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Original Article

Comparative Evaluation of Neck Length, Relative Neck Length and Total Body Height in Cervical Spondylosis Affected and Non-Affected Individual

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ABSTRACT

Anthropometric measurements, including neck length, relative neck length and total body height, have been proposed as potential indicators of cervical spine health, yet their association with cervical spondylosis remains relatively understudied. **Objective:** To compare neck length, relative neck length, and total body height between individuals affected by cervical spondylosis and a non-affected control group. **Methods:** This case-control study was conducted at Department of Anatomy Multan Medical and Dental College (MMDC), Multan from April 2023 to September 2023. Cases were diagnosed with cervical spondylosis and controls were selected from the same population without a history of cervical spine pathology or symptoms. The collected data were analyzed using IBM SPSS, version 27.0. **Results:** Gender distribution revealed females in both cases (63, 60.6%) and controls (59, 56.7%). The age of participants ranged from 25 to 75 years. The mean age for cases was 49.2 ± 12.93 years and for controls was 49.7 ± 13.19 years. The mean neck length among cases and controls was 105.2 ± 17.22 mm and 107.7 ± 20.02 mm, respectively. Regarding relative neck length, cases and controls exhibited measurements of 6.41 ± 1.07 mm and 6.42 ± 1.27 mm, respectively. Height-wise, cases measured 164.4 ± 10.27 cm, while controls measured 168.3 ± 8.53 cm. **Conclusions:** In conclusion, while no significant differences were observed in neck length or relative neck length between cervical spondylosis patients and controls, a notable disparity in height was noted.

INTRODUCTION

Cervical spondylosis, often referred to as neck arthritis or cervical osteoarthritis, is a common degenerative condition affecting the cervical spine, particularly as individual's age. This condition affects the bones, discs and joints in the neck and may cause the following symptoms: neck pain and stiffness, with radiation of the symptoms to the arms and shoulders [1, 2]. The most common cause of cervical spondylosis is advancing age, but heredity and other factors including some lifestyle aspects and prior neck injuries may also lead to the formation of this disease [3, 4]. Disc desiccation and possible future bone spurring due to loss of water content in cultural discs of the cervical spine As people grow older, the discs in the cervical spine progressively lose their water content and elasticity and thereby their ability to withstand pressure and shock. They can lead to the reduction in the size of the spinal canal and the neural foramina therefore causing spinal nerves to be compressed and stimulated [4]. Headache and stiffness of the neck is common and sometimes it becomes severe if one has to bend forward or has to sit or stand for long hours.

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n severe cases where spinal cord compression is established, people may develop weakness in arms and/or legs, coordination issues, or bladder and bowel changes; they should seek medical help [5]. Conservative treatment interventions may include: inactivity or modification of an individual's activities; physiotherapy; various analgesics and anti-inflammatory agents; epidural steroid injections and/or muscle relaxants. [6]. The study varies from the common approach where one, researches only on conventional diagnostic indicators or management procedures; but instead, the study was centered on anthropometric measures including neck length, relative neck length, and total body height as the possible indicators or correlation of cervical spine health [7]. Structural measures are one of the most fascinating approaches that may offer great potential in the dissection of skeletal features and the onset of cervical spondylosis. The human neck, the section when combined with the cervical vertebrae, is of critical consideration as it forms part of the head support as well as affords a host of movements. Thus, changes in the neck dimension or its relative length compared to the rest of the body may impose substantial effects on spinal mechanics and loading[8, 9].

Thus, this study contributes to the existing literature on cervical spondylosis by considering anthropometric markers, namely, neck length, relative neck length, and total body height as potential markers of the cervical spine health, which has been less researched. In the context of Pakistan, where research on cervical spondylosis is limited, this study fills a crucial research gap by exploring a unique aspect of the condition that has not been extensively investigated in the local context. By addressing this gap, the study aims to contribute valuable insights into the structural predispositions or risk factors associated with cervical spine degeneration specifically within the Pakistani population. This study aimed to conduct a comparative evaluation of neck length, relative neck length, and total body height in cervical spondylosis affected and non-affected individuals.

METHODS

This prospective case-control study was carried out in the Department of Anatomy, Multan Medical and Dental College, Multan, from April 2023 to September 2023. The study followed the ethical principles specified in the Declaration of Helsinki and received permission from the institutional review board (Ref: MMDC/IRB/121/24). All participants provided informed consent. The sample size calculation was done using the WHO sample size calculator with an expected frequency of cervical spondylosis set at 13.76% taking a significance level of 0.05 and a margin of error of 5% were utilized [10]. Convenience sampling was used in the study. Cases were diagnosed with cervical spondylosis if CT or MRI reveals osteophytes ≥ 2 mm, moderate to severe disc degeneration (≥ Grade 2, Pfirrmann scale), and facet joint changes (≥ Grade 2, Weishaupt scale). Clinical symptoms, including neck pain (VAS ≥ 4), reduced range of motion (< 60 degrees) and neurological deficits (radiculopathy or myelopathy) and were indicative of cervical spondylosis. Controls were selected from the same population without a history of cervical spine pathology or symptoms. Exclusion criteria included prior cervical spine surgery or trauma, other neurological conditions, systemic illnesses affecting measurements, cognitive impairments and pregnancy/lactation. Anthropometric measurements, including neck length, relative neck length, and total body height, were measured using standardized procedures. The patients were instructed to maintain an upright posture with their neck in a neutral position and to lower their shoulders. The neck length was determined by determining the vertical distance in the outer occipital protuberance as well as the tip of the seventh cervical vertebra using Synapse software. The senior radiologist conducted a cross-check. In order to get the relative neck length, we divided the neck length by the total body height and then multiplied by 100. This method is commonly used to standardize neck length measurements relative to the individual's height [18].

Relative Neck Length (%) = (Total Body Height ÷ Neck Length)×100

The participants stood barefoot against the height rod of the stadiometer to measure their total body height. The outcome of the study was a comparison of anthropometric measurements between individuals with cervical spondylosis and a non-affected control group. Additionally, gender-based differences within the cervical spondylosis group were assessed. Data were analysed using IBM SPSS 27.0. Categorical variables are frequency and percentage. Mean and SD describe continuous variables. Analytical methods included independent sample t-tests to compare cervical spondylosis patients' neck length, relative neck length, and height to controls. Statistical significance was set at $p < 0.05$.

RESULTS

The study comprised 104 cases with cervical spondylosis and an equal number (n=104) of controls. Gender distribution revealed a slightly higher representation of females in both cases 63 (60.6%) and controls 59 (56.7%). The age of participants ranged from 25 to 75 years. Regarding age distribution, participants were categorized into four groups: less than 30 years, 30-44 years, 45-59 years, and 60 years and above. The majority of both cases and controls fell within the 45-59 age group, constituting 45.2% (n=47%) and 44.2% (n=46) respectively, followed by

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30-44 age group (24% vs 23.1%). The mean age for cases was 49.2 ± 12.93 years and for controls was 49.7 ± 13.19 years as shown in table 1.

Table 1: Age and Gender Distribution of Study Participants (n=208)

Variables	Cases N (%)	Controls N (%)
Gender		
Male	63 (60.6%)	59 (56.7%)
Female	41 (39.4%)	45 (43.3%)
Age Groups (Years)		
< 30	9 (8.7%)	12 (11.5%)
30-44	25 (24.0%)	24 (23.1%)
45-59	47 (45.2%)	46 (44.2%)
≥ 60	23 (22.1%)	22 (21.2%)
Age (Years)	49.7 ± 13.19	

Among the cases, the most prevalent symptoms were neck pain 82 (78.8%), followed by radicular pain 54 (51.9%), painful neck movements 52 (50.0%), clumsiness of hands 27 (26%), headache 23 (22.1%) and vertigo 8 (7.7%). Common signs included Spurling's sign (60.6%), stiffness (48.1%), and Lhermitte's sign (47.1%). Radiographic findings indicated straightening 72 (69.2%) and osteophytes 71 (68.3%) as the predominant observations as shown in table 2.

Table 2: Distribution of Cases According to Clinical and Radiographic Findings (n=104)

Cases	N (%)
Neck Pain	82 (78.8%)
Radicular Pain	54 (51.9%)
Painful Neck Movements	52 (50.0%)
Clumsiness of Hands	27 (26.0%)
Headache	23 (22.1%)
Vertigo	8 (7.7%)
Sensory Loss	27 (26.0%)
Motor Weakness	42 (40.4%)
Stiffness	50 (48.1%)
Lhermitte's Sign	49 (47.1%)
Spurling's Sign	63 (60.6%)
Straightening	72 (69.2%)
Osteophytes	71 (68.3%)
Disc Herniation	8 (7.7%)
Narrowing of Disc Space	20 (19.2%)

The mean neck length among cases and controls was 105.2 ± 17.22 mm and 107.7 ± 20.02 mm, respectively. Regarding relative neck length, cases and controls exhibited measurements of 6.41 ± 1.07 mm and 6.42 ± 1.27 mm, respectively. Height-wise, cases measured 164.4 ± 10.27 cm, while controls measured 168.3 ± 8.53 cm. Comparison between cases and controls revealed no significant difference in neck length (p = 0.338) or relative neck length (p = 0.986). However, a statistically significant difference was observed in height between cases and controls (p = 0.003) as shown in table 3.

Table 3: Measurements of Case and Control Subjects' Height, Neck Circumference and Relative Neck Circumference (n=208)

Measurements of Case and Control	Cases (Mean ± SD)	Controls (Mean ± SD)	p-Value[a]
Neck Length (mm)	105.2 ± 17.22	107.7 ± 20.02	0.338
Relative Neck Length (mm)	6.41 ± 1.07	6.42 ± 1.27	0.986
Height (cm)	164.4 ± 10.27	168.3 ± 8.53	0.003

[a] Independent sample t-test

Within the cases group, Male (n=41) and Female (n=63), a gender-based comparison showed significant differences in neck length (p = 0.005) and height (p < 0.001) between males and females. Males exhibited longer necks (111.02 ± 16.85) compared to females (101.40 ± 16.50), whereas females had a shorter stature (160.54 ± 8.83) in contrast to males (170.36 ± 9.52) as shown in table 4.

Table 4: Male and Female Cases Were Compared in Terms of Neck Length, Relative Neck Length and Height (n=104)

Measurements	Male (Mean ± SD)	Female (Mean ± SD)	p-Value[a]
Neck Length (mm)	111.02 ± 16.85	101.40 ± 16.50	0.005
Relative Neck Length (mm)	6.53 ± 1.03	6.33 ± 1.09	0.360
Height (cm)	170.36 ± 9.52	160.54 ± 8.83	< 0.001

[a] Independent sample t-test

DISCUSSION

Cervical spondylosis, a common degenerative disorder of the cervical spine, often presents with neck pain and stiffness, along with neurological symptoms such as numbness and tingling. The hallmark radiographic features of cervical spondylosis include reduced intervertebral disc space and the formation of osteophytes along the vertebral bodies. In advanced stages, cervical spondylosis can lead to spondylotic myelopathy, characterized by impaired upper limb function due to spinal cord compression [11]. Height significantly influences personality traits such as leadership and academic success, with average stature reflecting a complex interplay of factors like nutrition, genetics, ethnicity, and hormones, falling within the 3rd to 97th percentiles, while short and tall statures represent natural variations across diverse populations [12]. In our study, the age of cervical spondylosis patients ranged from 25 to 75 years, with majority falling within the 45-59 age group (45.2%), followed by 30-44 age group (24%), ≥ 60 years' age group (22.1%) and < 30 years' age group (8.7%). This observation was comparable with the findings of Lv Y *et al.*, in 2018 who reported 46.6% patients in 45-59 age group, 24.7 % in ≥ 60 years' age group, 21.7% in 30-44 age group and 7% in < 30 years' age group [13]. The previous study of Alshami AM *et al.*, in 2015 reported that most of patients with cervical spondylosis fell in 30-49 years' age group (35.3%) followed by 50-59 years' age group (32.1%), indicating lower proportion compared to our study [14]. The mean age for cases was 49.2 ± 12.93 years and for controls was 49.7 ± 13.19 years in our study. Singh S *et al.*, in

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2014 also reported a mean age for cases similar to ours which was 49.76 years, but lower mean age for controls which was 39.38 years [15]. Our study revealed a slightly higher proportion of females in both cases (60.6%) and controls (56.7%) compared to males (39.4% vs 43.3%). Alshami AM *et al.*, in 2015 also reported higher proportion of females (73%) compared to males (27%) in cervical spondylosis patients, which are lower than our findings [14]. Another study conducted by Genji L *et al.*, in 2020 showed that the incidence of cervical spondylosis was more in females (22%) than males (16%) [16]. In this study, neck pain was seen in 78.8% patients, radicular pain in 51.9%, painful neck movements in 50.0%, clumsiness of hands in 26%, headache in 22.1% and vertigo in 7.7% patients. A study conducted by RoseBist PK *et al.*, in 2018 reported slightly higher proportion of neck pain (84%), radicular pain (56%), painful neck movements (53%), clumsiness of hands (30%) and headache (25%), but slightly lower proportion of vertigo (9%) in cervical spondylosis patients [17]. Common signs included Spurling's sign (60.6%), stiffness (48.1%) and Lhermitte's sign (47.1%) in our study RoseBist PK *et al.*, in 2018)7also reported similar findings having spurling's sign in 60%, stiffness in 52% and Lhermitte's sign in 47% patients [17]. In our study, cases showed decreased neck length (105.2 ± 17.22 mm) as compared to controls (107.7 ± 20.02 mm) but similar relative neck length in cases (6.41 ± 1.07) as compared to controls (6.42 ± 1.27), although difference was not significant. These findings were consistent with the study of Ahmad SB *et al.*, in 2020, who also reported shorter neck length in cases (104.15 ± 18.9 vs 106.98 ± 19.0 mm) but almost similar relative neck length in cases and controls (6.90 ± 0.89 vs 6.93 ± 0.87) [18]. In present study, the mean height was 164.4 ± 10.27 cm in cases and 168.3 ± 8.53 cm in controls. A study in Lucknow conducted by Singh S *et al.*, 2014 revealed that the average height of individuals with cervical spondylosis was 156.58 ± 8.84 cm, whereas the control group's mean height was 159.54 ± 8.17 cm [15]. This was supported by a study carried out by Ulbrich EJ *et al.*, in 2014 indicating a positive correlation between body height and cervical spinal canal dimensions [19]. Our study also indicated a significant decrease in neck length in females (101.40 ± 16.50 mm) as compared to the males (111.02 ± 16.85). Ahmad SB *et al.*, in 2020 also reported that the mean height in females (159.14 ± 8.88) was lower than males (168.81 ± 8.42) [18]. In another study, these findings were comparable with the study of Taha M *et al.*, in 2022 who also reported slight decrease in neck length in females (109.25 ± 13.97 mm) as compared to males (110.31 ± 12.71 mm). Females had a shorter stature (160.54 ± 8.83) in contrast to males (170.36 ± 9.52) in our study [20]. The limitations of our study included single-center study, small sample size and measurement errors. In future research endeavors, the study should be conducted across several tertiary care medical facilities to establish correlations between various patient variables, thus discerning the risk factors and prevalence of the disease within our population.

CONCLUSIONS

In conclusion, while no significant differences were observed in neck length or relative neck length between cervical spondylosis patients and controls, a notable disparity in height was noted. Furthermore, gender-based variations in neck length and height within the cervical spondylosis group suggest potential anatomical considerations in the pathogenesis of the condition.

Authors Contribution

Conceptualization: MKA
Methodology: MKA, FM, KM, HA, FI
Formal analysis: FM
Writing, review and editing: HA, FI

All authors have read and agreed to the published version of the manuscript.

Conflicts of Interest

The authors declare no conflict of interest.

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