

Journal of Anatomical Sciences

Email:anatomicaljournal@gmail.com

J Anat Sci 12 (1)

## ABSTRACT

# Clinical Assessment of the Neck Circumference-Carotid Artery Diameter Relationship among Adult Nigerians.

Kpuduwei SPK, Fawehinmi HB and Oladipo GS Department of Anatomy, University of Port Harcourt, Port Harcourt, Nigeria.

**Corresponding Author:** Kpuduwei SPK Email: selekeowei kpuduwei@uniport.edu.ng; +234-8035382152

The location of the carotid arteries in neck and their important role in the blood supply to head and neck places them in the special interest of researchers, especially on their relationship with the size of the neck. The aim of this study was to assess the relationship of the arterial diameters to neck circumference among Nigerian adults. A total of 104 human subjects with seemingly healthy parameters following screening were sampled. Using a measuring tape, neck circumferences were taken in centimeters. An EcoMed USS machine was used to scan both carotid triangles of all participants and luminal diameter measurements of common, internal and external carotid arteries were obtained. The results showed significant but weak positive correlations of neck circumference with right external carotid artery and left internal carotid artery in the males and only with the left external carotid artery in the females. However, no correlation with common carotid artery was noted. Although, neck circumference to a large extent can be used as a screener to determine overweight and obese individuals, its applicability to determine size of carotid artery diameter and predict cardiometabolic risk independently is doubtful. In addition, statistical significance may not be clinically applicable when the correlation is either weak or not uniform on all carotid arteries. From our index study, we believe that there is indication that neck circumference could be used for size determination of the carotid arteries among Nigerians, if all the compounding factors are known. Until then generalization is difficult. Therefore, there is need for further study using meta-analysis to arrive at a formula for Nigerians.

Keywords: carotid artery, diameter, neck circumference, Nigerians.

### **INTRODUCTION**

The carotid arteries are located on either side of the neck in the carotid triangle. The common and internal carotid arteries are enveloped in their own fascial compartment- the carotid sheet, which is an extension of the deep cervical fascia. The common carotid divides into a larger internal carotid artery and smaller external carotid artery at the C4 vertebral level". There are opinions from a previous study that patients with smaller heights may likely have shorter necks. This may portend a limitation for surgical access to the carotid arteries, hence the importance to consider neck size as part of the study on carotid arteries. In addition to the above, we believe that not only does access to arteries the only concern but also their size in a small or large neck circumference that may affect size of the structures like vessels located there, especially in obesity. However, healthy subjects and patients may have different correlation to diameters of the arteries. This study was aimed at determining the association of neck circumference with carotid artery diameter among seemingly healthy Nigerian adults with no previous history of cardiovascular or cerebrovascular disease conditions.

## **MATERIALS AND METHODS**

We randomly sampled 104 (62 males and 42 females) seemingly healthy adult Nigerians in a prospective

study. Following informed consent, subjects' neck circumferences were measured after ruling out clinical hypertension. They all had ultrasound scans of their necks bilaterally as the simplest test for the arteries using EcoMed USS machine and measurements of the carotid arteries for diameter were taken. Data was analysed with IBM SPPS v23 and results of Pearson ranking correlation to determine the relationship of the variables presented in tables and figures.

## RESULTS

The results showed the carotid artery measurements and neck circumferences that were analysed. There was significant difference in means of neck circumference between male and female (tables 1 and 2). There was significant positive correlation between neck circumference and some of the carotid artery diameters in both sexes, however the correlations were weak and not consistent. These weak relationships were observed only in the right external carotid artery and left internal carotid artery in the males and only in the left external carotid artery in the females (tables 3 and 4). Figures 1 and 2 demonstrates the relationship between left internal carotid artery and right external carotid artery diameter with neck circumference respectively. No significant relation between neck circumference and the common carotid artery was observed.

Measured parameters	Male [62]			Female [42]			Total [104]		
	Min	Max	Mean $\pm$ SD	Min	Max	Mean <sup>±</sup> SD	Min	Max	Mean $\pm$ SD
Height (m)	1.62	1.93	1.74±0.06	1.61	1.77	1.69±0.04	1.61	1.93	1.72±0.06
Weight (kg)	50.00	104.90	67.66±11.11	43.10	93.80	67.63±14.29	43.10	104.90	67.65±12.42
NC (cm)	32.00	42.00	35.76±2.09	27.00	36.00	32.33±2.27	27.00	42.00	34.38±2.73

Table 1: Descriptive statistics of the measured anthropometric and blood parameters

Table 2: T-test comparing the male and female anthropometric parameters

		Mean Difference				t-test for Equality of Means		
Measured parameters	Comparison	MD	SEM	95% C.I of the Diff		t volue	16	a voluo
<b>I</b>			SEW	Lower	Upper	t-value	uı	p-value
Height (m)	M v F	0.05	0.01	0.03	0.07	4.31	102.00	0.00*
Weight (kg)	M v F	0.04	2.62	-5.18	5.25	0.01	73.21	0.99
NC (cm)	M v F	3.42	0.43	2.57	4.28	7.93	102.00	0.00*

**Table 3:** Relationship between carotid artery size and other measured parameters in male subjects

Parameters	Correlation	Right diameter			Left diameter		
		CCA	ICA	ECA	CCA	ICA	ECA
Age (years)	r	0.007	0.208	0.227	-0.082	0.201	0.117
	p-value	0.954	0.105	0.076	0.524	0.118	0.363
NC (cm)	r	0.065	0.323	0.362**	0.163	0.345**	-0.217
	p-value	0.614	0.010	0.004	0.206	0.006	0.090

Table 4: Relationship between carotid artery size and other measured parameters in female subjects

Parameters	Correlation		Right c	liameter		Left diameter			
		CCA	ICA	ECA	CCA	ICA	ECA		
Age (years)	r	0.095	0.050	0.091	-0.129	0.071	0.272		
	p-value	0.549	0.752	0.568	0.417	0.656	0.081		
NC (cm)	r	0.294	0.239	0.062	0.114	0.124	0.341*		
	p-value	0.058	0.127	0.697	0.471	0.433	0.027		



Figure 1: A scatterplot of left internal carotid artery diameter against Neck Circumference in male subjects



Figure 7a: A scatterplot of right external carotid artery diameter against Neck Circumference in male subjects

## DISCUSSION

Krejza *et al.* used a multivariate regression for the best predictors of ultrasound to determine diameters of CCA and ICA based on neck circumference and noted neck circumference to be a stronger predictor of carotid artery diameter than neck length in hypertensives. Our index study did show some positive relationship between external carotid artery and neck circumference, but it was weak for clinical application. We believe that many factors could be at play when cardiovascular or cardiometabolic risks are assessed and predicted and not just a single factor. The status of the individual with respect to blood pressure, adiposity, comorbidities are important. Some authors believe that neck circumference (NC) is independently associated with cardiometabolic risk factors and can be used as practical tool for assessment cardiometabolic risk. However, this is still debatable as Kim *et al* noted that the sensitivity and specificity of neck circumference in classifying overweight/obesity was less than that of BMI in their study to "evaluate classification accuracy of neck circumference and compare it with body mass index (BMI) in identifying overweight/obese children". Although, neck circumference to a large extent can be used as a screener to determine overweight and obese individuals according to Verma *et al.*, 2017, there is not enough data for his universal application. This is mainly because body statute of different ethnic/racial groups vary and threshold for determination of obseity in each group using neck circumference has not been consensused yet. The artery itself is influenced by race/ethnic factors. Patil *et al* had among Indians also observed weak to moderate correlations between neck circumference and body mass index, which is different from studies on other populations. The data from our study did indicate that the relationship between neck circumference and carotid artery diameter is statistically significant, however its clinical applicability is not yet clear as it was weak and not in all carotid arteries.

One drawaback is the lack of previous Nigerian data on categorization of neck circumference into normal and obese/ abnormal category. This would have helped our study in comparing both groups to identify any difference and their associations with carotid artery diameter.

### CONCLUSION

Larger neck circumference may suggest larger carotid diameter from previous studies, however the association may not be strong enough for universal clinical judgement as there was none found in our study on Nigerians for the common carotid artery except the internal and external carotid arteries, which were weak. This fact is important in clinical practice and every patient may require individualized assessment and care as the factors for cardiometabolic risk differ in each person. There is need for further study on this relationship and the compounding factors for cardiometabolic risk assessment in clinical practice to enable universal applicability.

## REFERENCES

1. Sethi D, Cofur EM, Munakomi S. Head and Neck Anatomy: Carotid Artery. *StatPearls Publishing*; 2020. internet.

- 2. Garner DH, Kortz MW, Baker S. Head and Neck Anatomy: Carotid Sheet. Internet: *StatPearls Publishing*; 2020.
- Kpuduwei SPK. Clinical Basis for the Knowledge of Anatomy of Carotid Artery: A Review Article. *Yenagoa Med J.* 2020;2(3):23–8.
- Krejza J, Arkuszewski M, Kasner SE, Weigele J, Ustymowicz A, Hurst RW, et al. Carotid Artery Diameter in Men and Women and the Relation to Body and Neck Size. *Stroke*. 2006;37:1–3.
- 5. Ratchford EV., Evans NS. Carotid Artery Disease. *Vasc Med.* 2014;19(6):512–5.
- Tellez, Maria Jose Arias; Silva, Analiza M.; Ruiz, Jonatan R.; Martins, Sandra S.; Palmeira, António L.; Branco, Teresa L.; Minderico, Claudia S.; Rocha, Paulo M.; Themudo-Barata, José; Teixeira, Pedro J.; Sardinha LB. Neck circumference is associated with adipose tissue content in thigh skeletal muscle in overweight and obese premenopausal women. *Sci Rep*. 2020;8324.
- Kim, Youngwon; Lee, Jung-Min; Laurson, Kelly; Bai, Yang; Gaesser, Glenn A.; Welk GJ. Accuracy of Neck Circumference in Classifying Overweight and Obese US Children. *Int Sch Res Not*. 2014;1–4.
- Verma, Madhur; Rajput, Meena; Sahoo, Soumya Swaroop; Kaur N. Neck Circumference: Independent Predictor for Overweight and Obesity in Adult Population. *Indian J Community Med.* 2017;209–13.
- Koskinen, SM., Soinne, L., Valanne, L., & Silvennoinen H. The normal internal carotid artery: a CTA study. *Neuroradiology*. 2014;56(9):723–9.
- 10. Patil, Chaitanya; Deshmukh, Jyotsna; Yadav, Shivani; Patil, Sneha; Sheikh A. Neck Circumference: A novel anthropometric tool for screening obesity in adults. *Int J Collab Res Intern Med Public Heal*. 2017;711–20.