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A Novel Approach to Understanding Functional Gait and Variable Walking Strategies in an Asymptomatic Low Back Pain Population

Rachel Berns
Chapman University, rberns@chapman.edu

Thomas Fountain
Chapman University, tfountain@chapman.edu

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Rachel Berns, Thomas Fountain, Jo Armour Smith Ph.D, PT, OCS (emeritus)

Chapman University Crean College of Health and Behavioral Sciences - Department of Physical Therapy

INTRODUCTION

Low back pain (LBP) is a common symptom experienced by people of varying ages and persistent back pain is the leading cause for disability worldwide, making it a global health concern that requires further assessment[1]. LBP is often accompanied by changes in gait patterns, therefore, clinical evaluations of persistent low back pain commonly assess walking and running gait biomechanics. Previous studies have investigated less ecologically valid, short, steady-state walking paradigms[2]. However, meaningful gait assessment in individuals with LBP should involve prolonged, dynamic walking conditions with directional changes that resemble functional gait.

METHODS

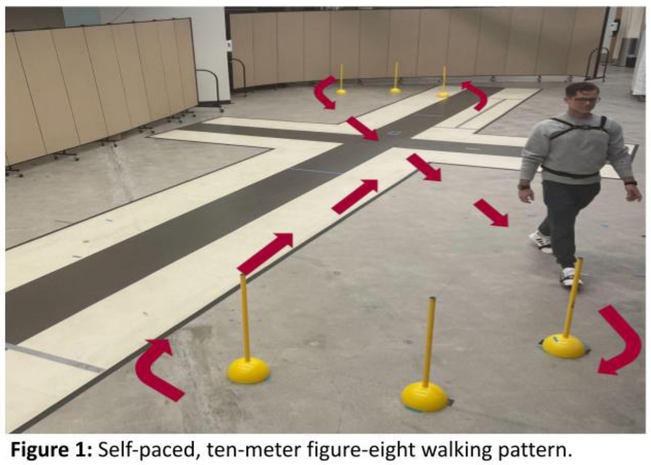

Figure 1: Self-paced, ten-meter figure-eight walking pattern.

- Fifty-nine young adults between the ages of 18 and 35 participated (average age 22.4 ± 0.5 years), primarily from the student populations of Chapman University and University of California, Irvine
- Inclusion criteria for LBP participants:
  - history of pain between lower rib and gluteal fold for over one year, at least one functionally limiting episode of pain in the previous six months, asymptomatic at the time of data collection
- Exclusion criteria for all participants:
  - other chronic pain conditions, significant musculoskeletal and neurological disorders, inflammatory diseases, history of brain or spinal injury, significant spinal pathology
- Participants were instrumented with six inertial sensors (APDM Wearable Technologies) on the sternum, wrists, lumbar spine, and feet
- Participants walked at a self-selected speed for five minutes in a predetermined, ten-meter figure-eight pattern (see Figure 1)
- Spatiotemporal gait characteristics across stride cycles were calculated using Mobility Lab software (APDM Inc.)
- Group comparisons were conducted with independent sample t-tests, and effect sizes were calculated using Cohen's d

RESULTS

LOW BACK PAIN (LBP) GROUP DEMOGRAPHICS			
(N = 36, M = 21, F = 15)	**Range**	**Mean**	**SD**
Age	18 - 32	22.03	3.30
Height (cm)	152.4 - 187.96	168.37	9.02
Weight (kg)	43.19 - 104.55	69.73	17.96
Typical Physical Activity	31.7 - 75.30	46.60	11.77
Body Mass Index	17.41 - 38.04	24.40	4.77
BACK-HEALTHY (BH) GROUP DEMOGRAPHICS			
(N = 23, M = 15, F = 8)	**Range**	**Mean**	**SD**
Age	18 - 31	23.00	3.68
Height (cm)	152.4 - 187.96	166.62	11.60
Weight (kg)	45.45 - 90.91	60.85	11.94
Typical Physical Activity	16.9 - 80.70	45.09	12.73
Body Mass Index	18.03 - 28.19	22.14	2.71

The two groups did not differ significantly based on age, height, weight, typical physical activity, and body mass index (BMI) ($p > 0.05$ for all comparisons).

	LBP	BH	P-value
Cadence (steps/min)	**110.15 ± 6.44**	**113.94 ± 5.82**	**0.026**
Duration of Gait Cycle (s)	**1.09 ± 0.07**	**1.06 ± 0.06**	**0.027**
Step Duration (s)	**0.55 ± 0.03**	**0.53 ± 0.03**	**0.044**
Lateral Step Variability (cm)	4.91 ± 1.06	4.99 ± 0.98	0.787

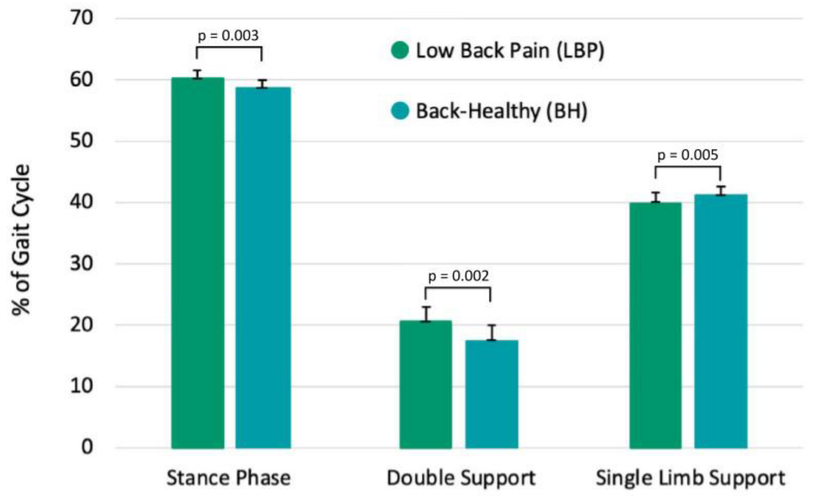

Figure 2: LBP participants spent a greater percentage of their gait cycle in stance phase (LBP = 59.93%, BH = 58.72%, p = 0.003, d = 0.84) and in double support (LBP = 19.90%, BH = 17.50%, p = 0.002, d = 0.86) compared to BH participants. Subsequently, the LBP group spent a smaller proportion of their gait cycle in single limb support (LBP = 40.03%, BH = 41.23%, p = 0.005, d = 0.81) compared to the BH group.

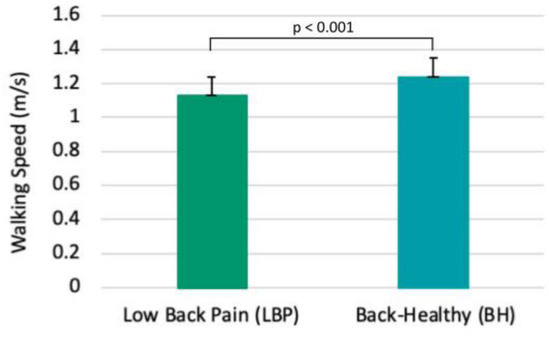

Figure 3: Walking speed for the LBP group was less than the BH group (LBP = 1.13 m/s, BH = 1.24 m/s, p < 0.001, d = 1.01).

CONCLUSIONS

- Despite being asymptomatic at the time of data collection, young adults with a history of LBP displayed notably more conservative spatiotemporal gait characteristics during prolonged figure-eight walking in comparison to BH individuals
- Continuous perturbed walking may be a useful paradigm to identify functional gait strategies in young, asymptomatic adults with LBP
- Ongoing research will determine if this gait strategy is more favorable for limiting the progression of LBP over time, and in what other activities of daily living (ADLs) those with LBP demonstrate conservative movement compensations

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2. Hicks, G. E., Sions, J. M., Coyle, P. C., & Pohlig, R. T. (2017, April 23). *Altered spatiotemporal characteristics of gait in older adults with chronic low back pain*. Gait & Posture, *55*, 172-176.

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