**Aim 1: Observing Metabolic Cost At Different Loads And Slope Grades**

The aim for this section is to understand how metabolic cost for walking changes at different iterations of slope grades and loads using unloaded level walking as a baseline comparison. Our hypothesis is that as the slope incline increases, metabolic cost will increase and as load increases, metabolic cost will still increase. We expect to see the greatest costs at the highest slope testing grade while carrying the heaviest testing load.

As stated in the overview, a dual-belt treadmill with force sensors will be used to test subjects at various slope grades: 0° (level), +4°, +8°, and +12°. These angles were chosen based on both the angle limit the treadmill can go and on angle settings from past research that tested metabolic costs for uphill walking.[1,5,11,12] Force sensor are required since ground reaction forces (GRF) will change as the slope grade is adjusted and joint kinematic data will be used to observe the changes in joint moments. Knee moment is expected to change the most from prior research.[6,20] Both legs are expected to generate more force at double support for steeper inclines.[13]

Subjects will also be tested with 0%, 5%, 10%, 15% additional bodyweight strapped to their back using the backpack that is stated in the overview. Prior research for various load carrying tests have led us to expect large changes in ankle and hip moments, and a greater pelvic lean as the carried load becomes heavier.[7,21,22]

This test will go through a total of 16 iterations with 4 different slope grades (level, +4°, +8°, and +12°) and 4 different loads (+0%, +5%, +10%, +15% body weight). Although this may seem like many tests, there is a very scarce amount of data for loaded uphill walking. All hypotheses so far are based on unloaded uphill walking and loaded level walking so acquiring data for various slopes and loads will show what has a greater significance for effecting metabolic costs. The metabolic and kinematic data obtained from the baseline test of level walking with a 0% additional load (unloaded) will be used for the following two aims as well.

Subjects will complete four testing sessions on four different days. Each day will begin with a 5 minute warm-up session that requires them to walk on the treadmill at level slope grade at 1.0 m/s. Afterwards subjects will be required to walk at the specified slope grade and load weight which will be determined at random for 6 minutes at 1.0 m/s. Each subject will perform this test four times a day at a different slope and load, with 6 minute breaks in between. By the end of the fourth testing day, there will be 16 iterations of slope and load walking data for each test subject. Data collection method is the same as what is stated in the main overview. ~~This data is composed of indirect calorimetry data that measures the O~~~~2~~ ~~consumption and CO~~~~2~~ ~~output of each subject and the GRFs retrieved from the force sensors of the treadmill. This data will be used to calculate the metabolic cost of walking and the joint moments, respectively.~~