Comparison of Non-Motorized Treadmill & Overground Running: Power Output & Gait Metrics

Introduction: Runners are continually striving to improve their performance. To supplement traditional track and road training, many runners complete workouts on a treadmill. Traditional treadmills, however, do not allow natural acceleration and deceleration as speed is controlled by a motor[5]. For competitive runners, as well as field sport athletes, sprints, fartlek, pyramid and interval running that involve periods of acceleration and natural changes of pace are an integral part of their training programs. New non-motorized curved treadmills (NMT) are purported to offer a more natural running experience [8]. On a NMT, runners must produce all aspects of power to get the treadmill going giving runners a more authentic running compared to a motorized treadmill. Non-motorized treadmills were designed specifically to recreate the overground running experience including accelerations, pace changes with more similar running biomechanics compared to motorized treadmills.

Initial testing of NMT suggest that NMTs allow reliable assessment of running performance for field sport athletes including measures of power and speed during sprint testing [7] and that sprinting power output and speed on a NMT are related to OG sprint performance [4]. However, NMT have higher physiological demand when running at similar speeds as compared to OG and traditional motorized treadmills (MT) [6, 1, 8]. Moreover, NMT running biomechanics are different from OG running, particularly lower extremity joint range of motion and increased muscle activity [3]. Training on a NMT has been shown to alter the hamstring quadriceps strength ratio differently than MT training [2]; a comparison to OG was not made. Thus, the evidence suggests power output and speed can be replicated in sprints on NMT, but

that physiological demand and kinematics during NMT running are different in comparison to OG running, leaving runners with conflicting evidence on the efficacy of training on a NMT to replicate OG workouts.

In previous research measuring running performance has been confined to traditional laboratory testing. New trends in wearable technology provide measures of accurate and reliable running power output and basic running kinematics allowing running performance to be measured in any training setting. Knowledge of similarities and differences in NMT and OG running will provide valuable information for constructing effective training programs on the different running modalities. Thus, the purpose of this study is to compare power output (PO), pace, stride rate (SR), ground contact time (GCT), vertical oscillation (VO), and leg stiffness (LS) in a common Fartlek style running workout for OG and NMT running.

Methods: Twelve healthy competitive collegiate athletes involved in running intensive sports were recruited and gave their written informed consent (IRB# 1118-02). Subjects were excluded if they had a history of lower extremity injuries in the last six months or other contraindications to participating in a high intensity run. Subjects completed two high intensity interval runs and one familiarization session. Session 1 was an overground (OG) high intensity interval run on the indoor track, session 2 was a familiarization to the non motorized curved treadmill (NMT) at the Wellness Center, and session 3 was the high intensity interval run on the NMT. The high intensity interval run consisted of a warm up and alternating high to moderate intensity running intervals with light jogging intervals. The interval run was 23 minutes long including the warm-up and cool-down.

Power output, pace, SR, GCT, VO, and leg stiffness LS were measured with a STRYD Power meter during the middle 20 seconds of each high intensity run (OG and NMT) [9]. From the STRYD meter data, peak and average PO, average SR, average GCT, average VO, and average LS will be calculated for 10 running strides from each 20 second epoch. Two way repeated measures ANOVAs (interval by modality (OG versus NMT) will be used to test for significant differences in the dependent variables. Alpha = 0.05.

Summary: To date, we have collected data on 12 subjects. Based on literature, we expect to see that the NMT data collected will be similar to the data collected during the OG data. The purpose of the NMT is to mimic gait patterns seen in natural OG running, and so we expect to see that the data collected confirms this.

References

[1] Edwards, R.B., Tofari, P.J., Cormack, S.J., Whyte, D.G. (2017) Non-motorized Treadmill Running is Associated with Higher Cardiometabolic Demands COmpared with Overground & Motorized Treadmill Running. *Frontiers in Physiology.* 8

[2] Franks, K.A., Brown, L.E., Coburn, J.W., Kersey, R.D., & Botarro, M. (2012) Effects of motorized vs. non-motorized treadmill training on hamstring/quadriceps strength ratios. *Journal of Sports Science & Medicine.* 11, 71-76

[3] Fullenkamp, A.M., Tolusso, D.V., Laurent, C.M., Campbell, B.M, & Cripps, A.E. (2018) "A Comparison of Both Motorized & Non-Motorized Treadmill Gait Kinematics to Overground Locomotion" *Journal of Sport Rehabilitation.* 28(4), 357-363

[4] Mangine, G.T., Hoffman, J.R., Gonzalez, A.M., et. al. Speed, Force, and Power Values Produced From Non-motorized Treadmill Test Are Related to Sprinting Performance (2014) *Journal of Strength & Conditioning Research*. 28(7): 1812-1819.

[5] Nigg B, De Boer R, & Fisher V. A kinematic comparison of overground and treadmill running . *Medicine and Science in Sports and Exercise*. 1995;(*27*(1), 98-105.