Thesis Project Portfolio

Mathematical Modeling of Muscle Cramps

(Technical Report)

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

(STS Research Paper)

An Undergraduate Thesis

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Sociotechnical Synthesis

Mathematical Modeling of Muscle Cramps and the Lack of Pregnancy Symptom Research

Nocturnal leg cramps are a common symptom of pregnancy that interrupt sleeping patterns and cause many women significant pain. This symptom, though a fairly common occurrence among pregnancies, is severely under-researched. How cramps are formed, sustained, and released is unknown, and there are minimal efforts to determine it. This thesis focuses on muscle cramps and the prevalence, impact, and disparities of pregnancy symptoms. The technical project was completed in a capstone team under the Department of Biomedical Engineering, where I collaborated with a partner to model the muscle for use in muscle cramp research. My STS research investigates the pain associated with pregnancy and how it is viewed and treated by society, medical professionals, and researchers.

The capstone project is a model of the muscle, most relevant to the human gastrocnemius muscle in the lower leg. It was built using Python software and consists of individual components that combine to form a muscle. Each component is defined by one or multiple equations that represent its behavior mathematically, derived from research into literature and characteristic equations of viscoelastic elements that define the muscle. The components are the muscle spindle, golgi tendon organ, central nervous system, and contractile element. Each component interacts with the network, creating a virtual muscle that stretches, contracts, and responds accordingly through neural firing. We used the model to analyze the behaviors of a muscle when given different stimuli, and going forward, the model could be used to evaluate hypotheses for cramp etiology.

The STS research uses actor-network theory to analyze the systems involved in pregnancy symptom care and treatment. I surveyed 148 women who have completed a pregnancy at some point in their lifetime to provide real and relevant data on the subject. Throughout the year, I investigated the discrepancies in pain treatment between men and women, concluding the effects of this on pregnancy treatments. I also focused on the normalization of pregnancy symptoms and analyzed how it impacts the network of obstetric care. Finally, I researched the treatment of pregnancy symptoms and the research focused on or involving pregnant women. All subtopics were analyzed based on how they demonstrate and affect the existing views and practices surrounding pregnancy-related pain.

The technical project and STS research provide insight into muscle cramps and the pain they cause, as well as other pregnancy symptoms and the societal impacts associated with them. The lack of research focused on muscle cramp etiology prompted the investigation into pregnancy-related pain, and the STS research resulting from that investigation gives a clear look at the inadequate respect for and treatment of pregnancy symptoms. I would like to thank Dr. William Guilford for supporting my capstone team throughout the duration of the technical project. Additionally, I would like to thank Dr. Richard Jacques for his continued support in my STS research.