Variability Based Analysis of Torso Loaded Gait Stability

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Torso loads are common in many everyday activities such as hiking, carrying boxes, and picking up children and are also a part of many long-term conditions such as pregnancy and obesity. Backpacks, worn on either the front or back of the body, may be used to simulate these loads and ultimately, can help us understand how torso loading affects gait stability. One method of assessing gait stability is through changes in average temporal-spatial gait parameters, where significant changes can represent compensation for instability. Another way to study gait stability is to measure variability in temporal-spatial parameters. The main objective of this study was, therefore, to determine if there were differences in the variability of temporal-spatial parameters between loaded and unloaded gait. Temporal-spatial gait parameters were measured using a 20' pedobarograph carpet (GAITRite). Twenty-four participants (12 females, age: 20 years, height: 170 cm, and weight: 73.6 kg) were enrolled in the study. Each participant signed an informed consent form approved by the IRB prior to beginning the study. Participants were instructed to walk barefoot, at a self-selected pace, back and forth across the mat under five different loading conditions. Unloaded (U) was used as the baseline. Loads of 20% and 10% of the participant's body weight were carried in a backpack on the back (B20 and B10, respectively) and the front of the body (F20 and F10, respectively). The order in which the loads were carried was block randomized. Participants were instructed to adjust the straps for comfort. The standard deviation of each individual's step length, step width, and double limb support (DLS) time were used to assess loading effects on variability. Overall, regardless of the position, the average standard deviation of all parameters increased from the baseline for loads of 20%. Results were less consistent for loads of 10%, with some parameters increasing and others decreasing. Front loads tended to show greater variability than back loads of the same magnitude. To conclude, gait variability does change in the presence of torso loading. Greater variability may be interpreted as highly flexible and adaptable compensation, and thus indicate good stability. Alternatively, it may also mean that gait compensation has failed and that more varied gait has arisen from the resulting instability. The results also hint that the compensatory mechanisms may transition somewhere between 10% and 20% body weight loads. Overall, this research further highlights the distinctions between loaded and unloaded gait and the differences between various loads based on position and magnitude.