Mental Distances and Relationship to Body Mass Index in Young Healthy Nigerian Adults: A Population Based Study

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ABSTRACT

AIM: This study was conducted to determine normal ranges of sterno-mental distance (SMD) and thyro-mental distance (TMD) and to examine the relationship of these measurements to each other and the body mass index (BMI).

METHODS: The SMD, TMD and BMI were assessed in a total of 409 apparently healthy adult subjects comprising 218 male and 190 female participants who volunteered for the study. The parameters were measured by standard methods and the obtained data analysed for the degree of association using Pearson Correlation Statistics.

RESULTS: Mean values of SMD and TMD were significantly higher in males than in females. The BMI was statistically same in both sexes. Sterno-mental distance correlated positively with TMD in both sexes ($r = 0.86$, $p = 0.005$) while BMI correlated negatively with SMD ($r = -0.166$, $p = 0.108$) as well as to the TMD ($r = -0.147$, $p = 0.04$) in both sexes.

CONCLUSION: In young healthy adult populations the SMD and TMD are strongly related to each other but are unrelated to the BMI. Males tend to have on average longer SMD and TMD as compared to females. Our findings could be a useful tool during pre-anaesthetic airway assessment of patients.

KEYWORDS: *Body Mass Index, Sterno-Mental Distance, Thyro-Mental Distance*

INTRODUCTION

Anthropometric parameters are used in clinical practice as screening tests to identify individuals who may be at risk of particular conditions and in whom special considerations are required.[1] In anaesthesia, the sterno-mental distance (SMD) and the thyro-mental distance (TMD) are simple, easy, quick and non-invasive anthropometric measurements which could be used to predict the risk of difficult laryngoscopy and tracheal intubation.[2, 3] Body mass index (BMI) is the standard means of estimating adiposity and the risk of related complications.[1, 4] Patients who are obese may experience difficulty during intubation, this being related to their tendency to have a short and fat neck.[5, 6]

Several studies have been undertaken to assess the validity and reliability of using the SMD, TMD and other anatomical measures as preoperative airway examination tests, with much variations noted in the reported diagnostic accuracy of these tests.[7, 8, 9] The limited clinical utility of bedside anthropometric screening tests has been related to factors such as definitions of outcome measures, different tests thresholds, predictive accuracy of different test combinations, patient demographics and statistical power.[7] In addition, among anaesthesiologists, there is little or no agreement as to the significance of obesity as an independent determinant of difficult laryngoscopy and tracheal intubation.[10]

Whereas diagnostic accuracy of bedside tests such as the TMD and SMD for predicting difficult airway has received attention, not much has been done in the way of clearly defining values of these variables and their relationship to other anthropometric indices in healthy adult humans. It is likely that the inconsistent findings across several studies as regards the reliability of simple bedside anthropometric screening tests are, in part, the result of the potential confounding effect of demographic factors.

We undertook this population based study with the aim to define average values of the TMD and the SMD in apparently healthy young adult subjects in the catchments area of our hospital; and examine the relationship between SMD and TMD, and the body mass index (BMI).

SUBJECTS AND METHODS

STUDY POPULATION: The study was a prospective, cross sectional study conducted in the Niger Delta region of Southern Nigeria. The sample frame consisted of young healthy African adults within the age range of 19-25 years who reside in Port Harcourt. The choice of this frame is informed by the fact that the population falls under the catchments area of our hospital; the University of Port Harcourt Teaching Hospital, the tertiary referral centre of the region. Secondly, this age range represents the period of optimal growth in body proportions. Sampled subjects were recruited from communities in Port Harcourt by stratified sampling. All sampled subjects were required to give informed consent. In order to minimise the likelihood of selection bias associated with single centre, hospital-based studies, we had utilized a prospective cross sectional

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study design to sample a variety of apparently healthy subjects from our frame. The study protocol received appropriate institutional ethical clearance prior to the conduct of the study. Subjects who had bone, joint or soft tissue disorder or previous operations involving the thyroid gland or the soft tissues of the neck were excluded from the study.

METHODS: The sterno-mental distance (SMD) was determined by measuring in the midline the distance between the tip of the mandible (mentum) and the sternal notch. The thyro-mental distance was measured as the midline distance between the mentum and the thyroid notch (*prominentia laryngea)* of the thyroid cartilage of the larynx. All measurements were performed with the patient's head in midline-neutral position, neck fully extended, the mouth closed, and the patient lying supine. Both measurements were done with a non stretchable tape measure calibrated in millimetres and obtained values estimated to the nearest 0.5mm.

Extension of the neck was measured with the use of a goniometer while the subject was in the sitting position. The angle of the jaw and the upper incisor teeth were the reference points. The subject was then asked to fully extend the neck while the measuring side of the goniometer was moved parallel to the upper incisors, and the maximum extension was recorded.

The BMI was assessed by recording the body weight (kg) and height (m) of the subjects and calculated as the weight in kg divided by the square of height in metres. The height of subjects was measured against a wall mounted gauge calibrated in metres and the weight by using a bathroom scale. One of the authors did all measurements twice under identical conditions and the average was taken. This was done in order to ensure standardization of measurements and evaluation of the tests

STATISTICAL ANALYSIS: The data obtained from the study were entered into the SPSS data analysis software, version 15.0 (SPSS Incorporated, Chicago Illinois, USA). Mean and standard deviation were computed. Test of significance of the differences between mean values was performed using the *z*- test, with probability (*p*) value less than 0.01 considered as significant. Pearson correlation coefficients (*r*) were computed for the studied variables and based on significance level, univariate analysis was performed to give a simple algorithm which best related studied parameters.

RESULTS

The total number of sampled subjects was 409. The number of males was 219 (53.5%) and that of females was 190 (46.5%).

Table 1 shows mean values of SMD, TMD and BMI. Male subjects had significantly greater values of SMD (15.78±2.28 cm) and TMD (7.05±1.18 cm) as compared to females (p=0.001). There was no statistical difference in the values for the BMI in both sexes (p=0.455).

Table 1: Mean values of SMD, TMD and BMI

	Male		Female			
	Mean	SD	Mean	SD	*z*	*p*
SMD (cm)	15.78	2.28	15.04	2.22	3.33	0.001
TMD (cm)	7.05	1.18	6.71	1.29	2.78	0.006
BMI (kg/m^2)	19.11	4.47	19.43	4.22	0.75	0.455

Table 2 shows correlation values of studied parameters. Sterno-mental distance correlated positively with TMD in both sexes (r = 0.86, p =0.005) while BMI correlated negatively with SMD (r= -0.166, p = 0.108) as well as to the TMD (r = -0.147, p = 0.04) in both sexes.

Table 2: Correlation Coefficient and *p* values for studied parameters

	Male		Female	
	r	*p*	*r*	*p*
SMD vs. TMD	0.856	0.005	0.816	0.000
TMD vs. BMI	-0.147	0.43	-0.146	0.045
SMD vs. BMI	-0.166	0.374	-0.117	0.108

In Figures 1 and 2, line plots are presented showing the nature of the relationship between TMD and SMD in females and males respectively. Predictive equations that best correlate TMD to SMD in females was TMD= 0.4747/SMD-0.4334 and TMD= 0.4451/SMD+0.0234 in males.

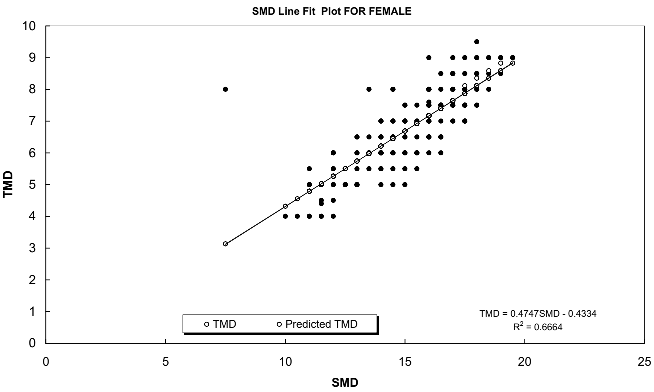

Fig. 1: Line plot of the relationship between TMD and SMD in females

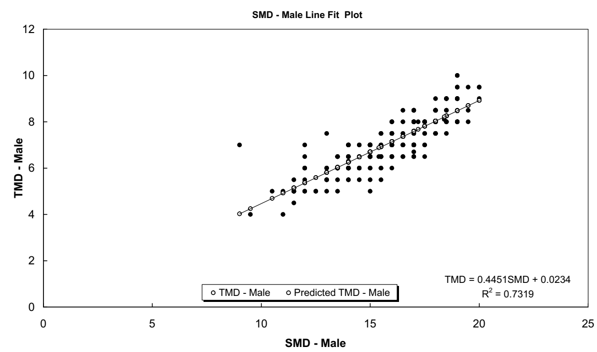

Fig. 2: Line plot of the relationship between TMD and SMD in males

DISCUSSION

Difficult laryngoscopy may be present in one out of every ten patients with greater percentage occurring in obese patients.[5, 7] A battery of tests have been developed to predict difficult airway, among which are the mallampati test, inter-incisor gap, protrusion of the mandible, sternomental distance, thyromental distance, hyo-mental distance, neck extension, to mention a few. No single screening test may best predict difficult intubation, but combination of individual tests generally has been shown to improve discriminate power.[8, 9]

A meta-analysis of the performance of bedside screening tests performed by Shiga *et al*[7] noted that the thyro-mental distance is an indicator of mandibular space and arguably the most commonly used bedside screening test. The sterno-mental distance could determine cranio-cervical angulations and is probably the best single test for ruling out difficult intubation; although it has been less studied than other screening tests. One study on African subjects reported that the modified mallampati test, thyro-mental distance and inter-incisor gap are the best predictors of difficult laryngoscopy in West Africans[3], having the best combinations of sensitivity, specificity, positive and negative predictive values.

In terms of age, we limited the scope of our study to young adult populations. Although in a study by Turkan et al, it was shown that the TMD and SMD are influenced by age in adult populations; this was not the finding of earlier studies.[14, 15, 16] Furthermore, the present study has a relatively larger sample size than those of most previous studies which aimed to validate the clinical utility of bedside screening tests.

We confirmed the effect of sex on the TMD and SMD in the present study. Although, demographic factors are well established confounders, their effect has scarcely been addressed in studies conducted to examine the clinical usefulness of bedside anthropometric screening tests. Significant differences in mean values of TMD and SMD are seen across different studies utilizing patient sets from different geographic regions, suggesting that regional and racial differences may influence the utility of the TMD and the SMD, as is the case with most other anthropometric measures.

The SMD and TMD were strongly associated with each other in the current study, most likely because both share a common landmark- the mentum; but, both mental distances were poorly related to the BMI. We had used the BMI as a surrogate measure of body proportion in this study. The body mass index is generally considered as an indicator of the risk of obesity related problems. Patients whose BMI is greater than 30kg/m^2 have been shown to have a fivefold increase in the risk of difficult airway.[6] Brodsky and others,[10] has reported that 'problematic' laryngoscopy and tracheal intubation are related to short mental distances but not to the BMI.

In a different study to examine the clinical utility of the SMD in obstetric anaesthesia, Ramadhani and colleagues[16] found no association between the SMD and BMI, weight and height in pregnant Arab women. Indeed, whereas some authors have reported that difficult intubation increases with increasing BMI,[18] some other reports have also indicated that increasing BMI poorly predicted risk of difficult laryngoscopy and tracheal intubation.[17] It is therefore reasonable to expect that the mental distances and the BMI are independent determinants of the risk of difficult intubation. This hypothesis we shall examine in further studies to assess the relationship of airway management, such as mask ventilation and tracheal intubation, to variations in the mental distances and BMI in young adult patients within are practice setting.

In conclusion, morphometric measurements of the human airway, like other measures of body proportion, are influenced by demographic factors, but this interaction is incompletely understood, and could be a contributory factor to the limited reliability of routine pre-anaesthetic anthropometric screening tests. Defining ranges of these variables in apparently healthy populations not only provide population specific baseline values, but it may help to identify subsets of patients for whom planned intervention is necessary, which is particularly important in resource limited settings and in an era of health care cost economics. The present study has documented the average values of the TMD and SMD in apparently healthy adult populations within our practice setting. The study also confirms that on univariate analysis, these values vary with sex and are unrelated to the body mass index.

Sources of Support: nil
Conflict of Interest: None

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