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Evaluation of the Cervical Curvature Index of Apparently Healthy Nigerians

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# ABSTRACT

Spinal curvature is one of the most significant spine parameters for the evaluation of spinal deformities, providing support to various spine-related clinical measurements and image processing techniques. The purpose of this study was to determine normative reference values of the Cervical Spine Curvature Index in apparently healthy Nigerians and determine if the parameter has sex- discriminating attributes. The study was a prospective cross-sectional study involving 100 (62 males, 38 females) apparently healthy volunteers which underwent simple radiography of the lateral cervical spine. The radiographic data of interest, cervical curvature index was measured using digital tools. The result showed the mean cervical curvature of index to be  $24.58\pm8.01$  (%),  $23.32\pm7.59$  for males and  $26.63\pm8.36$  for females. It also exhibited sex-discriminating attribute. This study was able to establish reference normative values for the Cervical curvature index for the Nigerian population, a useful parameter in clinical and forensic science.

Keywords: Cervical spine, Cervical Curvature index, Nigeria

#### **INTRODUCTION**

Spinal curvature is one of the most significant spine parameters for the evaluation of spinal deformities, providing support to various spine-related clinical measurements and image processing techniques. Cervical lordosis is the anterior convexity of the cervical spine from the first thoracic vertebra to the foramen magnum<sup>(1),</sup> looking like a wide-shaped letter "C". Curvature of the cervical spine has important clinical implications <sup>(2)(3)</sup>. Reattainment of cervical lordosis after a surgical intervention is also considered important as compression of nervous tissue may cause injury otherwise <sup>(4)</sup>. An appropriate cervical lordosis is essential for efficient mastication function, breathing control, vocal production, and eye movement, and serves as part of the shock absorbing mechanism during walking and running <sup>(1).</sup> The four most common methods for measuring cervical lordosis include the modified Cobb method (mCM), Jackson physiological stress lines (JPS), Harrison's posterior tangent method (HPT), and the Ishihara Index  $^{(5)(6)(7)}$ . The Ishihara index also known as the Cervical Spine Curvature Index (CSCI) was developed by Ishihara<sup>(8).</sup> A higher ratio of the Ishihara index corresponds to a more lordotic cervical spine, whereas a lower ratio corresponds to a "straighter" cervical spine. If the cervical spine is perfectly straight, then the Ishihara index equals to zero.

Several studies  $^{(9)(10)(11)(12)}$  have been carried out on the Cervical curvature index in the bid to address the

challenge of dearth of cervical quantitative data, of which most of the published data are of the Caucasian and Asian populations. However, no study may have reported values of the Cervical Spine Curvature Index for apparently healthy subjects in the Nigerian population. This Study therefore measured the Cervical spine Curvature index in apparently healthy Nigerians and determined mean values. The purpose of this study was to establish normative reference values of the Cervical Spine Curvature Index and determine if the parameter has sex- discriminating attributes.

### **MATERIALS AND METHODS**

The study was a prospective cross-sectional design, conducted at Health Bridge Medical Consultants Port Harcourt, Rivers State and Orange Diagnostics, Alakahia, Rivers State. One hundred (100) apparently normal volunteer subjects comprising of sixty-two (62) males and thirty-eight (38) females were recruited into the study. The inclusion criteria were adult Nigerians who could read and give their informed consent and who has no history of traumatic injury to the neck. They all underwent simple lateral radiography of the cervical spine after administrative ethical approval was granted by the various ethical board of the study centres.

On the lateral radiograph, line segment A is drawn between the posterior inferior edges of the C2 -C7 spinal bodies. The four lines are al-a4 is drawn perpendicular to line A from the posterior inferior margins of C3, C4, C5 and C6 vertebral bodies. The

cervical curvature index is the percentage of the sum of the four segments divided by line segment A i.e CCI=  $100 \times (al+a2+a3+a4)/A$  (Takeshita *et al*; 2001) as shown in Fig 1. Measurements were taken with the K-PACS workstation V.1.6.0 software and documented accordingly.



Figure 1: Lateral radiograph of the Cervical vertebrae showing measurement of the Cervical Curvature Index

**Statistical Analysis:** Statistical Package for Social Sciences version 23 (IBM®, Armonk, USA) and Minitab version 18.1 (Minitab® Inc. 2017) was deployed for analysis. SPPS described the data and evaluated differences in mean of males and females.

# RESULTS

 $\begin{array}{l} \mbox{Continuous data were represented as mean (S.D). The} \\ \mbox{measurements were tabulated (as mean $\pm$ S.D) and} \\ \mbox{range (min-max) for the sexes (male and female).} \end{array}$ 

Table 1: Descriptive statistics of cervical curvature index

Parameter	Male [N = 62]		Female [N = 38]			Total [N = 100]			
	Min	Max	Mean±SD	Min	Max	Mean±SD	Min	Max	Mean±SD
CCI (%)	14.00	43.00	23.32±7.59	18.00	58.00	26.63±8.36	14.00	58.00	24.58±8.01

The mean and standard deviation of Cervical curvature index (CCI) were  $23.32\pm7.59$  for the males and  $26.63\pm8.36$  for the females of normal subjects, while the total mean for both male and female is  $24.58\pm8.01$ .



**Figure 1:** Descriptive characteristics for CCI and normality test of data From Fig. 1, the cervical curvature index was observed to have failed the test of distributional normalcy of data.

S/N	H <sub>o</sub> (Hypotheses)	Sex	Median	Yates's (fi2) value	p- value	Inference
	The median of CCI (%) is the same for both groups	Male	21.00		0.055	Fail to reject
		Female	25.00	3.668		

Table 2: Yates's continuity correction after chi-square median test of distributional difference

From Table 2, there is observational difference between the sexes.

Table 3: T-test of mean d	lifference in	male and	female
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		Differences				t-test for Equality of Means			
Cervical Parameters	MD	SEM	95% C.I of the Diff		t-value	Df	P-value		
			Lower	Upper					
CCI (%)	-3.31	1.62	-6.53	-0.09	-2.04	98.00	0.04*		

From Table 3, there are observable significant difference in the mean between male and female.

#### DISCUSSION

The result from the study established the mean for cervical curvature index to be  $24.58\pm8.01$ , while  $23.32\pm7.59$  for the males and  $26.63\pm8.36$  for the females. Establishing normative values of the Cervical curvature of index in healthy Nigerians was the aim of this study. Other studies carried out on the cervical curvature index of other populations significantly differed from the study <sup>(9)(10)(11)</sup>. There are sufficient documented literature that underscore the variations that exist in spinal morphometry <sup>(13)(14)(15)</sup>, making it necessary to determine normative values of bony parameters that will serve as reference values for a given population. Some of these variability in spinal parameters could be due to regional, racial and even lifestyle.

Findings from this study has revealed that the Cervical curvature of index has been shown exhibits sexdiscriminating characteristics, hence possessing sexestimating potentials.

In conclusion, the Cervical curvature index is a useful bony parameter that clinically is used to determine cervical lordosis, as a higher ratio of the cervical curvature index corresponds to a more lordotic cervical spine. Normative reference value of this parameter will be a useful a data in clinical and forensic science.

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