**Specific Aims**

Uphill walking requires more energy to be used in comparison to level walking and the demand is even greater when a load, such as a backpack, is being carried. This research will develop an informative approach on how people can make a hill climb less strenuous when carrying a load. This will be accomplished by understanding the mechanics around uphill walking and how certain parameters such as load weight, incline grade, and center of mass location, can affect metabolic costs. It is important to note that there is very little research done on uphill walking with a load. There are studies that look at pure uphill walking to observe the costs and work the human body puts in to carry itself up a hill. This research is then used in future studies to develop exoskeletons that assist in muscle actuation and shoe modifications that changes how the foot interacts with sloped surfaces. Furthermore, there is research on the costs of carrying a load on level ground, which looks at the adjustments the human body makes to compensate for the added load and the increased costs for carrying a load, leading studies to make modifications and design different backpacks that try to reduce this cost. With these prior findings in mind, our research will address three key aims for walking uphill efficiently with a load. The first aim is to understand how metabolic cost changes with load and slope/grade. Our hypothesis for this is that metabolic costs for walking uphill with a load increases as the slope grade of the hill and/or the load being carried increases. Our next aim looks at how the location of the center of mass (COM) can affect metabolic costs. We hypothesize that the further a load’s COM is moved from the human’s COM, the higher the metabolic cost will be. Our last aim looks at how implementing a heel wedge can affect metabolic costs. The influence of heel height on kinematics and gait during level walking has been studied extensively. However, while walking uphill, a heel wedge which negates the slope reduces metabolic cost. We hypothesize that a heel wedge which brings an uphill slope closer to level walking will reduce metabolic cost while walking with a backpack load. Strategies to reduce cost can be derived based on the significant changes the human body makes in uphill walking with a load. We believe our research can be used to develop assistive methods and/or devices with respect to human biological capacities to reduce costs for loaded uphill walking.

Text I used to work on Specific Aims. May help with making the rest of the document too: [The Ins and Outs of NIH](https://docplayer.net/5572207-Grants-r01-r21-r15-and-r03-the-ins-and-outs-of-nih-understanding-nih-requirements-impressing-reviewers-and-writing-a-competitive-proposal.html)