The Significance of Pain in Pregnant Women Caused by Muscle Cramps and Other Pregnancy Symptoms

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On my honor as a University Student, I have neither given nor received unauthorized aid on this assignment as defined by the Honor Guidelines for Thesis-Related Assignments

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Introduction

Pregnancy is a process that is essential for the existence of humankind. It is the beginning of every person's life. No matter who someone is or what they have accomplished, they had to first be carried, grown, and completely sustained by their mother alone. In 2023, approximately 134 million babies were born,[1] so pregnancy is evidently very common, yet it is still under-researched and often not well understood. Pregnant women commonly endure a lot of struggles, and the process is frequently marked by severely painful or life altering symptoms.

The lack of research into these symptoms is partially displayed in the case of muscle cramps. An estimated 40-50% of pregnant women experience severe nocturnal leg cramps, however the limited research in this area has failed to validate any mechanism of cramp formation.[2] While pregnancy is often listed as a cause of muscle cramps, generally no information about why pregnant women experience cramps or how to prevent them is given, making this a common symptom that they endure with little to no explanation or treatment.[3] Why is there a lack of importance placed on a potentially solvable issue that causes such a large percentage of pregnant women significant pain? The minimal interest displayed here by medical research and society prompts an investigation into the other aspects of pregnancy that are likely also neglected, overlooked, or under-researched.

How should we place importance on the pain and experience of pregnant women? In this paper, I will use actor-network theory to answer this question by investigating the symptoms associated with pregnancy, their prevalence, and their impact, as well as the current attitude of the general population toward these symptoms. I will also address pain and how it is treated differently between men and women. Through my analysis I aim to convince readers of this paper that the public's view has a positive or negative impact on the experience of pregnancy and

the research surrounding it. We must view the pain and symptoms of pregnant women with the same attitude we apply to symptoms of illnesses, pain occurring in healthy or sick individuals, and any other medical issue that we actively seek to resolve.

Background and Significance

Most pregnant women experience symptoms that negatively impact their quality of life. It has been reported that up to 98% of pregnant women experience fatigue, up to 88% experience nausea, up to 74% experience poor sleep, up to 60% experience back pain, and up to 57% experience vomiting as a result of pregnancy.[4] These are only the most well-known symptoms, and for some women, this doesn't begin to cover their experience. A more comprehensive list, with percentages of women reported to experience each symptom, includes bladder weakness (53.1%), shortness of breath (81%), constipation (76.2%), diarrhea (49%), flatulence (49.7%), foot pain (26.4%), headache (72.7%), heartburn (69%), incontinence (45.6%), mood swings (70.3%), stress (57.3%), neck pain (72.9%), nutrition deficiencies (82%), and pelvic pain (69%).[4] Thus, significant pregnancy symptoms are extremely common and affect millions of women every year, making research and conversation about these experiences exceedingly important. Many of these symptoms cause severe pain that goes untreated for months, but the lack of pain treatment for women may extend beyond pregnancy.

It is often casually stated that "women have a higher pain tolerance than men." This is a seemingly harmless phrase describing the way men and women relate to their pain, but it perpetuates the subconscious narrative that the pain of women needs to be treated less aggressively than that of men. As people with significant biological differences, men and women do experience pain differently. Some studies site hormonal differences and structural differences in the central nervous system as factors affecting the perception of pain among women and men,

and a greater sensory receptor density in women is believed to increase the sensitivity of women's skin when compared to men's.[5] The underlying biology that shapes human sensory experience is often not considered when treating pain differently between the sexes.

Even though women have a higher incidence for reporting pain, they are treated less frequently and less aggressively than their male counterparts. The complaints are seen as emotional, where the complaints of men in pain are seen as logical and valued more highly. The statement comparing the pain tolerance of men and women is most likely accepted because women are better at managing the pain they experience. Studies have shown that while women do not, on average, have a higher pain tolerance than men, they do have more and healthier coping mechanisms that better equip them to endure pain.[5] If this is true, then women are experiencing the same or greater levels of pain than men but are treated less due to their ability to continue functioning even in times of significant pain.

Though pain is significant, it is not the only adverse effect of pregnancy. There are also many mental health concerns for antepartum and postpartum mothers. Some research shows that 12.7% of pregnant women experience a major depressive disorder, [6] and another paper suggests that 1 in 3 women show elevated symptoms of depression for two years after childbirth. There is also speculation that pregnancy related pain is linked to postpartum depression; however this concept is largely under researched,[3] which further displays the widespread impact of pregnancy and increases the importance of research in this field.

Failure to consider the complex experiences of pregnancy and the factors that have shaped current standards of practice in treatment removes the possibility of progress. In our fixed mindset, we resign ourselves to the continued oppression of women, isolation of pregnant people, unnecessary difficulties surrounding pregnancy, and lasting mental health impacts and

burdens on mothers. If the general population is willing to consider the arguments discussed in this paper, we could see lasting impacts on the global population through improved mental and physical health, decreased fear, and increased resources and support during and after pregnancy. This shift in thinking is an opportunity for people to increase the respect for pregnant women and the pain they experience, increase their autonomy, and create a better experience for all pregnant women in the future.

Conceptual Framework

In the following analysis, I will employ actor-network theory to construct an argument aiming to shift the readers' views on pregnancy related pain. Actor-network theory is a theoretical framework that defines materially heterogeneous networks as the foundation of society. In this school of thought, components of the world are defined as human or non-human actors, all of which combine to create complex networks that produce order, society, and social effects. The theory also maintains that every actor affects the network, and thus the addition or removal of an actor will change its function.[7] Networks can also be consolidated; in which case they behave as single point actors that play a role in a larger network.[8] It differs from many other schools of thought in that actor-network theory does not align with social constructionism, in which everything is socially constructed, nor does it align with realism, in which everything is pre-existent.[7] Instead, this theory focuses on interactions between actors that can be pre-existent or constructed, and the networks they exist in and influence.[7–9]

A critical component of actor-network theory is the heterogeneity of the networks. This theory argues that networks are made of people, technology, and other types of materials, all interacting with each other. Social and technical components are not independent creations, rather, they are constantly mutually defining one another.[9] The relationships between

heterogeneous actors are essential for the development of society, thus, the organization and social effects produced by networks would not exist if networks were purely social. One important social product to consider is knowledge, which is characterized in actor-network theory as being produced by hard work of heterogeneous components in a patterned network.[8] The production of knowledge is especially valuable when considering the topic of this paper, as it functions well as a measure of the work contributed by actors surrounding a specific issue or group of issues.

Actor-network theory allows me to analyze the research and development of medical technology focused on the symptoms of pregnancy as the result of the networks that exist in our society. I will consider actors such as pregnant women, existing technology, the members of society, and medical professionals. Actor-network theory also allows me to observe the network of pain treatment and analyze the discrepancies between the treatment of men and women as a social product. This network will then be consolidated to the role of an actor in my argument focusing on the underappreciation of pregnancy related pain. Finally, I will use actor-network theory to discuss how a shift in the views of the general public, or those reading this paper, would affect the pregnancy experience and the network as a whole.

Methodology

Some of the data used in the following analysis was collected specifically to complete this paper. The research was conducted via a survey on Google Forms consisting of 43 questions about the experience of pregnancy. The survey was distributed through Facebook groups and was taken anonymously by 148 women ages 22 to 65 who have given birth at some point in their lifetime. The data was analyzed using Python software to examine general results and correlations between various answers. In efforts to protect the identities of the women who

participated in the study and respect data privacy, the dataset is not available to view, but overall results and conclusions drawn from the data are discussed in the analysis.

Analysis

The actors in the network of obstetric care include pregnant women, the existing treatments for pregnancy symptoms, medical technology, healthcare workers involved in pre and postnatal care, the general population, and the discrepancy between pain treatment in men and women. The effects of the pain treatment discrepancy are complicated and are best understood when the network of pain treatment among men and women is analyzed independently.

Discrimination of Women in Pain Treatment

The belief that women have a higher pain tolerance than men is not supported by scientific evidence and perpetuates harmful disparities in pain treatment. A comprehensive case study examining gender bias in relation to pain presents abundant evidence in contrast to this assumption.[10] Research indicates that women actually have lower pain thresholds, greater ability to detect pain, higher pain ratings, and less tolerance of noxious stimuli compared to men. There is also evidence that these differences in pain experience are influenced by biological factors, such as mechanisms of nerve growth factors and sex-based differences in the sympathetic nervous system.[10]

According to the aforementioned studies, there is actually more biological evidence for a difference in pain experience between the sexes than what is presented in reality, which prompted the authors to ask, “How do women dampen the effect of powerful sex differences in physiological pain mechanisms to achieve only small sex difference[s] in their actual pain experience?”[10] Using actor-network theory, one can investigate this question viewing women,

men, and healthcare professionals as actors continuously interacting with one another. If the healthcare professionals for some time neglected to sufficiently treat women's pain, women would be pushed to develop more rigorous coping mechanisms, allowing them to manage their pain sufficiently. Such a development within the network could produce the social effect that men, women, and medical professionals believe women are better at tolerating and managing pain, or have a higher pain tolerance, than men. This belief then held by all or most actors in the network would enforce the decision of healthcare professionals to treat women less aggressively for pain. This theory holds up well, as there is evidence that women have healthier and more effective coping mechanisms than men,[10] as well as evidence that women are treated less aggressively for pain than men, discussed below.

Harvard Health presented a review of disparities, with studies showing that women are much more likely to receive prescriptions for sedatives rather than pain medication, and women who receive coronary bypass surgery are only half as likely as men to be prescribed painkillers. Furthermore, in United States emergency rooms, women wait an average of 65 minutes to receive medication for abdominal pain compared to men, who wait an average of 49 minutes when experiencing the same pain.[11] These discrepancies continue in cases with severe long-term effects, as data shows women seven times more likely than men to be misdiagnosed and discharged while actively having a heart attack.[12] Another study found that women suffering from an ST-Segment Elevation Myocardial Infarction have a 59% higher chance of misdiagnosis compared to men.[13] It is likely that these repeated errors in pain related diagnoses are partially caused by the lack of inclusion of women in medical research. Until the 90s, almost all clinical research studies excluded women.[10] This only changed in response to the NIH Revitalization Act

of 1993, which mandated the inclusion of women in medical research.[14] Unfortunately, the effects of years of research involving only men are still lingering.

The entire network of pain significance and treatment can be consolidated into a single actor to investigate how the discrepancies discussed above impact the experience of pregnancy. If healthcare workers believe that women need less pain treatment, women will continue being treated less for their pain, leading to the lack of development of pregnancy related pain treatments. Finally, if pain experienced by women is left untreated, women and men in our population are more inclined to believe that women do not need to be treated for pain. Without change led by an actor within the network, these beliefs and practices will continue to be perpetuated.

Normalization of Pregnancy Symptoms

In the case study focusing on pain discrepancies, Hoffmann and Tarzian reference a statement that "women more often experience pain that is part of their normal biological processes,"[10] referring to menstruation and pregnancy. While it is true that normal female biological processes frequently cause pain, the classification of this pain as "normal" leads to a reduction of its importance. Specifically in relation to pregnancy, symptoms that are painful, debilitating, or have extremely negative impacts on quality of life are often brushed aside and left untreated and uninvestigated because they are considered "normal."

While investigating symptoms of pregnancy, I primarily found two types of content: articles focusing on warning signs during pregnancy or content about symptoms that indicate pregnancy. While both topics are extremely important, this highlights an unfortunate lack of research into the experience of pregnant women. People are seldom focused on the struggles

endured by pregnant women if their symptoms are "normal." In my own research, 65.5% of women reported being told during pregnancy that their pain was normal, a notion also displayed in many articles. For example, an article titled "Pregnancy Warning Signs: Symptoms Not to Ignore" discusses dangerous signs during pregnancy.[15] The content is important, but the article and the title suggest that, if a symptom is not indicative of a severe complication, the mother should be able to ignore it. Another article, "Danger Signs in Pregnancy" has a similar premise. It lists vaginal bleeding, convulsions, severe headaches causing blurred vision, being too weak to get out of bed, severe abdominal pain, and fast or difficult breathing as the danger signs that should be taken seriously.[16] Again, this is helpful information, but it also maintains the idea that any symptom not listed here is normal, and thus insignificant.

One article published by Stanford Medicine refers to most pregnancy related symptoms as "annoying, but normal."[17] The use of the word "annoying" to describe these symptoms well captures the attitude of healthcare professionals as well as the general population. It perpetuates the idea that the suffering endured by pregnant women is a nuisance that can be overlooked. Some of these "annoying" symptoms are as follows, according to Stanford Medicine: mild swelling, stomach problems including nausea, vomiting, heartburn, gas, and bloating, bathroom issues including leaky bladder, constipation, and hemorrhoids, swollen gums or mouth bleeding, and mild aches and pains, including backaches and leg cramps at night.[17] While leg cramps are classified as "mild" aches and pains in the article, 79.3% of the women I surveyed who experienced leg cramps rated their pain above a 5 on a scale of 1 to 10, and the most common answer was a pain level of 8 (32.8%). Furthermore, 86.4% of the women who experienced leg cramps reported that the pain caused them to wake during the night, which expands the impact of this so-called mild pain.

Treatment of Pregnancy Symptoms

The normalization and dismissal of pregnancy symptoms also impacts the network of obstetric care, primarily on the treatment and research, or lack thereof, in this area of medicine. 71% of the women I surveyed reported receiving some type of treatment for their pain, and 63% of these women had to advocate for themselves before treatment was offered. Another 13.2% reported advocating for their own treatment and still receiving none. The discrepancies in experience of pregnant women and treatment received also extend beyond pain, and the issue is particularly significant in cases of postpartum depression.

A review of postpartum depression trajectories asserts that prenatal care providers are uniquely fit to assess patients for risk factors but are not well educated in detecting depression or treating it.[6] Another paper reports that 1 in 9 mothers are diagnosed with postpartum depression, and 1 in 3 show elevated symptoms of depression for 2 years after childbirth.[3] Comparable results were found in my own research, where 30.1% of women reported experiencing postpartum depression after at least one pregnancy. Though the issue is common, the lack of training for prenatal care providers directly results in a lack of care for mothers experiencing postpartum depression. This is also reflected in my research, as 52% of women who experienced postpartum depression reported receiving no treatment from a doctor.

Research Focused on Pregnant Women

Further lack of research focused on pregnant women exists in leg cramps, the etiology of which is not well researched or understood,[18] as well as medication use. One review highlights the need for pharmacologic research in pregnancy, stating that “the majority of current therapeutics were never studied in pregnancy during development.”[19] More specifically, only 5%

of pharmaceuticals approved by the FDA between 2003 and 2012 included human data in their pregnancy studies. Almost all safety and toxicity data that is available in relation to pregnancy was obtained from post-marketing surveillance or late-stage retrospective studies, and most efficacy and dosing data of these drugs were extrapolated from studies in men and non-pregnant women.[19] While much of the lack of pregnant women's inclusion in these studies can be attributed to ethical concerns, an equally significant ethical concern arises when these drugs are prescribed to pregnant women without being tested for them in any capacity. Additionally, many women are self-medicating with over-the-counter drugs to manage their symptoms, but the lack of pregnancy focused research makes this a dangerous practice.[19]

Without research focused on pregnant women, we cannot expect to see improvements in the experience of pregnancy, which is shown in the research I conducted this semester. My data shows no correlation between the year the subjects gave birth and pain, symptoms, or overall experience. Year of childbirth of the women surveyed range from 1990 to 2024, and both self-reported pain ratings and experience ratings were evenly distributed across the years. This shows no improvement in these areas over the past 35 years, and without active participation of the actors within this network to increase research and view the symptoms of pregnancy as significant, we will continue to see the same lack of improvement for years to come.

Conclusion

By applying actor-network theory, I have analyzed the disparities of pain treatment in women and the effects of this on pregnancy related pain treatment as well as the broader network of pregnancy symptom treatment and research. The analysis highlighted the persistence of stabilized networks and how the actors involved in obstetric care participate in the perpetuation of existing social products. The discrimination against women in the way pain is valued and

treated contributes to the underappreciation and normalization of pregnancy related pain. This normalization of pain and other symptoms associated with pregnancy perpetuates inadequate research and treatment, and the lack of research and treatment for pregnant women continually confirms the societal belief that pregnancy symptoms do not need to be treated.

These cycles of disparity and underappreciation will remain unchanged unless there is active involvement of actors within the network to disrupt the pattern. However, if we critique the factors contributing to the development and sustenance of the current treatment standards and challenge the way the medical field and the public view pregnancy, we move towards the improvement of pregnancy overall. People can become the actors that shift the patterns of research and treatment by placing more importance on the pain of women and the experience of pregnant women. The proper shift in conversation can drive the call for an increase in research, which will shift treatment patterns, decrease the pain associated with pregnancy and its impacts, and improve the experience of pregnancy for all women.

References

(1) Ritchie, H.; Mathieu, E.; Roser, M. How Many People Die and How Many Are Born Each Year? *Our World in Data* **2024**.

(2) Giuriato, G.; Pedrinolla, A.; Schena, F.; Venturelli, M. Muscle Cramps: A Comparison of the Two-Leading Hypothesis. *J Electromyogr Kinesiol* **2018**, *41*, 89–95. https://doi.org/10.1016/j.jelekin.2018.05.006.

(3) Mathur, V. A.; Nyman, T.; Nanavaty, N.; George, N.; Brooker, R. J. Trajectories of Pain during Pregnancy Predict Symptoms of Postpartum Depression. *Pain Rep* **2021**, *6* (2), e933. https://doi.org/10.1097/PR9.0000000000000933.

(4) Nissen, M.; Barrios Campo, N.; Flaucher, M.; Jaeger, K. M.; Titzmann, A.; Blunck, D.; Fasching, P. A.; Engelhardt, V.; Eskofier, B. M.; Leutheuser, H. Prevalence and Course of Pregnancy Symptoms Using Self-Reported Pregnancy App Symptom Tracker Data. *NPJ Digit Med* **2023**, *6*, 189. https://doi.org/10.1038/s41746-023-00935-3.

(5) Smith, S. Who's Really Hurting? *AMA Journal of Ethics* **2002**, *4* (8), 228–230. https://doi.org/10.1001/virtualmentor.2002.4.8.jdsc1-0208.

(6) Lancaster, C. A.; Gold, K. J.; Flynn, H. A.; Yoo, H.; Marcus, S. M.; Davis, M. M. Risk Factors for Depressive Symptoms during Pregnancy: A Systematic Review. *American Journal of Obstetrics and Gynecology* **2010**, *202* (1), 5–14. https://doi.org/10.1016/j.ajog.2009.09.007.

(7) Cresswell, K. M.; Worth, A.; Sheikh, A. Actor-Network Theory and Its Role in Understanding the Implementation of Information Technology Developments in Healthcare. *BMC Medical Informatics and Decision Making* **2010**, *10* (1), 67. https://doi.org/10.1186/1472-6947-10-67.

(8) Law, J. Notes on the Theory of the Actor-Network: Ordering, Strategy, and Heterogeneity. *Systems Practice* **1992**, *5* (4), 379–393. https://doi.org/10.1007/BF01059830.

(9) *To Reveal is to Critique: Actor–Network Theory and Critical Information Systems Research*. https://doi.org/10.1080/02683960210145986.

(10) Hoffmann, D. E.; Tarzian, A. J. The Girl Who Cried Pain: A Bias Against Women in the Treatment of Pain. **2001**, *29*.

(11) *Women and pain: Disparities in experience and treatment*. Harvard Health. https://www.health.harvard.edu/blog/women-and-pain-disparities-in-experience-and-treatment-2017100912562 (accessed 2024-04-12).

(12) *Coronary Heart Disease in Women — An Ounce of Prevention | New England Journal of Medicine*. https://www.nejm.org/doi/full/10.1056/NEJM200008243430809 (accessed 2024-04-12).

(13) Leeds, U. of. *Women more at risk of dying after a heart attack*. https://www.leeds.ac.uk/news-health/news/article/4269/women-more-at-risk-of-dying-after-a-heart-attack (accessed 2024-04-12).

(14) Studies, I. of M. (US) C. on E. and L. I. R. to the I. of W. in C.; Mastroianni, A. C.; Faden, R.; Federman, D. NIH Revitalization Act of 1993 Public Law 103-43. In *Women and Health Research: Ethical and Legal Issues of Including Women in Clinical Studies: Volume I*; National Academies Press (US), 1994.

(15) *Pregnancy Warning Signs: Symptoms Not to Ignore | Pampers*. https://www.pampers.com/en-us/pregnancy/pregnancy-symptoms/article/pregnancy-warning-signs (accessed 2024-04-12).

(16) DANGER SIGNS IN PREGNANCY. In *Counselling for Maternal and Newborn Health Care: A Handbook for Building Skills*; World Health Organization, 2013.
(17) *Pregnancy: What's Normal … and What's Not*. https://www.stanfordchildrens.org/en/topic/default?id=pregnancy-whats-normal-and-whats-not-1-4076 (accessed 2024-04-12).
(18) Hensley, J. G. Leg Cramps and Restless Legs Syndrome During Pregnancy. *Journal of Midwifery & Women's Health* **2009**, *54* (3), 211–218. https://doi.org/10.1016/j.jmwh.2009.01.003.
(19) Ayad, M.; Costantine, M. M. Epidemiology of Medications Use in Pregnancy. *Seminars in Perinatology* **2015**, *39* (7), 508–511. https://doi.org/10.1053/j.semperi.2015.08.002.