered more frequently. In similar sports (baseball/softball, basketball, and soccer), females had “roughly twice the concussion risk of males.”²⁷³ To remedy this, modifications should be considered to rules, protective equipment, and/or level of contact permitted to bring females’ concussion risk more in line with males.²⁷⁴ This idea is supported by the fact that girls participating in lacrosse had a lower concussion rate than boys participating in lacrosse—where there are fundamental differences in the rules, protective equipment, and level of contact based upon sex.²⁷⁵ In male lacrosse, checking or physical contact with body or

267. *Id.* at 447.

268. Matzkin, *supra* note 52, at 39.

269. Carter, *supra* note 1, at 449.

270. *Id.* (noting that a significant modifiable risk factor for ACL injury is the way athletes land after jumping with female athletes tending to land in a way that predictably leads to ACL injury and that modifiable leg and pelvis positioning tendencies make female athletes more vulnerable to ACL rupture); see also, Tosi, *supra* note 1, at 1638 (noting that before puberty, males and females land similarly with knees wide apart, but this changes after puberty such that females land with their knees closer together in a position called ‘valgus,’ which makes females more prone to ACL tears because it increases strain across the ACL.).

271. Tosi, *supra* note 1, at 1638.

272. *Id.*

273. Lincoln, *supra* note 129, at 961.

274. *Id.* at 962.

275. *Id.* at 960.

sticks is allowed, whereas in female lacrosse, there is a no-checking rule.²⁷⁶ Women's sticks are smaller than men's, meaning contact with the smaller stick may be less likely to cause injury.²⁷⁷ Also, "[m]ost female players are required to wear goggles and mouth guards."²⁷⁸ In addition, expanded access to athletic trainer coverage for female athletes should be considered because it increases the likelihood that concussions are recognized and treated.²⁷⁹ Further, new state laws, along with rule changes and treatment recommendations by national organizations, can lead to improvement in concussion recognition and treatment.²⁸⁰

Also, surprisingly only 37% of physicians in one study had heard of Female Athlete Triad mentioned above, which can have significant effects on bone mass in teenage girls—so better physician education is needed.²⁸¹ Failure to develop strong bone mass at an early stage in life can be particularly important because 90% of peak bone mass is accumulated by adolescence, which means that untreated girls may end up with a higher incidence of osteoporosis and fragility fractures later in life.²⁸² Early treatment and recognition can therefore have dramatic and permanent positive effects.

Finally, some traditionally female-dominated sports—like cheerleading—should be recognized as sports potentially warranting closer attention to potential injuries. Designation of cheerleading as a "sport" is important, so that it is subject to rules and regulations set forth by organizations like the NCAA—improving access to "athletic trainers, appropriate medical care, certified/qualified coaches, better facilities, and an injury surveillance program."²⁸³ Designation as a "sport" also ensures that cheerleaders must get a pre-participation physical examination and have access to appropriate strength

276. *What's the Difference Between Men's and Women's Lacrosse*, DICK'S PRO TIPS, <https://protips.dickssportinggoods.com/sports-and-activities/lacrosse/whats-the-difference-between-mens-womens-lacrosse> (last visited Nov. 30, 2018) [<https://perma.cc/HGS3-6GZT>].

277. *Id.*

278. *Id.*

279. Lincoln, *supra* note 129, at 962 (noting that expanded access to athletic trainers from two part time to one full time and one part time trainer led to better concussion recognition and treatment).

280. Lincoln, *supra* note 129, at 962 ("New state laws and rule changes and treatment recommendations by the National Collegiate Athletic Association, the National Athletic Trainers' Association, the National Federation of State High School Associations, the Centers for Disease Control and Prevention, and sports-governing bodies have likely contributed to greater awareness of concussion among players, coaches, parents, and clinicians.").

281. Carter, *supra* note 1, at 449.

282. *Id.* at 448.

283. Grant Jones & Michael Khazzam, *Cheerleading Injuries*, SPORTS MEDICINE (Am. Orthopaedic Soc. Sports Med., Rosemont, Ill.), 2017, at 3, 6. <https://www.sportsmed.org/aossmimis/members/downloads/SMU/2017Fall.pdf> [<https://perma.cc/U8E6-X4U6>].

and conditioning programs.²⁸⁴ This is important because cheerleading leads to a disproportionately high rate of catastrophic injuries, accounting for over 65% of catastrophic injuries in female high school athletes—“including skull fractures, death, cervical fractures or major ligamentous injury, spinal cord contusions, paralysis, and severe head injuries resulting in permanent brain injury.”²⁸⁵ Prevention efforts should “focus on activities placing cheerleaders at risk for severe injuries,” including practices—where cheerleaders are particularly susceptible to injury.²⁸⁶

Safety organizations like the American Association of Cheerleading Coaches and Administrators (AACCA), the United States All Star Federation (USASF), CheerSafe, and the National Federation of State High School Associations (NFHS), and even the American Academy of Pediatrics (AAP) are important in helping reduce these numbers.²⁸⁷ Emergency plans should be developed for serious injuries to involve athletic trainers and team physicians.²⁸⁸ Cheer venues should be compliant with national safety recommendations, including appropriate medical coverage and proper landing mat, foam floor, or grass/turf.²⁸⁹ Adequate supervision by properly trained coaches is important to prevent and treat injury.²⁹⁰

b. General musculoskeletal care

Musculoskeletal evaluation, intraoperative decision making, and postoperative care often need to be modified based upon sex. A few known examples follow here. Many more are evident, and more are likely to be discovered with increased attention to this issue.

First, attention to sex-specific musculoskeletal disease patterns is necessary. One example is obviously fracture care with the recognition and treatment of intimate partner violence (IPV) among women with broken bones. Almost 2% of women in the orthopedic fracture clinic attended their visit as a direct result of IPV, but only 14% of them were ever asked about IPV in a health care setting.²⁹¹ Musculoskeletal professionals should be trained to recognize that IPV is a “serious public health issue that affects a large proportion of orthopaedic

284. *Id.* at 4, 6 (By 2012, “only 29 state high school athletic associations recognized cheerleading as a sport and the [NCAA] did not include competitive cheerleading as a sponsored sport.” Therefore, up until more recently, “injuries that occur[ed] in cheerleading [were] often not reported in sports injury surveillance systems.”).

285. *Id.* at 4, 5 (observing that cheerleading accounted for 71% of catastrophic injuries to female college athletes in one study over a 17-year period).

286. Currie, *supra* note 179, at 7.

287. Jones, *supra* note 284, at 5-6.

288. *Id.* at 6.

289. *Id.*

290. *Id.* (In one study, “cheerleaders supervised by coaches with the most education, qualifications, and training had a nearly 50% reduction in injury compared to those supervised by coaches with less training.”).

291. PRAISE Investigators, *supra* note 36, at 872.

patients,” and should be prepared to handle the issues and complexities surrounding IPV.²⁹² Policymakers should consider requiring IPV training similar to child abuse training required for medical licensure in some states.²⁹³ Board certification should include some assessment of ability to recognize IPV. Fracture clinics should improve identification of and response to victims of IPV including offering referral services to people who can provide assistance.²⁹⁴

Another example of a musculoskeletal disease where sex-based recognition and treatment is important is osteoporosis—where interestingly males may have the most to gain. Postmenopausal women at risk for osteoporosis and hip fracture related to estrogen deficiency should be recognized and treated or referred.²⁹⁵ In addition, orthopedists should recognize that osteoporosis is underdiagnosed in men, and similarly, be aware of its risks—especially considering men’s higher mortality rates associated with hip fractures.²⁹⁶ Failure to diagnose osteoporosis in males has important implications to prevent future fractures and to improve longevity.²⁹⁷

Second, preoperative surgical decision-making and evaluation should include evaluation of sex-based factors. Sex-biased “social determinants of health” should be considered—like (1) socioeconomic and insurance status and (2) whether the person is living alone or serving as a caregiver. In addition, providers should not assume male elective surgery (i.e., “male norm”) rates are correct and should consider whether males or females are currently choosing elective surgeries at the optimum rate. In fact, some studies show that with the use of better education preoperatively through decision aids, many fewer patients choose to proceed with total knee replacement²⁹⁸—so it is possible that the current female rate of TKR is actually closer to the optimum than the male rate, and if the male rate were diminished, the disparities would decrease.²⁹⁹

292. Sheila Sprague et al., *Intimate partner Partner Violence and Musculoskeletal injury: Injury: Bridging the knowledge Knowledge Gap in Orthopaedic fracture clinics*, *Fracture Clinics*, 14 BMC MUSCULOSKELETAL DISORDERS 1,8 (2013), <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3585708/> [<https://perma.cc/Z7SY-QWN6>] (suggesting that orthopedic surgeons in fracture clinics should consider who to include in IPV screening, decide who should ask about IPV, ensure confidentiality and patient safety, and help in the development of social support programs).

293. See, e.g., *Mandated Training Related to Child Abuse*, N.Y STATE. ST. DEPARTMENT EDUC. DEP’T, <http://www.op.nysed.gov/training/camemo.htm> [<https://perma.cc/3SBY-CCCX>.] (last updated April 4, 2017).

294. PRAISE Investigators, *supra* note 36, at 874.

295. Wolf et al., *supra* note 26, at 341.

296. *Id.* at 341-2.

297. *Id.*

298. Emily Lee, *Shared Decision Making to Improve Care and Reduce Costs*, 368 NEW ENG. J. MED. 1 (Jan. 3, 2013)

(finding that when patients received enhanced preoperative counseling for TKR with decision aids, TKR surgery rates dropped by 38%).

299. Celik et al., *supra* note 3, at 1.

In addition, socioeconomic and insurance status can affect whether or not a person opts for an elective surgery—like total knee replacement—and can lead to delays that ultimately negatively impact outcomes because the disease progresses to a point where the treatment is simply less effective. If socioeconomic issues are identified early, appropriate counseling might help some women decide to go ahead with elective surgeries previously outside their financial reach at earlier stages of their disease by revealing sources of assistance that were previously unknown to the patient.

Also, practical factors like living alone or functioning as a caregiver for a dependent spouse or relative can lead to delays of necessary surgery. Women who are living alone or serving as caregivers may need special assistance or planning in order to recover after surgery. Early identification of these factors may allow health care providers to alert women to options for postoperative assistance for those living alone and assistance for those serving as caregivers. The medical community's involvement in developing and promoting support for older women may be helpful in eliminating disparities affecting elective surgery.³⁰⁰ Pension reforms and reforms to the Supplemental Security Income and Disability Insurance Benefits (SSI/DIB) program to ensure widows who have not worked are not left alone without income after their husband's death may be important. Also, supporting employment opportunities for older women to allow them to remain active and provide income may help eliminate disparities.

Further, continued trends toward equal pay and equal insurance coverage will likely help eliminate disparities related to socioeconomic differences. Also, under the ACA's minimal essential benefits provisions, the gap between coverage obtained through employer-based plans compared to marketplace plans or plans obtained via Medicaid is narrowing. Therefore, disparities related to differences in insurance coverage (i.e., fewer women on employer-based plans and more on Medicaid) differences should diminish.

Third, sex-based decisions may be necessary during surgery (i.e., intraoperatively). For example, with regard to ACL reconstruction, women may not be getting equal results because “[F]emales [are] more likely than males to require further ACL surgery and less likely to return to play.”³⁰¹ Some authors suggest that the graft material used in males and females during ACL reconstruction surgery may need to be sex-specific.³⁰²

The story is a little different and confusing with regard to knee replacement. Several studies have shown equal results for standard non-sex-specific total knee

300. SUPPORTIVE OLDER WOMEN'S NETWORK, HELPING WOMEN DISCOVER THE POWER OF MUTUAL SUPPORT AS THEY AGE, <http://www.sown.org/PDF/SOWN-Brochure.pdf> [https://perma.cc/4PC6-LXXC].

301. Carter et al., *supra* note 1, at 450 (referring to one study of soccer players followed for seven years after ACL reconstruction).

302. *Id.* at 447-48 (“For example, the intraoperative choice of an anterior cruciate ligament (ACL) autograft is a notable factor in determining return-to-sport and reinjury rates, especially for adolescent females with high quadriceps to hamstring strength ratios.”).

implants when comparing the sexes with regard to implant survival/failure.³⁰³ Research suggests that a gender-specific total knee implant did not result in improved outcomes for women—“although differences between the bony anatomy of the knee joint of men and women are well-documented.”³⁰⁴ A review at the American Academy of Orthopaedic Surgery meeting in 2008 did not “consistently show differences between men and women in most outcomes of tricompartmental total knee replacement surgery” raising questions about the need for a gender-specific implant.³⁰⁵ In addition, a 2011 systematic review revealed that “function and satisfaction scores did not differ with use of gender-specific knee implants when compared to unisex implants.”³⁰⁶ While this specific implant did not seem to make a difference in these studies, with more research, sex-specific knee replacements might eventually make important clinical differences given some of the documented differences in bone and ligament anatomy around the knee in men and women.

Fourth, postoperative musculoskeletal care may also need to be sex-specific. Recognition of differences in pain perception and response may eventually lead to different treatment protocols for postoperative and preoperative pain in men and women with musculoskeletal problems.³⁰⁷ Women may perceive pain differently and respond differently to pain medications than men, and therefore, different pain management protocols may be appropriate for women over men.³⁰⁸ Sex-based differences in animals and humans have been found in response to the use of opiates and anti-inflammatory medications often used to treat musculoskeletal disorders.³⁰⁹ Therefore, preoperative pain recognition and postoperative pain management protocols may need to be modified based upon sex. Finally, many other differences may become evident with more research as outlined above.

2. In Law and Policy: Emerging Legal Issues Related to Sex-Based Medical Treatment

Recognition and proper treatment of sex-based differences in musculoskeletal care requires support from the legal community and from policymakers. Biologic males and females are different—even beyond the obvious differences involving

303. Wolf et al., *supra* note 26, at 343.

304. *Id.*

305. *Id.*

306. *Id.* at 344.

307. E.J. Bartley & R.B. Fillingim, *Sex Differences in pain: a brief Pain: A Brief Review of Clinical and Experimental Findings*, 111(1) BRIT. J. ANESTHESIA 52, 52 (2013).

308. Kamath et al., *supra* note 39, at 3359 (noting that women often have worse pain postoperatively than men); Tosi, *supra* note 1, at 1639 (observing that “[d]ifferences in the efficacy of analgesics in men and women have also been described.”).

309. Tosi et al., *supra* note 1, at 1639 (including specifically differences in responses to “mu-receptor opiates, kappa-acting opiates, and anti-inflammatory medications . . .”).

the reproductive system. As discussed above, failure to recognize biologic differences in female versus male response to disease and treatment has likely led to diminished success in the treatment of both sexes—but especially in women. Therefore, it is important for policymakers to acknowledge biologic and other differences between the sexes when it comes to musculoskeletal health care.

a. Recognizing “real differences” between the sexes under the Constitution

Current sex discrimination doctrines—either constitutional or statutory—generally are considered to recognize formal equality as the standard,³¹⁰ which usually allows room for medical professionals to properly acknowledge sex-based treatment and training protocols. Formal equality requires equal treatment of persons who are similarly situated (e.g., persons who have similar athletic interests).³¹¹

The Supreme Court has recognized *real differences* between males and females,³¹² and has “consistently upheld statutes where the gender classification . . . realistically reflects that the sexes are not similarly situated in certain circumstances.”³¹³ “‘Real’ differences are defined broadly to include definitional differences, legally created differences, and differences that result from past discrimination against women.”³¹⁴

The Court notes that the Equal Protection Clause “does not ‘demand that a statute necessarily apply equally to all persons’ or require ‘things which are different in fact . . . to be treated in law as though they were the same.’”³¹⁵ “This approach is also associated with a high degree of tolerance for facially sex-neutral rules that have a disparate impact on one sex.”³¹⁶ The Court also makes clear that “a legislature may ‘provide for the special problems of women.’”³¹⁷ However, a “legislature may not ‘make overbroad generalizations based on sex which are entirely unrelated to any differences between men and women or which demean the ability or social status of the affected class.’”³¹⁸ Therefore, generally speaking, policy initiatives can take into account sex-based differences and allow for different treatment of men and women—even for the same types of issues—so, the proposals mentioned above should generally be permissible. Therefore, sex-specific protocols with regard to treatment of female athletes and

310. Katharine Bartlett, *Gender Law*, 1 DUKE J. GENDER L. AND POL’Y 1, 2-4 (1994) (“Formal equality is the familiar principle that individuals who are alike should be treated alike, according to their actual characteristics, rather than stereotypical assumptions.”).

311. *Id.*

312. Ann Freedman, *Sex Equality, Sex Differences, and the Supreme Court*, 92 YALE L.J. 913, 918 (1983); Michael M. v. Superior Court Sonoma Cty., 450 U.S. 464, 481 (1981).

313. *Michael M.*, 450 U.S. at 469.

314. Freedman, *supra* note 312, at 931.

315. *Michael M.*, 450 U.S. at 469.

316. Freedman, *supra* note 312, at 931.

317. *Michael M.*, 450 U.S. at 469.

318. *Id.*

female Medicare recipients are likely within the Equal Protection Clause if based upon real differences between men and women.

b. Development of sex-specific protocols under Title IX and HHS rules

Title IX, implemented in 1972, prohibits discrimination on the basis of sex in educational programs and activities that receive federal funding.³¹⁹ Title IX led to vastly increased participation in sports by females from fewer than 300,000 female students participating in interscholastic athletics in 1971 to over 2.6 million in 1998-99.³²⁰ For perspective, only one in twenty-seven girls played high school sports prior to Title IX, whereas by 1998, it was one in three.³²¹ Likewise, at the college level, female participation has increased from 32,000 in 1971 to 150,000 in 1998.³²² Girls and women also are increasingly involved in traditionally male sports like baseball, football, “rugby, boxing, judo, wrestling, body-building, stock car driving, weightlifting, and throwing events.”³²³ With increased participation, comes increased risk of sports-related injury.

Title IX compliance includes “the treatment and benefits provided to male and female athletes”—which may arguably include access and quality of musculoskeletal care provided.³²⁴ Title IX includes a three-part test for measuring discrimination in provision of athletic opportunities to male and female students.³²⁵ Under Title IX, “No person . . . shall, *on the basis of sex*, be excluded from participation in, be denied the benefits of, or be subjected to *discrimination* under any education program or activity receiving Federal Financial assistance.”³²⁶ The three-part test issued in 1979 means that an institution may comply with Title IX by meeting at least one of three benchmarks:

- (1) Whether intercollegiate level participation opportunities for male and female students are provided in numbers substantially proportionate to their respective enrollments; or
- (2) Where the members of one sex have been and are underrepresented among intercollegiate athletes, whether the institution can show a history

319. 20 U.S.C. § 1681 (2018) (“No person in the United States shall, on the basis of sex, be excluded from participation in, be denied the benefits of, or be subjected to discrimination under any education program or activity receiving Federal financial assistance . . .”).

320. Deborah Brake, *The Struggle for Sex Equality in Sport and the Theory Behind Title IX*, 34 U. MICH. J. L. REFORM 13, 15 (2001); *see also* Carter, *supra* note 1, at 448 (stating, “[s]ince the implementation of Title IX in 1972, the number of females participating in sports has increased dramatically at all levels of play.”).

321. Brake, *supra* note 320, at 15.

322. *Id.*, at 15.

323. *Id.*, at 16.

324. *Id.*, at 47.

325. *Id.*, at 47-8.

326. 20 U.S.C. § 1681(a) (2018) (emphasis added).

and continuing practice of program expansion which is demonstrably responsive to the developing interest and abilities of the members of sex; or

(3) Where the members of one sex are underrepresented among intercollegiate athletes, and the institution cannot show a continuing practice of program expansion such as that cited above, whether it can be demonstrated that the *interests and abilities of the members of that sex have been fully and effectively accommodated by the present program.*³²⁷

Really, only the third option addresses obtaining equally effective accommodation of sex-specific musculoskeletal differences—so programs are not obligated under Title IX’s three-part test to make sex-based changes to musculoskeletal care . . . unless they fail to meet the other two options.

However, some argue that Title IX goes beyond formal equality because it can hold institutions accountable for “their role in constructing and perpetuating such differences.”³²⁸ Title IX’s three-part test is “influenced by structuralism, a theoretical approach which emphasizes the need to critically examine the structures and cultures of institutions that differently situate men and women and result in subordination of women.”³²⁹ It may be possible to argue that failure to develop sex-specific protocols discourages participation of women in sports due to their fear of injury, which has led to continued disparities in the number of women participating in athletics compared to men. Even with the previously noted gains under Title IX, participation disparities still persist; for example, 3.8 million high school males competed in sports compared to only 2.6 million females, and women comprise fifty-three percent of undergraduate college students, but only thirty-seven percent of college athletes.³³⁰

“Equality” may be another perceived concern when treatment recommendations diverge based upon sexual dimorphism—especially if the treatment for one sex is significantly more expensive or more burdensome than for the other sex. HHS says that “[w]omen must be treated equally with men in the health care they receive . . .”³³¹ “Sex-specific health programs or activities are permissible only if the entity can demonstrate an *exceedingly persuasive justification*, that is, that the sex-specific health program or activity is substantially related to the achievement of an important health-related or scientific objective.”³³² When treating the same disease, however, “equally” may not necessarily mean the “same,” because sexual dimorphism may mandate different treatments for the same musculoskeletal issue—as outlined above. Sometimes, exceedingly persuasive justifications—like double-blind, randomized

327. Title IX and Intercollegiate Athletics, 44 Fed. Reg. 71413 (Dec. 11, 1979) (to be codified at 45 C.F.R Part 86) (emphasis added).

328. Brake, *supra* note 320, at 22.

329. *Id.* at 23.

330. *Id.* at 19.

331. HHS, *supra* note 12.

332. *Id.* (emphasis added).

research studies—simply are hard to find in medicine, even though there is a medical consensus that one treatment is better than the other.³³³ When treatments fail or become outdated, providers and institutions may become targets for sex discrimination lawsuits accusing them of basing treatment upon “archaic stereotypes,”³³⁴ even though the treatment was based upon medical consensus—just as much treatment is based upon medical consensus without “exceedingly persuasive justification,”³³⁵ even in modern medicine. Physicians must be allowed to acknowledge sex-based differences and treat patients accordingly without fear of reprisals from lawyers based upon accusations of sex discrimination where medical consensus warrants. An alternative analysis to formal equality is “anti-subordination,” which “is as concerned with the perpetuation of existing disadvantages through formally neutral structures as it is with formal barriers to equality.”³³⁶ Under anti-subordination, the “central question is whether the challenged rule or practice perpetuates the subordination of women.”³³⁷ As long as the medical consensus did not somehow subordinate women, it could be justified, even if “exceedingly persuasive justification”³³⁸ was lacking, and the treatment later turned out to be suboptimal in retrospect.

c. Balancing transgender rights with medical need to recognize biologic sex

Failure to recognize and acknowledge biologic sex-based differences will continue to lead to disparities in musculoskeletal care. This is true, even though societal shifts demanding “non-binary” treatment threaten to label recognition of patients’ biologic sex as discrimination.

Nonbinary people may identify themselves on a spectrum between male and female, as neither male nor female, as both male and female, or as totally outside of a male-female dichotomy and instead inhabiting a “gender galaxy,” defined as “a three-dimensional non-linear space in

333. INSTITUTE OF MEDICINE, EVIDENCE-BASED MEDICINE AND THE CHANGING NATURE OF HEALTH CARE: 2007 IOM ANNUAL MEETING SUMMARY 49 (The Nat’l Acad. Press 2008) (noting that “recommended care is often not delivered and insufficient evidence often leads to wide practice variations with little to no health benefit to patients”); *See also* Frank Griffin, *Prejudicial Interpretation of Expert Reliability on the “Cutting Edge” Enables the Orthopaedic Implant Industry’s Bodily Eminent Domain Claim*, 18 MINN. J.L. SCI. & TECH. 207, 254 (2017) (stating, “[o]nly 11.3% of the orthopaedic literature used the most reliable level of evidence (Level 1) and only 3% of orthopaedic articles were randomized, controlled trials (the gold standard for clinical research).”).

334. Brake, *supra* note 320, at 25.

335. HHS, *supra* note 12 (emphasis added).

336. Brake, *supra* note 320, at 27.

337. *Id.* at 28.

338. HHS, *supra* note 12 (emphasis added).

which every gender has a location that may or may not be fixed.”³³⁹

However, generally speaking (unless the person has a genetic anomaly) every cell in each person’s body is biologically male or female and the proper treatment of that cell, organ system, and entire body often requires accurate acknowledgement of those basic differences by medical professionals.³⁴⁰

The importance of genetics cannot be overemphasized. Twin studies reveal just how important a person’s biologic genetic makeup can be.³⁴¹ Medical charts and physicians communicating with each other regarding patient care should be allowed to communicate biologic sex clearly and protected from claims of discrimination for “misgendering.” Certainly, where feasible, medical personnel should also attempt to honor patients’ preferences that do not impact the patient by a preferred sex pronoun as long as it does not disrupt medical care or endanger the patient.

However, the landscape is under increasing scrutiny that could make it more difficult for medical professionals to avoid allegations of discrimination. For example, Section 1557 of the Affordable Care Act “prohibits discrimination on the grounds of . . . sex . . . in certain health programs and activities” with the “final rule appl[ying] to any health program or activity, any part of which receives funding from” HHS funded entities like Medicare and Medicaid, which includes activities like physician and hospital interactions with patients.³⁴² “The rule makes clear that sex discrimination prohibited under Section 1557 includes discrimination based on . . . sex stereotyping.”³⁴³

HHS initially enacted rules including “gender identity” in the definition of sex discrimination in Title IX; the rule from section 1557 of the ACA defines gender identity as follows:

Gender identity means an individual's internal sense of gender, which may be male, female, neither, or a combination of male and female, and which may be different from an individual's sex assigned at birth. The way an individual expresses gender identity is frequently called “gender expression,” and may or may not conform to social stereotypes associated with a particular gender. A transgender individual is an individual whose gender identity is different from the sex assigned to that person at birth.³⁴⁴

339. Olga Tomchin, *Bodies and Bureaucracy: Legal Sex Classification and Marriage-Based Immigration for Trans* People*, 101 CALIF. L. REV. 813, 854 (2013) (citation omitted).

340. IOM, *supra* note 1, at 1 (“Evidence suggests that the distinct anatomy and physiology that develop as a result of having been dealt two X chromosomes (XX) or an X chromosome and a Y chromosome (XY) at fertilization can have a much broader influence on an individual’s health than was previously thought.”).

341. *See generally* Bouchard, *supra* note 156.

342. HHS, *supra* note 12.

343. *Id.*

344. 45 C.F.R. § 92.4 (2019).

However, the HHS rule including gender identity in the definition of sex discrimination was found to be “contrary to law” and “exceed[ed] statutory authority,” so “the prohibition of discrimination on the basis of ‘gender identity’” was enjoined.³⁴⁵ The court explained:

Prior to the passage of the ACA in 2010 and for more than forty years after the passage of Title IX in 1972, no federal court or agency had concluded sex should be defined to include gender identity. Accordingly, HHS's expanded definition of sex discrimination exceeds the grounds incorporated by Section 1557.³⁴⁶

Adding gender identity to the potential legal pitfalls for physicians could potentially lead to less acknowledgment of sex-based differences given the difficult social interactions physicians face daily, with resultant increases in disparities and discrimination against women—so, this injunction potentially helps protect physicians trying to treat patients based upon biologic sex.

Physicians may be leery of acknowledging sex in some cases because they can be accused of sex stereotyping and/or discrimination on the basis of sex for recognizing and treating patients based upon their biologic sex, instead of their asserted gender. The law in this area is still emerging and can be quite confusing. For example, a California court found that because a hospital's staff often misgendered a deceased transgender male teen by referring to him as “she” or “her,” the patient's mother was permitted to recover damages for the deceased's emotional distress prior to his death, and that under the ACA, discrimination on the basis of transgender identity was discrimination “on the basis of sex.”³⁴⁷ Yet, under Title IX (and similarly under the ACA), another court held that sex discrimination “unambiguously refers to ‘the biological and anatomical differences between male and female students as determined at their birth.’”³⁴⁸ The *Franciscan Alliance* court concluded that “Congress intended to prohibit sex discrimination on the basis of the biological differences between males and females.”³⁴⁹ The issue appears in lay blogs and media and includes allegations that doctors who acknowledge biologic sex are discriminatory. For example, in one article, the author accused the hospital and physicians of discrimination because a transgender teen was misgendered and later committed suicide.³⁵⁰

Physicians must be able to recognize and acknowledge biologic sex to

345. *Franciscan All., Inc. v. Burwell*, 227 F. Supp. 3d 660, 695 (N.D. Tex. 2016).

346. *Id.* at 689.

347. *Prescott v. Rady Children's Hosp.—San Diego*, 265 F. Supp.3d 1090 (S.D. Cal. 2017).

348. *Franciscan All.*, 227 F. Supp. 3d at 687.

349. *Id.*

350. Shabab Ahmed Mirza & Caitlin Rooney, *Discrimination Prevents LGBTQ People from Accessing Health Care*, CTR. AM. PROGRESS, (Jan. 18, 2018, 9:00 AM), <https://www.americanprogress.org/issues/lgbt/news/2018/01/18/445130/discrimination-prevents-lgbtq-people-accessing-health-care/> [<https://perma.cc/NPK2-PVK6>].

optimally provide medical care without being accused of discrimination for misgendering someone or of acknowledging medically valid differences between the sexes that some might see as a stereotype. And doctors must be able to treat patients differently based upon sex when medically appropriate—even when treating identical disease processes unlinked to obvious sex differences because without considering biologic sex, the lack of a sex-based link may not have been evident because consideration of sex-based issues is part of the diagnostic and treatment process for all patients.

Although they might be hesitant to acknowledge it in a socially charged environment, it is possible that medical schools and residency training programs feel some pressure to avoid emphasizing sex differences based upon mixed messages present today in the law and in society. Failure to recognize sex-based differences can lead to disparities and discrimination—especially against women for the reasons outlined in this paper.

IV. CONCLUSIONS

Each individual's biologic sex plays an important role in his or her experience of musculoskeletal disease, in the physician's accurate diagnosis of the problem, in the treatment prescribed, and in the ultimate outcome of the experience. Significant disparities exist negatively impacting females related to failure of the health care delivery system to recognize and treat sex-based differences—including disparities impacting young, active girls and women, as well as adult and aging women. Sometimes failure to recognize sex-based differences also negatively affects males.

The medical community has historically been inundated with adoption of male norm in research and male bias in thinking that has likely contributed to disparities impacting females. Physicians and other musculoskeletal care providers have largely been undereducated in sex-based differences outside obvious differences related to the reproductive organs and sex hormones. While significant biological differences exist in the musculoskeletal systems of men and women, these biologic differences often fail to account for disparities observed in treatment and outcomes. Societal and cultural influences often play a significant role in propagating disparities in musculoskeletal health and health care.

To reduce sex-based disparities in musculoskeletal health care, more sex-specific research is needed with an emphasis on development of sex-specific treatment protocols. Increased gender diversity of orthopaedic surgeons would also likely help. Improved medical education regarding sex-based differences in presentation, diagnosis, treatment, and response to treatment is needed, with continued updating of medical education as research continues to emerge—including recognition of social and cultural factors that contribute to disparities.

Law and policy makers can help improve sex-based musculoskeletal care by continuing to address gender inequalities affecting socioeconomic status and insurance status. In addition, legal scholars, lawmakers, and the courts should carefully consider law and legal precedent that inhibits physicians' and providers'

ability to acknowledge and communicate openly their patients' biologic sex without fear of being accused of sex stereotyping or misgendering. With continued research and attention to sex-based differences in musculoskeletal care, outcomes for all patients are likely to improve in this emerging area.