Gait Analysis in Egyptian Physical Therapy Students with Non-specific Low Back Pain: A Pilot Study

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ABSTRACT

Background: *The biomechanics of the lower limbs during walking are frequently assessed in individuals with low back pain (LBP), LBP is commonly treated by physiotherapists. However, physiotherapists themselves have been reported as being LBP sufferers. A among medical college students worldwide physical therapy students is the most complaining of back pain, Non-specific low back pain (NSLBP) is common cause of LBP and has a lot of causes that considered as life threatening disability.* ***Purposes:*** *was to investigate whether there are differences in spatiotemporal parameters during walking in Egyptian physiotherapist with NSLBP compared with asymptomatic Methods: twelve students were assigned to the study, their age ranged from 18-29 years old, students divided into two groups and assessed for their current level of back pain using Arabic modified Oswestry disability index before study. The two groups received the same instructions to walk in motion capture lab, stride length, step length, walking speed, cadence and gait cycle were the parameters measured in the two groups.* ***Result:*** *there was a significantly decrease in stride length, step length and walking speed in experimental group compared to control. and increased in stride time and step time in experimental group compared to control. There was no significance in cadence between the two groups.* ***Conclusion:*** *within the limitation of this study it could be conducted that spatiotemporal parameters of gait are affected in Egyptian physical therapy students with NSLBP, therefore when treating non-specific low back pain students then gait pattern should be evaluated.*

Keywords: *Low Back Pain, 3D Motion Analysis, Physical Therapy Students, Spatiotemporal*

INTRODUCTION

The experience of low back pain (LBP) is almost universal. Almost all people experienced an episode of LBP in their lifetimes (1). Low Back Pain (LBP) affects people of all ages and is a leading contributor to disease worldwide and Non-Specific Low Back Pain (NSLBP) is considered the most cause (2*).* NSLBP is defined as pain, increased muscle tension with or without referred lower limb pain (3). This pain is diagnosed in the absence of any pathologies i.e., (tumor, osteoporosis, spinal canal stenosis, etc.) (4). It is however interesting to note that health care professionals are not excluded from suffering from LBP. Consequently, several studies have focused on the prevalence of LBP among various health care professionals including physiotherapists worldwide (5). LBP is commonly treated by physiotherapists. However, physiotherapists themselves have been reported as being LBP sufferers (6). Over time, LBP can affect the execution of many activities of daily living resulting in changes in biomechanics of trunk and lower limbs, the nature of walking shows response to any mechanical changes in the trunk or lower limbs that may affect it (1).

Normal human walking can be defined as a method of locomotion involving the use of the two legs, alternately, to provide both balance and propulsion (7). Gait is a kind of physical and behavioral biometric characteristic that enumerates the walking patterns of a person (8). Abnormal gait which contains biomechanical alterations in upper and lower body motor mainly associated with Low Back Pain (9*).* As a valuable tool for the understanding of motion disorders and treatment outcomes, gait evaluation is essential, this evaluation is to avoid lower limb musculoskeletal injuries (10).

Walking is usually assessed in LBP patients. Adaptations in gait biomechanics in individuals with LBP may include changes in spatiotemporal like speed or step length, kinematic characteristics like joint/segmental motion, (1). That showed a significance difference in step time, stride time, step length, stride length, and walking speed.

In individuals with low back pain, gait is often disordered. Although it appears to be a consistent finding that individuals with LBP walk more slowly than pain-free individuals. Recent work has highlighted differences in the parameters of gait in activity daily livings ADL in individuals with persistent NSLBP compared to pain-free controls (11).

Purposes of the study

The purposes of this study were to determine gait spatiotemporal parameters in Egyptian physical therapy students with non-specific low back pain and to compare them with controls.

Hypotheses

There will be no significant differences in the gait of Egyptian physical therapy students with non-specific low back compared to controls.

MATERIALS AND METHODS

The study was approved by the research ethical committee of physical therapy, Faculty of Physical Therapy, Cairo University's (Approval number P.T.REC/012/004640) it was conducted in the motion analysis lab at Faculty of Physical Therapy, Ahram Canadian University. The time taken to complete the practical part of this study was from June 2023 to March 2024. The evaluators had undergone condensed training on measurement tools.

Design: cross-sectional observational study

Participants

Twelve physical therapy students participated at the study. The students were recruited from physical therapy College at Ahram Canadian University, they were assigned into two groups. All Students received a thorough and understandable explanation of the procedures. When answering the Arabic Modified Oswestry Disability Index (AMODI) the students were totally honest. Group I included 6 students with nonspecific low back pain and group II included 6 healthy students as controls.

Inclusion Criteria: 12 students of both genders were included in the study, ranged between 17 to 29 years old, Mild (0%-20%) and moderate (21%-40%) grades according to Arabic Modified Oswestry Disability Index (AMODI) Version (2.0), students complaining of nonspecific low back pain with maximum 12 weeks with no history before joining college, healthy students without any back pain., the body mass index (BMI) (18.5-24.5) kg/m2.(12)

Exclusion Criteria: the student was excluded if he/she had lumbar (herniation – disc -surgery- etc.), any history of tumor or surgery in lumber or hip or whole lower limb, Systematic disease that affects the gait like diabetes or cancer, Posture abnormalities like scoliosis or kyphosis, history of low back pain or sacroiliac dysfunction pain felt the past 2 years, any pain of gynecological cause in females, student who complains a severe pain in sacroiliac joint, student who complains sever grade in disability AMODI, the participants should not take medications during assessment.

Instrumentation Procedure:

8-camera, 3-dimensional (D) motion capture system (Vicon Nexus version 2, Oxford, UK). Fig (1)

Vicon Nexus is a motion capture platform designed expressly for Life Sciences applications. Clinical and research laboratories, sports performance centers, universities and other institutions can take advantage of the user-friendly interface to track and measure motion in real time. Optical, digital, and analog capture are all contained in a single, easy-to-use platform that gives Life Sciences professionals an advantage in their applications for gait analysis and rehabilitation; biomechanical research; posture, balance, and motor control; sports performance; and animal science. It is a commercially available and validated gait analysis package, for sagittal plane hip and knee kinematics at three different velocities (13). One of the most known, the Vicon system (Vicon Motion Systems, Oxford, United Kingdom), consists of multiple infrared cameras for kinetic, kinematic, and spatiotemporal movement analysis. The markers, positioned on anatomical landmarks in correspondence with the joints involved in the analysis, allow tracking all the human motion features with high accuracy. The markers in the landmarks on bony prominent directly toward skin in each lower limb of each student as following (14)

Figure 1: 3D Motion capture lab

Arabic Modified Oswestry Disability Index:

The Arabic version of the ODI showed validity and has high metrological qualities (15). The questionnaire is divided into ten sections: one to assess pain and nine to assess limitations of various activities in daily living. Each section is scored on a 0–5 scale, 5 representing the greatest disability. The scores of each section are added up, multiplied by 2 and expressed as a percentage. The maximum score is 100% and expresses maximum disability. For interpretation the ODI is subdivided into five categories: 1) 0–20 %, representing minimal disability meaning; 2) 21–40 %, representing moderate disability; 3) 41%–60%, representing severe disability; 4) 61%–80% representing crippled patients; 5) 81%–100%, representing bedbound patients or patients overestimating their symptoms (16)

length, knee width, ankle width). A total of 16 reflective markers were positioned at

2 markers on Anterior Superior Iliac Spine.

2 markers on Posterior Superior Iliac Spine.

2 markers on lower third of femure each lower limb.

2 markers on the lateral epicondyle of the femure each lower limb.

2 markers on lower third of leg each lower limb.

2 markers on lateral malleolus each leg.

2 markers on the base of the 2nd toe each foot.

2 markers on the base of the heel each foot.

using double sided adhesive tape according to the Lower-body plugin marker position scheme (Vicon Nexus version 2, Oxford, UK) Fig (2)

Procedures:

The procedures included the following steps:

1. Demographic data.

2. Subjects' preparation.

3. Subject's walking barefoot to capture spatiotemporal data

1. Demographic data:

Age, weight, height, sex, BMI & dominant extremity were taken.

2. Subjects' preparation:

For Each student's these measurements were taken (inter anterior superior iliac spines distance, both lower limbs

Figure 2: Marker placement.

3. Subject's walking to capture spatiotemporal data:

The students start to take a few steps to get familiar with the markers, then start to walk barefoot (12 meters distance) in an ordinary way on the colored line on the ground and focus their eyes on the red marks at the opposing wall Fig (3), we repeat this procedure 6 times for each students to get the average of the trials, the outcomes divided as follow:- (Step Time per second, Step length per meter, Stride time per second, Stride length per meter, Walking speed meter per second, width of step per meter, gait cycle in time per second and Cadence number of steps in minute) all equation automatically

processed and extracting the data in excel sheet by Nexus software.

Figure 3: Students walking on colored line.

Data Analyses:

by IBM SPSS, located in Chicago, IL, USA

The statistical analyses were performed through the statistical package for social sciences (SPSS) version 25 for windows.

Descriptive statistics in the form of mean and standard deviation used.

Data screened for normal distribution by Shapiro wilk test to determine parametric or non-parametric analysis. An unpaired t-test was used to investigate the comparison between two groups for demographic data.

The alpha point of 0.05 had been used as a level of statistical significance.

Results

The present study results showed no statistically significant differences between the NSLBP and control groups in terms of age and BMI (Table 1) ($p>0.05$).

Table 1. Demographic data of the two groups.

Data	Control group. n=6		NSLBP group n=6		p-value
	Mean	SD	Mean	SD	
Age	22.67	2.25	22.33	1.74	0.845
BMI	22.87	3.39	23.78	1.36	0.294
Gender	Male 66.67%, Female 33.33%		Male 83.33%, Female 16.67%		0.549

There was a statistically significant decrease in both right and left spatial and temporal parameters of gait in experimental group than controls (fig.4,5) while there was no significant difference in cadence between control and NSLBP (fig.6). (table.2).

Table 2. Difference between right and left spatiotemporal parameters of gait between both groups.

Data	Control		NSLBP		t-test	p-value
	Mean	SD	Mean	SD		
Right stride length (Meter)	1.40	0.067	1.20	0.12	3.53	0.005*
Left stride length (Meter)	1.41	0.69	1.20	0.13	3.23	0.009*
Right stride time (Second)	1.02	0.11	1.15	0.054	2.52	0.032*
Left stride time (Second)	1.02	0.11	1.15	0.048	2.55	0.029*
Right limb speed (Meter/Second)	1.37	0.14	1.05	0.92	4.65	0.001*
Left limb speed (Meter/Second)	1.37	0.14	1.09	0.12	3.81	0.003*
Right step width (Meter)	0.12	0.04	0.17	0.31	2.41	0.037*
Left step width (Meter)	0.12	0.04	0.17	0.31	2.51	0.031*
Right step length (Meter)	0.71	0.03	0.59	0.06	3.59	0.005*
Left step length (Meter)	0.71	0.03	0.59	0.60	3.75	0.004*
Right step time (Second)	0.51	0.06	0.57	0.31	2.31	0.044*
Left step time (Second)	0.51	0.05	0.58	0.29	2.66	0.024*
Cadence (Steps/Minutes)	235.5	14.25	221.33	14.25	1.72	0.116
Gait cycle (Second)	2.81	0.14	2.41	0.25	3.38	0.007*

*Significant at p-value<0.05. *NSLBP: Nonspecific low back pain.*SD: Standard deviation. *Confidence interval=95%.

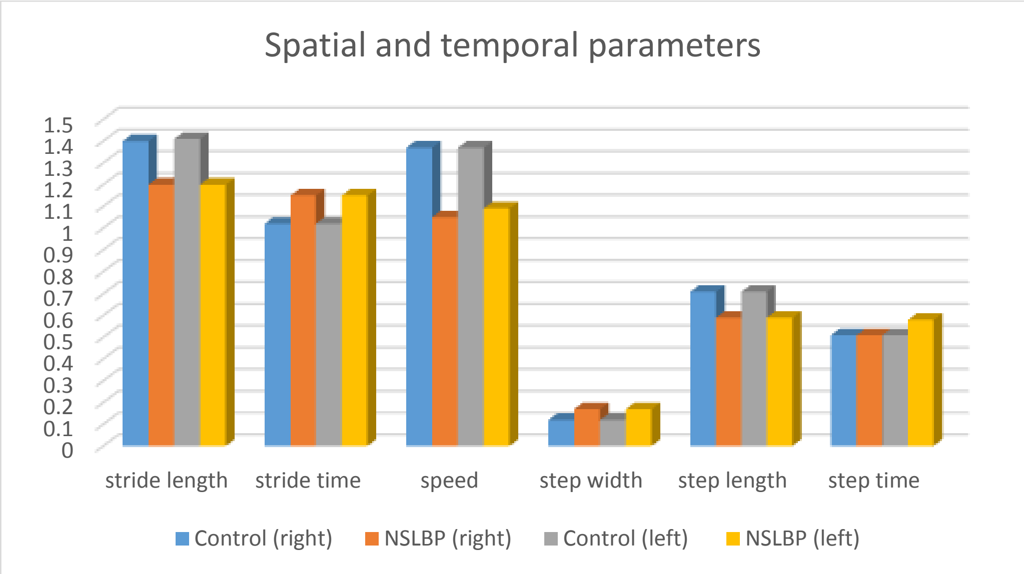

Figure 4. Comparison of right and left spatial and temporal parameters between the two groups.

Notes: NSLBP: Nonspecific low back pain.

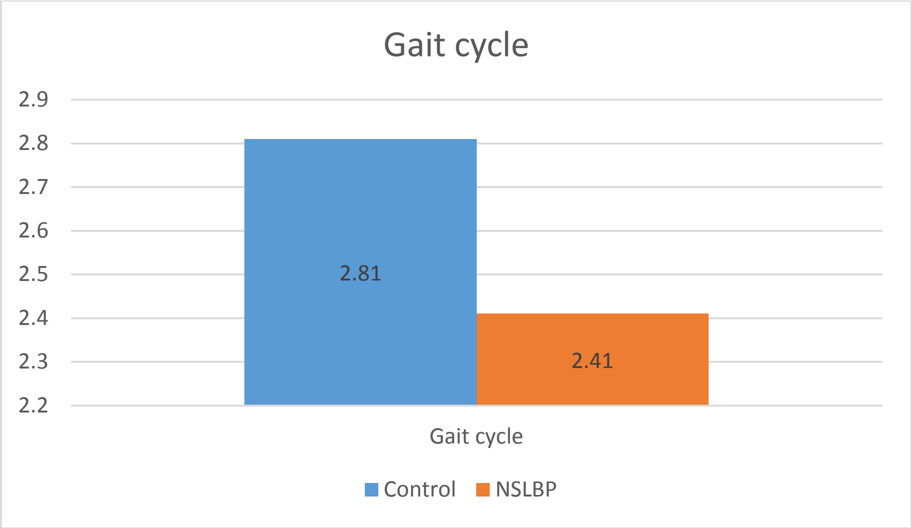

Figure 5. Comparison of gait cycle between the two groups.

Notes: NSLBP: Nonspecific low back pain.

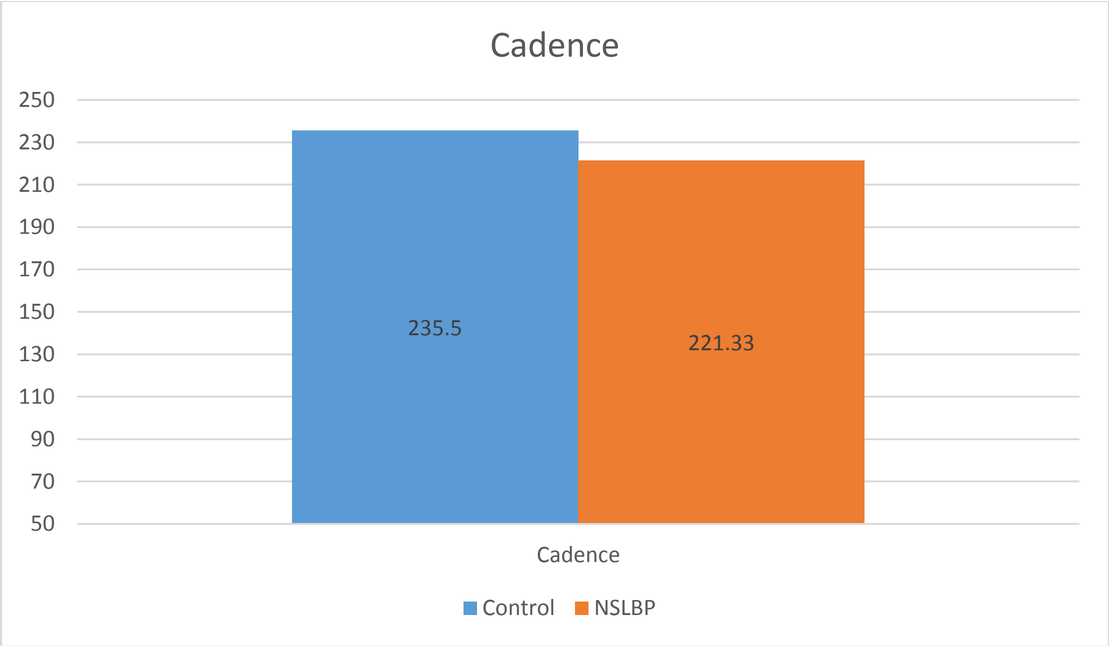

Figure 6. Comparison of cadence between the two groups.

DISCUSSION

The present study investigated whether there are differences in spatiotemporal parameters during walking in Egyptian physiotherapist students with NSLBP compared with asymptomatic. Based on the review of literature that suggests most physiotherapist students LBP, analysis revealed. a significant decrease in stride length, step length and walking speed in experimental group compared to control. And increased in stride time and step time in experimental group compared to control. There was no significance difference in cadence between the two groups.

Our findings are similar to (17) and (12) results reported in patients with LBP which had significantly shorter step length, shorter stride length and walking speed than the healthy control groups. And that may be due to fear avoidance and pain anticipation significantly predicted reduced walking speed in individuals with NSLBP according to (18). Our study supports previous findings reported by (19) who compared the spatiotemporal gait parameters in the stance phase, double support phase, the step length, and velocity between LBP and healthy groups. Therefore, it is possible that individuals with LBP use a strategy of slower walking velocity and slightly reduced stride length to minimize the kinematic and kinetic demands of walking.

The Result of the current study is compatible with (18) and (20) result as at walking performances, individuals with LBP showed reduced step length and stride length as same as the current study and that may be due to students try to minimize forces acting on the body which may exhibit pain and to avoid large range of motion of spine and lower extremity, all these movements are a protective and adaptive strategy, they negatively affect the objective gait parameters. This may cause different problems later. Otherwise, the results obtained by (21) suggested that there is no statistically significant difference in bilateral gait cycle duration, bilateral step length, bilateral double step length, and velocity that may be due to the pain itself not interfering the nature of walking and these gait parameters were similar between patients with LBP and healthy control group. But In most studies, step and stride length are decreased in patients with LBP as to healthy controls, the current study showed: step length, stride length, and walking speed parameters differed between groups, whereas no significance differences were found in cadence which was different from (22) results which were cadence had increased in LBP group furthermore (23) had found the oppose that the cadence decreased in LBP group rather than the healthy controls. Overall, the present study revealed significant differences between the two groups in spatiotemporal parameters and a relation between low back pain and gait parameters in physical therapy students and it was unclear whether these differences were due to pain, fear of pain, or generalized deconditioning.

Limitations:

The study was limited to a small sample.

The main cause of low back pain for students is unknown and should be noted because it may be from practical sections and also training of the students with wrong body mechanics that cause the alteration of the movement.

There was not a focus on a specific educational level of student and distinguish the outcomes between the levels of the students.

CONCLUSION

within the limitation of this study, it could be conducted that spatiotemporal parameters of gait are affected in Egyptian physical therapy students with NSLBP, therefore when treating non-specific low back pain students then gait pattern should be taken in consideration.

Declarations

Consent for publication: I attest that all authors have agreed to submit the work.

Availability of data and material: Available.

Competing interests: None

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Conflicts of interest: no conflicts of interest.

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