Supplementary Essays for the Women in Health Research Phylo Trading Card Game

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In the US, black women are 3 to 4 times more likely than white women to die from pregnancy or childbirth-related causes. Racial bias in treatment practices as well as higher levels of stress associated with discrimination (weathering) appear to be major factors [1].

Other striking racial pregnancy related discrepancies include infant mortality rates for Puerto Rican born babies versus other Hispanic background (especially for previable infants <23 months). For Puerto Ricans, this is 42% higher than the National average, despite Hispanic infant mortality rates being generally lower than the US average. [2].

Another example research that looks at racial discrepancies and pregnancy health includes a paper that examined the link between opioid use and pregnancy within the Northern Ontario Indigenous population. In this population, opioid use is affecting upwards of 30% of pregnancies. This paper outlines the factors that would be most important to address for improving the healthcare provided to women in rural and remote settings where such substance use issues exist [3].

[1] cdc.gov/reproductivehealth/maternalinfanthealth/
[2] doi: 10.1016/j.puhe.2018.04.001
[3] doi: 10.17269/CJPH.108.5524

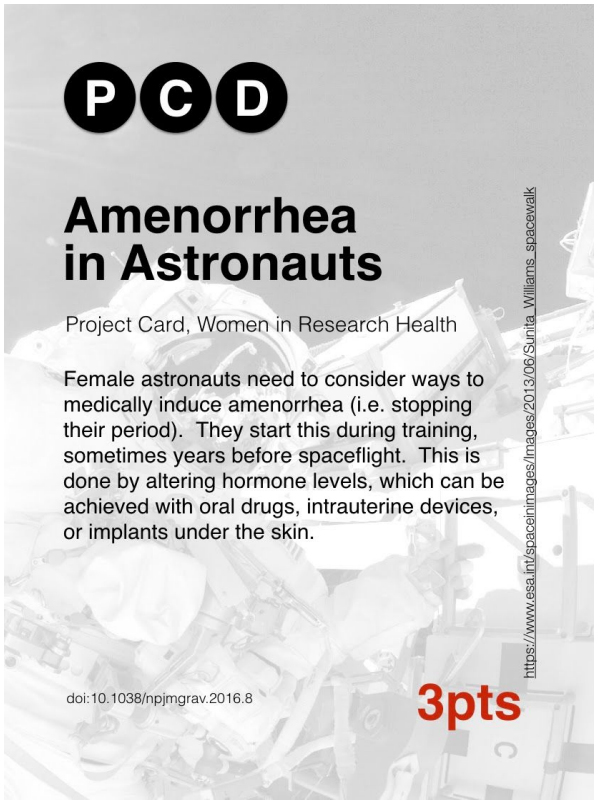
"*This is a global trend where young girls are experiencing their first period (menarche) earlier.*" Currently, estimates of an average onset of menarche place it at roughly 13 years old.

One general hypothesis around menarche onset suggests that food availability and growth rates in childhood have led to faster development. This in turn could lead to earlier onset of puberty.

This nutritional angle is supported by a wide variety of studies that link earlier menarche to metabolic and cardiovascular conditions. For instance, this card focuses on a disease such as gestational diabetes, which is often associated with being obese [1].

There is another hypothesis that attempts to explain this phenomenon. This one focuses on parental investment. Examples of research include evidence that shows that a more positive childhood experience may correlate with a later menarche [2]. For example, girls that experienced more paternal affection and involvement are typically older at menarche. Children who are adopted typically have earlier menarche.

[1] doi:10.7554/eLife.01604.001
[2] doi:10.2217/17455057.5.2.175



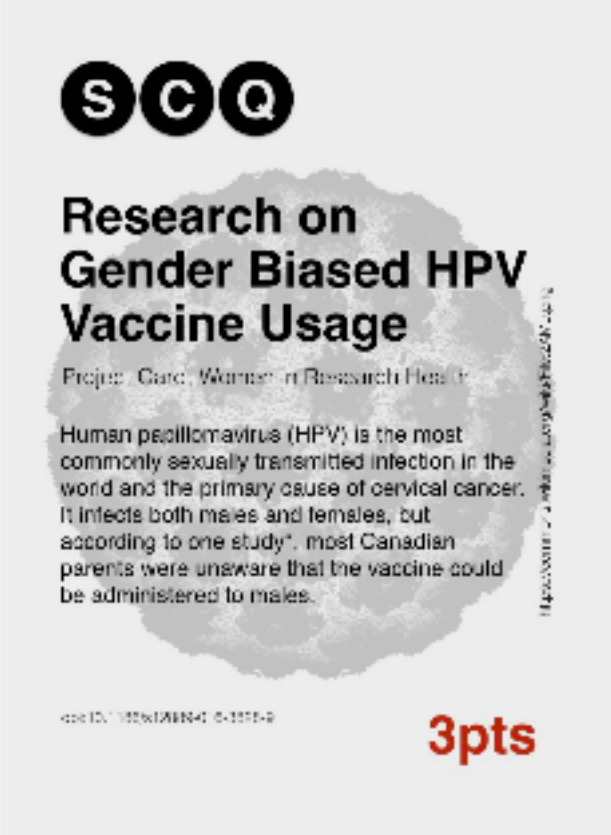
"Female astronauts need to consider ways to medically induce amenorrhea (i.e. stopping their period). This, they would start during their training, sometimes years before space flight."

For context, it's interesting to note how women in spaceflight were generally perceived. For instance, in the 50s, NASA did not even have female washroom facilities figured out for spaceflight. As a result, menstruation was commonly used as an excuse to disqualify women from being astronauts. As well, historical records also suggest that authorities believed that a women's period would also be a "distraction" to her ability [1].

Such disparity, led to an advocacy group called "Women in Space Program" being formed in 1962. Here, tests were conducted to measure how females performed in a variety of physical and mental tests. Results showed that in many cases, females performed better than males [1].

Today, there are a number of medical devices that have been designed to induce amenorrhea (stopping menstruation). These primarily work by delivering hormones that alter the menstrual cycle. *This can be achieved with oral drugs, intrauterine devices, or even implants under the skin* [2].

[1] doi:10.1152/advan.00034.2009
[2] doi:10.1038/npjmgrav.2016.8



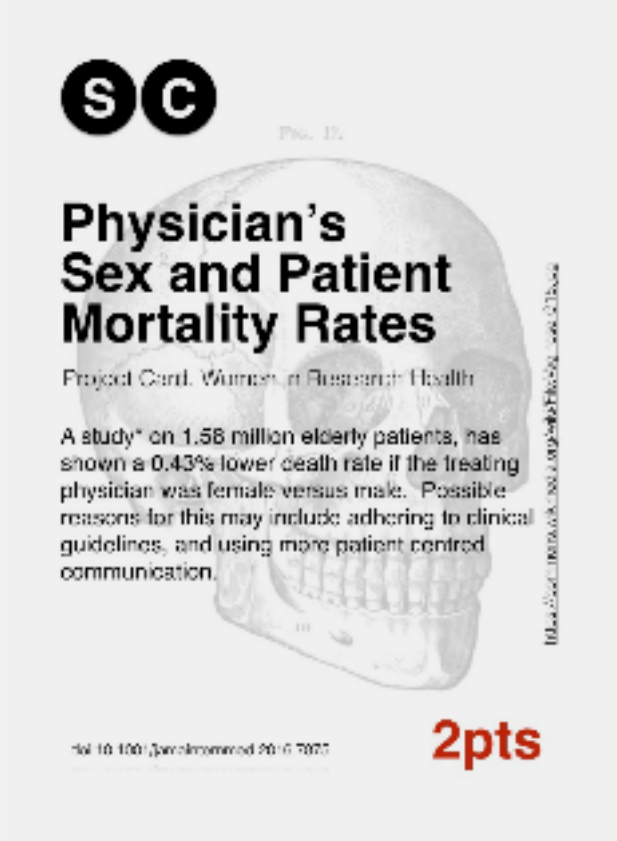
Human papillomavirus (HPV) is the most commonly sexually transmitted infection in the world and is also the primary cause of cervical cancer. Both boys and girls can be infected. Males are obviously carriers of the virus and whilst most individuals do not exhibit symptoms, for females, there is a significant chance of getting cervical cancer.

Despite this, in Canadian health policy, access to the HPV vaccine has been provided in nuanced ways. In some provinces, access was set up so that girls had free access to the HPV vaccine, whereas boys (carriers) did not.

Research like the one mentioned in this card examines the psychosocial elements in how people decide whether to immunize boys versus females [1].

Note that in British Columbia (2018), the HPV vaccine is now provided freely to any female born in 1994 or later, and males under 27 years old that are considered higher risk of getting an STI, those that have sex with other males, or are questioning their sexual orientation.

[1] doi:10.1186/s12889-016-3828-9

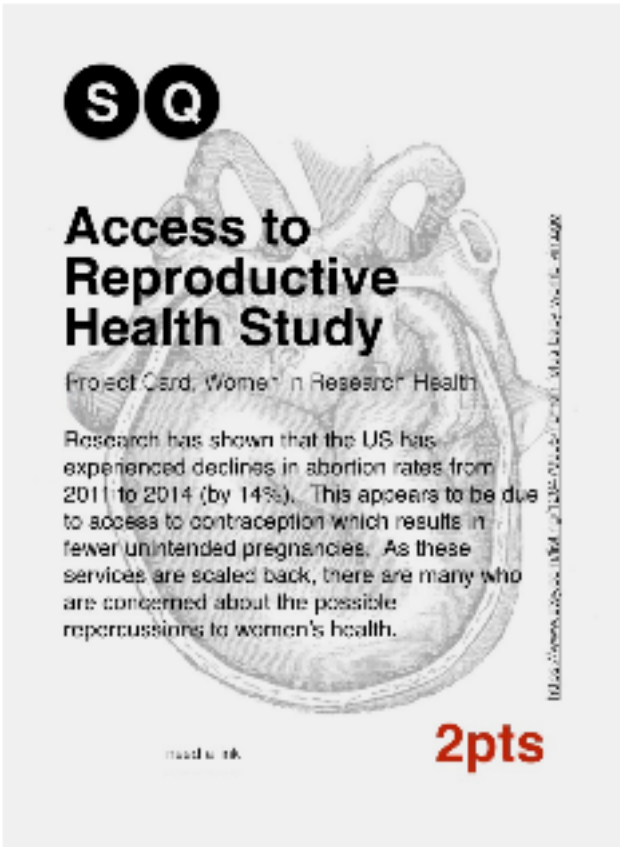


This paper uses rigorous statistics to examine whether the sex of the doctor can affect the mortality rates of elderly patients. *Here, when examining the records of 1.58 million elderly patients, there was a 0.43% lower death rate if the treating physician was female versus male.* Although the differences look relatively small, they are significant (due to the scale of numbers) and represent a difference of approximately 7000 lives. This analysis also controlled for a variety of alternate correlations that could have resulted in this interpretation (i.e. women tend to treat healthier patients, men tend to have older patients, etc) [1].

Data from this paper also suggests that this difference may be due to female physicians being more considerate of quality of life factors. In other words, men may choose therapies that on paper are more successful, but may be too aggressive for those in weakened states. *Other possible reasons may include adhering to clinical guidelines, and using more patient centred communication.* Note that these claims still require more evidence [1].

Interestingly, there is another group of researchers that examined the mortality rates of older patients after non-elective surgery. They found that the older the surgeon, the lower the mortality rates of the patients, and that female surgeons had significantly lower mortality rates than male surgeons of the same age groups [2].

[1] doi:10.1001/jamainternmed.2016.7875
[2] doi.org/10.1136/bmj.k1343



Research has shown that the US has experienced declines in abortion rates from 2011 to 2014 (by 14%). This appears to be due to access to contraception which results in fewer unintended pregnancies [1]. However, these trends are also complicated by data that also measures the loss of access to services. For instance, "The number of clinics providing abortions declined 6% between 2011 and 2014, and declines were steepest in the Midwest (22%) and the South (13%) [1]."

Given that reproductive health service providers (such as Planned Parenthood) are constantly challenged and (in some cases) forced to shut down due to changing regulations and political pressure, *there are many who are concerned about possible repercussions to women's health*. Currently, studies have shown that as medically safe provision of abortion becomes more limited, "people in 27 US cities must travel over 100 miles (160 km) to reach an abortion facility; the state with the largest number of such cities is Texas (n=10) [2]." These long distances also compounding effects, in that they tend to "push women to seek abortion in later gestations when care is even more limited [2]"

All of this discussion can be framed under the backdrop of human rights. There have been many studies that have looked at how essential access to these services are, especially given their importance to gender equity and women's health in general, which in general have far reaching community repercussions. There is also a strong relationship between lack of service and its disproportionate negative effects on underprivileged communities, both in North American and in global contexts [3].

[1] dx.doi.org/10.1363%2Fpsrh.12015
[2] dx.doi.org/10.2196%2Fjmir.9717
[3] doi.org/10.1016/S0140-6736(18)30293-9

Stroke is the third leading cause of death for females in the US. There are only a few therapeutic options right now, which may be due to most research being done only with male rodent mice [1]. This is changing: for instance, females have (recently?) been shown to react better to intravenous thrombolysis, a treatment that dissolves clots in blood vessels [2]

The symptoms of stroke are also somewhat gendered (possibly due to effect on brain function) - men tend to exhibit the classic stroke symptoms (hemi body paraesthesia, speech/language disturbance, visual impairment, facial weakness, dizziness, etc), whereas women are more likely to exhibit non-classical stroke symptoms (mental status change, migraine, general neurological symptoms such as nausea, hiccups, non-facial weakness, and non-neurological symptoms such as chest pain, palpitations and shortness of breath. Although these differences are not observed in every study, they are seen in many [3]

Estrogen might play a neuroprotective role in stroke incidence and severity and could explain why the stroke risk increases sharply with menopause [4].

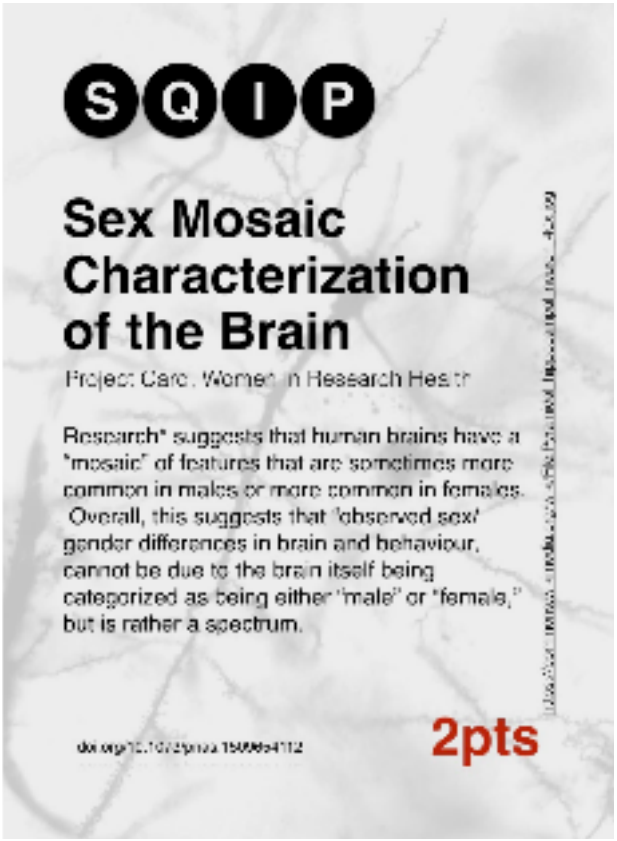
[1] doi: 10.1042/CS20160841
[2] doi.org/10.1007/s12975-017-0579-6
[3] doi.org/10.1016/j.neubiorev.2015.08.020
[4] doi.org/10.1038/sj.jcbfm.9600270

It is widely known that within most African cultures, women play a central role in the community. This strong matriarchal presence also has a pronounced influence on the health of the community at large. For instance, when women become ill the effects on the community will be much more significant. This turns out to be an important consideration as *diseases like HIV and diabetes affect women disproportionately in Sub-Saharan Africa.*

Therefore, it is important for researchers to be aware of this cultural dynamic. This type of research provides insight on how empowering women's health can lead to better outcomes in the developing world context [1].

An example of this is examination of the psychological aid that grandmothers provide to people suffering from the stigmatization of HIV and mental health conditions. Here, studies in Zimbabwe have shown that men, in particular, are not inclined to talk to female doctors about their health. However, because of the high place that Grandmothers hold in their communities, individuals can feel more comfortable talking to them in less formal situations [2].

[1] doi:10.1038/550S4a
[2] doi:10.1001/jama.2016.19102

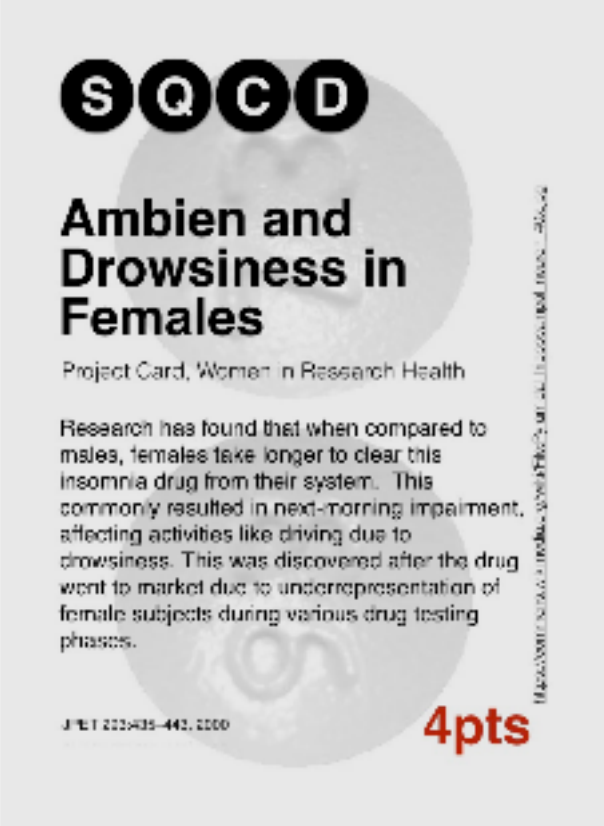


There has been ongoing and controversial discussion about whether the brain has physical/anatomical elements that can lead one to classify the brain as being specifically female or male in nature. Here, studies using MRI brain scans suggest that perhaps a better way to envision brain anatomy is to conclude that the organ is neither “female” nor a “male,” but rather, it exists as a mosaic [1]. In other words, although certain features may be consistently different between the sexes (for example, females have more grey matter), there is usually a spectrum of male and female anatomical characteristics that make up a single brain.

The consequences of these results could be significant from a variety of angles. For instance, there may not be the need to do comparative research between male and female brains. Furthermore, any type of policy which presumes innate differences between male and female brains may need to be re-examined (an example would be single sex educational resources). In fact, the mosaic effect could even affect gender definitions at large [2].

In the research highlighted in this card, scientists found that regardless of what anatomical feature was examined and the technique used for visualization, it was clear that many of the brains (ranging from 23 to 53%) contained a combination of conventionally regarded male and female regions. Furthermore, only a few of the brains examined appeared to be at the male and female extremes[1].

[1] doi.org/10.1073/pnas.1509654112
[2] doi:10.1126/science.aad7499

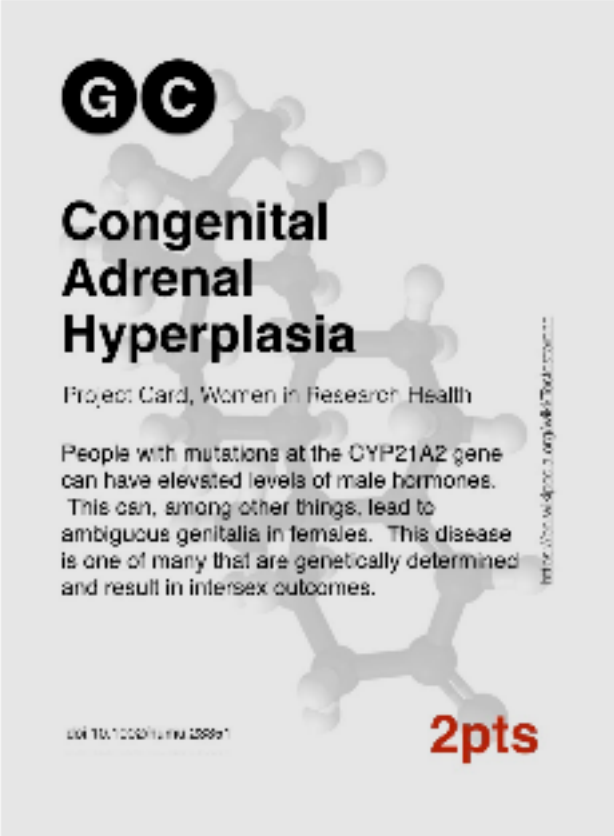


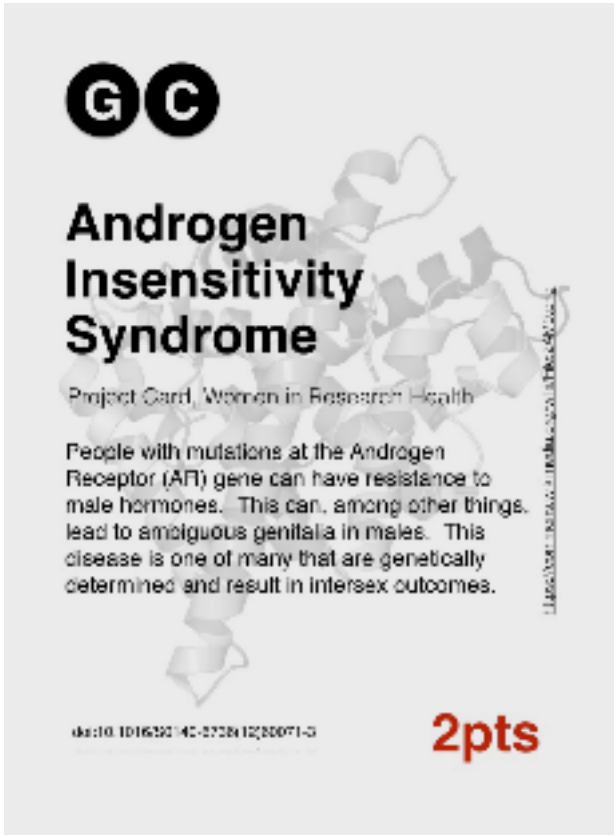
Clinical trials in humans are important to assess the safety and efficacy of various drugs. This is because drugs that work in rodents and other animals might have different effects on humans.

To protect the health of women of childbearing age, and to prevent birth defects in unborn children, young women were banned from participating in clinical trials in 1977. Although this seemed like a reasonable way to test drugs and to protect the public's health, in 1993 in the US, the FDA reversed this guideline. This was in part due to the work of the Office of Research on Women's Health at the NIH, whose advocacy for fairer, less biased drug trials were a success.

Due to basic physiology, males and females might differ in their reaction to certain drugs. An example of this is the dosage of Ambien [2], a sleeping pill. This drug was originally tested in males during Phase I of the clinical trial, when safe dosages are determined. Once the drug went to market, however, it was discovered that Ambien has longer-lasting effect in females. This meant that females, even on low doses of the drug, woke up with next-morning impairment and occasional bouts of strange behavior. This meant that women tended to be more affected by the drug leading to higher incidence of activities like "sleep driving" which have led to car accidents, and "sleep eating" which have led to weight gain and ulcers. Ambien dosages have since been altered.

[1] doi.org/10.1038/550S18a
[2] JPET 293:435–443, 2000 /2133/819964



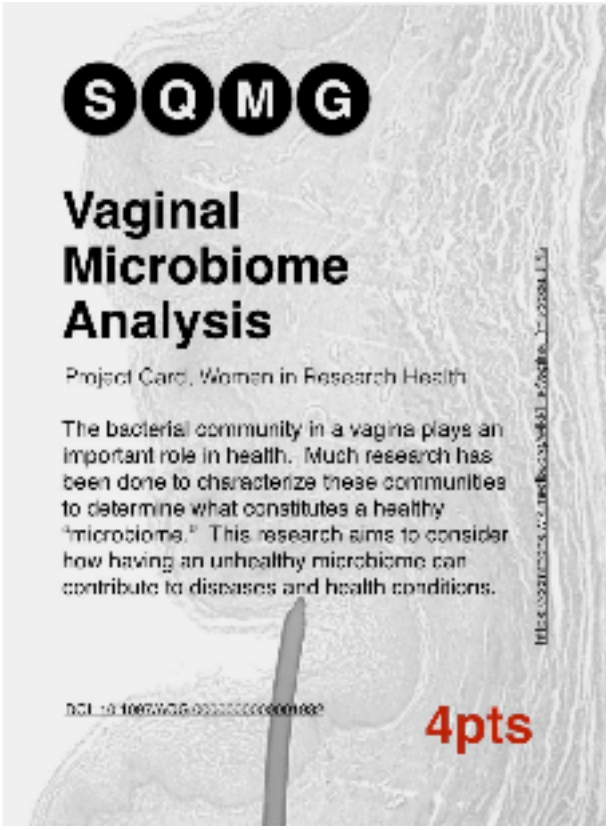


Intersexuality is defined as when a person may have variations in sex characteristics, such that they may not be considered as typically female or male. Variations include genetic determinants (sex chromosomes as being XX, XY, or something else), gonads (eggs/ovaries, sperm/testes), genitalia (external), or sex hormones. The development of a person's sex organs, and the regulation of this through hormonal systems are complicated and require specific steps to occur at specific time points. This means that there are many regulatory checkpoints that could be missed, and is the reason why intersexuality has many causes, whether it is through a mutation or some genetic factor. Congenital Adrenal Hyperplasia [1] and Androgen Insensitivity Syndrome [2] are examples of genetic conditions where this regulation is altered leading to ambiguous development of sex organs.

In both cases (and in other instances of intersexuality), there is much controversy in the medical community around appropriate responses [3]. This is because of the longstanding practice in the 19th and early 20th centuries where the ambiguity (also a response to discrimination of gay people) was thought of as something requiring intervention or in need of being "fixed" [4]. Surgical procedures were often performed to the infant to "correct" the genitalia to match their genetic sex. Note that these activities were often promoted in tandem with Western culture's discrimination of gay people.

Navigating sex assignment of an infant is also clinically difficult because of how interdisciplinary the condition is (involves usually urologist, endocrinologist, gynecologist, psychologist, neonatologist, clinical geneticist, medical ethicist, and social services) [5]. This continues to be an ongoing medical discussion, but there are many examples, where intersex outcomes are being better considered as a natural part of the gender spectrum. For example, by way of patient advocacy, clitoroplasty is on the decline for intersex people, as well as other surgeries being performed that can make the genitalia look more feminine without decreasing pleasure [6].

[1] doi:10.1002/humu.23351
[2] doi:10.1016/S0140-6736(12)60071-3
[3] doi.org/10.1016/j.jpedsurg.2015.10.004
[4] https://rm.coe.int/16806da5d4
[5] doi.org/10.1016/j.beem.2015.04.005
[6] doi.org/10.1177/0009922818803407



The bacterial community (a microbiome) in the vagina plays an important role in health. Much research has been done to characterize these communities to determine what constitutes a healthy "microbiome. [1]"

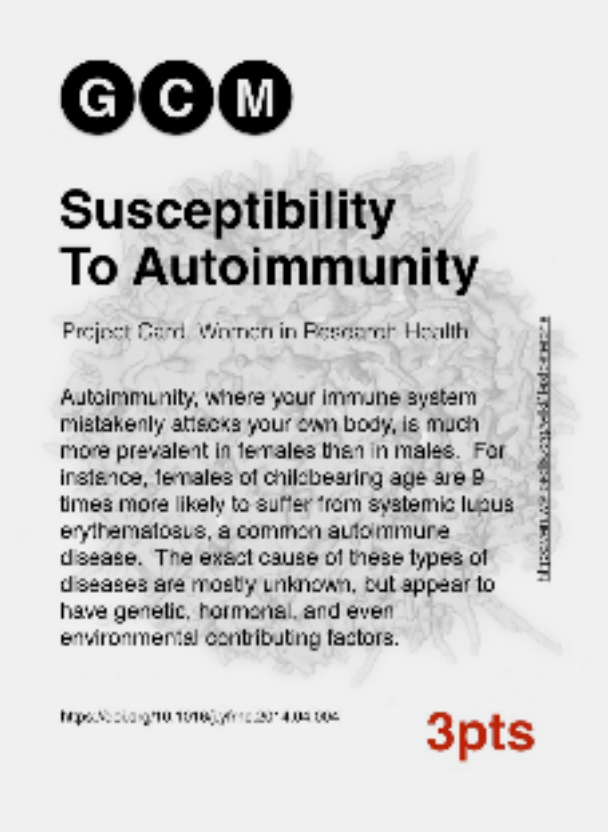
This characterization is generally done via molecular biology techniques that allow high throughput DNA sequencing of samples. In other words, a vaginal swab can be prepared so that all of the DNA contained can be sequenced, and therefore allow identification of the organisms present.

Examples of this include research that has looked at vaginal microbiome characteristics of women infected with HIV (it has less bacteria diversity), which may have implications on effectiveness of some topical medicine applications) [2].

Onset of gestational diabetes (a common disorder where a women has difficulty in producing enough insulin to compensate for the variety of physical changes during pregnancy) also appears to correlate with a lowering of the diversity of the vaginal microbiome [3].

In general, though, the ecology of microbiomes is still under investigation, especially in terms of whether these analyses can be used for treatment purposes (by possibly attempting to readjust bacterial communities back to their ideal state) [4].

[1] DOI: 10.1097/AOG.0000000000001932
[2] iasusa.org/wp-content/uploads/2018/09/26-3-75.pdf
[3] doi.org/10.1007/s12020-018-1813-z
[4] doi.org/10.1016/j.ajog.2018.11.1089

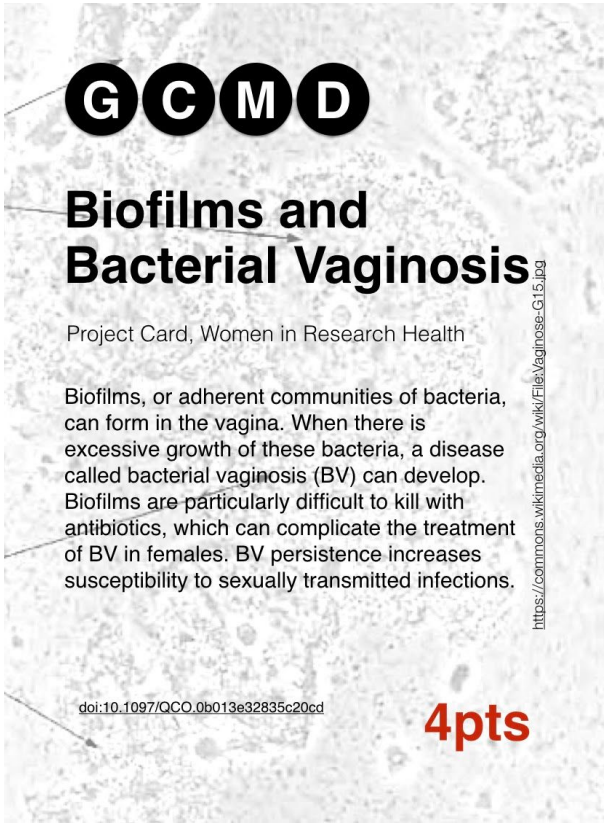


In general, data show that occurrences of autoimmune diseases tend to be more prominent in women than men. Overall, the factors underlying this sexual dimorphism in autoimmune diseases have yet to be clearly characterized. It is, however, likely to be complex as current studies tend to suggest a potential combination of factors, rather than a single one.

One possible link that is likely to be implicated is the ebb and flow of hormonal changes during a person's life (i.e. through puberty for example).
As well, there may be environmental causes at stake (for example: Early reports of multiple sclerosis showed an equal prevalence between the genders, by the 80s, the ratio was 2:1 female to males, and today that ratio is closer to 3:1. This significant changes has been attributed to environmental changes).

Worth noting, is the more recent research around microchimerism. Here, scientists have found that during pregnancy, fetal cells escape and actually become part of the mother's anatomy. This in turn may lead to altered immunological outcomes, with evidence suggesting both good or bad effects.

[1] doi.org/10.1016/j.yfrne.2014.04.004
[2] doi.org/10.1016/j.jaut.2018.05.008

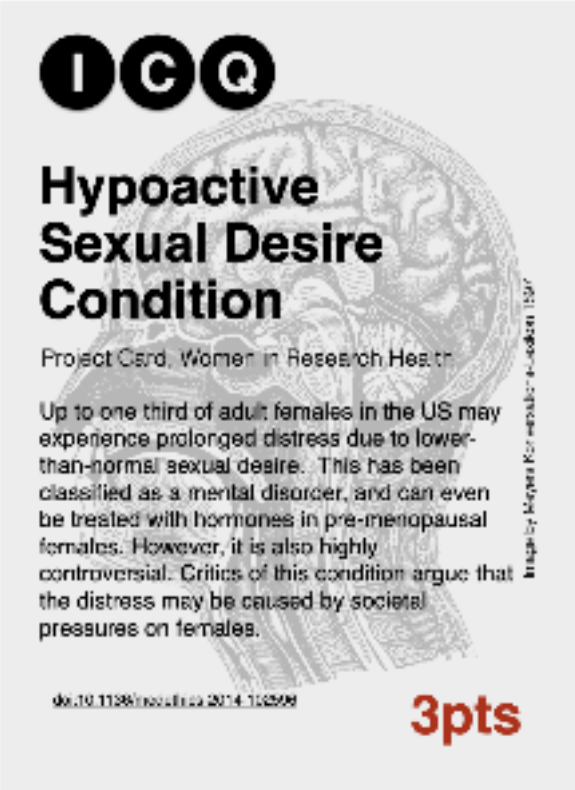


Biofilms, or adherent communities of bacteria, can form in the vagina. When there is excessive growth of these bacteria, a disease called bacterial vaginosis (BV) can develop. Although, usually not considered a serious infection, this change in the bacterial community in the vagina can lead to various forms of discomfort (and potentially serious problems as well) [1].

Common hallmarks of BV are a vaginal bacterial community that is more diverse than usual, and yet low in a particularly important bacteria, known as *lactobacillus*. Together, these changes lead to increased likelihood of infections. This trend has been studied in sex workers, where results suggest that BV increases the rate of HIV acquisition by about 60%, and it also increases the rate of passing HIV to their partner(s) by up to three fold [2].

Biofilms, in general, are difficult to kill with antibiotics. In fact the persistence of biofilms contribute to many diseases in a variety of human environments, such as *P. aeruginosa* in the lungs (pneumonia, cystic fibrosis), and *E. coli* in the urinary tract [3]. In fact, biofilms are especially problematic when implanted medical devices are used (i.e. catheters, joint prosthetics, heart pacemakers, etc) and has been identified as a major cause of clinical infections. This persistence and resistance to treatment of biofilms also complicates treatment of BV in females.

[1] doi:10.1097/QCO.0b013e32835c20cd
[2] doi.org/10.1371/journal.pone.0187612
[3] doi:10.1099/jmm.0.000032



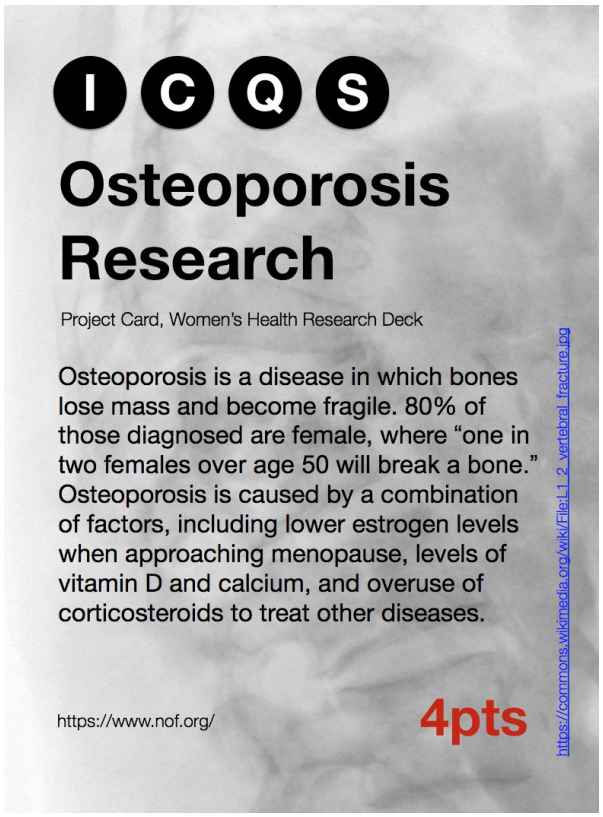
Up to 1/3 of adult females in the US may experience prolonged distress due to lower-than-normal sexual desire. This has been classified as a mental disorder (hypoactive sexual desire disorder or HSDD), and can even be treated with hormones in pre-menopausal females. However, it is also highly controversial. Critics of this disorder argue that the distress may be caused by societal pressures on females.

Much of the narrative centres around a few basic observations. (1) that more medical treatments exist for sexual problems in men (and therefore profitable) than that of women; (2) that norms for sexual desire have not really been scientifically determined; and (3) that therefore, one might argue that HSDD is not a medical condition in the first place. Instead, it's possible that "HSDD is a typical example of a condition that was sponsored by industry to prepare the market for a specific treatment [1]."

For example, the drug Flibanserin was originally marketed and tested as an antidepressant but failed due to efficacy measurements and concerns over side effects [2]. However, since the drug could increased 'sex drive' in women, it was later approved for this alternate purpose. In a way, this shows how the pharmaceutical and medical industries can sometimes develop and prescribe a drug without really understanding the 'medical condition' first.

To conclude, hypoactive sexual desire disorder is an interesting topic as it goes beyond only a scientific viewpoint. Given the ongoing discussions regarding women's sexuality, an approach that includes other disciplines is best suited to provide a more complete picture of this subject.

[1] doi:10.1136/medethics-2014-102596
[2] 10.1016/j.jsxm.2018.01.001



Osteoporosis is a disabling and serious health problem worldwide as it affects 200 million people globally. The disease is characterized by three main elements: (1) Loss of bone mass - bone quantity; (2) Deterioration of bone microarchitecture - bone quality; (3) and an increasing fracture risk, all of which are associated with significant morbidity and mortality [1,2].

While the illness can affect both sexes, women are significantly more at risk, with 80% of those diagnosed being female. This is due in part to bone health being closely tied with estrogen production which has a protective effect on the former. Yet, throughout their life, women's estrogen levels can be affected by irregular menstrual cycles, pregnancy, breast cancer therapies and most importantly menopause. All of which significantly reduce the production of estrogen, and in turn, can result in a weakened bone mass. However, it should be noted that many other important factors can influence the onset of osteoporosis: this includes Vitamin D and calcium intake, as well as genetic factors [1,2].

[1] doi.org/10.1007/s10067-018-4370-1

[2] doi.org/10.1016/j.pop.2018.07.011

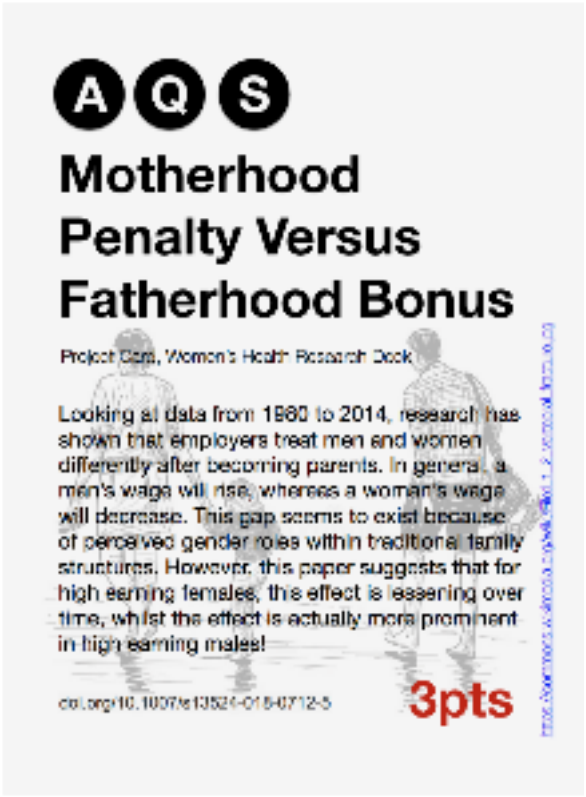
A study aimed to understand and analyze the distribution of industry-related payments to physicians in the United States. This research, based on 2015 records, divided the studied population into categories related to gender, nature of practice and payments in order to uncover and analyze any discrimination-based disparities.

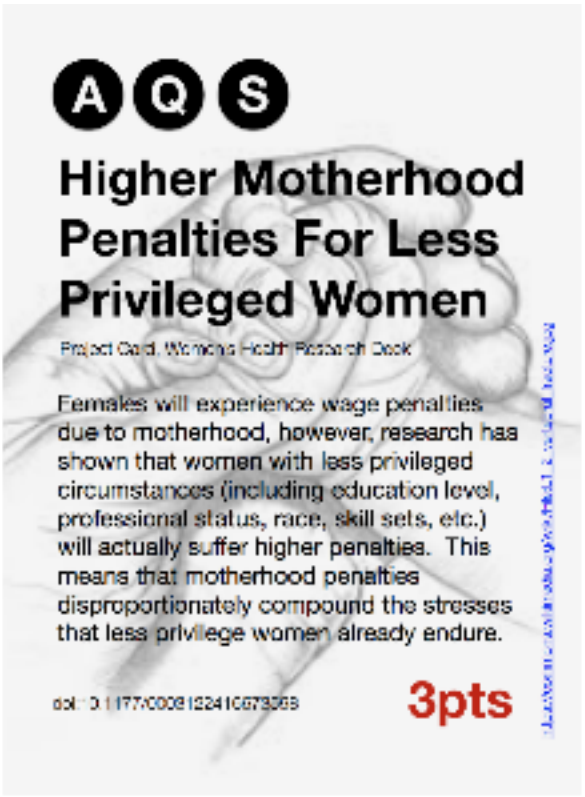
Here, statistics revealed that the distribution of payments between male and female physicians differed significantly and consistently. Overall, it *showed that male doctors obtain higher amounts of industry payment (including grants, travel, gifts, investments, etc).*

For instance, male doctors were not only more likely than female doctors to receive general payments, but also that the value of these payments were significantly higher for men than women (mean values of $5031 versus $1390). Although the paper doesn't directly look at the reasons for this difference, it does suggest a combination of factors responsible. For instance, industry may favour male physicians for representation, possibly due to males holding more leadership positions, which in itself reflects gender inequity ingrained in society.

Finally, the paper points out that whilst doctors, regardless of gender, may consider themselves ethical when accepting industry payments, the reality is that unconscious bias is likely to affect decision making in their practice.

[1] doi:10.1001/jama.2017.3091





Looking at data from 1980 to 2014, research has shown that employers treat men and women differently after becoming parents. In general, a man's wage will rise, whereas a woman's wage will decrease (this also appears to be an incremental change dependent on the number of children). *This gap seems to exist because of perceived gender roles within traditional family structures*. Specifically, this paper provides a good overview of this phenomena and attempts to follow trends in these gaps as categorized by the earnings of the parent.[1]

In this line of research, there are also several papers that examined the specific work conditions that may affect this wage gap: For example, exposure to hazardous conditions, schedule regularity, required on-the-job training, competitiveness, level of autonomy, and emphasis on teamwork. For instance, one paper demonstrated that for every child the women had, there were higher wage penalties for women that had more competitive jobs and/or jobs that required a lot of teamwork. Conversely, there was less pronounced wage decreases if the jobs were more autonomous (i.e. there was some level of independence in the job itself [2]).

Research has also looked at various conditions that define the status of the worker as well. Here, it was *shown that women with less privileged circumstances (including education level, professional status, race, skill sets, etc.) will actually suffer higher motherhood penalties. This means that motherhood penalties disproportionately compound the stresses that less privilege women already endure* [3].

More recently, statistical analysis has shown some improvement in these gaps. In fact, the motherhood penalty appears to be lessening when looked at over the last three decades.

However, this is definitely more so in high earning females, whereas the trend towards parity is not as significant in women of less privilege workplace. Interestingly, when looking at statistics of male parents, the fatherhood bonus has become more exaggerated - i.e. worse - over time (particularly for high earners).

[1] doi.org/10.1007/s13524-018-0712-5
[2] doi/10.1177/0003122417712729
[3] doi:10.1177/0003122416673598

This card highlights *a study that has shown that start up funds for females in basic research positions are 32.5% lower than what males would receive [1].*

Although this paper provided statistics for a specific region in the United States and also focused on biomedical fields, it showcases an overall trend that is commonplace.

"Women are underrepresented in the biomedical research workforce. Only 30% of funded investigators are women. Junior faculty women have fewer peer-reviewed publications than men and are more often on clinician-educator (vs traditional) tracks." [1]

Indeed, there have been a wide variety of studies that demonstrate a lack of equity when comparing female academics versus male academics in STEM related fields. This includes poor gender parity at every step of the research pipeline (from hiring parameters, grant submission rates, grant success statistics, representation via prominent awards, as well as nuances around scientific paper authorship - all nicely reviewed in [2]).

[1] doi:10.1001/jama.2015.8517
[2] doi.org/10.1038/s41559-018-0747-4

This study used fake resumes *where female and male names were randomly switched, to show that there was bias towards males in things like competence and hireability.* [1]

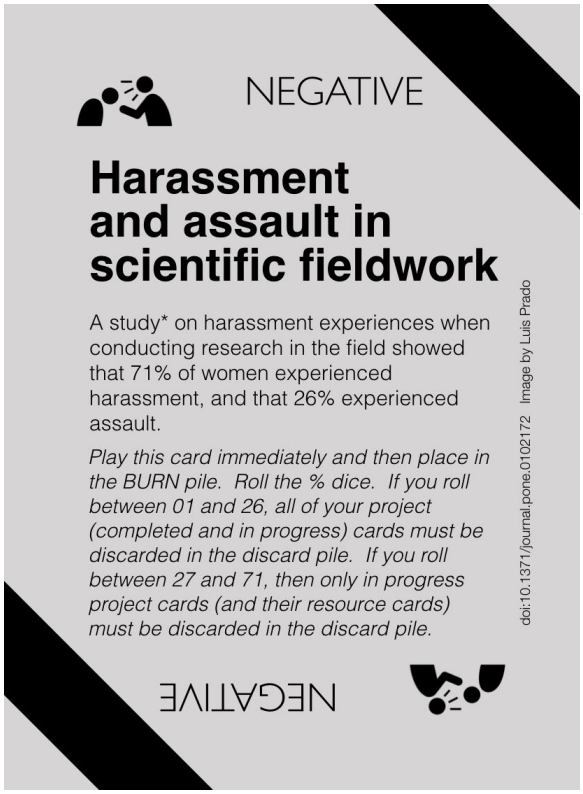
For example, results indicated that female candidates were seen to deserve a smaller starting salary (mean of ~$30,000 for male and ~$26,500 for female) despite their similar qualifications.

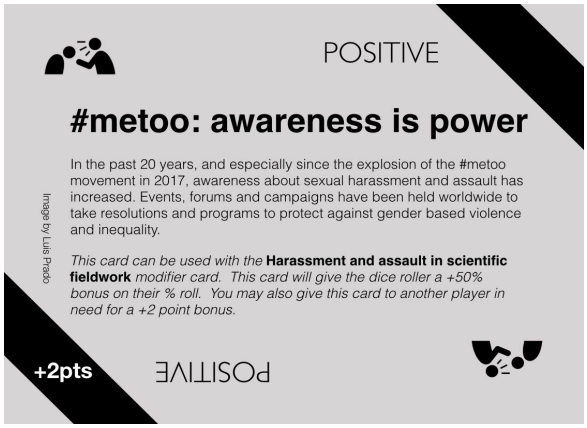
Surprisingly, this paper also showed that both female and male faculty exhibited this hiring bias. A finding that has been supported in other papers [2].

This data appears credible because of its double blind nature (defined from wikipedia: “neither the participants nor the researchers knew which participants belong to the control group and which belong to the test group”)

Overall, this study suggests that the discrimination at the hiring level does not appear to stem from intentional willingness to prevent women to succeed or progress in the academic STEM, but rather that they emerge from larger and pervasive cultural stereotypes present in our society which consistently depict women as less competent than men (often referred to as preexisting subtle bias).

[1] doi:10.1073/pnas.1211286109
[2] doi.org/10.1037/apl0000022





Sex discrimination harassment refers to any unwanted offence (including verbal) perpetuated on a person because of their sex. Reports and allegations of sexual harassment, as well as assault (which involves physical contact) have demonstrated that the workplace is one of the most prevalent environment for such event to occur.

In 2014, a study aimed to investigate the experience of sexual harassment and assault for biological anthropologists and field scientists during field research settings. This study revolved around an anonymous online survey in which participant could provide information about past fieldworks and experiences.

The results demonstrated that conducting research in the field exposes scientist to numerous negative experiences, especially for women (71% of female biological anthropologists and field scientists experienced harassment and 26% experienced assault in the field).

The study further describes that trainee women (individual that are earlier in their career) are disproportionately more likely to report these kind of experiences. These results may suggest that these experiences occur in context of power imbalances where the perpetrator is in a higher senior professional position.

The author has also more recently published research examining other disciplines (astronomy and planetary sciences) where she found similar trends.

[1] doi:10.1371/journal.pone.0102172
[2] doi.org/10.1002/2017JE005256