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Influence of Prolonged Sitting Posture on lumbar range of motion in computer users

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Abstract

Background: Prolonged sitting posture as in computer users is harmful to the spine and may lead to posture abnormalities, which are due to changes in spinal mobility, leading to changes of back functional stability and mobility**. Purpose:** to investigate the effect of prolonged sitting posture on lumbar range of motion (LROM) in computer users. **Material and methods**: thirty-two adult computer users of both sexes participated in this study. Their age ranged from 20 to 35 years, with no musculoskeletal diseases or current spinal pain. Group A: "16" participants were using computer from 8 to 10 years, divided into: A1: 8 participants were using computer more than 5 hours daily. A2: 8 participants were using computer from 2 to 5 hours daily. Group B: "16" participants were using computer from 2 to 4 years, divided into: B1: 8 participants were using computer more than 5 hours daily. B2: 8 participants were using computer from 2 to 5 hours daily. Back range of motion device (BROM II) was used to evaluate LROM. **Results**: Two-way

MANOVA was conducted to investigate the effect of years and daily hours of computer usage on all lumbar range of motion. Two-way MANOVA showed a significant effect of years of computer usage on lumbar flexion, extension, right lateral flexion, left lateral flexion and left rotation ROM. A significant effect of daily hours of computer usage was found on lumbar extension ROM, while there was no significant effect of daily hours of computer usage on other ROM measurements. There was no significant interaction effect of years and daily hours of computer usage on lumbar flexion ($p = 0.24$), extension ($p = 0.26$), right lateral flexion ($p = 0.73$), left lateral flexion ($p = 0.54$), right rotation ($p = 0.61$) and left rotation ROM ($p = 0.1$). **Conclusion:** the effect of prolonged sitting posture on LROM in computer users varies according to the daily hours and number of years of computer usage.

Key words: Computer users, prolonged sitting, Lumbar spine, BROM.

Introduction:

The presence of modern technology brings convenience to our lives but removes physical activity from our daily routines, therefore putting our lives at risk. Extended period of computer uses leads to many diseases such as visual impairment and musculoskeletal disorders. Therefore, ergonomic recommendations are needed to help reduce the risk of physical inactivity and promote a healthy computer usage (1).

In computer work places, sustained non-neutral postures during computer use are defined**.** Prolonged sitting in an incorrect, fixed position increases the biomechanical stress on the back, neck, shoulders, and upper limbs (2), (3).

Increasing numbers of people spend the majority of their working lives seated in an office chair. Musculoskeletal disorders, especially low back pain (LBP), resulting from prolonged static sitting are common, but regularly changing sitting position throughout the day is thought to reduce back problems (2).

Scientific measurement of musculoskeletal function and treatment outcomes is required because the measurement is vital to the advancement of human performance assessment (4). Therefore, evaluation of the lumbar spine is integral to the assessment and treatment of patients with lumbar spine dysfunction and determining the most reliable and reasonable technique of quantification of the ROM available to the lumbar spine is important to the clinics in physical therapy (5).

Human standing posture is the result of balance between spine and pelvis, recently, it is also known that abnormal

lumbar spine measurements may cause persistent back pain and be central to the development and progression of many spinal disorders, including spondylolysis, spondylolisthesis and a variety of other spinal diseases (6). So, this study was conducted to investigate the effect of prolonged sitting posture on lumbar range of motion (LROM) in computer users. This would provide physiotherapist with basic information concerning the effect of long periods of sitting using computer on lumbar movement which can be used for precaution and ergonomic recommendation in rehabilitation programs and public health planning.

Material and methods:

This study was across sectional stud y. It was conducted to determine the changes of lumbar ROM produced by sitting for long time in the computer users of the information technology and statistics center at El Monira General Hospital, Cairo, Egypt

The participants' age, height and weight were recorded and their body mass index (BMI) was calculated, all the participants were asked a standardized set of questions regarding their occupational status and duration of using computer.

The subjects of this study were using computer as a basic agent to their work, Furthermore, the subjects were excluded if they suffered from lumbar or pelvic disorders (lumbar disc lesion, lumbar spondylitis, lumbar myelopathy, sacro iliaitis, pelvic trauma…), any history of disease or any problem with walking and congenital postural deformities. Also, pregnant women, women who had pregnancy before and participants with BMI greater than 25 kg/m² or lesser than 18.5 kg/m² all were excluded.

This study included 32 subjects who met the selection criteria, they were assigned into four subgroups according to the number of years and the number of hours per day they were using computer (7).

Measurements were performed under the following standardized conditions: (1) measurements were carried out by the same investigator and (2) the same lumbar ROM measurements were assessed for each participant by using back range of motion device (BROM II).

II) Active Lumbar ROM Assessment:

Evaluation of lumbar spine active range of motion (AROM) was performed using back range of motion device (BROM) (Fig. 1)

Figure (1): *The back range of motion device (BROM II)* ***(adapted from Paul, 2014)(8).***

The BROM II device in this study was used for three measurements:

- Flexion and extension measurements.
- Rotation measurements (right & left rotation).
- Lateral flexion measurements(right & left side bending).

The device consists of 2 plastic units: an inclinometer for measuring movements of the sagittal plane and a combination gravity goniometer/compass for lateral flexion and rotational motions, respectively.

a) Flexion/Extension measurements:

It uses a unique combination of inclinometer and goniometer technology with a standardized protocol to easily give objective repeatable measurement. The base has a two vertical contact point approximately 5 cm apart, facilitating positive placement on the sacrum. The unit is held by the right wing with the left hand. The left wing is rest securely on the subject's buttocks, providing added contact and minimizes rocking on the sacrum. The pointer on the base indicates flexion and extension angle on the protractor degree scale (8).

(Fig. 2): Flexion/Extension measurements using BROM device ***(Sallam, 2015) (9).***

b) Rotation/ lateral flexion measurements:

Use an inclinometer and a compass on a positioning frame, a magnetic booster, and a standardized protocol to give objective and reliable measurement. The positioning frame has two slip-resistant feet, which are approximately 15 cm wide and rest against subject back. The inclinometer is mounted on the vertical plane for assessing lateral flexion. The compass is mounted on the horizontal plane for measuring rotation. The magnetic boosters which consist of belt and magnets

encased in vinyl with Velcro straps give a stable magnetic field for the compass. The magnetic booster compensates for the undesirable pelvis rotation as it move with subject's pelvis (8).

(Fig. 3): Rotation/ lateral flexion measurements using BROM device ***(Sallam, 2015) (9).***

Statistical analysis:

All statistical measures were performed through the statistical package for

social studies (SPSS) version 19 for windows. The level of significance for all statistical tests was set at $p < 0.05$. Descriptive statistics and one-way MANOVA were conducted for the mean age, weight, height, and BMI of the study groups. Two-way MANOVA was conducted to investigate the effect of years and daily hours of computer usage on lumbar range of motion.

Results and Discussion

This study was conducted on 32 computer users of both sexes (20 male, 12 female) who were recruited from the information technology and statistics center at El-Monira General Hospital, Cairo, Egypt during the period of June 2014 to December 2014. Their age ranged from 20 to 35 years old.

The subjects were divided according to years of computer usage into two equal groups, group A and B. Group A were using computer from 8 to 10 years, and group B were using computer from 2 to 4 years. The two groups were subdivided in two subgroups based on hours of computer usage. Group A1 and B1 used computers for more than 5 hours daily, and group A2 and B2 used computers between 2-5 hours daily.

Comparing the general characteristics of the subjects of study groups revealed that there was no significance difference between groups in the mean age, weight, height and BMI ($p > 0.05$). The demographic data of the participants is shown in table (1).

Data obtained from all groups regarding lumbar range of motion were statistically analyzed and compared.

Table (1): *Descriptive statistics and t test for the mean age, weight, height, and BMI of the study groups:*

	Group A	Group B	MD	t- value	p-value	Sig
	$\bar{X}$ ± SD	$\bar{X}$ ± SD				
Age (years)	30.31 ± 2.82	30.06 ± 2.71	0.25	0.25	0.8	NS
Weight (kg)	72.93 ± 3.97	73.25 ± 4.07	-0.32	-0.22	0.82	NS
Height (cm)	176.25 ± 3.21	176.06 ± 4.25	0.19	0.14	0.88	NS
BMI (kg/m²)	23.47 ± 0.92	23.62 ± 0.74	-0.15	-0.5	0.62	NS

$\bar{X}$: *Mean* *SD: Standard Deviation* *MD: Mean difference*
t value: Unpaired t value *p value: Probability value* *NS: Non significant*

I. Effect of years and daily hours of computer usage on lumbar ROM:

(1) Effect of years and daily hours of computer usage on lumbar flexion:

There was a significant decrease in lumbar flexion ROM of group A1 compared with group B1 ($p = 0.0001$), also there was a significant decrease in lumbar flexion ROM of group A2 compared with B2 ($p = 0.0001$).

There was no significant difference in lumbar flexion ROM between group A1 and A2 ($p = 0.14$), also there was no significant difference in lumbar flexion ROM between group B1 and group B2 ($p = 0.86$).

There was no significant interaction effect of years and daily hours of computer usage on lumbar flexion ROM ($p = 0.24$), as shown in table 2.

Table 2: *Two way ANOVA for the effect of years and daily hours of computer usage on lumbar flexion ROM*

Lumbar flexion ROM (degrees)			
Group A		Group B	
Group A1	Group A2	Group B1	Group B2
$\bar{X}$ ±SD	$\bar{X}$ ±SD	$\bar{X}$ ±SD	$\bar{X}$ ±SD
31.87 ± 3.83	35 ± 3.81	44 ± 3.54	43.62 ± 5.37
Interaction effect (years * hours)			
F = 1.38		*p = 0.24*	

$\bar{X}$: Mean SD: Standard Deviation p value: Probability value
*: Significant **: Non significant

(2) Effect of years and daily hours of computer usage on lumbar extension ROM:

There was a significant decrease in lumbar extension ROM of group A1 ($p = 0.0001$) and A2 ($p = 0.0001$) compared with group B1 and B2 respectively.

There was no significant difference in lumbar extension ROM between group A1 and A2 ($p= 0.17$), while there was a significant decrease in lumbar extension ROM in group B1 compared with group B2 ($p = 0.006$).

There was no significant interaction effect of years and daily hours of computer usage on lumbar extension ROM (p = 0.26), as shown in table 3.

Table 3: *Two way ANOVA for the effect of years and daily hours of computer usage on lumbar extension ROM*

Lumbar extension ROM (degrees)			
Group A		Group B	
Group A1	Group A2	Group B1	Group B2
$\bar{X}$±SD	$\bar{X}$±SD	$\bar{X}$±SD	$\bar{X}$±SD
10.25 ± 3.37	12.37 ± 3.11	16.62 ± 2.82	21.25 ± 3.01
Interaction effect (years * hours)			
F = 1.31		*p = 0.26*	

$\bar{X}$: Mean SD: Standard Deviation p value: Probability value

*: Significant **: Non significant

(3) Effect of years and daily hours of computer usage on lumbar right lateral flexion ROM:

There was no significant difference in lumbar right lateral flexion ROM between A1 and B1 (p = 0.08), while there was a significant decrease in lumbar right lateral flexion ROM of A2 compared with B2 (p = 0.02). There was no significant difference in lumbar right lateral flexion ROM between both A1 and A2 (p= 0.37) and between B1 and B2 (p = 0.67). There was no significant interaction effect of years and daily hours of computer usage on lumbar right lateral flexion ROM (p = 0.73), as shown in table 4.

Table 4: *Two way ANOVA for the effect of years and daily hours of computer usage on lumbar right lateral flexion ROM*

Lumbar right lateral flexion ROM (degrees)			
Group A		Group B	
Group A1	Group A2	Group B1	Group B2
$\bar{X}$±SD	$\bar{X}$±SD	$\bar{X}$±SD	$\bar{X}$±SD
33.5 ± 4.3	31.87 ± 3.27	36.75 ± 2.37	36 ± 4.03
Interaction effect (years * hours)			
F = 0.12		*p = 0.73*	

$\bar{X}$: Mean SD: Standard Deviation p value: Probability value

*: Significant **: Non significant

(4) Effect of years and daily hours of computer usage on lumbar left lateral flexion ROM:

There was a significant decrease in lumbar left lateral flexion ROM of A1 compared with B1 (p = 0.01), while there was no significant difference in lumbar left lateral flexion ROM between A2 and B2 (p = 0.09).

There was no significant difference in lumbar left lateral flexion ROM between A1 and A2 (p= 0.43), also there was no significant difference in lumbar left lateral flexion ROM in between B1 and B2 (p = 0.1).

Table 5: *Two way ANOVA for the effect of years and daily hours of computer usage on lumbar left lateral flexion ROM*

Lumbar left lateral flexion ROM (degrees)			
Group A		Group B	
Group A1	Group A2	Group B1	Group B2
$\bar{X}$±SD	$\bar{X}$±SD	$\bar{X}$±SD	$\bar{X}$±SD
32.87 ± 3.64	31.62 ± 2.97	37 ± 2.07	34.37 ± 3.66
Interaction effect (years * hours)			
F = .038		*p = 0.54*	

$\bar{X}$: Mean SD: Standard Deviation p value: Probability value

*: Significant **: Non significant

There was no significant interaction effect of years and daily hours of computer

usage on lumbar left lateral flexion ROM (p = 0.54), as shown in table 5.

(5) Effect of years and daily hours of computer usage on lumbar right rotation ROM:

There was no significant difference in lumbar right rotation ROM of group A1 (p = 0.13), and group A2 (p = 0.41) compared with group B1 and B2 respectively.

Also, there was no significant difference in lumbar right rotation ROM of group A1 (p= 0.15) and group B1 (p = 0.47) compared with group A2 and B2 respectively.

There was no significant interaction effect of years and daily hours of computer usage on lumbar right rotation ROM (p = 0.61), as shown in table 6.

Table 6: *Two way ANOVA for the effect of years and daily hours of computer usage on lumbar right rotation ROM:*

Lumbar right rotation ROM (degrees)			
Group A		Group B	
Group A1	Group A2	Group B1	Group B2
$\bar{X}$ ±SD	$\bar{X}$ ±SD	$\bar{X}$ ±SD	$\bar{X}$ ±SD
12.12 ± 2.1	14.12 ± 3.04	14.25 ± 2.81	15.25 ± 2.91
Interaction effect (years * hours)			
F = .026		*p = 0.61*	

$\bar{X}$: *Mean* *SD: Standard Deviation* *p value: Probability value*
: Significant* *: Non significant*

(6) Effect of years and daily hours of computer usage on lumbar left rotation ROM:

There was a significant decrease in lumbar left rotation ROM of group A1 compared with group B1 (p = 0.01), while there was no significant difference in lumbar left rotation ROM between group A2 and group B2 (p = 0.77). There was no significant difference in lumbar left rotation ROM between group A1 and A2 (p= 0.06), also there was no significant difference in lumbar left rotation ROM in between group B1 and group B2 (p = 0.63).

There was no significant interaction effect of years and daily hours of computer usage on lumbar left rotation ROM (p = 0.1), as shown in table 7.

Table 7: *Two way ANOVA for the effect of years and daily hours of computer usage on lumbar left rotation ROM:*

Lumbar left rotation ROM (degrees)			
Group A		Group B	
Group A1	Group A2	Group B1	Group B2
$\bar{X}$ ±SD	$\bar{X}$ ±SD	$\bar{X}$ ±SD	$\bar{X}$ ±SD
10.5 ± 2	13 ± 2.82	14 ± 2.82	13.37 ± 2.77
Interaction effect (years * hours)			
F = 2.82		*p = 0.1*	

$\bar{X}$: *Mean* *SD: Standard Deviation* *p value: Probability value*
: Significant* *: Non significant*

Discussion:

In the last two decades, computer use has increased dramatically at workstations, and nowadays computers have become an essential and integral part of almost all office environments (10). So, the current study was conducted to determine the changes of

lumbar range of motion (LROM) produced by sitting for long time in computer users.

To show alteration of lumbar ROM in computer users, BROM II was used to measure the active lumbar flexion, extension, right lateral flexion, left lateral flexion, right rotation and left rotation.

By reviewing the literature, we found normative values of lumbar range of motion by BROM device in normal adults for the egyptian population, as reported by El-Hakke, (2001). Based on these data the results of lumbar AROM of the current study are within normal range, this may be due to the participants were not complaining from any pain, they were young and wide range of values for normal back motion was reported, also conducting the measurements during summer and afternoon may be another contributing factor (11). This came in agreement with Reilly et al., (2007) who reported that the ranges of motion are not stable with time. In addition, in the current study all measurements were done at least 2 hours after arising in the morning to overcome the initial stiffness of the spine (12, 13).

In the current study there was a significant effect of years of computer usage on lumbar flexion, extension, right lateral flexion, left lateral flexion and left rotation ROM. A significant effect of daily hours of computer usage was found on lumbar extension ROM, while there was no significant effect of daily hours of computer usage on other ROM measurements. This may be due to the flexion attitude, which is often found in desk workers and computer users, thus Youdas et al., (2000) reported that patients with chronic low back pain (CLBP) had less lumbar extension ROM than those without low back pain (14). This finding is consistent with results reported by Pope et al., (1985) who also noted diminished lumbar extension ROM in 215 patients with LBP compared with 106 control subjects (15). In contrast, Esola et al., (1996) reported that patients with LBP had no difference in spinal ROM compared with their counterparts without low back pain (16).

The results showed that there was no significant interaction effect of years and daily hours of computer usage on lumbar flexion, extension, right lateral flexion, left lateral flexion, right rotation and left rotation ROM. These results came in agreement with Youdas et al., (2000) who found that there was no difference in spinal ROM in both men and women between the subjects with CLBP and the control subjects (14).

The age effect was statistically significant across all primary movements.

The asymptomatic subjects exhibited a reduction in the active lumbar ROM throughout the years (17). Also, Smith et al., (2008) reported that the lifestyle factors including sleep position, time spent sitting and side dominant lifestyle did not appear to influence variability in mobility. In contrast Gordon et al., (2002); Lee et al., (2004) reported that the lifestyle factors including sleeping position, side dominant exercise or occupation and hours spent in sustained positions such as sitting all appear to have some influence on ROM measures (18,19).

Limitation of this study: this study was limited to the small sample size. The discrete hours or the continuity of hours using computer, this factor was not considered in the current study. Another limitation is that there were great variations in method of assessment and in normal value of lumbar ROM measured by BROM to be used in comparison with the variant back AROM.

Conclusion:

According to the findings of this study, it was concluded that there were changes in lumbar ROM in computer users with prolonged sitting. Increased number of hours per day using computer did not affect all lumbar ROM measurements in computer users except lumbar extension movement.

Author contributions:

All authors contributed to the study including data collection, carrying out the study design, drafting the manuscript and statistical analysis.

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Disclosure:

The authors declare that they have no conflict of interests.

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