# SPONTANEOUS OVERGROUND WALK-TO-RUN TRANSITIONS ARE PREPARED DURING THE LAST WALKING STRIDE

[1]Kristof De Smet, [1]Veerle Segers and [1]Dirk De Clercq

[1]Ghent University Belgium, Department of Movement and Sports Sciences

email: kristof.desmet@ugent.be

## INTRODUCTION

Steady-state walking has been extensively studied and reviewed, but little is known about how humans accelerate. Investigating the walk-to-run transition (WRT), i.e. accelerating from walking to running, enables us to determine the mechanical characteristics of walking and running while accelerating. The purpose of the present study was to investigate the spatiotemporal variables and kinematics of subjects realizing the spontaneous overground WRT. This way, we aimed to provide further insight into the question whether making the WRT is controlled on a higher level (semi-conscious) or merely a consequence of the intrinsic dynamics of the locomotor system [1].

## METHODS

17 female subjects participated in the present study. Each subject performed at least 5 successful WRT trials on a 30 meter long walkway. Subjects were asked to start walking from a stand still position in a spontaneously accelerating way, until the moment it would be more comfortable for them to run.

Kinematical data were collected at 200 Hz using 8 infrared cameras (Pro Reflex) and Qualisys® software. A 11-segment model was developed to calculate kinematics using Visual 3D®. Walking steps prior to transition were given negative signs. Running steps after transition were given positive signs. The transition step (step 0) was defined as the first step with a flight phase. Kinematical variables of the last two (contralateral) walking strides were analyzed. Strides were normalized to 100%. A paired sample T-test was used to compare kinematical variables every five percent of the stance and swing phase.

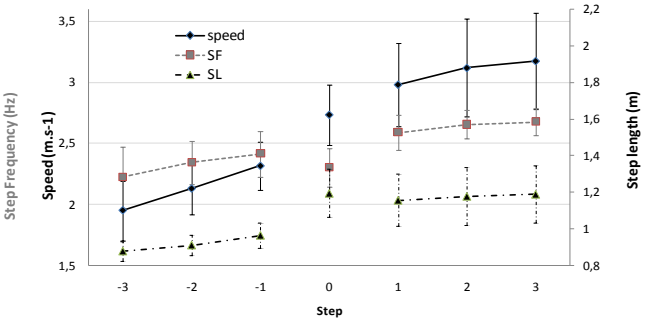


**Fig. 1**: Evolution of the spatiotemporal parameters (speed, SF and SL) from step -3 to step +3.

## RESULTS AND DISCUSSION

Subjects took on average 5.0 ± 1.0 walking steps before making the WRT. During the last 3 walking steps, speed increased at a constant acceleration of 0.42 $m.s^{-2}$. The highest speed increase was observed between step -1 and step 0 (speed jump of 0.417 $m.s^{-1}$). The transition step was characterized by an increased SL and a decreased SF, showing a clear discontinuity between the walking and the running mode (Fig. 1).

During the last walking stride, the trunk went more in anteversion, leading to a beneficial push-off position for generating the speed jump at transition (Fig. 2A). This strategy allows subjects to bring the body centre of mass (COM) closer to the front foot without having to shorten the last walking step. This was confirmed by the finding that subjects place their front foot 3.48 cm closer to the COM at initial contact of step 0 compared to step -1.

An ultimate kinematical adaptation was observed in the knee and hip at the end of the swing of the last walking stride before transition. Compared to the swing of the previous walking stride, knee and hip were more flexed towards the end of the swing phase (Fig. 2, B and C). This ultimate flexion goes over into a deeper flexion during stance of the transition stride (spring mass behavior of running), needed to launch the body into the first flight phase.

## CONCLUSIONS

The present study showed that the realization of the actual spontaneous overground WRT is prepared during the last walking stride. First, the trunk inclines forward. Subsequently, the knee and hip adopt a more flexed position at the end of the swing phase. Future studies are needed to establish whether these kinematical adaptations are controlled, or whether they are merely a consequence of altered body dynamics when walking at high walking speeds near transition.

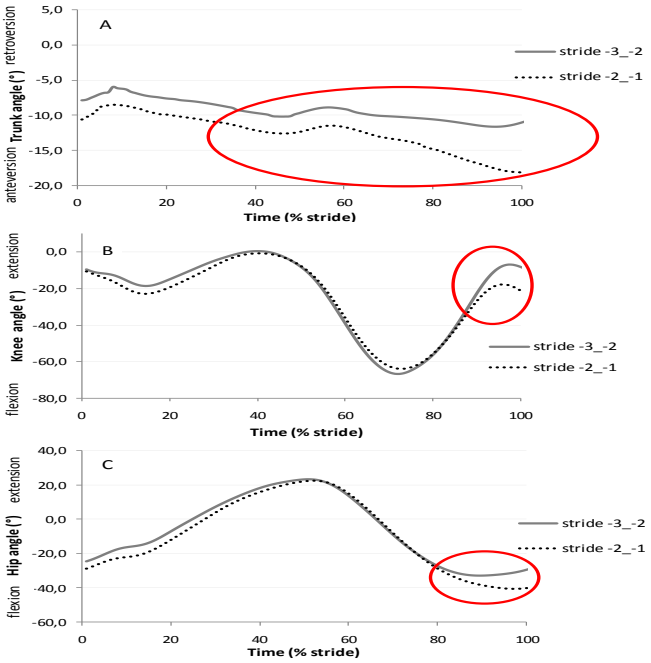


**Fig. 2:** Kinematics of the trunk (A), knee (B) and hip (C) of the last two walking strides. Stride -3_-2 starts at heel strike of step -3 and ends at heel strike of step -1. Stride -2_-1 starts at heel strike of step -2 and ends at heel strike of the transition step (step 0). The circle indicates statistically significant differences between both strides.

## REFERENCES

[1] Diedrich FJ and Warren WH Jr. *Exp Psychol Hum Percept Perform*. **21**: 183-202, 1995.