Journal of Novel Physiotherapies

Umunnah et al., J Nov Physiother 2018, 8:5
DOI: 10.4172/2165-7025.1000397

Research Article Open Access

# Assessment of Cervical Resting Posture among Apparently Healthy Individuals Using an Adapted Linear Excursion Measurement Device

**Umunnah Joseph Onuwa[1*], Okeke Chukwuebuka Olisaemeka[1], Ihegihu Chima Collins[3], Mue Daniel[4], Ihegihu Yvonne Ebere[2] and Ahwen Peter Agba[1]**

[1]*Department of Medical Rehabilitation, Nnamdi Azikiwe University, Nnewi Campus, Nnewi, Anambra State, Nigeria*

[2]*Department of Physiotherapy, Nnamdi Azikiwe University Teaching Hospital, Nnewi, Anambra State, Nigeria*

[3]*Department of Surgery, Nnamdi Azikiwe University, Nnewi Campus, Nnewi, Anambra State, Nigeria*

[4]*Department of Surgery, Benue State University, Makurdi, Benue State, Nigeria*

***Corresponding author**: Dr. Joseph Onuwa Umunnah, Department of Medical Rehabilitation, Nnamdi Azikiwe University, Nnewi Campus, Nnewi, Anambra State, Nigeria, Tel: +2348036071257; E-mail: dynamojoe2000ng@yahoo.com

**Received date:** September 02, 2018; **Accepted date:** September 21, 2018; **Published date**: September 25, 2018



## Abstract

**Background:** The relationship between all the segments of the human body is an indicator of biomechanical efficacy, equilibrium, and neuromuscular coordination. The unique anatomical characteristics and complex biomechanical nature of the cervical spine gives it a wide range of mobility but less stability; thus poor cervical posture has been shown to be a risk factor for neck pain.

**Objective**: The study aimed at investigating the cervical resting posture and its relationship with age, gender, and height; with a view of ascertaining possibility of disposition to developing neck pain.

**Method:** The study adopted an ex-post facto design in which 522 individuals (235 males, 287 females) consenting apparently healthy undergraduates were randomly selected. Cervical excursion angle was measured using an adapted Linear Excursion Measuring Device (LEMD). Data was summarized using descriptive statistics of mean, standard deviation and percentages and analyzed using independent t-test and Pearson's Product Moment Correlation Co-efficient at the < 0.05 level of significance.

**Results**: Significant gender difference existed at only the excursion angles of the upper cervical spine (p=0.007). Height, sex and age showed positive significant correlation with the degree of movement at the upper and lower cervical spine (p=0.05 in all cases), while age significantly correlated with only excursion at the lower cervical spine (p=0.039). Combinations of extremely small and/or extremely large excursion angles were found at the upper and lower cervical spine of 61 (11.69%) individuals. Also, 59% had at least one of their excursion angles at either of the two extremes.

**Conclusion:** Although most of the participants did not exhibit poor cervical posture, the finding of extreme small and/or large excursion angles may suggest the possibility of future cervical postural problems. Thus, it would still be of importance that greater awareness of proper ergonomics be taught among this group.

**Keywords:** Cervical excursion angle; Linear excursion measuring device; Posture

## Introduction

Posture is defined as the relationship between a segment and part of the body related to other adjacent segments; and the relationship between all the segments of the human body [1]. It is an indicator of biomechanical efficacy, equilibrium, and neuromuscular coordination [2]. The biomechanical ideal configuration for the human cervical spine is characterised by a posterior concave arc or lordosis [3]. Incorrect posture characterized by loss or reversal of the normal cervical lordosis, has been associated with chronic musculoskeletal pain in a number of studies [4-6]. The cervical spine acts as the junction between the head and the trunk. Skeletal mal-alignment or changes in alignment may indicate muscle lengthening or shortening, and strength imbalances between muscular agonists and antagonists [7]. Excessive or abnormal muscle tension, required when abnormal postures are maintained over time, can lead to muscle spasm and pain [8,9].

University students seem to be a high risk group for neck pain [10]. In addition to the factors predisposing to pain in the general population, students subject themselves to hours of prolonged reading, [10,11] writing and computer work [12] which make them high-risk group for neck pain due to the relatively poor posture adopted during these activities [11].

A method of objectively assessing cervical resting posture and defining poor posture has been reported by Grimmer [13-15], who developed the Linear Excursion Measurement Device. In this study, an adaptation of this instrument was used to assess and ascertain the risk of developing neck pain among students and the need for greater awareness of proper ergonomics with a view to reducing the likelihood of developing cervical postural problems.

It is clear that there is a need for reliable methods to objectively assess neutral posture of head and neck. Several studies have shown that maintaining a poor cervical resting posture over time is a risk factor for predisposition to development of neck pain. Poor head posture is considered to be inefficient, increasing the antigravity load on cervical structures, instigating abnormal and compensatory activities by them, and resulting in pain. This poor posture is characterized by extremely large and/or extremely small cervical excursion angles at both the upper and lower cervical region, measured using the linear excursion measuring device as noted by Grimmer [13-15].

## Materials and Methods

This study adopted an ex-post facto research design and involved apparently healthy undergraduate students of College of Health Sciences, Nnamdi Azikiwe University, Nnewi campus. Participants were randomly selected, involving volunteering individuals who met the inclusion criteria and gave informed consent. The sample size was obtained using the sample size estimation table [16]. Ethical approval was sought and obtained from the Ethical Review Committee of the Nnamdi Azikiwe University Teaching Hospital, Nnewi, before the commencement of the study. The procedure was explained to the participants before measurements were taken. Participants' bio-data including their gender, age and height was obtained and recorded.

Resting cervical posture was assessed using an adapted Linear Excursion Measurement Device [13-15]. There was no specific time for carrying out the measurements during the day since the instrument has been found to have a satisfactory temporal stability [17]. Four measurements were taken on each participant: the horizontal and vertical movements at the superior most tips of the helix of the ear, and the horizontal and vertical movements at the spinous process of C7. By combining the vertical and horizontal measurements occurring at the superior most tips of the helix of the ear (D1 and D2) and at the spinous process of C7 (D3 and D4), the excursion angles at these anatomical points was calculated using the formula; [13-15]

Tan ø = (vertical distance) ÷ (horizontal distance)

## Procedure

Two anatomical reference points i.e. superior-most tip of the helix of the ear as an indicator of skull movement (because it is clearly visible, moves in direct relation to the skull and can be indelibly marked for re-measurement) were marked as the first point and the spinous process of C7 (because it can be located by sight and palpation whether the person's neck is flexed as far as possible) as the second point [13-15,17].

As each participant sat on the LEMD, the hips, knees, and ankle joints were kept in 900. After this, the participants were made to sit comfortably, resting their forearms on their thigh while the selected reference points were marked. They were then instructed to maximally retract their chins by pressing the back of their head and their shoulder blades unto the vertical backboard (so as to standardize the chin retraction mobility) and this was the starting position for all the measurements [13-15,17]. Participants were then asked to spot a letter level with their horizontal gaze on a wall chart in front of them [17]. Horizontal gaze orientation is associated with head movement in sagittal plane and this ensured consistent horizontal head placement. The horizontal T-square was positioned at 900 to the marked anatomical reference points, and position of the T-square bracket on the vertical ruler marked on the LEMD with a marker.

The Participants were instructed to assume their habitual cervical resting posture, which consists of flexion and extension of the cervical spine in three decreasing amplitude movements, until the usual resting posture of the head was obtained. Contact between their scapulae and the vertical back-board and spotting the selected letter during each head sweep were maintained. By opening the screws and sliding the bracket, the horizontal T-square was fixed at 90 degree with the marked anatomical reference points and the position of the T-square bracket on the vertical ruler was marked on the LEMD with the marker [13-15,17].

The data obtained was summarized using descriptive statistics of mean and standard deviation. Independent t-test was used to determine significant gender differences; while pearson product moment correlation co-efficient was used to determine relationship between different variables. Level of significance was set at <0.05 for all calculations.

## Results

A total of 522 participants (235 males and 287 females) who were undergraduates of College of Health Sciences, Nnamdi Azikiwe University, were involved in this study. They were all apparently healthy individuals of mean age of 21.75 ± 2.57 years. The physical characteristics of the participants are presented in Table 1. Comparison of upper and lower vertical distance, upper and lower horizontal distance and both upper and lower cervical excursion angles between males and females using the independent t-test is presented in Tables 2 and 3, and shows a significant difference at the upper cervical excursion (p=0.007).

| Parameters | N | Mean ± S.D (cm) |
|---|---|---|
| Height(m) | 522 | 1.69 ± 0.92 |
| Upper vertical(cm) | 522 | 1.56 ± 1.86 |
| Upper horizontal(cm) | 522 | 18.17 ± 2.72 |
| Lower vertical(cm) | 522 | 1.60 ± 1.79 |
| Lower horizontal(cm) | 522 | 12.81 ± 2.06 |
| C. E upper(deg) | 522 | 4.93 ± 5.84 |
| C. E lower(deg) | 522 | 7.20 ± 8.13 |
| Age (yrs) | 522 | 21.75 ± 8.13 |
| Key: C.E=cervical excursion, yrs=years, S.D=standard deviation, N=number of participants, cm=centimeters deg=degrees, M=meters | | |

**Table 1:** Mean values of height, linear, vertical and angular measurements of participants.

| Excursion angles (Degrees) | Male Mean ± SD | Female Mean ± SD | t-value | p-value |
|---|---|---|---|---|
| upper Horizontal | 19.11 ± 2.72 | 17.40 ± 2.48 | 7.438 | 0 |
| lower Horizontal | 13.43 ± 1.95 | 12.31 ± 2.00 | 6.415 | 0 |

| | | | | |
|---|---|---|---|---|
| upper Vertical | 1.42 ± 1.33 | 1.68 ± 2.20 | -1.583 | 0.098 |
| lower Vertical | 1.69 ± 1.56 | 1.51 ± 1.96 | 6.415 | 0.273 |
| C.E upper | 4.18 ± 0.24 | 5.62 ± 0.48 | -2.723 | 0.007 |
| C.E lower | 7.25 ± 0.43 | 7.35 ± 0.63 | -0.122 | 0.903 |
| Key: C.E=cervical excursion, S.D=standard deviation, Upper=upper cervical spine, Significant difference is set at 0.05 level. lower=lower cervical spine | | | | |

**Table 2:** Comparison of upper and lower vertical distance, upper and lower horizontal distance and both upper and lower cervical excursion angles between males and females using the independent t-test.

| Variables | r | p-value |
|---|---|---|
| Age vs CE upper | 0.004 | 0.465 |
| Age vs CE lower | 0.077 | 0.039 |
| Sex vs CE upper | 0.071 | 0.001 |
| Sex vs CE lower | 0.071 | 0.001 |
| Height vs CE upper | -0.102 | 0.01 |
| Height vs CE lower | 0.84 | 0.027 |
| Key: Significant difference is set at 0.05 level, r=correlation co-efficient values, CE=cervical excursion, Deg=degrees | | |

**Table 3:** Correlation of age, sex and height with upper and lower cervical excursion angle measurements using the pearson's product moment correlation coefficient.

The typical distribution of cervical posture of both males and females was shown by distribution of upper and lower cervical excursion angles illustrated in Table 4 and 5 by a combination of quintile divisions of C7 and helix of the ear excursion angles for males and females. The five columns and rows in the table, represents the 1st to 5th quintile divisions at both the upper and lower cervical spine respectively. These five quintile divisions group the sample population into five parts. Excursion angles falling either in the 1st or 5th quintile divisions were designated as being extremely small or extremely large excursion angles respectively and were shown to be poor [15]. This study showed that individuals who had poor cervical resting posture (males=29: females=32), falls into one of this 4 groups as represented in Table 5. Those having:

- Extremely small excursion angles at both upper and lower cervical spine (column 1, row 1) as shown on Tables 4 and 5 for females and males respectively (females=13: males=20).
- Extremely large excursion angles at both upper and lower cervical spine (column 5, row 5) as shown on Tables 4 and 5 for females and males respectively (females=8: males=0).
- Extremely large excursion angles at the upper cervical spine and extremely small excursion angles at the lower cervical spine (column 5, row 1) as shown on Tables 4 and 5 for females and males respectively (females=6: males=1).
- Extremely small excursion angle at the upper cervical spine and extremely large excursion angle at the lower cervical spine (column 1, row 5) as shown on table 4 and 5 for females and males respectively (females=5: males=8).

- Extremely small excursion angles at both upper and lower cervical spine (column 1, row 1) as shown on Tables 4 and 5 for females and males respectively (females=13: males=20).
- Extremely large excursion angles at both upper and lower cervical spine (column 5, row 5) as shown on Tables 4 and 5 for females and males respectively (females=8: males=0).
- Extremely large excursion angles at the upper cervical spine and extremely small excursion angles at the lower cervical spine (column 5, row 1) as shown on Tables 4 and 5 for females and males respectively (females=6: males=1).
- Extremely small excursion angle at the upper cervical spine and extremely large excursion angle at the lower cervical spine (column 1, row 5) as shown on Tables 4 and 5 for females and males respectively (females=5: males=8).

| | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|
| 1 | Poor+poor<br>13 1st grp) | Poor+av<br>8 | Poor+av<br>9 | Poor+av<br>7 | Poor+poor<br>6 (3rd grp) |
| 2 | av+poor<br>12 | Average<br>12 | Average<br>11 | Average<br>15 | av+poor<br>4 |
| 3 | av+poor<br>17 | Average<br>21 | Average<br>19 | Average<br>11 | av+poor<br>9 |
| 4 | av+poor<br>20 | Average<br>21 | Average<br>15 | Average<br>11 | av+poor<br>6 |
| 5 | Poor+poor<br>5 (4th grp) | Poor+av<br>8 | Poor+av<br>12 | Poor+av<br>6 | Poor+poor<br>8 (2nd grp) |

**Table 4:** Combination of quintile divisions of C7 and helix of the ear excursion angles for females.

| | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|
| 1 | Poor+poor<br>20 (1st grp) | Poor+av<br>26 | Poor+av<br>10 | Poor+av<br>2 | Poor+poor<br>1 (3rd grp) |
| 2 | av+poor<br>34 | Average<br>30 | Average<br>7 | Average<br>6 | av+poor<br>1 |
| 3 | av+poor<br>34 | Average<br>13 | Average<br>1 | Average<br>4 | av+poor<br>1 |
| 4 | av+poor<br>19 | Average<br>4 | Average<br>1 | Average<br>0 | av+poor<br>1 |
| 5 | Poor+poor<br>8 (4th grp) | Poor+av<br>2 | Poor+av<br>2 | Poor+av<br>1 | Poor+poor<br>0 (2nd grp) |
| Key: C7 (rows)=Landmark for cervical excursion at the lower cervical spine<br>Helix (columns)=Landmark for cervical excursion at the upper cervical spine<br>av=Average, grp=Group (representing individuals with poor posture) | | | | | |

**Table 5:** Combination of quintile divisions of C7 and helix of the ear excursion angles for males.

## Discussion

The instrument LEMD [15,17] was used in this study to access the typical cervical resting posture among undergraduates of college of Health Sciences and Technology, Nnamdi Azikiwe University, Okofia campus, with a view of ascertaining their likelihood or disposition to neck pain. This is based on the premise that chronic adoption of poor posture by these students would impact on their cervical resting posture. This instrument has also been tested for its temporal stability and reliability in the Nigerian environment [17]. In this study was investigated the temporal stability and reliability of the computed sagittal cervical excursion angles obtained at two selected landmarks, i.e. the superior most tips of helix of the ear and the spinous process of C7, from an adaptation of LEMD in apparently healthy individuals. It also investigated the influence of time of day on the measurement obtained from the device. From the results, [17] found the LEMD to be cost effective, time efficient and reliable in agreement with Grimmer [13] but with weak temporal stability in this environment. It was then concluded that it could be used by physiotherapists in the treatment setting for assessing and quantifying improvement with intervention in patients with cervical spine problems but with improvement to increase the temporal stability [17].

Evidence to specifically associate particular cervical resting postures with pain has been provided largely by single case studies or anecdotal reports, in which correction of perceived poor posture by realigning the position of the head with respect to the gravitational line [18] effects a decrease in headache and/or neck pain [19-23]. Also presenting as a challenge in the study was a lack of a gold standard values with which deviations could be judged.

Studies by Ayaniyi [10] have shown that university students are predisposed to poor posture due to the several postures they adopt while reading, writing and using their laptops. Chronic adoption of this poor posture subjects the spinal tissues to significant load for a sustained period of time. They therefore deform and undergo remodeling changes that could become permanent [24]. These changes are characterized by flattening of the neck curve, resulting in long-term muscle strain, disc compression and early arthritis.

This study devised a similar method used by Grimmer [15] and the following results were obtained; the mean upper vertical excursion, upper horizontal excursion, lower vertical excursion and the lower horizontal excursion were 1.56 ± 1.86 cm, 18.17 ± 2.72 cm, 1.60 ± 1.79 cm and 12.81 ± 2.06 cm. The mean upper and lower cervical excursion are 4.93 ± 5.84 and 7.20 ± 8.13 degrees. The frequency distribution of the excursion angle data was significantly left skewed for both anatomical points, in both males and females. This result agrees with Grimmer [15] who postulated and gave evidence that supports the hypothesis that no subject had resting posture perfectly aligned with the gravitational line. Had any individual's cervical resting posture been aligned with the gravitational line the lowest value in the excursion angle range would have been 0 degree (indicating no linear excursion movement from the starting position).

Penning [25] reported wide variability in resting head position of the upper and lower aspects of the cervical spine, the reason of which included individual genetic composition, body build, and performance of cervical and thoracic muscles, occupational demands, cultural and environmental factors, nutrition and emotional influences [26,27]. This variability has also been found in the current study population and this could possibly be due to the different postures they adopt while reading, writing, and operating computers, though other factors [25], may have also contributed.

A significant difference was found between males and females in the movement at the upper cervical spine, gotten from the measured excursion angles but not at the lower cervical spine resulting from significant differences that existed in the horizontal and vertical distance measurements from which the excursion angles were calculated. This is somewhat in agreement with Grimmer [15] who suggested that gender-specific mechanisms underlie development of habitual resting head posture. This might have also been due to an error arising from the hair-do of certain female subject or from the tester due to fatigue or error due to parallax.

Another findings of this study is the correlation between height and the degree of movement at the upper and lower cervical spine which might be due to anatomical structures of the neck, consequent of its height as postulated by Pope [28], who stated that human posture is influenced by a number of interconnected factors, including height. It was also observed that there was a positive correlation between age and excursion at the lower cervical spine and this could be attributed to the fact most neck movements occur at the lower cervical region therefore the possibility of degenerative changes more at the area, and could also result with increasing age, which may impact on the integrity of the structures around the cervical spine.

The non-normal distribution of the excursion angles at the superior-most tip of the helix of the ear and the spinous process of C7 directed the identification of subjects with extreme excursion angles by the method of dividing the data into quintiles. The first and last categories in each excursion angle frequency distribution were designated as extreme. Of the 522 (235 males and 32 females) students sampled, 61 (29 males and 32 females) were found to have combinations of extremely small and/or extremely large excursion angles at the upper and lower cervical spine. This corresponded with those defined as having poor posture by Grimmer [15] and represented 11.69% of the population studied. This percentage proves to be of little significance and does not agree with the findings of Ayaniyi [10], who concluded that university students were predisposed to neck pain due to chronic adoption of poor posture. Hence, it could be inferred that less significant number of students in this particular study possibly adopted poor posture. This could possibly be as a result of the population having a better knowledge of proper ergonomics or the likely provision of ergonomically friendly postures and furniture.

However, this study also showed that 312 (162 males and 150 females) of the total sampled population had at least one of their excursion angles at either of the two extremes (1$^{st}$ and 5$^{th}$ quintile) representing 59% of the sample population. This showed that more number of students may possibly have a tendency towards developing poor posture, based on the premise that they either had extremes of the cervical excursion angles at both the upper and lower cervical spine or at least one of them. Hence it would still be of importance that greater awareness of proper ergonomics be taught among this group.

## Conclusion

From results obtained, it could then be inferred that few students had poor resting cervical posture. Majority of the students had at least one of their excursion angles at either of the two extremes possibly indicating a tendency towards developing poor posture. Hence it would still be of importance that greater awareness of proper ergonomics be taught among this group. The adapted LEMD can be used as an outcome measure to objectively assess cervical posture and monitor attempts at correction.

## References

1. Gonzale HE, Manns A (1996) Forward head posture, its structural and functional influence on the stomatognathic system, a conceptual study. Cranio 14: 71-80.
2. Magee D (2002) Assessment of posture. Orthopaedic physical assessment. 4th ed. St Louis: Elsevier sciences pp: 873-903.
3. Jackson R (1971) The cervical syndrome. 3rd Edtn, Charles Thomas Publisher, New Delhi.
4. Kendall HO, Kendall RP, Boynton DA (1952) Posture and Pain. Robert publishers, Florida.
5. Lezberg SF (1966) Posture of the head: It's relevance to the conservative treatment of cervico-brachial radiculitis. Phys Ther 46: 953-957.
6. Raine S, Twomey C (1994) Posture of the head, shoulders and thoracic spine in comfortable erect standing. Aust J Physiother 40: 25-32.
7. Braun BL, Amundson LR (1989) Quantitative assessment of head and shoulder posture. Arch Phys Med Rehabil 70: 322-329.
8. Petersen CM, Amundsen LR, Schendel MJ (1987) Comparison of effectiveness of two pelvic stabilization systems on pelvic movement during maximal isometric trunk extension and flexion muscle contractions. Phys Ther 67: 534-539.
9. Braun BL (1991) Postural differences between asymptomatic men and women and craniofacial pain patients. Arch Phys Med Rehabil 72: 653-656.
10. Ayanniyi O, Mbada CE, Iroko OP (2010) Neck pain occurrence and characteristics in Nigerian university undergraduates. Prev Med Bull 9: 167-174.
11. Rose KA (2000) The effect of neck pain and headaches on academic performance of college students. J Neur muscul Sys 8: 118-122.
12. Palmer KT, Walker-Bone K, Griffin MJ, Syddall H, Pannett B, et al. (2001) Prevalence and occupation associations neck pain in the british population. Scand J Work Environ Health 27: 49-56.
13. Grimmer K (1993) Measurement of cervical resting excursion angles in a treatment setting. Physiotherapy 79: 7-16.
14. Grimmer K (1996) The relationship between cervical resting posture and neck pain. Physiotherapy 82: 45-51.
15. Grimmer K (1997) An investigation of poor cervical resting posture. Aust J physiother 43: 7-16.
16. Krejcie RV, Morgan DW (1970) Determining sample size for research activities. Educ Psychol Meas 30: 607-610.
17. Umunnah JO, Nwaefulu VA, Ihegihu YE, Okeke C (2018) Temporal stability and Reliability of an Adaptation of the Linear Excursion Measurement Device. J Nov Physiother 8: 384.
18. Kendall FP, McCeary EK (1982) Testing and Function. Williams & Wilkins publishers, Baltimore.
19. Ayub E, Glasheen-wray M, Kraus S (1984) Head posture: A case study of the effects on Rest position of the mandible. J orthop sports phys ther 5: 129-183.
20. Bibby RE, Preston CB (1981) The hyoid triangle. Am J orthod 80: 92-97.
21. Jull GA (1988) Headaches of cervical origin. In Grant, R. E. (Ed). Physical therapy of the cervical and thoracic spine. Clinics in Physical Therapy. Churchhill Livingstone, Newyork.
22. Rocabado M (1983) Biomechmical relationship of the neck, cervical, and hyoid regions. J Craniomandibular Pract 1: 61-66.
23. Trott PH (1988) Manipulative therapy techniques in the management of some cervical syndromes (In) Grant, R.E (ed). Churchill Livingstone, Newyork.
24. Gore DR, Sepic SB, Gardner M (1986) Roentgenographic findings of the cervical spine in asymptomatic people. Spine 11: 521-524.
25. Penning L (1978) Rotation of the cervical spine. A computer tomography scan in normal subjects. Spine 12: 732-738.
26. Janda V (1988) Muscle and cervicogenic pain syndrome, (In) Grant, R.L. (ed), Physical Therapy of the cervical and thoracic spine. Clinics in physical therapy. Churchill livingstone, New York.
27. Penning L (1988) Differences in anatomy, motion, development and aging of the upper and lower cervical disk segments. Clin biomech 3: 37-47.
28. Pope PM (2002) Posture management and special seating. In Edwards (Ed) neurological physiotherapy. Churchill living stone, London.