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Musculoskeletal pain and posture decrease step length in young adults

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ABSTRACT

Pain of the musculoskeletal system, especially low back pain, is one of the most frequent problems with a high risk of disability. The aim of this research study was to determine the existence of an association between low back pain on one hand, posture and step length on the other. This cross-sectional study was conducted on 77 healthy young adult subjects. Step length was measured with the Biodex Gait Trainer 2 (230 VAC). The study results indicate that 62.3% of the young adult subjects had suffered from low back pain. There was no significant association between gender and pain. In male subjects no significant association was found between pain on one hand and mean difference in step length and posture on the other. However, in female subjects with abnormal posture, there was a highly significant difference in left step length between subjects with back pain and those without (p=0.007). The results of a multiple regression analysis indicate that posture has the greatest influence on left step length (B=4.135; 95% Confidence Interval 0.292-7.977). It is recommended that in the examination of low back pain an assessment be made of posture, step length and difference in step lengths.

Keywords: Musculoskeletal pain, posture, step length, young adults

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INTRODUCTION

Pain is one of the most frequent health problems that causes an individual to consult a physician. The most prevalent pain suffered by an individual is low back pain (LBP). Inadequate management of LBP may result in disability and impact on socio-economic aspects, both due to high costs of medical care and to indirect costs, such as loss of working hours and forced early retirement.[1,2] The lower back is that area of the spinal column from below the twelfth rib to the inferior gluteal fold, anatomically composed of the lumbal vertebrae associated with the inferior extremities, comprising the pelvis and the bones of the extremities. Based on this structure, the biomechanical system of the spinal column forms the axis of the biomechanical system of the inferior extremities, and a disorder of one of these systems may affect the other as well.(3-6) Walking is an activity of the inferior extremities that is essential to human activities, as a result of complex actions of the neuromuscular and musculoskeletal systems on the spinal column and inferior extremities. The assessment of gait pattern may be performed by measuring several components of gait, namely step length, cycle length, and walking speed, which may also be termed the vital signs of gait.(7) A disturbance of gait may ultimately lead to disability. The spinal column and inferior extremities constitute one interrelated biomechanical system. Thus a disorder of the spinal column, such as postural abnormalities (scoliosis, S posture, kyphosis, hyperlordosis), may presumably affect the gait pattern, due to a shift of the gravitational axis in relation to the spinal column, causing the body to find a new equilibrium, e.g. by modifying the gait pattern. Pain in the region of the spinal column as well as in the inferior extremities leads to a compensatory movement that may presumably also affect gait pattern, among others by asymmetry of right and left step lengths. Asymmetrical step lengths are thought to result in disequilibrium of the actions of the musculoskeletal biomechanical system of the spinal column and inferior extremities, such that one component is overworked, leading to the complaint of pain.(8-11) One study has demonstrated that in patients with chronic low back pain a decrease in lumbar curvature and anteroposterior movement occurs on prolonged standing. This may possibly be due to a disturbance of the sensorimotor system causing a decreased adaptibility on prolonged standing, in comparison with normal individuals, thus increasing the risk of recurrence of low back pain.(12,13)

Walking is frequently promoted as a safe exercise treatment for back pain patients. The purpose of this investigation was to determine the existence in young adults of an association between musculoskeletal pain on one hand posture and step length on the other.

METHODS

Research design

This cross-sectional study was used to answer the research question and attain the goal of the study.

Research subjects

The subjects for this study were students of productive age enrolled at a private medical faculty in Jakarta. At the start of the study, the students were informed about the background and goal of the study, and those willing to participate in the study by signing an informed consent form were recruited for this study.

Assessment

Complaints of musculoskeletal pain in the back and/or lower extremities were assessed through interviews. The quality of musculoskeletal pain was scored according to the visual analogue scale (VAS). The subjects graded their symptom of low back pain on a 10-cm scale, anchored with the descriptors ‘no pain’ at one end and ‘pain as bad as it could possibly be’ at the other end. Severe pain was defined as VAS 75–100.(14) Assessment of posture was performed by physical examination, in which the subjects were asked to remove clothing and footwear and stand upright with their backs to the examiner. A plumb line was hung from the level of the spinous process of the seventh cervical vertebra without touching the subject’s skin, and used for assessment of the alignment of the subject’s spinal column. The examination also involved a

Figure 1. Biodex Gait trainer 2 (230 VAC)

determination of a difference in length between the right and left legs, which is deemed capable of causing postural abnormalities. Right and left step lengths (in centimeters) were measured using the Biodex Gait trainer 2 (230 VAC). Measurement of step length was performed while the subjects were walking for 5 minutes at their normal daily walking speed (Figure 1).

Statistical analysis

The study data were analyzed using the Statistical Package for Social Sciences (SPSS) version 10.0 for Windows (SPSS Inc., Chicago, IL, USA). Descriptive statistical methods were used to evaluate sociodemographic characteristics. A p-value below 0.05 was considered to be statistically significant. The independent samples t-test and chi-square test were used to compare groups for the parameter of pain.

RESULTS

Of the 126 subjects examined at the start of the study, comprising 68 (54%) females and 58 (46%) males, only 77 (64%) completed the study. This was due to the fact that the step length measuring instrument was kept in a hospital

Table 1. Distribution of relevant subject characteristics

Features characteristics	n (%)
Gender	
Male	28 (36.4)
Female	49 (63.6)
Age (years)	22.2 (SD 0.7)
Posture	
Normal	40 (51.9)
Abnormal	37 (48.1)
Postural abnormalities	
Postural kyphosis	2 (5.4)
Hyperlordosis	1 (2.7)
Postural scoliosis	28 (75.6)
Structural scoliosis	6 (16.3)
Pain	
Yes	48 (62.3)
No	29 (37.7)
Duration of pain onset (months)	
≤ 1	15 (45.4)
3	8 (24.3)
> 12	10 (30.3)
Stride/step length (cm)	
Right	42.8 (SD 6.1)
Left	40.0 (SD 8.5)

situated at a considerable distance from the location of the basic data collection. The analyzed study subjects consisted of 28 (36.4%) males and 49 (63.6%) females, with mean age of 22.2 years (SD=0.7). (Table 1) From the medical history a total of 48 (62.3%) subjects was found to have had back pain with the most frequent duration of onset of ≤ 1 month (45.4%). On examination of posture 40 (51.9%) subjects had a normal posture, whilst the remaining 37 (48.1%) had postural abnormalities, consisting of postural kyphosis in 2 (5.4%) subjects, hyperlordosis in 1 (2.7%), postural scoliosis in 28 (75.6%), and structural scoliosis in 6 (16.3%) subjects. The results of step length measurement using the Biodex gait trainer were as follows: mean right step length = 42.8 cm (SD 6.1); mean left step length = 40.0 cm (SD 8.5); mean variation in right step length = 23% (SD 12); and mean variation in left step length = 25% (SD 16). Subjects with equal right and left step lengths were only 6 (7.8%) in number, whereas 92.2% had unequal right and left step lengths. Mean difference in right and left step lengths was 4.3 cm (SD 3.2).

There was no significant difference between subjects with normal or abnormal posture and the occurrence of pain (p=0.331) (Table 2). Table 2 shows that the proportion of back pain sufferers was higher among subjects with normal posture (67.5), compared with subjects with abnormal posture (32.5%), although the difference in proportions was not statistically significant.

In male subjects there was no significant difference in right and left step lengths among subjects with back pain and among those without back pain (Table 3). In male subjects with back pain the difference in right and left step lengths was smaller than that in male subjects without back pain, although the difference was not statistically significant.

Table 2. Distribution of back pain by posture

Posture	Back pain		p
	Yes (n=48)	No (n=29)	
Abnormal	21 (56.8%)	16 (43.2%)	0.331
Normal	27 (67.5%)	13 (32.5%)	

Table 3. Differences in step lengths by back pain in male subjects

Step length	Back pain		p
	Yes (n=20)	No (n=8)	
Right step length (cm)	43.50 (SD5.86)	45.00 (SD 5.29)	0.531
Left step length (cm)	39.90 (SD 5.98)	40.25 (SD 7.76)	0.899
Right-left step length difference (cm)	3.60 (SD 3.84)	4.75 (SD 4.62)	0.505

Table 4. Differences in step lenghts by back pain in female subjects

Step length	Back pain		p
	Yes (n=28)	No (n=21)	
Right step length (cm)	42.11 (SD 6.91)	42.05 (SD 5.50)	0.974
Left step length (cm)	39.68 (SD 11.84)	40.43 (SD 5.37)	0.789
Right-left step length difference (cm)	2.43 (SD 6.43)	1.62 (SD 3.89)	0.612

In female subjects no significant difference was found in right or left step lengths between those with or without back pain (Table 4). Female subjects with back pain had a larger difference in right and left step lengths compared with those without back pain, but the difference was not statistically significant.

The results of stratification analysis of back pain and step length by gender and posture is presented in Tables 5 and 6.

Table 5 indicates that, both in male subjects with normal posture and those with abnormal posture, no significant difference was found in right or left step lenghts between subjects with or without back pain.

In female subjects with normal posture there was no significant difference in right or left step lengths between subjects with or without back pain. However, in female subjects with abnormal posture a considerably significant difference was found in left step lengths between subjects with back pain and those without (Table 6). Left step length in female subjects with abnormal posture was significantly shorter in those with back pain, compared with those without back pain (p=0.007).

Table 5. Differences in step lenghts by posture and back pain in male subjects

Step length by posture	Back pain		p
	Yes	No	
Normal posture	11	3	
Right step length (cm)	42.18 (SD 5.08)	45.67 (SD 4.73)	0.307
Left step length (cm)	38.91 (SD 6.41)	45.66 (SD 7.02)	0.837
Abnormal posture	9	5	
Right step length (cm)	45.11 (SD 6.64)	44.64 (SD 6.11)	0.890
Left step length (cm)	41.11 (SD 5.53)	37.01 (SD 6.75)	0.240

Table 6. Differences in step length by. posture and back pain in female subjects

Step length by posture	Back pain		p
	Yes	No	
Normal posture	16	10	
Right step length (cm)	44.7 ± 7.9	42.6 ± 6.6	0.574
Left step length (cm)	44.2 ± 13.4	40.5 ± 6.0	0.440
Abnormal posture	12	11	
Right step length (cm)	39.2 ± 3.9	41.5 ± 4.5	0.191
Left step length (cm)	33.7 ± 5.6	40.4 ± 4.9	0.007

The results of a multiple regression analysis showed that in subjects with abnormal posture left step length was significantly shorter by 4.135 cm, compared with those subjects with normal posture (B = 4.135; 95% Confidence interval 0.292 -7.977) (Table 7). Gender and back pain had no significant influence on left step length.

In subjects with abnormal posture the right step length was considerably shorter by 1.469 cm compared with those subjects with normal posture, but the difference was not statistically significant (B = 1.469; 95% Confidence interval – 1.322 – 4.259) (Table 8). Gender and back pain had no significant influence on right step length.

Table 7. Multiple regression analysis of left step length justified by gender, posture and back pain

Variable	B	95 % Confidence interval B
Gender	- 0.287	- 4.294 – 3.720
Posture	4.135	0.292 – 7.977
Back pain	1.121	- 2.880 – 5.122

Table 8. Multiple regression analysis of right step length justified by gender, posture and back pain

Variable	B	95 % Confidence interval B
Gender	- 1.981	- 4.890 – 0.929
Posture	1.469	-1,322 – 4.259
Back pain	0.621	- 2.284 – 3.527

DISCUSSION

The results of this study demonstrate that the prevalence of low back pain in young adults was 62.3%. This figure is at variance with that from a propspective study in young Danish twins showing a prevalence of LBP of 35%.(15) However, a Finnish study comprising 7,333 male conscripts (median age 19), yielded a considerably lower prevalence of LBP of 12.7%.(16) There are several factors associated with LBP in young adults, such as smoking, which has been shown to be significantly associated with the occurrence of LBP in young adults.(17) In the present study no association was found between back pain and postural abnormalities. A number of causal mechanisms have been proposed for adolescent back pain, including rapid bony growth, inadequate fit of furniture to body size, poor muscle strength, poor motor control, balance and coordination, and poor posture.(18-20)

It is imperative that a study be conducted on the occurrence of a step length difference between a study group with back pain and one without, and that a stratification analysis be performed based on posture and gender. The present study shows that in female subjects with abormal posture, a significant difference in left step length was found between subjects with and without back pain. Female subjects with abnormal posture had a shorter left step length when also having back pain. Previous studies have yielded evidence that posture and pelvic shape play a significant role in determining the gait pattern of an individual. This is the result of a shift in the center of gravity in persons with abnormal posture, which affects the mechanism of action of the muscles and their surrounding supporting tissues.(3,4)

According to previous studies, in the elderly age group a significant association has been found between back pain and step length of the inferior extremities, which is due to abnormal posture.(5) However, the present study shows that left step length is significantly shorter in female subjects with abnormal posture and back pain.

Currently, whether abnormal postural coordination can cause or contribute to LBP is not known. Some authors have hypothesized that poor coordination could lead to pain, for instance, by producing greater loading within the trunk.(21,22) In support of this hypothesis, people with LBP have greater muscular activity and greater spinal loading than people without LBP.(23) Alternatively, abnormal postural coordination could result from the pain itself (eg, splinting to avoid pain).

The results of a multiple linear regression analysis showed that posture had the greatest influence on mean left step length (B=4.135: 95% IK 0.292-7.977), which is consistent with previous study results indicating that posture and pelvic shape play an important role in determining an individual's gait pattern, due to a shift in the gravitational center of persons with abnormal posture, thus affecting the mechanism of action of the muscles and surrounding supporting tissues.(6,7)

The present study did not find a significant association between abnormal posture and back pain, which is at variance with previous study results in the elderly, namely the finding of a significant difference between back pain and/or pain in inferior extremities on one hand, and abnormal posture on the other.(8,24) The differing results may be due to a difference in age of the subjects, as in young subjects the musculoskeletal system is still flexible and has not undergone degenerative processes, thus facilitating adjustment of the biomechanical system to the existing structural abnormalities.

CONCLUSIONS

The mayority of young adult subjects had suffered from back pain. Right and left step lengths did not differ in subjects with or without back pain. Female subjects with abnormal posture and back pain had a shorter left step length. However, it is unclear whether postural abnormalities are caused by asymmetry in step lengths or whether asymmetrical step lengths are caused by abnormal posture.

In the management of back pain, attention should be paid to improvement of posture and gait pattern. Young adults should be screened for postural abnormalities and gait pattern in order to lower the risk of occurrence of back pain in old age.

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