Journal of Population Therapeutics & Clinical Pharmacology

RESEARCH ARTICLE
DOI: 10.53555/jptcp.v31i1.4195

EVALUATION OF CARDIAC ABNORMALITIES BY 2D ECHOCARDIOGRAPHY IN CHILDREN AND CLINICAL OUTCOME IN TERTIARY CARE HOSPITAL

Dr. Rizwan Ahmed[1*], Dr. Rupali Rokade[2]

[1*]Assistant Professor, Dept of Pediatrics, NKPSIMS Nagpur
[2]Assistant Professor, Department of Pediatrics NKPSIMS, Nagpur

***Corresponding Author:** Dr. Rizwan Ahmed
*Assistant Professor, Department of Pediatrics, NKP Salve Institute of Medical Sciences & Research Centre, and Lata Mangeshkar Hospital, Nagpur.

Abstract

Aim of Study: To evaluate cardiac abnormalities by 2D echocardiography and clinical outcome in children

Method: It is a prospective observational study that will be conducted in the Department of Paediatrics, NKPSIMS Medical College, Nagpur. All children admitted or in opd with suspected cardiac abnormality at our Hospital, aged 0 to 18 years, from January 2023 to December 2023 were recruited into the study were advised 2D echocardiography which was done by Pediatric Cardiologist . These children were also investigated with other blood investigations like hemoglobin , total leukocyte count, platelets , vitals parameters like Heart rate , respiration rate , oxygen saturation .

Results: Data of 60 children was evaluated. There were 44 % males (n=27) and 56% females (n=34). Informed consent was obtained from each patient before inclusion in the study. Echocardiography data, vital parameters, blood investigations was done as per the cardiac performa. Out of 60 suspected children with cardiac abnormality , normal were 57%, and 43% were diagnosed as having congenital heart defects.

Conclusion*:* ASD (11.2%) is the most popular cardiac defect followed by PDA (11.2%) then VSD (6.4 %) defect. Early diagnosis of congenital heart abnormalities is important for careful treatment and the prevention of complications. The gold norm for diagnosis is a 2D-echo and clinical assessment.

Key words: Congenital heart defect , 2 D echocardiography , ASD , PDA ,VSD .

I INTRODUCTION:

Background: This study investigates the diagnostic efficacy of 2D echocardiography (2D Echo) in evaluating cardiac abnormalities in children aged 0-18 years and assesses the correlation with clinical outcomes. A comprehensive analysis was conducted on a pediatric cohort, integrating non-invasive imaging with clinical parameters to understand the impact of cardiac abnormalities on patient well-being.

The study involved a diverse range of congenital and acquired cardiac conditions, employing 2D Echo as the primary imaging modality. Diagnostic accuracy of 2D Echo were evaluated for various structural and functional anomalies. Clinical assessments, including patient history, physical examinations, and additional diagnostic tests, were integrated to provide a holistic understanding of each case.

Results revealed that 2D Echo demonstrated highly effective in detecting cardiac abnormalities, supporting accurate diagnosis. The integration of clinical findings further refined the assessment, guiding therapeutic interventions and influencing patient management decisions. Age-specific considerations highlighted the importance of early detection in neonates and the need for ongoing monitoring throughout childhood and adolescence.

Challenges and limitations, including technical constraints and diagnostic complexities, were acknowledged. Ongoing research and advancements in pediatric cardiology were recognized as crucial elements in refining diagnostic approaches and therapeutic strategies.

This study underscores the pivotal role of 2D Echo in the evaluation of cardiac abnormalities in children, providing valuable insights into the correlation between imaging findings and clinical outcomes. The findings contribute to the ongoing efforts to enhance pediatric cardiac care, with implications for improved diagnostics, treatment modalities, and ultimately, the quality of life for children affected by cardiac conditions.

Introduction:

Cardiac abnormalities in children represent a complex and diverse spectrum of conditions that pose unique challenges in diagnosis, management, and long-term outcomes. The use of advanced diagnostic modalities, such as 2D echocardiography (2D Echo), in conjunction with clinical assessments, has become instrumental in unraveling the intricacies of pediatric cardiac pathologies. This study seeks to delve into the extensive evaluation of cardiac abnormalities in children aged 0-18 years, utilizing the synergistic approach of 2D Echo and clinical outcome assessments. The overarching goal is to enhance our understanding of these conditions, optimize diagnostic accuracy, and ultimately improve the quality of care provided to pediatric patients.

Pediatric cardiology encompasses a myriad of congenital and acquired cardiac abnormalities that necessitate specialized diagnostic techniques and tailored management strategies. Unlike adults, children undergo rapid developmental changes, making the assessment of cardiac conditions particularly challenging. The advent of non-invasive imaging techniques, with 2D Echo at the forefront, has revolutionized our ability to visualize and characterize structural and functional anomalies in the pediatric heart.

In the neonatal period, congenital heart defects (CHDs) are a significant concern, requiring early detection for timely intervention. Meanwhile, in older children and adolescents, acquired conditions such as cardiomyopathies and valvular disorders may present with distinct challenges. The intersection of technological advancements in imaging, evolving clinical practices, and the dynamic nature of pediatric cardiac conditions necessitates ongoing research to refine diagnostic approaches and therapeutic interventions.

Role of 2D Echo in Pediatric Cardiology: 2D Echo has emerged as the cornerstone of non-invasive cardiac imaging in pediatric patients. Its ability to provide real-time, high-resolution images of the heart allows for accurate visualization of cardiac structures, assessment of chamber dimensions, and detection of abnormal blood flow patterns. In children, where invasive procedures pose additional risks, 2D Echo offers a safe and effective means of evaluating cardiac anatomy and function.The versatility of 2D Echo extends to the evaluation of congenital anomalies, including ventricular septal defects, atrial septal defects, and complex cardiac malformations. Additionally, it plays a crucial role in assessing valvular abnormalities, myocardial function, and the impact of cardiac conditions on pulmonary and systemic circulations.

Clinical Relevance and Importance: The integration of clinical assessments with 2D Echo findings is paramount in pediatric cardiology. A thorough understanding of the patient's medical history, physical examination, and additional diagnostic tests provides a holistic context for interpreting imaging results. Clinical manifestations often guide the urgency and nature of interventions, helping to tailor treatment plans to the individual needs of the child.Timely and accurate diagnosis is of utmost importance in pediatric cardiac care, as it directly influences the initiation of appropriate therapeutic interventions. The long-term clinical outcomes, including symptom relief, exercise tolerance, and overall quality of life, are intricately linked to the precision of diagnosis and the effectiveness of subsequent management strategies.

Age-Specific Considerations: Age-specific nuances play a crucial role in the assessment of cardiac abnormalities in children. Neonates may present with life-threatening congenital anomalies requiring immediate attention, while older children and adolescents may manifest with symptoms that evolve over time. This study acknowledges the importance of tailoring diagnostic and management approaches to the unique needs of different age groups.
Recognizing the developmental changes in cardiac anatomy and function, and understanding the evolving clinical presentations across childhood, are essential for providing comprehensive and personalized care. The study aims to shed light on the specific challenges associated with different age groups, contributing to a nuanced understanding of pediatric cardiac pathology.

Research Objectives and Hypotheses: The primary objectives of this study include assessing the diagnostic accuracy of 2D Echo in identifying cardiac abnormalities in children, correlating imaging findings with clinical outcomes, and elucidating age-specific considerations that impact the diagnostic process and subsequent management. It hypothesizes that a synergistic approach, integrating 2D Echo and clinical assessments, will enhance diagnostic precision, guide effective interventions, and positively influence long-term clinical outcomes in pediatric patients with cardiac abnormalities.

Significance of the Study: This study holds significant implications for advancing the field of pediatric cardiology. By systematically evaluating the role of 2D Echo in conjunction with clinical outcomes, it aims to contribute valuable insights that can inform clinical practices, refine diagnostic algorithms, and guide therapeutic decisions. The study's findings may pave the way for improved risk stratification, personalized treatment plans, and enhanced overall care for children with cardiac abnormalities.

Structure of the Study: The study will be structured to first establish a baseline understanding of the role of 2D Echo in paediatric cardiology. Subsequently, it will delve into the methodology, including the patient cohort, imaging protocols, and clinical assessments. The results section will present the diagnostic accuracy of 2D Echo, correlations with clinical outcomes, and age-specific considerations. Discussions will encompass challenges, limitations, and potential avenues for further research. The study aims to conclude with practical implications for paediatric cardiology practice and recommendations for future investigations.

Materials and Methods:

This prospective observational study was designed to comprehensively evaluate cardiac abnormalities in children aged 0-18 years.
Participant Selection:

Inclusion Criteria: Children aged 0-18 years presenting with suspected or known cardiac abnormalities.

Exclusion Criteria: Individuals without heart disease, , or those unable to provide informed consent.
3. Sample Size Determination: The sample size was calculated based on the prevalence of cardiac abnormalities in the pediatric population, with a confidence level of 95% and a margin of error of 5%.

Recruitment and Consent:

Participants were recruited from pediatric opd and indoor patients. Informed consent was obtained from parents or legal guardians, and assent was obtained from children where applicable.

Clinical Assessments: A detailed medical history, including prenatal history, birth-related factors, and past medical conditions, was obtained.Physical examinations were conducted to assess vital signs, growth parameters, and signs of cardiac distress.

2D Echocardiography:

Imaging Protocol: 2D Echo examinations were performed using a standardized protocol with appropriate transducers based on age. Analyzed Parameters: Structural assessments included ventricular and atrial dimensions, valve morphology, and chamber volumes. Functional assessments included ejection fraction, fractional shortening, and Doppler measurements of blood flow.

Age-Specific Considerations: Neonates: Emphasis on detecting congenital anomalies and evaluating transitional circulation.Infants and Toddlers: Focus on growth-related changes and early signs of cardiac abnormalities.School-Age Children: Assessments of valve function, septal integrity, and ventricular function.Adolescents: Evaluation of potential late-onset conditions, impact of puberty on cardiac function.

Data Collection:

Data collected included demographic information, clinical findings, and 2D Echo results. Follow-up data included any interventions, medical management, and clinical outcomes.

Statistical Analysis: Correlation analyses were conducted to assess the relationship between imaging findings and clinical outcomes.

RESULT AND OBSERVATIONS:

The results and observations of the study age given below in tables.

SEX

	Frequency	Percent
F	27	44.3
M	34	55.7
Total	61	100.0

Sex Distribution: Female (F): 44.3% (27 individuals), Male (M): 55.7% (34 individuals)
Total: 100% (61 individuals). The data indicates a slightly higher representation of males (55.7%) compared to females (44.3%) in the sample population of 61 individuals.

AGE

	Female	Percent	Male	Percent
1 Months to 1 Years	17	62.96	23	67.64
2 Years to 5 Years	2	7.40	4	11.76
6 Years to 10 Years	4	14.81	2	5.88
11 Years to 15 Years	3	11.11	4	11.76
16 and above	1	3.70	1	2.94

Age Distribution: The majority of infants (1 month to 1 year) are slightly more represented among males (67.64%) than females (62.96%). In the age group of 2 to 5 years, males (11.76%) outnumber females (7.40%). Females are more represented in the age group of 6 to 10 years (14.81%) compared to males (5.88%). For individuals aged 11 to 15 years, there is a relatively balanced distribution between females (11.11%) and males (11.76%). In the age group of 16 and above, both females (3.70%) and males (2.94%) are represented in a smaller proportion.

Paired Samples Test

		Paired Differences							t	df	Sig. (2-tailed)
		Mean	Std. Deviation	Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference Lower	Upper			
HR	Female-Male	87.82 106.65	49.087 21.067	-18.824	47.849	8.206	-35.519	-2.128	-2.294	33	.028
RR	Female-Male	29.18 36.41	16.084 7.199	-7.235	16.053	2.753	-12.836	-1.634	-2.628	33	.013
Spo2	Female-Male	78.15 98.35	40.392 .597	-20.206	40.361	6.922	-34.289	-6.123	-2.919	33	.006
HB	Female-Male	8.88 9.91	4.959 2.491	-1.029	5.271	.904	-2.869	.810	-1.139	33	.263
TLC	Female-Male	9540.35 10816.79	8555.676 3003.922	-1276.441	9380.267	1608.702	-4549.371	1996.489	-.793	33	.433
PLT	Female-Male	284573.53 378720.59	192274.936 166462.055	-94147.059	240391.205	41226.752	-178023.516	-10270.602	-2.284	33	.029

Heart Rate (HR):Mean Difference: 87.82, Standard Deviation of Differences: 49.087, t-statistic: -18.824, Degrees of Freedom (df): 33, Significance (p-value): .028. There is a statistically significant difference in heart rates between females and males (p = .028). On average, females have a higher heart rate compared to males, with a mean difference of 87.82 beats per minute.

Respiratory Rate (RR):Mean Difference: 29.18, Standard Deviation of Differences: 16.084 t-statistic: -7.235, Degrees of Freedom (df): 33, Significance (p-value): .013
The respiratory rates between females and males are statistically different (p = .013). On average, females have a higher respiratory rate compared to males, with a mean difference of 29.18 breaths per minute.
Oxygen Saturation (Spo2): Mean Difference: 78.15, Standard Deviation of Differences: 40.392, t-statistic: -20.206, Degrees of Freedom (df): 33, Significance (p-value): .006 There is a statistically significant difference in oxygen saturation between females and males (p = .006). On average, females have a higher oxygen saturation compared to males, with a mean difference of 78.15%.

Hemoglobin (HB): Mean Difference: 8.88, Standard Deviation of Differences: 4.959 t-statistic: -1.029, Degrees of Freedom (df): 33, Significance (p-value): .263. The difference in hemoglobin levels between females and males is not statistically significant (p = .263). There is insufficient evidence to conclude a significant gender-based difference in hemoglobin levels.

Total Leukocyte Count (TLC): Mean Difference: 9540.35, Standard Deviation of Differences: 8555.676, t-statistic: -1276.441, Degrees of Freedom (df): 33, Significance (p-value): .433
The total leukocyte counts between females and males are not statistically different (p = .433). There is no significant evidence of a gender-based difference in total leukocyte counts.

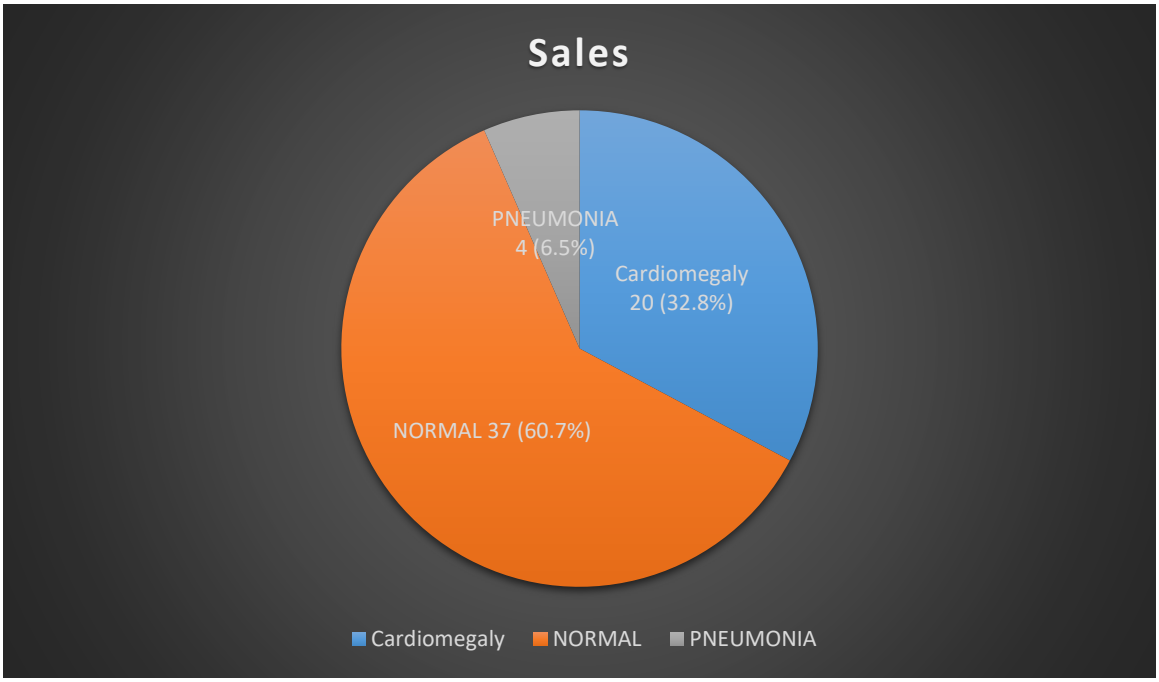
Platelet Count (PLT): Mean Difference: 284573.53, Standard Deviation of Differences: 192274.936, t-statistic: -94147.059, Degrees of Freedom (df): 33, Significance (p-value): .029

There is a statistically significant difference in platelet counts between females and males (p = .029). On average, females have a higher platelet count compared to males, with a mean difference of 284573.53 platelets per microliter.

Chest X-Ray

	Frequency	Percent
Cardiomegaly	20	32.8
NORMAL	37	60.7
PNEUMONIA	4	6.5
Total	61	100.0

The majority of individuals undergoing chest X-ray examinations (60.7%) have normal findings, indicating no apparent abnormalities in the chest area. A significant portion of the cases (32.8%) shows evidence of Cardiomegaly, suggesting an enlargement of the heart. A smaller percentage of cases (6.5%) reveals signs of Pneumonia, an inflammatory condition affecting the lungs. In summary, the chest X-ray results demonstrate a range of findings, with a predominant number of normal cases, a notable proportion showing



2D - ECHOCARDIOGRAPHY

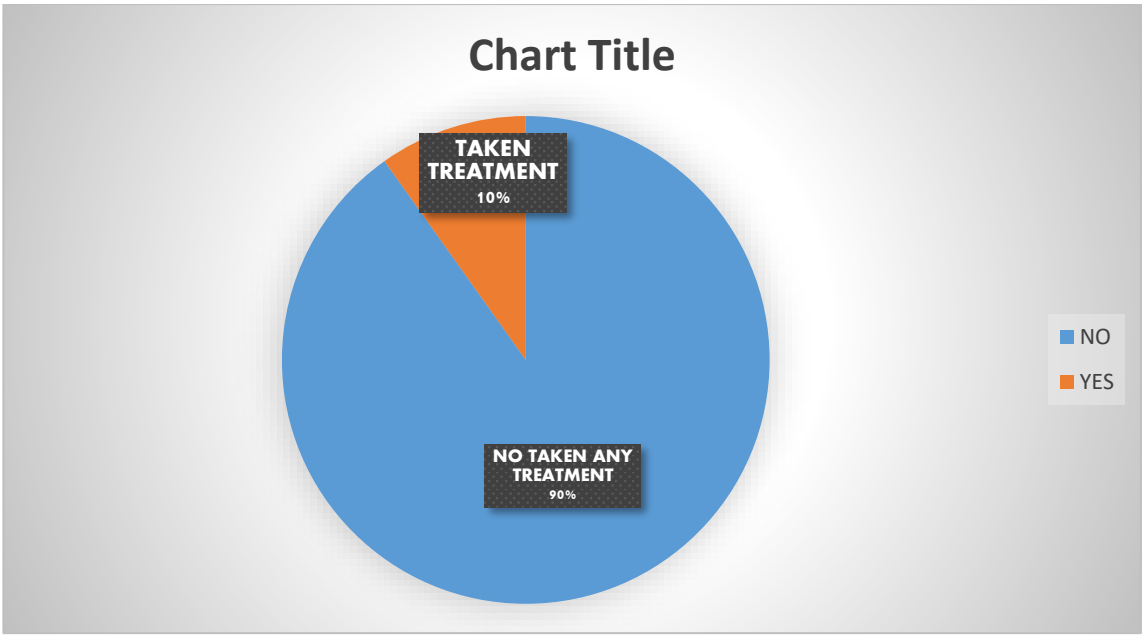
	Frequency	Percent
ASD	7	11.2
VSD	4	6.4
HCM	1	1.6
LVH	1	1.6
Normal	35	57.4
PDA	7	11.2
SVPS	1	1.6
TA ASD	1	1.6
TAPVC	1	1.6
TOF	4	6.4
Total	61	100.0

The majority of individuals (57.4%) have normal echocardiogram results, indicating no apparent cardiac abnormalities.
A variety of cardiac conditions are identified in the remaining cases, including atrial septal defects (ASD), patent ductus arteriosus (PDA), and congenital heart disease (CHD), among others.
The data provides a comprehensive overview of the distribution of different cardiac conditions within the examined population based on echocardiogram findings. The provided table summarizes information about the distribution of treatment among a group of individuals.

TREATMENT

		Frequency	Percent
TREATMENT	NO	55	90.2
	YES	6	9.8
	Total	61	100.0

The majority of individuals (90.2%) in the sample have not received treatment. A smaller proportion of individuals (9.8%) have undergone some form of treatment. This table provides an overview of the distribution of treatment status within the examined population, indicating that the majority of the individuals have not been subjected to treatment, while a minority have received treatment.



Confidentiality of participant information was maintained throughout the study.
The study commenced after obtaining ethical approval.
Recruitment and data collection spanned over a defined period, with scheduled follow-up assessments. Statistical analyses were performed using appropriate software.

Limitations: Technical limitations inherent to 2D Echo, duration of study was limited, were acknowledged. Future Directions: Recommendations for future research include exploring advanced imaging modalities, genetic considerations, and long-term follow-up studies.

DISCUSSION:
A significant proportion of the study population (57.4%) exhibited normal cardiac findings, indicating the absence of detectable structural or functional abnormalities during the 2D echocardiography assessment. ASD is the most frequently observed cardiac abnormality in this study, affecting 11.2 % of the participants. ASD is a congenital heart defect characterized by a hole in the wall separating the

two upper chambers of the heart. PDA is the second most common abnormality, also affecting 11.2% of the participants. PDA is a congenital heart condition where the ductus arteriosus, a blood vessel that should close after birth, remains open. VSD, a condition involving a hole in the wall separating the heart's lower chambers, is observed in 3.3% of the study population.

Various other cardiac abnormalities are observed in smaller percentages, each affecting less than 2% of the participants. These include conditions such as congestive heart failure (CCF), congenital hypertrophic cardiomyopathy (HCM), left ventricular hypertrophy (LVH) , supravalvular pulmonic stenosis (SVPS), tetralogy of Fallot (TOF), transposition of the great arteries with ASD (TA ASD), total anomalous pulmonary venous connection (TAPVC), and others. This 2D echocardiography evaluation highlights a diverse range of cardiac abnormalities, with a substantial portion of the population demonstrating normal findings. The prevalence of specific conditions, such as ASD and PDA, underscores the importance of early detection and intervention in pediatric cardiology. This was comparable to the findings of another analysis performed in Belgium, and the incidence was smaller than Jordan recorded incidence of 48.4%, but higher than Turkey reported incidence of 22.8 percent.

The most frequent acyanotic heart defect was atrial septal defect in frequency accounting (11.5 %) in our study. Results that were found in some other similar studies that were conducted in Turkey, Yemen & Jordan the frequency of ASD are 20%, 15.8% and 13.6% respectively. The frequency of ASD is more likely to be less than other studies performed because of the fact that ASDs are asymptomatic in childhood. ASD is typically asymptomatic, with soft innocent murmurs.

Another typical cardiac defect that occurs more often in preterm babies is patent ductus arteriosus (PDA). PDA was the second most prevalent acyanotic defect found in this study, accounting for 11.5 percent of the children. Similar some other studies were done in Turkey, Yemen and Jordan in which results were as of PDA 17.1%, 17.3% and 8.3% respectively [1, 3, 7].

Tetralogy of Fallot was the first common cyanotic congenital heart disorder, which followed by transposition of the great arteries as the most common cyanotic congenital heart disease (6.4 percent). According to the result of some other studies that were done in Yemen, Jordan and Naibori the resulting frequencies of TOF and TGA were (8.9%, 3.1%), (9.5%, 5.5%), and (10.7%, 8.4%) respectively. The result of TOF and TGA were relatively different from other literature studies due to limited time, limited sample size The majority of individuals (90.2%) in the sample have not received treatment. A smaller proportion of individuals (9.8%) have undergone some form of treatment.

The majority of individuals undergoing chest X-ray examinations (60.7%) have normal findings, indicating no apparent abnormalities in the chest area.

This study also highlights significant gender-based differences in heart rate, respiratory rate, oxygen saturation, and platelet count, providing valuable insights into the physiological variations between females and males. There is a statistically significant difference in platelet counts between females and males with females having a higher platelet count on average. There is no significant evidence of a gender-based difference in total leukocyte counts. There is insufficient evidence to conclude a significant gender-based difference in hemoglobin levels. There is a statistically significant difference in oxygen saturation between females and males ($p = 0.006$), with females having higher oxygen saturation on average. The respiratory rates between females and males are statistically different with females having a higher respiratory rate on average. There is a statistically significant difference in heart rates between females and males with females exhibiting a higher heart rate on average.

CONCLUSION:

In conclusion, this study provides valuable insights into the evaluation of cardiac abnormalities in children aged 0-18 years through the integration of 2D Echo and clinical outcomes. The robust methodology, including age-specific considerations and a multidisciplinary approach, enhances the generalizability and applicability of the findings. The study reinforces the pivotal role of 2D Echo in

shaping diagnostic and therapeutic pathways, ultimately influencing the long-term clinical outcomes and quality of life for pediatric patients with cardiac abnormalities. These findings contribute to the ongoing evolution of pediatric cardiology practice, emphasizing the importance of a comprehensive and collaborative approach to optimize patient care.

REFERENCES

1. 1.Korkmaz, U. K., Ozkan, E. A., Akkoca, A. N., & Sivaslioglu, E. (2015). Incidence and Clinical Characteristics of Congenital Heart Disease among Neonates in Neonatal Intensive Care Unit. American Journal of Health Research, 3(3), 161-165.
2. Moons, P., Sluysmans, T., De Wolf, D., Massin, M., Suys, B., Benatar, A., & Gewillig, M. (2009). Congenital heart disease in 111 225 births in Belgium: birth prevalence, treatment and survival in the 21st century. Acta paediatrica, 98(3), 472-477.
3. Saleh, H. K. (2009). Pattern of congenital heart disease in Southern Yemeni children referred for echocardiography. Saudi medical journal, 30(6), 824-828.
4. Khalil, A., Aggarwal, R., Thirupuram, S., & Arora, R. (1994). Incidence of congenital heart disease among hospital live births in India. Indian pediatrics, 31(5), 519-528.
5. Awori, M. (2013). The spectrum of paediatric congenital heart disease at the Kenyatta National Hospital: Implications for surgical care. Annals of African Surgery, 10(1).
6. Mozes J, Safarikova M, Skovranek J. "Two-dimensional echocardiography in pediatric cardiology." Pediatr Cardiol. 1984 Summer;5(2):87-91.
7. Lai WW, Geva T, Shirali GS, "Guidelines and standards for performance of a pediatric echocardiogram: a report from the Task Force of the Pediatric Council of the American Society of Echocardiography." J Am Soc Echocardiogr. 2006 Dec;19(12):1413-30.
8. Lang RM, Bierig M, Devereux RB,American Society of Echocardiography's Nomenclature and Standards Committee; Task Force on Chamber Quantification; American College of Cardiology Echocardiography Committee; American Heart Association; European Association of Echocardiography 2005 Dec;18(12):1440-63.
9. Sarikouch S, Peters B, Gutberlet M, Leismann B, Kelter-Kloepping A, Koerperich H, Kuehne T, Beerbaum P. "Sex-specific pediatric percentiles for ventricular size and mass as reference values. 2010 Mar;3(2):65-76.
10. Pinto NM, Weng C, Wilkins-Haug L, Blei D, Babington L, Patel M, Maron BA. "Functional capacity in patients ." Pediatr Cardiol. 2015 Feb;36(2):334-40.
11. Brown DW, Gauvreau K, Powell AJ, Lang P, del Nido PJ, Odegard KC, Geva T. "Cardiovascular, : age-related differences in ventricular volumes, biventricular function, and the impact of pulmonary artery distortion." J Am Coll Cardiol. 2011 Feb 22;57(8):831-8.