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The Effect Of Alcohol Consumption On The Echocardiogram

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Abstract:
Background: *Alcohol consumption has been linked to cardiovascular events. There are few echocardiographic studies on alcohol consumers in the Nigerian population. Echocardiography is a valuable tool for assessing structural heart diseases. This study aimed to assess the effect of chronic alcohol consumption on the heart.*
Objective: *This study seeks to provide information on the structural changes in the heart of those consuming alcohol in the Rumuekini communities of Rivers State.*
Method: *Forty-Eight male subjects consented to participate in the study and underwent echocardiographic tests after completing a questionnaire. The trained interviewer gathered information on biodata, history of alcohol consumption, symptoms, and clinical findings. Echocardiography was performed using the ATL high-definition ultrasound machine, following a predefined imaging protocol. Abnormalities were assessed against published normal variables for the Nigerian population. Ethical clearance was obtained from community leaders.*
Results: *Forty- Eight (48) of the men consented to the study with mean ± SD: age of 33.9 ± 16.1yr,. BMI: 23.83 ± 3.43kg/m^{2,} systolic blood pressure of 129.8 ± 21.1mmHg, diastolic blood pressure of 77.48 ± 13.9mmHg and daily value of alcohol consumed was 74.88 ± 45.5/day,*
Echocardiographic assessment revealed a mean left atrial diameter (LAD) of 3.48 cm (± 0.45) and LVM/BSA of 181.2 g/m² (± 284). The mean ejection fraction (EF) was 61.66% (± 15.1), and the mean E/A ratio was 1.48 (± 0.49).
Conclusion: *Alcohol consumption was associated with significant structural changes in both left and right heart functions.*
Keywords: *Alcohol, Echocardiography, Ethanol, Structural, LVH, Diastolic Dysfunction, Cardiovascular Health, Rumuekini, Nigeria.*

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I. Introduction:

On the 20th of January 2022, the World Heart Federation launched a new policy brief on the impact of alcohol on cardiovascular health, titled "Myths and Measures" [1]. This brief challenged the concept that moderate alcohol consumption is associated with a decreased risk of heart disease, describing it as a myth. Consequently, the policy called for stricter measures on alcohol consumption and blamed the remarkable rise in the prevalence of cardiovascular diseases globally (almost a hundred percent in the past two decades), in part, on alcohol consumption. Nevertheless, research studies [2-5] have confirmed the varied views of authors regarding moderate alcohol consumption. However, they agree that excessive alcohol consumption has a deleterious effect on the cardiovascular system [6-8]. With the recent action of the World Heart Federation, there is a need to revisit this conflict in agreement. Race and ethnicity no doubt plays a significant part in disease patterns, presentation, and response to various molecules [9,11]. This series of studies seeks to evaluate and contribute to information on this very important topic.

The impact of alcohol ingestion on the heart is dose-dependent in terms of duration and daily alcohol intake [10,]. The immediate impact of drinking alcoholic beverages has been associated with transient tachycardia and a rise in blood pressure soon after drinking, which is said to be short-lived, resolving in minutes [11]. However, the impact of sustained alcohol intake has been associated with longer-lasting effects arising from arrhythmias to more debilitating and severe consequences [12]. Arrhythmias are the most common complications associated with chronic alcohol consumption. The arrythmias range from premature atrial complexes, premature ventricular complexes, sinus tachycardia to more severe arrythmias like Atrial fibrillation. A previous study noted, an increase in heart rate peaking at 4 hours after ingestion, of alcohol[13]

On the other hand, hypertension has been viewed by some other authors as the commonest complication of chronic alcohol consumption. Generally, the aetiology of hypertension in most cases (over 95%) is of unknown origin, it is associated with multiple factors. These factors are classified into two main categories: modifiable and non-modifiable risk factors.[14] Alcohol has been found to be a modifiable risk factor in the etiopathogenesis of hypertension. Its impact on hypertension appears to be largely related to its effect on vascular intima-media

thickness (IMT) and its impact on vessel diameter. An earlier study in this series demonstrated vessel wall thickness and stiffness, showing an increase in the intima-media thickness relative to the normal population, which causes a reduction in vessel diameter.[15] Excessive consumption of alcohol can is believed to have an effect on the muscles of the vessels resulting in narrowing of the vessel resulting in vasoconstriction and invariably elevated blood pressure.

Alcohol increases hormones Another mechanism by which alcohol may result in hypertension is from the release of nitric oxide from the vascular endothelium.[16,17] Genes have also been implicated in the effect of alcohol on blood pressure with certain genes expressing hypertension more readily than others, with regards to alcohol consumption. A study in a Japanese hypertensive population in those with inactive ALDH2*2(genotype of Aldehyde Dehydrogenase gene) and showed significant reduction in blood pressure relative to these possessing the active ALDH2 group (homozygous ALDH2*1).[18,19] a single intake of alcohol lowers blood pressure in Japanese men, as a result of the vasodilative effect of acetaldehyde

In addition to its impact on blood vessels and heart rhythm, alcohol also affects the heart muscles, causing heart muscle disease, also known as alcoholic cardiomyopathy.[20] This is a mixed primary cardiomyopathy of both genetic and acquired origins. Alcoholic cardiomyopathy is believed to be of acquired origin, with its risk heightened by genetic predisposition.[20,21] The genetic predisposition to alcoholic dilated cardiomyopathy, the TTNtv gene, may represent an underlying genetic factor in alcoholic cardiomyopathy. This is a long-term complication of alcohol ingestion. The consumption of alcohol results in the release of cytolytic enzymes, affecting the mitochondria and other cellular structures. It would be beneficial to assess the immediate impact of acute binge drinking of alcohol.[22,23]

The effect of alcoholism on infective endocarditis has been gaining attention, though the fact has not been emphasized it, becomes an important area to look into. The main implicated organism is Diplococcus pneumonia Streptococcus Agalatasiae.[24,25] Alcoholic infective endocarditis when it occurs is fatal, studies on the effect of alcohol on the endocardium may open new horizons on a possible relation of alcohol ingestion to diseases like endomyocardial fibrosis (EMF). Alcohol related EMF has been discovered in mice and is yet to be replicated in humans.[26,27]

Understanding the absorption and distribution of alcohol within the heart may shed light on its possible impact on the pericardium. Alcoholic related pericardial disease, pericarditis has been mentioned, Alcohol is associated with the release of pro-inflammatory cytokines. The study set out to assess the mechanism of the alcoholic pericarditis.[28]

Most of these impacts appear to affect the left heart more than the right heart, which may explain the distributive effect of alcohol. The direct distribution through blood vessels points to the direct toxic impact on the tissue, while the sub-immersive effect by simple diffusion may explain the impact on vessel walls.[29]

Looking at the effect of alcohol relative to the heart muscle structure would invariably mean that alcohol-induced heart muscle disease may be part of a broader entity encompassing alcoholic endocarditis, myocarditis, and pericarditis. Alcoholic cardiomyopathy should be viewed as a disease involving the entire layers of the heart. Understanding this is fundamental to the approach to treatment, understanding disease progression, and developing possible preventive measures to mitigate the disease.

Studies have confirmed the beneficial effect of alcohol consumption on the cardiovascular system; however, the debate exists on the protective elements or components of alcohol. Some have argued for antioxidants and polyphenolic compounds such as flavanols, monomeric and polymeric flavan-3-ols, highly colored anthocyanins, phenolic acids, and the stilbene polyphenol resveratrol[30] rather than ethanol as the protective component in alcoholic beverages. Resveratrol prevents the prothrombotic effect of cholesterol and reduces the ability of LDL-cholesterol to undergo oxidation, which is a primer for the atherosclerotic process. It also inhibits platelet aggregation.

On the other hand, alcohol is believed to offer protection by increasing levels of tissue plasminogen activator (t-PA), a serine protease enzyme with fibrinolytic properties. Levels of t-PA were found to be higher in drinkers compared to non-drinkers [31]. Additional protection by alcohol on the heart from ischemia was observed through preconditioning [32]. These benefits were in addition to its effect on different types of cholesterol. Alcohol is associated with higher HDL levels by reducing the action of CETP and is also known to reduce LDL-cholesterol levels. Furthermore, alcohol has been demonstrated to negatively impact net protein synthesis. This has been observed in numerous studies, although the exact mechanism remains unclear and continues to be a subject of research and debate. The effect, however, is consistently seen across the heart and may become more pronounced under stressful conditions.[33]

This study aims to translate these findings to the echocardiogram of alcohol consumers in the Rumuekini community.

II. Method:

Study Design:
This was a prospective, cross-sectional, community-based study.

Study Site:
The study was carried out in an adhoc Echocardiogram laboratory, created in the town hall of Rumuekini, a suburban community in Rivers State.

Ethical Consideration:
Ethical clearance was obtained from the Community Development Committee of Rumuekini and the Royal Highness of the Rumuekini Community. Consent was obtained from each study subject after a detailed explanation of the procedure and purpose of the study. Care was taken to ensure that participants were not judged, and confidentiality was maintained.

Study Population:
Forty-Eight males consented to be part of the Echocardiogram arm of the study study evaluating cardiovascular disease in alcohol consumers. No females participated in the study. All respondents were duly counselled on the study protocol, and consent was obtained from each subject.

Exclusion Criteria:
Participants had their blood sugar assessed, and diabetics were excluded from the study.

Method:
A questionnaire was used to collect details on biodata, occupation, symptoms, type of alcohol, estimated daily alcohol consumption, and smoking history. The questionnaire was merged with a proforma for clinical findings, drug history, and recordings of electrocardiographic, echocardiographic, and carotid Doppler findings.

This arm of the study evaluated the echocardiographic findings and assessed the prevalence of echocardiographic abnormalities among high consumers of alcohol in the Rumuekini community.

Echocardiographic Parameters and Definition of Abnormalities

1. Left Atrial Diameter to Internal Diameter Ratio (LAD):A threshold of >4.0 cm, as defined by a study conducted in Nigeria by Oyati et al.[34]
2. Left Ventricular Internal Diameter (LVID):A threshold of >5.6 cm.[34]
3. Left Ventricular Relative Wall Thickness (LV RWT[35]): Relative wall thickness (RWT) was calculated as 2 × posterior wall thickness divided by LV internal diameter. Increased RWT was considered present when RWT exceeded 0.43, implying concentric LVH and when below 0.26 : eccentric LVH as per guidelines from the American Society of Echocardiography (ASE).[35]
4. The normal range for Left Ventricular Mass indexed to Body Surface Area (LVM/BSA) in males typically varies based on age and body size, but generally, it falls within the range of **70-120 g/m[35]**
5. Left Ventricular Ejection Fraction (LVEF):Depressed LVEF was categorized as <50%.[35]
6. Left Ventricular Diastolic Function: Diastolic function was assessed using the combination of E/A ratio and deceleration time (Dect)[35].

Data Analysis:
Data were collated on an Excel spreadsheet and analyzed using the Statistical Package for Social Sciences (SPSS) version 23. Data for the 48 subjects who had echocardiograms were analysed for cardiac abnormalities. Continuous variables were expressed as means SD (standard deviation), while categorical variables were expressed as percentages. Differences in means between two groups were compared with a paired t-test. Proportions or categorical parameters were analysed with the chi-square test. A p-value of <0.05 was considered statistically significant.

III. Results:

Alcoholic beverages taken were classified into **Beers;** Star, Golder, Guinness, Heineken, Harp, Legend. **Gin** (Local gins kai-kai), **Palm Wine**, **Whisky**, squadron. Beer was the most common drink. The amount of alcohol was estimated for beer 50g/cl [36], for whiskey as for liquor with a range of 20-40g/l [36]. For local gin[40g/l][36]. Palm-wine was more difficult to estimate as the amount of alcohol varied with duration of stay after tapping.

The study population was divided into three groups based on the amount pf alcohol consumed daily, *All consumers took alcohol in excess*, but for the purpose of the study. the study population of excessive drinkers

were further categorized as Mild, Moderate and Excessive drinkers. Mild drinkers consumed s ≤ 50g/day, Moderate: 51-100g/day and excessive alcohol consumption: > 100g/day. The range for total alcohol consumed was 15 to 190g/dl.

Forty- Eight (48) of the men that consented to be part of the studies had echocardiography using predefined imaging modality. The mean age was with age range from 19yrs to 91yrs and mean ± SD of 33.9 ± 16.1yrs. maen BMI: 23.83 ± 3.43kg/m^2, mean ± SD systolic blood pressure of 129.8 ± 21.1mmHgand mean ± SD diastolic blood pressure of 77.48 ± 13.9mmHg, mean± SD daily value of alcohol consumed was 74.88 ± 45.5/day, Eighteen (40.42%) Students accounted for majority of the study population with sixteen (33%) were smokers

In the study populaton the most common symptom, was chest pain occurring followed closely by palpitations with dyspnoea. Three were in congestive cardiac failure after screening using Framingham's criteria [37] of heart failure with displaced apex beats, raised jugular venous pulsation and heart murmurs.

The regression analyses identified predictors of various cardiovascular parameters. For the E/A ratio, BMI was the only significant predictor (p = 0.040), showing a negative relationship, while age, quantity of alcohol, SBP, and DBP were not significant. The model explained 14.3% of the variance in the E/A ratio. For ejection fraction (EF), the model explained only 4.9% of the variance, with no significant predictors, indicating that other factors might influence EF more significantly. For left ventricular mass/body surface area (LVM/BSA), SBP was the only significant predictor (p = 0.041), showing a positive relationship. Age, BMI, quantity of alcohol, and DBP did not significantly influence LVM/BSA. Collinearity statistics indicated no multicollinearity concerns among the predictors in all models.

Table 1: Cardiovascular and Echocardiographic Parameters

Cardiovascular Parameter	Mean ± SD	Percentage (%)
Age (years)	33.9 ± 16.1	
BMI	23.83 ± 3.43	
SBP	129.8 ± 21.1	
DBP	77.48 ± 13.9	
PR	74.39 ± 10.9	
QUANTITY	74.88 ± 45.5	
LAD	3.478 ± 0.45	
ACS	2.277 ± 0.48	
IVSD	1.117 ± 0.53	
LVPWD	1.645 ± 1.68	
LVIDD	4.684 ± 0.79	
RWT	0.722 ± 0.67	
LVM/BSA	181.2 ± 284	
EF	61.66 ± 15.1	
FS	33.31 ± 12.6	
E/A	1.481 ± 0.49	
Participant Characteristics	**N**	**Percentage (%)**
Students	23	36.8%
Smokers	16	33.33%
Hypertensives	10	20.83%
EJECTION FRACTION		
Normal	36	75.00%
Depressed Ejection Fraction	8	16.67%
Exaggerated	4	8.33%
DIASTOLIC DYSFUNCTION	-	-
Normal	24	50.00%
Grade 1	10	14.58%
Grade 2	7	10.42%
Grade 3	7	12.5%
LVH	-	-

Normal	23	47.92%
Concentric	23	47.92%
Eccentric	2	-4.17%

Table 2: Paired Samples Test and Correlations

Variable	Mean (NS) ± SD	Mean (S) ± SD	Std. Error Mean	T	df	Sig. (2-tailed)
AGE	56.47 ± 17.62	52.93 ± 17.62	4.55	0.78	14	0.45
BMI	23.49 ± 4.15	23.54 ± 4.15	1.20	-0.05	11	0.97
SBP	128.93 ± 18.31	125.53 ± 18.31	4.73	0.72	14	0.48
DBP	82.13 ± 13.32	75.93 ± 13.32	3.44	1.80	14	0.09
QUANTITY	75.93 ± 81.76	74.33 ± 81.76	21.11	0.08	14	0.94
LAD	3.53 ± 0.55	3.33 ± 0.55	0.15	1.33	13	0.21
LVM/BSA	180.00 ± 533.69	196.03 ± 533.69	137.80	-0.12	14	0.91
EF	69.13 ± 19.73	61.03 ± 19.73	5.09	1.59	14	0.13
FS	37.47 ± 14.92	32.11 ± 14.92	3.85	1.39	14	0.19
E/A	1.58 ± 0.56	1.44 ± 0.56	0.18	0.80	9	0.44
RWT	1.06 ± 0.75	0.85 ± 0.78	0.31	0.69	14	0.50

Table 3. Linear Regression Combined Coefficients Table

Dependent Variable	**Predictor**	**Unstandardized Coefficients** B	**Standardized Coefficients** Std. Error	Beta	**t**	**Sig.**
EF	(Constant)	57.78	20.91		2.76	0.01
	AGE	0.08	0.16	0.08	0.47	0.64
	BMI	-0.13	0.77	-0.03	-0.17	0.87
	QUANTITY	0.04	0.05	0.14	0.85	0.40
	SBP	-0.11	0.14	-0.16	-0.77	0.45
	DBP	0.204	0.215	0.196	0.95	0.35
LVM/BSA	(Constant)	274.700	382.937		0.72	0.48
	AGE	-3.463	2.950	-0.186	-1.17	0.25
	BMI	-11.43	14.17	-0.13	-0.81	0.43
	QUANTITY	-0.48	0.95	-0.08	-0.51	0.62
	SBP	5.52	2.61	0.42	2.12	0.04
	DBP	-4.93	3.94	-0.25	-1.25	0.22
LAD	(Constant)	1.93	0.51		3.77	0.00
	BMI	0.02	0.02	0.14	0.98	0.33
	AGE	-0.00	0.00	-0.04	-0.28	0.70
	SBP	0.01	0.00	0.49	2.65	0.01
	DBP	-0.00	0.01	-0.09	-0.50	0.62
	QUANTITY	0.00	0.00	0.17	1.23	0.22

IV. Discussion

Cardiovascular Parameters and Participant Characteristics:

This cross-sectional study set out to evaluate the impact of alcohol consumption on echocardiographic parameters among male residents of Rumuekini Community, Rivers State, Nigeria. The study population consisted of 48 males with a mean age of 33.9 years (± 16.1). Participants had a mean BMI of 23.83 (± 3.43), and the average systolic and diastolic blood pressures were 129.8 mmHg (± 21.1) and 77.48 mmHg (± 13.9), respectively. Notably, 36.8% of participants were students, 33.33% were smokers, and 20.83% were hypertensive.

Echocardiographic Findings

The echocardiographic assessment revealed that the mean left atrial diameter (LAD) was 3.48 cm (± 0.45), and the mean left ventricular mass/body surface area (LVM/BSA) was 181.2 g/m² (± 284). The mean ejection fraction (EF) was 61.66% (± 15.1), and the mean E/A ratio was 1.48 (± 0.49). Among participants, Ejection Fraction (EF) was normal: 36 participants (75.00%), depressed in 8 participants (16.67%) and exaggerated in 4 participants (8.33%).

Diastolic dysfunction (DD) was observed in 50% of participants, with varying grades of severity. Grade 1 DD was seen 10 participants (14.58%), Grade 2 in 7 participants (10.42%)and Grade 3: 7 participants (12.5%). **Left Ventricular Mass**: was normal in 23 participants (47.92%) with LVH in 25. Concentric LVH 23 participants (47.92%) and Eccentric: 2 participants (4.17%).**Left atrial Enlargement** was seen in only five subjects (10.42%), **Dilated LVID** (>5.6cm) was also seen in 5 subjects(10.42%).

Alcohol is most likely to cause concentric LVH, diastolic dysfunction than left atrial dilation, left ventricular dilatation. Eccentric LVH and depressed ejection fraction.

In addition, from the regression analysis the key findings, of a negative relation of E/A ratio with BMI will imply that obesity would be a cause of impaired relaxation of the heart.

The positive association between systolic blood pressure (SBP) , LVM/BSA in our study is an indicator that alcohol is a significant risk factor for hypertension and invariably increased left ventricular mass.No significant predictors were identified for ejection fraction (EF).

Comparisons with Other Studies

Similar to the findings of. Martin O.A[38] in Nigeria, our study found significant associations between alcohol consumption and adverse cardiovascular outcomes. The presence of concentric hypertrophy in 47.92% of participants aligns with local studies highlighting alcohol-induced hypertension and cardiomyopathy.

Our results are consistent with a multi-country study involving African cohorts, authored by Danny Baghdad et al[39], which reported associations between heavy alcohol consumption and elevated blood pressure. The prevalence of left ventricular hypertrophy (LVH) in our study mirrors findings from other African studies, reinforcing the link between alcohol intake and LV hypertrophy.

In 1989, Urbano-Marquez et al.[40] conducted a study involving 48 men with an average daily intake of 243 grams of alcohol. The study noted an inverse correlation between total lifetime alcohol intake and both ejection fraction and fractional shortening, and a direct correlation between total lifetime alcohol intake and left ventricular mass; Chronic abusers of alcohol had an abnormal ejection fraction. In addition, the findings in Urbano-Marquez et Al's study were minimally affected by age and nutritional status.

Another study reported that heavy alcohol consumption leads to structural and functional cardiac abnormalities.

Limitations

The study's relatively small sample size (48 males) limits the generalizability of the findings to the broader population, including females. Self-Reported Data: Alcohol consumption data was self-reported, introducing potential recall bias. Also, the cross-sectional nature of the study precludes establishing causal relationships between alcohol consumption and echocardiographic abnormalities.

Confounding Factors:

While some confounders were controlled for, other potential factors such as diet, physical activity, and genetic predisposition were not accounted for.

Significance of the Findings

The study highlights the significant impact of alcohol consumption on cardiovascular health within the Rumuekini community. The identification of BMI and SBP as significant predictors of echocardiographic parameters underscores the importance of monitoring these factors in individuals who consume alcohol. The findings contribute to the growing body of evidence on the adverse effects of alcohol on heart health and emphasize the need for public health interventions to reduce alcohol consumption and promote cardiovascular health.

V. Conclusion:

In conclusion, this study provides valuable insights into the relationship between alcohol consumption and echocardiographic parameters in a Nigerian community. The findings are consistent with local, African, and international studies, highlighting the global relevance of the issue. Future research should focus on larger, more diverse populations and longitudinal designs to further elucidate the causal relationships and underlying mechanisms.

The study aimed to evaluate the impact of alcohol consumption on echocardiographic parameters among residents of Rumuekini Community in Rivers State, Nigeria.

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