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**Non-cardiac Chest Pain and Benign Palpitations Among Adult Patient Referred for Stress Electrocardiography (ECG) in the Cardiac Clinic in Southern Nigeria**

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**Abstract**

**Background**

Non-cardiac chest pain and benign palpitations are often seen in cardiac clinics, but they are usually not related to serious heart conditions. Exercise testing is usually used to detect cardiomyopathies; it is symptom-limited and may be stopped if patients report symptoms such as dyspnea, fatigue, chest pain or for medical reasons such as ischemic ST-segment changes, abnormal blood pressure response to exercise. With limited knowledge about these presenting symptoms on cardiomyopathies in developing country such as Nigeria, the study therefore aims to determine the stress ECG pattern among patients, reasons for interruption, and stress-induced changes in southern Nigeria.

**Materials and methods:** This was a retrospective study of 60 adult patients (age 18-69 years) at Good Heart Medical Consultants Hospital from October 2019 to January 2023 referred with non-cardiac chest pain and benign palpitations for stress ECG. Data collected was analyzed using the Bruce protocol.

**Results** 83% presented with chest pain and 17% with palpitations. Mean ages were 50±20 for chest pain and 45±13 for palpitations. Majority 66.6% were 41-60 years old. Muscle fatigue 48.3% was the most common reason for interruption. ST-T changes had no significant difference. Stress-induced ischemia 10% and arrhythmia 12% were more prevalent among subjects with chest pain while stress-induced hypertension 10% was significant among subjects with palpitations.

**Conclusion** Arrhythmia was rarely a reason for stopping the stress ECG test, as ST elevation and ischemia were minimal. Ischemic heart disease is becoming an increasing problem however, stress ECG is not commonly used in diagnosing this condition in our region.

**Keywords** Non-cardiac chest pain, benign palpitations, stress electrocardiography, Good Heart Medical consultant Hospital, cardiac clinic, referral.

## **Introduction**

Chest pain and palpitations are the two most common reasons for referral to a cardiologist,(1) with prevalence rates of 20–40% and 11%, respectively. (2) However, most of these patients suffer from non-cardiac chest pain and benign palpitations. (3,4) Little is known about the course of psychological symptoms from before to after negative cardiac evaluation, but study have shown poor long-term outcomes for these patients with worries about bodily sensations. (2) Chest pain and palpitations are core symptoms of panic disorder, with at least 25% of those with non-cardiac chest pain and 10-19% of those with palpitations suffering from panic disorder. The prevalence of somatoform disorders is 15-20% in patients with non-cardiac chest pain and 2-3% in palpitations. (4) Non-cardiac chest pain and benign palpitations are often seen in cardiac clinics, but they are usually not related to serious heart conditions. Proper evaluation and treatment can effectively manage these symptoms and alleviate patient anxiety. (3)

Chest pain is the chief complaint in about 1 to 2 percent of out-patient visits(5) while it can be caused by a wide range of different illnesses, cardiac disease is the most concerning. (6) A Swedish study found that 20% of emergency room visits were due to chest pain, with 25% of these patients being diagnosed with acute myocardial infarction or myocardial ischemia shortly after. (7) The frequency of chest pain as the main complaint ranged from 0.7% to 7%, with ischemic heart disease being diagnosed in 9% to 22% of cases. Approximately 15% of cases had chest pain of unknown cause. (8)

Palpitation is a term used by patients to describe when they are aware of their heartbeat. It can be caused by either a cardiac arrhythmia or anxiety (9) Palpitations can occur once to several times daily, weekly, monthly or yearly,(10) often described as a skipped beat, rapid fluttering in the chest, pounding sensation in the chest or neck, or a flip-flopping in the chest. Palpitations are nonspecific and can be a symptom or a diagnosis.(11) While they are usually benign, they can also be a sign of a life-threatening condition.(12,13) Palpitations are a common reason for medical consultation and can occur in up to 10% of the population at some point in their lives. (14) In primary care settings, they account for 16% of the symptoms that prompt patients to visit their general practitioner, and are second only to chest pain as the presenting complaint.(15) Mitral valve prolapse is the leading structural heart disease responsible for palpitations, affecting 1–3% of the population. (16) In a study of adult patients with palpitations, 43% had cardiac disease. (17)

Exercise stress testing is a noninvasive method that provides valuable information about the heart and lungs in both healthy and diseased populations. It is primarily used to diagnose coronary artery disease and develop exercise prescriptions. (18) Patients are encouraged to exercise for as long as possible, and achieving the target heart rate alone is not enough to terminate the test. The test is symptom-limited and may be stopped if patients report symptoms such as dyspnea, fatigue, or chest pain, or for medical reasons such as ischemic ST-segment changes, abnormal blood pressure response to exercise, or ventricular ectopy. Most tests are terminated due to fatigue. The standard Bruce protocol is used in the majority of tests. (19)

To our knowledge, this study is the largest investigation of chest pain and palpitation in a cardiac setting in southern Nigeria. The study therefore aims to determine the stress ECG pattern based on patients symptoms, reasons for interruption and stress-induced changes in our region.

### Materials and Method:

**Study Design:** A retrospective study at Good Heart Medical consultant hospital Port Harcourt, Nigeria. A total of 60 patients age 18 to 69 years were referred in this study, from October 2019 to January 2023 with presenting complaint of chest pain and palpitation.

**Sampling procedures:** Data on medication, blood pressure, body mass index was collected. The inclusion criteria were patients age (18 - 69 years) referral with presenting complaint of chest pain and palpitation. The exclusion criteria were patients who were unable to conduct an exercise test or were referred for other reasons such as medical fitness, dyspnea, suspected ischemic heart disease and abnormal ECG.

The procedure was carried out according to the American Heart Association (AHA) recommendation and guidelines of Bruce protocol.(20)

**Data analysis:** Data obtained was analyzed using the Microsoft excel version 2019 software and STATA version 15. Gender differences between the two groups were assessed using a chi-squared test. P value of <0.05 was considered as significant. The t test was used to calculate mean differences between chest pain and palpitations subjects.

### Results

The population consists of 60 subjects (50 chest pain and 10 palpitations) with a mean age of  $50 \pm 19$  years ranging from 18 to 69 years. The mean age for patients with chest pain and palpitations was ( $50 \pm 20$  and  $45 \pm 13$ ) years respectively. With the majority 40(66.6%) falling in the age group of 41-60 years with highest prevalence in chest pain subjects. There was a significant different between the age group and the presenting symptoms. The count of women to men was 3/7 for palpitations and 19/31 for chest pain with a significant correlation between male and female ( $p = 0.000^*$ ). The overall average duration for EST was  $8 \pm 2$  minutes, the average duration of patients with chest pain and palpitation was ( $8 \pm 2$  minutes and  $9 \pm 2$  minutes) respectively.

29(48.3%) of the study participant have a medication history, 24(48%) chest pain and 5(50%) palpitations. The mean systolic and diastolic blood pressure was  $122.6 \pm 16.6$  and  $80.5 \pm 12.1$  with BMI of  $30 \pm 9$  for chest pain and  $122.2 \pm 17.9$  and  $81 \pm 11.8$  with BMI of  $32 \pm 6$  for palpitation. The average heart rate (HR) target was  $120.6 \pm 9.2$ , maximum HR of  $170.2 \pm 13.2$  for chest pain and  $123.4 \pm 11.3$  bpm, maximum HR of  $176.4 \pm 16.5$  bpm for palpitation with no significant difference between the mean range and the corresponding presenting symptoms. Table 1

The overall reason for interrupting the stress ECG was muscle fatigue 29(48.3%), followed by breathlessness 12(20%), maximum HR age 8(13.3%); chest pain, abnormal ECG and blood spike account for 2(10%) respectively. Some patients experienced multiple symptoms, with muscle

fatigue +maximum HR and chest pain + fatigue being the most common combination. The least common combination was breathlessness + maximum HR. This prevalence was higher among the chest pain subjects. These findings have been presented in figure 2

ST\_T changes shows a prevalent of ST elevation and depression 4(8%), T-wave inversion 5(10) respectively among the chest pain subjects as compared to non ST-T changes record among those presented with palpitation as initial complaints with no significant difference between the ST\_T changes and chest pain. The study recorded a good amount of normal results. Table 2

Stress induced ischemia and Arrhythmia was prevalent among the subjects presenting with chest pain compare with those of palpitation with no significant difference. Stress induced hypertension was observed among the subject presenting with palpitation with a significant difference (P=0.026\*). Figure 2

The pattern of positive stress changes according to cardiovascular risk factors showed that hypertensive and obese subjects were more predominant compare to the other forms of cardiovascular risk factors seen. Table 3

Table 1 socio-demographic characteristic of study participant

Variables	Total N=60(100)	Chest pain N=50(100)	Pvalue	Palpitation N=10(100)	P value
Gender			0.000*		0.000*
Male	39(65)	31(62)		7(70)	
female	21(35)	19(38)		3(30)	
Age group			0.000*		0.000*
<40	11(18.3)	9(18)		2(20)	
41-60	40(66.6)	33(66)		7(70)	
>60	9(15)	8(16)		1(10)	
mean age	50±19	51±20	0.403	45±13	0.383
Medication history	29(48.3)	24(48)		5(50)	
Cardiovascular assessment and exercise capacity					
Resting SBP mmHg	121.7±16.5	122.6±16.6	0.352	122.2±17.9	0.911
Resting DBP mmHg	80.1±11.8	80.5±12.1	0.546	81±11.8	0.786
Mean(SD) BMI kg/m2	30±9	30±9	0.953	32±6	0.568
Average duration	8 ±2minutes	8±2minutes	0.154	9±2minutes	0.390
Average HR target	121.1±9.5bpm	120.6±9.2bpm	0.444	123.4±11.3bpm	0.402
Average maximum HR	172.9±13.8bpm	170.2±13.2bpm		176.4±16.5bpm	

Beat per minute, SBP=systolic blood pressure, DBP= diastolic blood pressure, BMI= body mass index, HR=heart rate

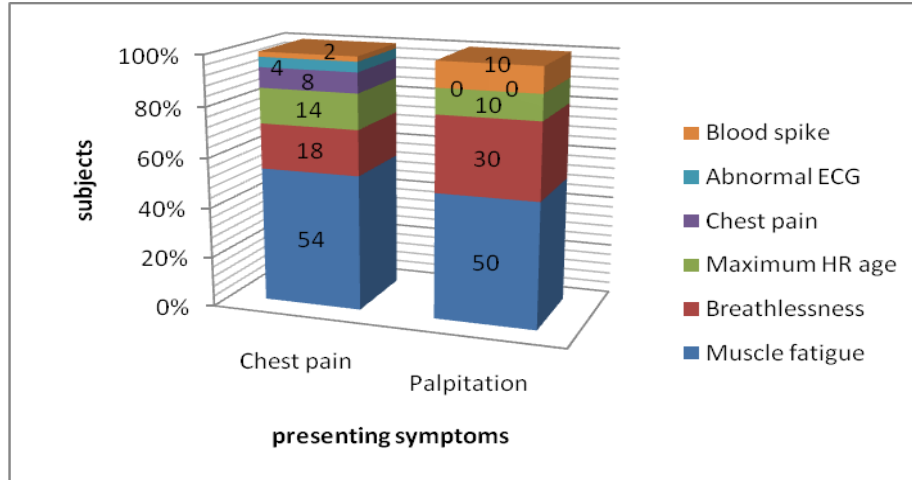


Figure 1: Reason for interrupting stress ECG according to presenting symptoms

Table 2: prevalence of ST\_T changes by presenting symptoms

ST-T changes	Chest pain (%)	P value	Palpitation (%)	Total (%)
ST-elevation	4(8)	0.573	0(0)	4(6.7)
T wave inversion and ST-depression	5(10)	0.291	0(0)	5(8.3)

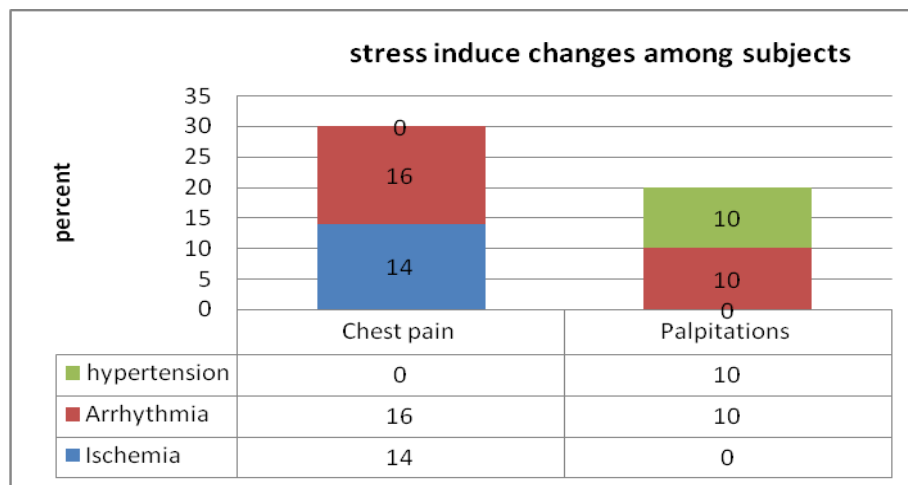


Figure 2: Pattern of positive stress induced changes by presenting symptoms

Table 3: pattern of cardiovascular risk factors based on stress induces changes and presenting symptoms

Cardiovascular risk factors	Frequency	Chest pain N=50		Frequency	Palpitation N=10	
		Arrhythmia	Ischemia		Arrhythmia	Ischemia
Hypertensive	26(52)	6(12)	4(8)	3(30)	1(10)	0(0)
Diabetes mellitus	5(10)	3(6)	1(2)	2(20)	0(0)	0(0)
Obesity	21(42)	6(12)	4(8)	7(70)	1(10)	0(0)
Smoking	1(2)	1(2)	0(0)	0(0)	0(0)	0(0)
Alcohol	2(4)	2(4)	0(0)	1(10)	0(0)	0(0)

**Discussion:**

The study was conducted between 2019 and 2023, where general practitioners referred patients aged 18 to 69 years to a single cardiologist. Prior to the cardiac evaluation, patients with palpitations had higher average scores for SBP, DBP, BMI, HR target, Maximum HR reached, and average duration compared to those with chest pain. Gender was found to have a significant correlation with the presenting symptoms. However, there were no significant differences in mean values before the cardiac evaluation between the groups. Patients with non-cardiac chest pain reported more symptoms of ST\_T changes and positive stress induced outcomes compared to the benign palpitation group. There were some similarities in presenting symptoms between the two groups. Out of the patients referred for chest pain and palpitations, 3% reported a combination of both symptoms. Arrhythmia was rarely a reason for stopping the stress ECG test, as ST elevation and ischemia were minimal. Many patients stopped the test due to non-cardiac complaints like muscle fatigue and breathlessness rather than worsening angina. Positive induced ischemia can indicate reduced blood flow in the muscle while positive induced arrhythmia can show conduction issues as the test progresses. Patient with positive inducible ischemia 7(11.6%) were referred to another facility where angiography and angioplasty were to be performed while subjects with positive inducible arrhythmia 9(15%) were recommended for Holter ECG and electrophysiology studies. Non-cardiac chest pain and benign palpitations are unique because their symptoms are unexplained and there is no specific treatment for them. To help patients cope with these symptoms, treatment should focus on increasing personal control and understanding. When evaluating these patients for cardiac disorders, they tend to be more focused on their symptoms and how they perceive their well-being after the evaluation. Understanding their illness perceptions is important in understanding why these patients have poor outcomes and determining the appropriate treatment.(21)

In our study, the average age was 50±19 years. For individuals presenting with chest pain, the mean age was 51, and for those with palpitations, it was 45. These findings align with those at General Psychiatry Hospital in Norway,(2) where mean ages of 54 and 44 years were recorded for chest pain and palpitations, respectively. Most chest pain cases were observed in the age

group of 41 to 60 years, which correlates with a similar study in primary health centers in south-eastern Sweden, (22) where chest pain consultations were most common in the age range of 45 to 64 years. Among males, chest pain was more prevalent, accounting for 62%, compared to females at 38%, similar to findings in the Warne ford Hospital, Oxford,(3) where 43% of male subjects reported chest pain. These trends were also consistent with age groups of 45 to 60 reported in younger and older subjects. (23)

Stress ECG stages exhibit a higher occurrence at stage 3, with equal frequency at stages 2 and 4, particularly prevalent among chest pain subjects compared to those with palpitations. Exercise duration serves as a crucial marker of functional capacity and predicts mortality and cardiac events in cardiovascular patients. While functional capacity generally diminishes with age and is lower in women than men, exercise duration remains a significant prognostic factor even after adjusting for age and gender. For patients with coronary artery disease (CAD), exercise duration proves valuable for risk assessment and stratification.(24, 25)

The primary cause for terminating the stress ECG was muscle fatigue in 48.3% of cases, followed by breathlessness at 20%, and reaching maximum heart rate at 13.3%. Other reasons included chest pain, abnormal ECG, and blood pressure spikes, each accounting for 10% of interruptions. Some patients experienced multiple symptoms, with muscle fatigue combined with maximum heart rate and chest pain combined with fatigue being the most common. The least common combination was breathlessness paired with reaching maximum heart rate. This prevalence was particularly higher among chest pain subjects, with no instances of injury or mortality recorded during the exercise. These findings align with a previous study (26) where the most common reasons for stopping tests prematurely included dyspnea, fatigue, leg pain or cramps, dizziness, intense anxiety, and occasionally angina pain, with no recognized complications or fatalities.

The study observed a prevalence of ST elevation 4(8%), T-wave inversion and ST depression of 5(10%), with no significant difference between ST-T changes and chest pain. Positive stress-induced ischemia and arrhythmia were more common in chest pain subjects compared to palpitation, with no significant difference. However, stress-induced hypertension was significantly more prevalent among those with palpitation. The study found a 11.6% incidence of positive ischemia, which is higher than the 4.4% reported in a previous study based on ECG changes during exercise.(27) Ventricular ectopy was the most common arrhythmia during exercise, positive arrhythmia accounts for 15% of the study population compared to 2% reported in previous studies. (28) However, the relationship between exercise-induced ventricular ectopy, ischemia, and left ventricular function remains unclear. (29)

The majority of palpitation cases are found in male subjects (70%) compared to females (30%). This differs from the findings at Oxford. (3) Stress-induced arrhythmia is less common among subjects with palpitation(10%) compared to a cardiac clinic study (33%). (30)The impact of palpitation on disability and distress is significant, with similar effects for benign palpitation and

arrhythmia. Most dangerous exercise-induced arrhythmias occur at this time and they can be lessened or avoided by cool-down activities.

Positive stress ischemia and arrhythmia was observed in 14% and 16% respectively among subjects presenting with chest pain while positive stress arrhythmia and hypertension was observed only in 10% respectively among subjects presenting with palpitation. The study was significantly different among the subject with stress induced hypertension. The pattern of positive stress changes according to cardiovascular risk factors showed that hypertensive and obese subjects were more predominant compare to the other forms of cardiovascular risk factors seen.

### **Conclusion and Recommendation**

Arrhythmia was rarely a reason for stopping the stress ECG test, as ST elevation and ischemia were minimal. Many patients stopped the test due to non-cardiac complaints like muscle fatigue and breathlessness rather than worsening angina. Positive Stress-induced ischemia and arrhythmia was more prevalent in chest pain and stress induced hypertension was significant in palpitations though minimal record was observed among the presenting symptoms. Patients tend to be more focused on their symptoms and how they perceive their well-being after when evaluating their cardiac disorders. Although Ischemic heart disease is becoming an increasing problem however, stress ECG is not common used in diagnosing this condition in our region.

Understanding their illness perceptions is important in understanding why these patients have outcomes and determining the appropriate treatment. To help patients cope with these symptoms, treatment should focus on increasing personal control and understanding.

### **Limitation of the study**

There was limited result on the palpitation data compare to chest pain hence could explain the difference in gap in the result finding

### **Acknowledgement**

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### **Statement of Ethical Approval**

Ethical approval of this study was obtained from the University of Port Harcourt teaching Hospital ethical committee.

### **Conflicts of Interest**

Authors declared they have no conflicts of interest

### **Authors' Contributions**

C.E.N performed the clinical examination of the patients, and C.E.N and J.A was a major contributor in writing the manuscript. J.A collected, analyzed and interpreted the patients' data. All authors read and approved the final manuscript.



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