

## ORIGINAL ARTICLE

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## EFFECTS OF WEARING HEADSCARVES ON CERVICAL SPINE MOBILITY

<sup>1</sup>Samiah F. Alqabbani, DSc<sup>2</sup>Gurinder S. Bains, PhD<sup>3</sup>Eric G. Johnson, DSc<sup>4</sup>Everett B. Lohman, DSc<sup>5</sup>Noha S. Daher, PhD

## ABSTRACT

**Background:** Cervical spine provides three-dimensional movements of the head on the body while keeping the horizontality of visual gaze. Thus, cervical range of motion (ROM) is an important assessment that is commonly used in clinical practice. The headscarf is commonly used attire by females in Islamic cultures. The study aimed to investigate the effect of wearing headscarves on cervical ROM in females who wear headscarves compared with females who don't wear headscarves.

**Methods:** A cross-sectional study was conducted on fifty-two females with mean age  $28.1 \pm 3.1$  years were divided into two groups: Headscarf group (n=26) and no-scarf group (n=26). Cervical Range of Motion Device was used to measure cervical spine range of motion in a seated position for flexion, extension, right lateral flexion, left lateral flexion, right rotation and left the rotation.

**Results:** The headscarf group reported a significant limitation in cervical ROM in all six directions. Moreover, females in the headscarf group who wore the headscarf for more or equal to 6 hours had significantly less left rotation compared to those who wear it for less than 6 hours ( $71.3 \pm 2.1$  vs.  $64.5 \pm 2.1$ ,  $\eta^2=2.2$ ;  $p=0.045$ ). No significant differences in mean ROM by age at onset of wearing a headscarf ( $\leq 12$  years vs.  $> 12$  years) or a number of years worn ( $\leq 15$  years vs.  $> 15$  years) were detected ( $p>0.05$ ).

**Conclusion:** Wearing the headscarf may influence cervical ROM. Also, six hours or more of daily wear may result in further decline of cervical ROM.

**Keywords:** Cervical spine, range of motion, mobility, Cervical Range of Motion Device, headscarf, and Hijab.

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<sup>2</sup>Associate Professor, Loma Linda University, School of Allied Health Professions, Department of Allied Health Studies, Loma Linda, California. Email: gbains@llu.edu

<sup>3</sup>Professor, Loma Linda University, School of Allied Health Professions, Department of Physical Therapy, Loma Linda, California. Email: ejohnson@llu.edu

<sup>4</sup>Professor, Loma Linda University, School of Allied Health Professions, Department of Physical Therapy, Loma Linda, California. Email: elohman@llu.edu

<sup>5</sup>Professor, Loma Linda University, School of Allied Health Professions, Department of Allied Health Studies, Loma Linda, California. Email: ndaher@llu.edu

## CORRESPONDING AUTHOR

<sup>1</sup>Samiah F. Alqabbani, DSc

Princess Nourah Bint Abdulrahman University  
College of Health and Rehabilitation Sciences  
Department of Rehabilitation Sciences  
King Khalid International Road, P.O. Box  
84428, Riyadh.  
e-mail: sfalqabbani@pnu.edu.sa

## INTRODUCTION

Cervical spine mobility is maintained by the unique bony and soft-tissue component of the cervical spine that allow for multidirectional movements of the head. A majority of the movements occur in the upper cervical spine at the craniocervical junction, which allows for three-dimensional movements while maintaining the horizontality of visual gaze [1]. Hence, cervical range of motion (ROM) is an important assessment that is commonly used to classify patients with neck pain with mobility deficits, according to the International Classification of Function (ICF) [2].

Wearing protective headgear has been shown to decrease active cervical ROM. McCarthy et al. (2015) [3] studied the impact of wearing an American football helmet on active cervical ROM and found that wearing helmets significantly decreased cervical extension. Additionally, soft neck collars significantly reduce cervical spine rotation from 75.8° to 67.4° a change of 11% [4]. Although it is not as rigid as a helmet or neck collar, headscarves may also provide resistance to cervical ROM.

The headscarf is operationally defined as a scarf that wraps up over the head and around the neck [5]. Females in Islamic cultures often wear the headscarf when they are in public and usually begin wearing it at the onset of puberty [6]. According to the Pew Research Center (2014), there are approximately 1.7 billion Muslims, and they constitute the second largest religious group in the world. Moreover, Muslims are estimated to become the second largest religious group in the United States of America by the year 2040 [7].

It is difficult to estimate the total number of females worldwide who wear headscarves, as several Islamic countries mandate females to wear them when out in public, while other countries have banned the use of headscarves in public. However, wearing headscarves is optional in the majority of the world's countries. For example, in the USA, where headscarves are optional, 43% of Muslim females reported that they wear the headscarf, which makes for a total of 433,000 females [8]. In contrast, in Saudi Arabia, a country that mandates the wearing of headscarves, all females over the age of 15 are expected to wear them, which makes for a total of 9,210,133 females [9]. In such cultures, females start wearing headscarves at an early age and for extended periods of time daily. Consequently, the routine wearing of headscarves might influence cervical ROM.

It has been reported that people with cervical spine pain report limited cervical ROM compared to people without cervical spine pain [10,11]. Lee et al. (2005) [10] investigated the ability to use active cervical ROM to distinguish between treated and untreated neck pain. Fifty-five subjects were divided into three groups: treated neck pain, untreated neck pain, and no neck pain. Subjects in the treated pain group reported more pain than subjects in the untreated pain group. The results indicated a reduction in head protraction range in the treated pain group compared to the untreated pain group. Additionally, there was a decrease in the rotation and extension ROM for the pain groups but not for the no-pain group. Lee et al. (2005) [11] further investigated a population with high incidence

of neck pain. They compared active cervical ROM among computer workers with frequent and infrequent neck pain. The findings revealed that cervical ROM is affected by the frequency of neck pain with limitations in cervical ROM with more frequent neck pain. Therefore, Lee et al. (2005) [10,11] suggested that impairments of cervical ROM may develop at an early stage of neck pain and can differentiate between people with subclinical neck pain and no neck pain. Kasch et al. (2008) [12] predicted that reduced cervical ROM is one of the prognostic factors for disability after acute whiplash. Moreover, Dall'Alba et al. (2001) [13] indicated that cervical ROM successfully discriminates between subjects with the whiplash-associated disorder (WAD) and an asymptomatic control group.

To the best of our knowledge, no previous investigations into the effects of wearing headscarves on cervical spine mobility have been conducted. Therefore, the primary aim of the present study was to investigate the effects of wearing headscarves on cervical ROM in females who wear headscarves compared with females who do not wear headscarves. Among females who wore the headscarf, a secondary aim was to compare cervical ROM measures by time spent per day wearing the headscarf ( $\leq 6$  hours versus  $> 6$  hours) and age at onset of wearing the headscarf ( $\leq 12$  years versus  $> 12$  years). We also examined the relationship between outcome variables and age at onset of wearing the headscarf, a number of years worn, and time spent per day wearing the headscarf.

## MATERIALS AND METHODS

### Study Design

The study is a cross-sectional study conducted at Loma Linda University.

### Subjects

Fifty-two females with mean age  $28.1 \pm 3.1$  years participated in the study. Subjects were divided into two groups (headscarf group: twenty-six females who routinely wore headscarves; control group: twenty-six age-matched females who never wore headscarves). Individuals who met the inclusion criteria ranged from 20-40 years of age, had been wearing the headscarf for a minimum of five years and began wearing the headscarf before or at 15 years of age. Subjects were excluded if they had cervical pain for less than six months, or if they had tenderness or muscle spasm in the cervical area.

Subjects were recruited from Loma Linda University and the surrounding communities by flyers and word of mouth. All subjects signed an informed consent form approved by Loma Linda University Institution Review Board before participation.

### Cervical Range of Motion device (CROM)

The Cervical Range of Motion device (CROM) (Performance Attainment Associates, Roseville, MN, USA) was used. CROM includes three inclinometers for the three planes of motion. The nonadjustable inclinometers measure the sagittal and frontal plane movements. While the third inclinometer has a magnet that works with the magnets located and secured at the subject's upper trunk to measure rotation. The inclinometers are attached to a

lightweight plastic mount. The mount is positioned on the subjects' head and secured with fastening straps. It has good validity [14]  $r=0.93-0.98$  and intra-rater reliability [15]  $ICC=0.87-0.94$ .

## PROCEDURES

The CROM device was used to measure flexion/extension, lateral flexion, and rotation for each subject. Subjects were seated in a comfortable chair with their feet resting on the floor and their backs against the chair and their arms resting on their laps. Any jewelry, hats, and glasses were removed before securing the CROM device on the subject's head. Subjects who wore the headscarves were asked to remove them before CROM device measurements. First, the investigator explained the cervical movements to the subjects and indicated that all movements should be performed to the end range. Second, subjects performed a practice trial in each direction to ensure familiarization when moving their heads with the CROM device. Then, subjects performed the neck movements in the following order: right rotation, left rotation, flexion, extension, right lateral bending, and left lateral bending. Each movement was repeated for three trials.

For the sagittal and frontal plane movements, the investigator recorded the value of the relevant inclinometer indicating the starting position. At the end of each movement, the investigator recorded the value of the inclinometer again, indicating the end position. The amount of movement was calculated by subtracting the ending position from the starting position. On the other hand, the amount of movement for rotation is directly read after zeroing the inclinometer.

## Data Analysis

The Statistical Product and Service Solutions (SPSS) for Windows version 24.0 (IBM Corp., Armonk, New York) were used to analyze the data. A sample size of 52 subjects was needed to obtain a medium effect size of 0.7 and power of 0.8. Data were summarized using frequencies and relative frequencies for categorical variables and means  $\pm$  standard deviation (SD) for quantitative variables. The normality of the quantitative variables was examined using Kolmogorov-Smirnov and Shapiro-Wilk tests. Mean age and body mass index ( $\text{Kg}/\text{m}^2$ ) of females in the headscarf group, and those in the control group were compared using independent t-test. Mean outcome variables (cervical ROM right rotation, left rotation, flexion, extension, right lateral flexion, left lateral flexion) by time spent per day wearing the headscarf ( $\leq 6$  hours versus  $> 6$  hours) and age at onset of wearing the headscarf ( $\leq 12$  years versus  $> 12$  years) were compared using independent t-test. The relationship between cervical ROM measures and age at onset of wearing the headscarf, number of years worn, and hours per day spent wearing the headscarf were examined using Pearson's correlation. Mean outcome variables by time spent per day wearing the headscarf ( $\leq 6$  hours versus  $> 6$  hours) and age at onset of wearing the headscarf ( $\leq 12$  years versus  $> 12$  years) were assessed using independent t-test. The level of significance was set at a p-value of  $\leq 0.05$ . Fisher's Chi-square test of independence was used to compare hand dominance between the two groups. The significance

level was set at a p-value of less or equal than 0.05.

## RESULTS

A total of 52 females with mean age  $28.1 \pm 3.1$  years participated in the study. The distribution of age, body mass index (BMI) in  $\text{Kg}/\text{m}^2$ , and range of motion (degrees) was approximately normal. Age, BMI, and hand dominance were similar between the two groups (Table 1). There was no significant difference in mean BMI between the headscarf and control groups ( $26.9 \pm 5.3$  vs.  $27.4 \pm 5.0$ ,  $p=0.73$ ) and hand dominance (right-handed (92.3%,  $n=24$ ) in the headscarf group vs. (84.6%,  $n=22$ ) in the control group;  $p=0.33$ ). In the headscarf group, the mean age at onset of wearing the headscarf was  $12.6 \pm 1.6$  years, the mean time spent per day wearing the headscarf was  $7.0 \pm 2.3$  hours, and the mean number of years worn was  $15.5 \pm 3.6$  years.

**Table 1:** Mean (SD) of subjects' demographics by study group (N= 52)

	Headscarf ( $n_1=26$ )	Control ( $n_2=26$ )	p-value <sup>a</sup>
Age (years)	28.1(3.1)	28.1(3.1)	1.0
BMI ( $\text{Kg}/\text{m}^2$ )	26.9(5.3)	27.4(5.0)	0.73
Right handed <sup>b,c</sup>	24(92.3)	22(84.6)	0.33

Abbreviation: SD, standard deviation; BMI, body mass index; ROM, range of motion

<sup>a</sup> Independent t-test

<sup>b</sup> Chi-square test

<sup>c</sup> results are reported as n (%)

There was a significant difference in mean  $\pm$  standard error (SE) in range of motion in all directions between the two groups (Table 2). Females in the headscarf group had a significant reduction in cervical ROM for right rotation ( $60.9 \pm 1.6$  vs.  $71.1 \pm 1.7$ ,  $\eta^2=1.2$ ;  $p<0.001$ ), left rotation ( $67.2 \pm 1.7$  vs.  $73.6 \pm 2.2$ ,  $\eta^2=0.7$ ;  $p=0.024$ ), flexion ( $55.0 \pm 1.3$  vs.  $61.4 \pm 1.6$ ,  $\eta^2=0.9$ ;  $p=0.004$ ), extension ( $63.5 \pm 2.0$  vs.  $72.0 \pm 1.8$ ,  $\eta^2=0.9$ ;  $p=0.003$ ), right flexion ( $40.6 \pm 1.3$  vs.  $46.5 \pm 1.8$ ,  $\eta^2=0.7$ ;  $p=0.01$ ), and left flexion ( $43.8 \pm 1.3$  vs.  $49.4 \pm 1.6$ ,  $\eta^2=0.7$ ;  $p=0.011$ ).

**Table 2:** Mean (SE) of cervical ROM between headscarf group and control group (N= 52)

	Headscarf Group ( $n_1=26$ )	Control Group ( $n_2=26$ )	Effect size	p-value <sup>a</sup>
Right Rotation	60.9 (1.6)	71.1(1.7)	1.2	<0.001
Left Rotation	67.2(1.7)	73.6(2.2)	0.7	0.024
Flexion	55.0(1.3)	61.4(1.6)	0.9	0.004
Extension	63.5(2.0)	72.0(1.8)	0.9	0.003
Right Lateral Flexion	40.6(1.3)	46.5(1.8)	0.7	0.010
Left Lateral Flexion	43.8(1.3)	49.4(1.6)	0.7	0.011

Abbreviation: SE, Standard error of the mean; ROM, range of motion.

<sup>a</sup> Independent t-test

In addition, there was a significant difference in mean cervical ROM in left rotation by the hours per day spent wearing the headscarf ( $71.3 \pm 2.1$  vs.  $64.5 \pm 2.1$ ,  $\eta^2=2.2$ ;  $p=0.045$ ), and a trend towards statistical significance in mean ROM



in flexion (57.8±2.4 vs. 53.2±1.4,  $\eta^2=1.6$ ;  $p=0.093$ ; Table 3).

**Table 3:** Mean (SE) of outcome variables by hours per day spent wearing the headscarf (N= 26)

	≤ 6 Hours (n <sub>1</sub> =10)	> 6 Hours (n <sub>2</sub> =16)	Effect size	p -value <sup>a</sup>
Right Rotation	63.8(2.4)	59.0(2.1)	1.5	0.158
Left Rotation	71.3(2.1)	64.5(2.1)	2.2	0.045
Flexion	57.8(2.4)	53.2(1.4)	1.6	0.093
Extension	65.9(3.3)	62.0(2.5)	0.9	0.359
Right Lateral Flexion	42.5(2.6)	39.5(1.3)	1.0	0.271
Left Lateral Flexion	44.0(2.4)	43.7(1.6)	0.1	0.927

Abbreviation: SE, Standard error of the mean.

<sup>a</sup>Independent t-test

There was also a correlation between the age subjects started wearing the headscarf and left flexion ROM ( $r=0.36$ ,  $p=0.04$ ). However, no significant differences in mean ROM by age at onset of wearing a headscarf (≤12 years vs. > 12 years) were detected ( $p>0.05$ , Table 4).

**Table 4.** Mean (SE) of outcome variables by the onset of wearing the headscarf (N= 26)

	≤ 12 years (n <sub>1</sub> =12)	> 12 years (n <sub>2</sub> =14)	Effect size	p -value <sup>a</sup>
Right Rotation	61.9(2.2)	59.9(2.4)	0.2	0.371
Left Rotation	68.2(2.1)	66.3(2.6)	0.2	0.523
Flexion	54.4(2.1)	55.5(1.7)	0.2	0.857
Extension	63.1(3.6)	63.9(2.3)	0.1	0.461
Right Lateral Flexion	39.4(2.2)	41.6(1.5)	0.3	0.714
Left Lateral Flexion	42.9(2.6)	44.6(1.2)	0.2	0.476

Abbreviation: SE, Standard error of the mean.

<sup>a</sup>Independent t-test

## DISCUSSION

In this study, the differences in active cervical ROM between females who routinely wore the headscarf and females who never wore the headscarf were investigated. The findings indicated that the headscarf group reported a significant limitation in cervical ROM in all six directions. Additionally, females in the headscarf group who wore the headscarf for six hours or more a day had significantly less left rotation compared to those who wore it for less than six hours a day. There was no significant difference in cervical ROM by age at onset of wearing the headscarf or number of years worn.

Podolsky et al. (1983) [4] revealed a significant cervical rotation limitation when using a soft-collar. Also, McCarthy et al. (2015) [3] reported limitation in cervical extension associated with helmet-wearing seen in American football players. However, no limitations were detected when measuring cervical ROM without the helmet. In contrast to our study, all measurements of cervical ROM were performed without the headscarf. This revealed a significant decrease in cervical ROM in all directions. Our subjects wore the headscarf for an extended period. The mean time spent per day wearing the headscarf was 7.0±2.3 hours and the mean

number of years worn was 15.5±3.6 years. Consequently, the headscarf can act as a physical restriction to maximum cervical mobility during everyday activities. This physical restriction over time may result in muscle adaptive shortening and postural changes, leading to restrictions in cervical ROM. Dunleavy and Goldberg (2013) [16] reported that erect posture is more likely to improve the amount of neck mobility as compared to habitual posture. Since, in the current study, neither EMG nor postural analysis was assessed, this explanation needs to be explored in future studies.

The standard error of measurement (SEM) for CROM device in all directions ranged from 1.6°- 2.8° for right-lateral bending and flexion respectively [14]. Audette et al. (2010) [14] indicated that the minimal detectable change (MDC) ranged from 3.6° to 6.5° for right lateral bending and flexion respectively. In our study, the decrease in cervical ROM was clinically important since the difference in CROM device measurements between the groups varied from 5.6° to 10.2° for Left lateral bending and right rotation respectively.

Wearing the headscarf for six hours or more resulted in a significant decrease in the left cervical rotation. Sjolander et al. (2008) [17] investigated chronic neck pain with insidious onset and reported similar findings in left rotation limitation. In their study, they assessed cervical ROM in the transverse plane motion only. Also, Lee et al. (2005) [11] reported a significant limitation in left rotation cervical ROM only in a group of young subjects with subclinical neck pain. Those studies were conducted to detect any limitation in cervical ROM regardless of the direction. Additionally, the studies calculated cervical ROM in one plane of motion. Therefore, no explanations or speculations on why the limitation was only recorded in the left rotation were provided.

Deficiencies in cervical mobility may start at an early phase of neck pain and can distinguish between people with subclinical neck pain and no neck pain [10,11]. Additionally, reduction in cervical ROM is one of the prognostic factors that may predict disability after acute whiplash [12]. There is an association between decreased cervical mobility and activity limitation in subjects with neck pain [13]. This association supports the clinical importance of detecting impairments in ROM when evaluating treatment effects on neck pain.

Hand dominance may be considered a factor, as 92.3% of the headscarf group participants were right-handed. Usually, right-handed females wrap the headscarf first over the left side then insert it near the right ear side. In this headscarf style, the female may avoid moving the head to the left side to keep the headscarf on. This headscarf style may explain the significant reduction in the left rotation. However, no detailed information was obtained from the subjects regarding headscarf style. In the current study, when the time spent per day wearing the headscarf was considered, it revealed a trend toward further implications in cervical ROM. This suggests that the amount of time females spend wearing the headscarf is a factor in cervical ROM limitation.

There is a general agreement in the literature that age generates a significant decrease in range of motion in asymptomatic subjects [18,19,20], as well as with subjects with neck pain [13]. In our sample, the mean age for the subjects was  $28.1 \pm 3.1$  years, which represents a relatively young population. Nevertheless, within this age range, a significant reduction in cervical ROM was detected. It is reasonable to predict that, within the population of females who wear headscarves, the limitation in cervical ROM may tend to be greater as they grow older. Therefore, future studies should investigate older adult females who wear headscarves.

There is also a link between headscarf use and cervical proprioception. Alqabbani et al. (2016) [21] found a trend towards less cervical repositioning accuracy in women who regularly wore headscarves. This suggests that wearing the headscarf may implicate other sensory-motor dysfunctions of the cervical spine. Further investigations are needed to determine the impact of using the headscarves on other cervical spine outcomes.

Furthermore, there is a relationship between cervical ROM and forward head posture (FHP) [22]. However, in this study, no FHP measurements were obtained. Thus, future studies are warranted to include postural or movement analysis to further explain the limitations of cervical ROM.

In this study, we considered three factors related to headscarves: onset of the practice, hours worn per day, and the number of years worn. Future research should include factors such as styles and textures of headscarves. Additionally, to further analyze the factors, more sample size is needed to achieve the required power.

## CONCLUSION

In conclusion, wearing the headscarf is an essential religious practice by females in Islamic cultures. Regular wear of the headscarf may influence cervical mobility. Additionally, wearing it for six hours or more may result in further decline of cervical ROM. Therefore, it is suggested that females minimize the amount of time spent wearing the headscarf, if appropriate. Moreover, to maintain cervical mobility, the performance of a regular range of motion exercises is recommended, especially for females whose daily routines require them to wear the headscarf for more than six hours.

## ABBREVIATIONS

ROM	Range of Motion
CROM	Cervical Range of Motion Device
WAD	Whiplash-Associated Disorder
ICF	International Classification of Function
SPSS	Statistical Product and Service Solutions
BMI	Body Mass Index
FHP	Forward Head Posture

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## IRB Approval:

Loma Linda University Institution Review Board approved this study (IRB # 5150011). All subjects signed an informed consent before participation.

## Conflicts of Interest and Source of Funding

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## Level of Evidence:

Level 3 according to Oxford Centre for Evidence-Based Medicine 2011.

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