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# Chronic low back pain and function of Greek office workers

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**Abstract**. The purpose of this observational study was to compare anthropometric and functional characteristics of office worker women who were healthy or suffered from chronic low back pain (CLBP). A group of 30 healthy and 30 women with CLBP were randomly selected from a sample of 648 office workers who participated in a previous epidemiological study. All subjects were matched for age, height and body weight. Their anthropometric and functional characteristics were measured using standardized procedures with established reliability and compared with the Student's t-test for independent samples. In their anthropometric characteristics, women with CLBP had significantly higher body mass index and percent body fat ($p = 0.035$) whereas their leg length difference ($p = 0.012$) was almost double compared to same characteristics of healthy women. Regarding their functional characteristics, women with CLBP displayed significantly restricted mobility ($p < 0.05$) in all directions and decreased endurance ($p < 0.05$) in muscle function of their lower extremity, abdominals and trunk extensors as compared to healthy women. These results might suggest that anthropometric and functional characteristics need to be improved in Greek office workers as they may relate to the incidence of their low back pain.

Keywords: Low back pain, office workers, spinal mobility, physical fitness

## 1. Introduction

One of the most common musculoskeletal disorders is chronic low back pain (CLBP) affecting approximately 30% of the general workers population in Europe and the USA [4,15,20,25]. In Greece, 44% of all workers suffer from CLBP whereas a recent epidemiological study recorded 33%, 37.8%, 41.8% and 61.6% at point, one-year, two-year and lifetime prevalence respectively among Greek office workers [34]. Anthropometric characteristics such as age, gender, body mass index (BMI), physical and psychosocial exposures are considered important risk factors to lumbar spine dysfunction [9,18,32]. Other researchers have biomechanically explained that lumbar overloading due to loss of lumbar lordosis during prolonged sitting could result in disc pathology and finally CLBP in office workers [23, 27,24].

It is generally accepted that individuals suffering from CLBP present reduced function in activities of their daily living. Indeed, several studies have examined physical fitness and the role of aerobic exercise on low back pain [13,30,33]. Although physical fitness was diminished in persons with low back pain, deconditioning was more related to measures of endurance in abdominal and trunk extensors muscles than to cardiovascular fitness. In addition, muscle reactivation induced by active exercise programs and not the reconditioning itself was assessed to be the important factor in reducing disability because of CLBP [33].

Conservative treatment of CLBP conditions has included rehabilitation programs in order to increase spinal mobility and stability of all sufferers, strengthen muscle groups of trunk flexors and extensors and

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improve their general aerobic capacity. It is also considered important to increase flexibility of hamstrings in order to attain correct lumbopelvic posture and better mechanical function in sacroiliac joint [5,19,32,35]. However, it was difficult to explain individually the contribution of each type of rehabilitation program in diminishing lumbar disability and dysfunction [3,17].

Although all previous studies have included various working populations, no information is known about the physical function of office employees. Such knowledge could be very useful in the prevention of CLBP in populations of office workers. In Greece, a high proportion of the working population is office clerks who are sufferers of CLBP as a recent study has demonstrated [34], thus, it might be interesting to investigate the physical function of office employees. The goal of this present study was to compare anthropometric and functional characteristics of healthy Greek office workers and those suffering from CLBP. Subsequently, proper prevention and rehabilitation programs could be developed and therefore, the financial and psychosocial cost of CLBP in Greece might be significantly reduced.

## 2. Materials and methods

### *2.1. Subjects*

This study was part of a standardized clinical survey recording risk factors in 648 office workers [34]. These employees were randomly selected among 3000 employees from 4 among 18 government offices in the greater area of Athens by utilizing the method of cluster sampling. After examining all ethical issues, approval and funding of this project was obtained by the Research Committee of the Greek Ministry of Education (EPEAEK II ‘Archimidis’ – project No. 8, TEI-A). Among the participants, 30 healthy women and 30 women with CLBP rating between 3 to 5 on the pain Visual Analog Scale (VAS: ratio scale ranging from 0–10) were randomly selected and volunteered to participate in the present investigation assessing their anthropometric and functional characteristics [11]. The participants were considered as chronic sufferers when the symptoms persisted for a minimum of 15 months. The average duration of complaints in the CLBP group was 23.5 months. All subjects had no managerial responsibilities and were performing office activities with an average of 3 hour computer work daily. Their personal data are shown in Table 1. The purpose of the study was explained to them along with potential future benefits resulting from subsequent advice on improving their function.

### *2.2. Procedure*

To ensure unbiased measurements a single examiner blinded to the health status of each subject gave same instructions with regards to all mobility and endurance tests before testing. No special encouragement commands were provided during testing. All participating women were assessed on the following standardized clinical tests and measurements [7,21].

### *2.3. Body mass index (BMI)*

BMI = weight (kg) / height x height (m x m)

### *2.4. Percent body fat*

By utilizing Harpenden calipers (Baty International, West Sussex UK), skinfold measurements on the right side of each participant’s body were taken at the anatomical sites of umbilicus, iliac crest, triceps and quadriceps. To ensure reliability, at each site three measurements were taken by a single examiner and the average value was calculated. All values were entered in the following prediction equation as proposed by Kenney and coworkers [28]:

Percent Body Fat $=$ 0.29669 (Sum of 4 Skinfold Measurements) – 0.00043 (Sum of 4 Skinfold Measurements)$^2$ $+$ 0.02963 (Age) $+$ 1.4072

### *2.5. Lower extremity length*

It is the distance from anterior superior iliac spine to medial malleolus by using nonflexible tape in millimeters [14]. This index is widely used by several researchers as it might provide information on lumbopelvic functional balance [10]. Three measurements were recorded by a single examiner and the average value was calculated.

### *2.6. Lumbar flexion /extension*

On each subject the sacral midpoint was marked which was palpated midway of a line connecting the inferior aspects of the posterior superior iliac spines. Approximately 3.0 cm superior to the sacral midpoint the lumbosacral interspace was located and counting up six interspinous spaces the thoracolumbar junction could be palpated. At first, the Saunders digital inclinometer (The Saunders Group, Inc, Minneapolis, MN) was placed at the sacral midpoint and zeroed while each office worker was standing freely. With the inclinometer in same position, maximal flexion and extension were performed and thus, readings represented the standing hip flexion and standing hip extension respectively. Secondly, the inclinometer was placed at the thoracolumbar junction and zeroed while each office worker was standing freely. With the inclinometer held in same position values were recorded after each subject was maximally flexing and extending her lumbar spine. These readings represented the gross lumbar flexion and gross lumbar extension respectively. Thus, lumbar flexion / extension were calculated as the difference between the gross lumbar flexion / extension and the standing hip flexion /extension. As suggested by the manufacturer, three sequential measurements were performed by a single examiner at each placement of the inclinometer provided there was not a difference among the recorded values greater than 5°; otherwise all measurements had to be repeated.

### *2.7. Trunk side flexion*

Each individual was standing with posterior part of body against a wall and feet in line with hips. While keeping both upper extremities to the side of body, the tips of her index fingers were marked on the skin of both thighs. The participant was then asked to maximally flex to the right and left while maintaining posterior trunk contact with the wall and the maximal reach of the tips of both index fingers was marked again on the skin of both thighs. By utilizing a nonflexible tape in millimeters, the distance between the upper and lower marks on the thighs were marked. Three efforts were performed for left and right side bending, recorded by a single examiner and the mean values represented the trunk side flexion.

### *2.8. Trunk rotation*

On each office worker the sacral midpoint and thoracolumbar junction were marked as described above. In addition, the cervicothoracic junction was palpated and marked. Each subject was then asked to actively bend forward at the hips and keep her arms folded across the chest so that the lumbar / thoracic spine to be horizontal. In this position, the inclinometer was zeroed at sacral midpoint, thoracolumbar and cervicothoracic junctions. Subsequently, the tested individual would turn right and left and readings were recorded at thoracolumbar and cervicothoracic junctions. As previously mentioned, the manufacturer has proposed three sequential measurements to be performed at each placement of the inclinometer by a single examiner provided there was not a difference among the recorded values greater than 5°; otherwise all measurements had to be repeated. Values of right and left trunk rotation were averaged to represent the trunk rotation of each participant.

### *2.9. Isometric muscle endurance*

The isometric endurance of lower extremity musculature (hip flexors and knee extensors) was assessed in upright position while each subject was keeping her trunk in contact with a wall and both arms were folded in front of the chest. The number of seconds was recorded with a stopwatch that each office worker was able to hold the right lower extremity in 90° hip and knee flexion.

Similarly, the isometric endurance of trunk extensors was evaluated as the time in seconds that each individual performed and held trunk extension in prone position.

During testing, the arms were kept behind the neck, the lower extremities were fastened with a belt at the ankles and the chest was raised completely off the floor.

Lastly, the isometric endurance of abdominals was assessed by recording the time in seconds that each office worker was able to perform and hold a sit-up up to the point that both scapulas were not in contact with the floor while knees were kept in 45° flexion and lower extremities were not stabilized. The mean of three repetitions recorded by a single examiner was the final result for each isometric muscle endurance test.

### *2.10. Sit and reach test*

Flexibility of trunk extensors and hamstrings was measured by a sit and reach test in which individuals sat on the floor and bent their trunk forward as far as possible with knees straight. Each subject's feet were kept against the front of a box bearing a measurement scale on top. Three recordings of maximum hand reach on the measurement scale were taken by a single examiner [12].

### *2.11. Lasègue's test*

The tested individual was in supine position. The examiner passively raised the lower extremity of each subject as far as possible with the knee straight up to the point that the anterior superior iliac spine started to move and the hip angle was measured with a 12.5

inch Jamar goniometer. The examined lower extremity was the same as the side of pain in low back of the tested individual; otherwise, the examined leg was the dominant one [28]. The test was repeated three times by a single examiner and the mean value was calculated for each worker.

### 2.12. Statistical analysis

Mean values between healthy office workers dependent variables and those suffering from CLBP were compared with the student's t-test for independent samples. Level of significance was set at $p = 0.05$. SPSS 13.0 for windows was utilized for all dependent variables.

## 3. Results

Table 1 shows the mean values and standard deviations of anthropometric characteristics in both tested groups. Healthy women and women with CLBP had similar values regarding their age, weight and height. Nevertheless, office workers with CLBP displayed almost 7% and 10% higher values regarding their BMI and percent body fat than healthy office workers. Moreover, individuals with CLBP presented with approximately 42% greater measurements in their leg length difference as compared to healthy subjects.

Measurements of lumbar spinal mobility are presented in Table 2. All tested motions were significantly reduced in women with CLBP. Specifically, mean values of women with CLBP were decreased by 17% in lumbar flexion, 35% in lumbar extension, 11% in trunk side flexion and 12% in trunk rotation as compared to mean values of healthy women.

Muscle endurance mean values of women with CLBP were also significantly lower than same dependent variable values of healthy women regarding trunk extensor muscles (38%) and abdominals (39%), whereas their flexibility mean values were also significantly diminished by 42% as assessed by the "sit and reach" test (Table 3). No significant values were calculated for lower extremity muscle endurance and Lasègue's test between both groups.

## 4. Discussion

This investigation compared the anthropometric and functional characteristics of healthy women and those suffering from CLBP. Our two groups of participants had had similar values regarding their age, weight and height (Table 1) and the statistical analysis has not shown any significant differences ($p > 0.05$) in these parameters. Nevertheless both BMI and percent body fat measurements were statistically higher in office worker women with symptoms of CLBP ($p = 0.035$). Both groups were matched in weight and height but because for the calculation of BMI the square of the height is considered, the statistical analysis has revealed significant BMI results. Indices of body mass and percent body fat are considered valid in determining good health and are widely used in predicting cardiovascular disease [7,36]. Recent research with participating machine drivers, construction carpenters, office workers and young adults who suffered from CLBP has confirmed our findings and reported higher values of BMI and percent body fat than healthy controls [18,32]. Apparently, individuals with CLBP have reduced daily activities and therefore they consume less energy, store more fat and maintain less muscle tissue [2].

Another anthropometric characteristic that was examined in this investigation was the difference in length between both lower extremities. Comparison of our results showed that office worker women with CLBP ($0.85 \pm 0.59$ cm) had almost twice the leg length difference ($p = 0.012$) than their healthy colleagues (049 $\pm$ 0.48 cm). Several researchers have stated than CLBP sufferers present difference in length between their lower extremities and our findings are in accordance to those in scientific literature [1,10] Probably the appearance of greater leg length discrepancy in office workers with CLBP is not true but apparent [14] and may be due to the fact that because of low back pain the sacroiliac joint could also dysfunction and therefore, the position of hip bones changes. The end result is the apparent length difference between lower extremities [10].

Spinal mobility in all directions was also greatly decreased ($p < 0.05$) in office worker women with CLBP as compared to the control group of our study (Table 2). While spinal mobility has not been investigated in office workers in scientific literature, other researchers have also reported reduced mobility in different populations suffering from CLBP [1,22,31]. Probably, paraspinal muscle tightness appearing in CLBP might be responsible for the reduced lumbar mobility of our sample [10].

Other factors might contribute to even more decreased lumbar mobility. Several researchers have examined the role of hamstrings in changes of lumbar mobility which may result in low back pain [8,12,28]. They explain that because of hamstrings' origin at is-

Table 1
Anthropometric characteristics of women with CLBP and healthy women

| Sample athropometric characteristics | Women with CLBP ($n_1 = 30$) | Healthy women ($n_2 = 30$) |
|---|---|---|
| Age | 41.7 ± 7.3* | 42.2 ± 7.3* |
| Weight (Kg) | 71.1 ± 5.9* | 70.3 ± 7.6* |
| Height (m) | 1.62 ± 0.07* | 1.66 ± 0.06* |
| BMI (Kg/m$^2$) | 27.1 ± 3.4** | 25.3 ± 3.1** |
| Percent body fat (%) | 34.7 ± 5.1** | 31.3 ± 5.2** |
| Inequality of lower extremities (cm) | 0.85 ± 0.59*** | 0.49 ± 0.48*** |

*$p > 0.05$ **$p = 0.035$ ***$p = 0.012$.

Table 2
Lumbar spinal mobility of women with CLBP and healthy women

| Mobility | Women with CLBP ($n_1 = 30$) | Healthy women ($n_2 = 30$) | P value |
|---|---|---|---|
| Lumbar flexion (°) | 34 ± 8 | 41 ± 7 | $p < 0.001$ |
| Lumbar extension (°) | 11 ± 6 | 17 ± 7 | $p < 0.001$ |
| Trunk side flexion (mm) | 155 ± 25 | 174 ± 27 | $p = 0.006$ |
| Trunk rotation (°) | 32 ± 7 | 41 ± 6 | $p < 0.001$ |

Table 3
Muscle endurance and flexibility of women with CLBP and healthy women

| Muscle endurance and flexibility | Women with CLBP ($n_1 = 30$) | Healthy women ($n_2 = 30$) | P value |
|---|---|---|---|
| Muscle endurance in lower extremities (secs) | 34.7 ± 11.8 | 41.1 ± 15.6 | $p = 0.08$ |
| Muscle endurance in trunk extensors (secs) | 20.4 ± 8.7 | 33 ± 9.6 | $p \leqslant 0.001$ |
| Muscle endurance in abdominals (secs) | 18 ± 6.7 | 29.6 ± 9.8 | $p \leqslant 0.001$ |
| Sit-and-reach (cm) | −10.8 ± 5.6 | −6.3 ± 5.6 | $p = 0.003$ |
| Lasègue's test (°) | 72 ± 18 | 78 ± 14 | $p = 0.178$ |

chial tuberosity, muscle tightness could greatly affect lumbopelvic rhythm resulting in low back pain. Sit and reach test clinically examines elasticity in trunk extensors and hamstrings. Our research has shown that women office workers with CLBP presented about 42% less hamstring and trunk extensor flexibility than healthy women ($p = 0.003$). It is worth mentioning that this lack of flexibility was not due to the appearance of sciatic pain because both of our groups had similar straight leg raisings ($p = 0.178$) from supine position (Lasègue's test). Tight hamstrings have been recorded in other populations with CLBP and our research is in accordance to these studies [28].

Other valid clinical evaluation tests for low back pain include the examination of endurance in muscle groups such as iliopsoas, quadriceps, abdominals and trunk extensors. Investigators have recorded decreased endurance in these muscles [29,33] in patients with CLBP. In this present study in women with CLBP there were also smaller endurance values by 15% in lower extremity muscles ($p = 0.08$), 39% in abdominals ($p \leq 0.001$) and 38% in trunk extensors ($p \leq 0.001$) as compared with those values of healthy office worker women. Apparently, in patients with CLBP there might be limited function in several muscle groups and the end result is reduced muscle endurance.

A limitation of this study might be its statistical analysis and its level of significance. Similarly to many studies reported in scientific literature, in this investigation several measurements were explored and compared with the Student's t-test for independent samples with the level of significance set at 0.05. However, no associations were examined among all dependent variables and thus, it is possible that some of the information is abundant in this research. Perhaps the use of multivariate statistical techniques or by setting the level of significance lower than 0.05 might contribute to the omission of abundant information.

## 5. Conclusion

In this study, it seems that women office workers suffering from CLBP present decreased lumbar spinal mobility and reduced endurance in muscles associated with the lumbar function and stability. Moreover, CLBP women display greater leg length discrepancy and percent body fat than healthy women; characteristics associated to lumbar dysfunction. From a clinical perspective, these findings could be useful when designing rehabilitation and prevention programs for the management of low back pain of office clerks. Thus, clinicians may consider therapeutic exercise programs that enhance spinal mobility, increase muscular endurance and in the long term control percent body fat in office employees.

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The experiments comply with the current laws of the country in which they were performed inclusive of ethics approval.

The authors declare that they have no conflict of interest.

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