

## Association between Tricuspid Annular Plane Systolic Excursion, Systolic Blood Pressure and Peak Systolic Velocity among Young Healthy Adults

Price Joffa, Michael Egbejimi, Emily Kiridi, Peter Erigbali\* and Kelvin Kiridi

Department of Human Physiology, Niger Delta University, Nigeria

\*Corresponding Author: Peter Erigbali, Department of Human Physiology, Niger Delta University, Nigeria.

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### Abstract

Tricuspid Annular Plane Systolic Excursion (Tapse) and peak systolic velocity (PSV) are important parameters used as reference in diagnostic procedure during normal and pathological conditions of cardiovascular health. We investigated association between TAPSE, Systolic blood pressure (SBP) and carotid artery peak systolic velocity in a group of 150 healthy young adults between ages (18 and 30 years) with normal vital statistics and no established history of underlying heart conditions. Systolic blood pressure was taken using auscultatory method, while ultrasound scan was used for TAPSE and PSV. Pearson's correlation analysis of data, for Tapse and systolic blood pressure showed no correlation,  $r = -0.025$ , but for Tapse and PSV a very weak positive correlation,  $r = 0.1$ ; Meanwhile a comparison of the mean Tapse between male and female gender showed that Tapse in male ( $24.17 \pm 3.92$  mm) was not significantly different from female ( $23.60 \pm 4.43$  mm). The results imply that in the study population, right ventricular function which is evaluated by the value of Tapse is not associated with systolic blood pressure, but has very weak correlation with PSV. Also, there does not appear to be significant difference in this function across gender.

**Keywords:** Tapse; PSV; SBP; Ultrasound; Cardiovascular Health

### Introduction

Counting down the decade, cardiovascular disease has persisted as one leading cause of fatality [1] and in several instances sudden death, which perhaps is because palpable clinical signs or symptoms are not explicit as the disease develops, progress and advances.

To track cardiovascular health conditions, diagnostic procedures that involve scanning have been developed. Tapse is an important M-Mode echocardiography procedure which involves the imaging of only right ventricle base and tricuspid annular plane, to give a measured value of Right ventricle systolic function with less complication; simplicity, ease of measurement and good reproducibility as well as surmounting difficulty of acquiring high-quality images of the entire right ventricle free wall [2]. On the other hand, Peak systolic velocity measured in the carotid artery gives an estimate of presence or absence of occlusion/stenosis in the vessel. And carotid artery stenosis has been known to be a risk factor for ischemic stroke [3]. The Society of Radiologists in Ultrasound Consensus Criteria for Carotid Stenosis consider Peak systolic velocity ( $PSV < 125$  cm/sec) measured for internal carotid artery as normal [3]. These cardiovascular parameters, Tapse in particular have gradually in recent times been shown to have useful prognostic values in general population [4,5]. The European society of cardiology has reported insufficiency in some risk score related to prediction or monitoring of cardiovascular health risk [6-8].

In a recent research Daniel, *et al.* reported the prognostic value of Right ventricle systolic function, as evaluated by tricuspid annular plane systolic excursion (Tapse) in predicting cardiovascular death (CVD), concluding that it is associated with CVD in a general population [5].

Sequel to these; in the course of monitoring cardiovascular health, it will not be out of place if more investigations into procedures that are less complicated, easy to perform, with possible early indication of risk and reasonably affordable are encouraged. We therefore embarked on this current research as preliminary to investigate possible association between Tapse (an indicator of Right ventricle function) and some cardiovascular parameters.

### Materials and Methods

One hundred and fifty (150) young healthy adults, between ages of 18 and 30 years randomly selected from a population of undergraduates were involved in the study. The consent of each one was received and the other guidelines of the University research ethics committee were adhered to. All the participants were briefed on the procedures of the investigation, some general health status were ascertained by physical examination and questionnaire. Any concern raised was addressed. Blood pressure was measured by auscultatory method, after which each one took turn to undergo the ultrasound investigation. Standard echocardiography procedure was used [9]. We obtained echocardiograms using a Philips HD11, machine with 7.5 MHz linear probe. For TAPSE, M-Mode echocardiography was done and for Peak systolic velocity of carotid artery, doppler mode was activated. Data for analysis of relationship between Tapse and systolic blood pressure and Tapse vs Peak systolic velocity were analyzed by Pearson's Correlation test; while the comparison of mean Tapse between male and female was by Student t- test, all using STATA version 17.0.

### Results

The result of correlation analysis for Tapse and systolic blood pressure (See figure 1) shows that correlation coefficient  $r = -0.025$ . From the interpretation of Pearson's scale, the negative sign is indicative of inverse direction but the figure indicates absence of correlation. And for analysis between Tapse and PSV (See figure 2), the correlation coefficient  $r = 0.1$ . This is indicative of a positive correlation, which is however very weak.

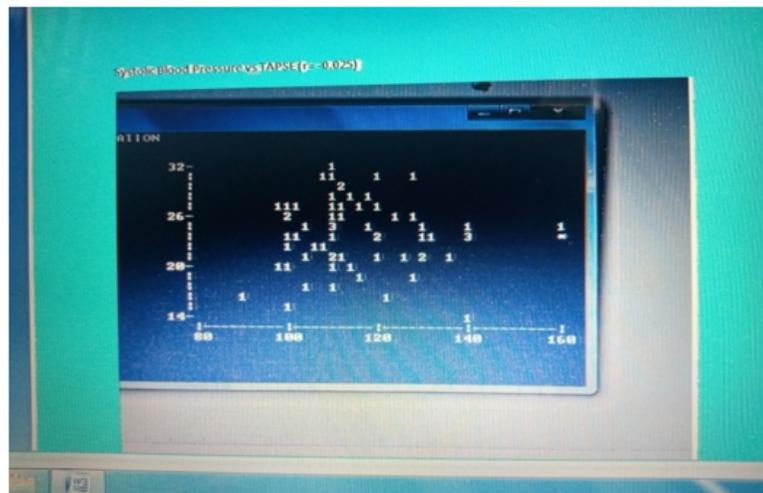
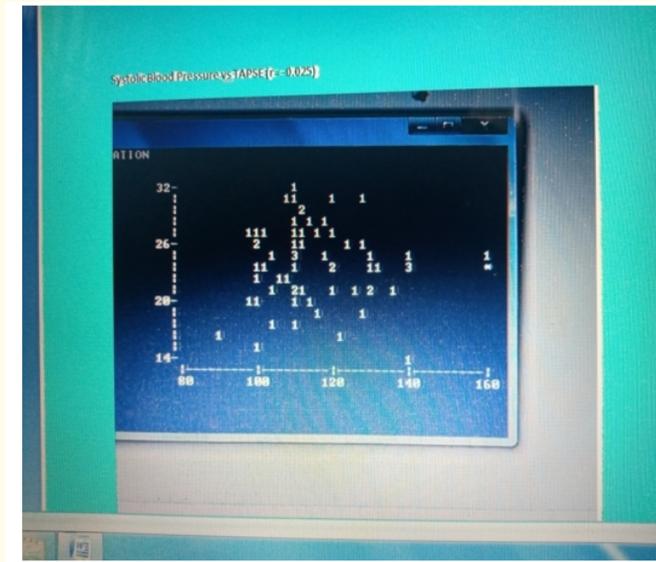


Figure 1: Correlation analysis of tapse vs systolic blood pressure ( $r = -0.025$ ).



**Figure 2:** Correlation analysis of tapse vs peak systolic velocity ( $r = 0.1$ ).

The result of comparing the mean value of Tapse in male ( $24.17 \pm 3.92$  mm) and female ( $23.60 \pm 4.43$  mm); shows that there was no significant difference at  $p < 0.05$  (See table 1).

Group	Sample Size	Mean	STD Deviation
Male	80	24.17	3.92
Female	70	23.60	4.43

**Table 1:** Comparison of mean Tapse between male and female.

## Discussion and Conclusion

There is perhaps undeniably, an enormous global burden on societies due to cardiovascular related illnesses or complications; ranging from morbidity, incapacitation, social and economic impact as well as eventual fatality. And arguably, all of these have resulted in a drastic reduction in the quality of life [10-12]. A more worrisome issue may be the fact that in the course of development and progression of cardiovascular diseases, except in few cases, the signs or symptoms may not be seen until an episode is experienced by the individual such as cardiac arrest or heart attack, stroke, myocardial infarction, etc [13]. Hence, it is conceivable that an emergence of various technology and procedures to monitor cardiovascular health will no doubt introduce a whole vista of opportunity to alleviate global burden by mitigating impact on society.

Tapse is a measurable cardiovascular parameter that gives an evaluation of Right ventricle function.  $24 \pm 3.5$  mm is considered as normal range of Tapse by current guidelines and values of Tapse  $< 17$  mm as abnormal [9]. Decreasing value of Tapse was shown to be associated with cardiovascular death, CVD in a general population. It is comparatively a less complicated, yet effective evaluation of Right ventricle function [5]. Meanwhile, Systolic blood pressure of between 90 and 120 mmHg is within normal physiological range. The

Joint National Committee on prevention, detection, evaluation and treatment of high blood pressure considers an SBP  $\geq$  140 mmHg to be abnormal and reports SBP as primary marker of risk for hypertension [14,15].

Along the same line, in this present study, we investigated the association between Tapse and systolic blood pressure as well as Peak systolic velocity in healthy young adults. And from the results, although the Pearson's test shows Tapse and systolic blood pressure on the inverse (negative scale), statistically it appears there is no correlation. This implies that the Right ventricle function may not independently influence outcome of systolic blood pressure and vice versa.

On the other hand, there seem to be a positive correlation between Tapse and Peak systolic velocity as expressed by the Pearson's test. However, this association on the Pearson's scale of interpretation is very weak. We may therefore loosely infer that when the Right ventricle systolic function is reducing, (Tapse  $<$  17 mm and beyond), the carotid Peak systolic velocity may also reduce, but perhaps not independent of other factors. This may require further investigation to assert, as there appear to be scanty information. Although, the study of Daniel, *et al.* [5], showed that decreasing Right ventricle function as determined by Tapse was significantly associated with decreasing right ventricle Peak systolic velocity and Koestenberger, *et al.* [16] reported that decreased right ventricle peak systolic velocity was associated with pulmonary artery hypertension. But from this study it appears like lower Tapse (Right ventricle dysfunction) as measured by Tapse does not predict cardiovascular health as the carotid peak systolic velocity is lower in the patients, which signifies no carotid plaques or stenosis.

The investigation for any possible gender based disparity in the Right ventricle systolic function as determined by Tapse shows that there is no significant difference between male and female. And as such, prognostic inferences which may be drawn from Tapse can be useful across gender lines. This agrees with the specifically elaborate research work of Andre, *et al.* [17], which showed that gender disparity did not exist in Tapse measured among a healthy population.

As a future perspective, this preliminary study could be expanded and extended to accommodate investigation of correlation between Tapse and more cardiovascular parameters, or related. Perhaps, some easier, less complicated, early indicative and particularly affordable inferential procedure of cardiovascular health monitoring may still be in view.

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