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ORIGINAL ARTICLE

Frequency of Attention-Deficit Hyperactivity Disorder (ADHD) in Patients with Congenital Heart Diseases (CHD) at NICVD Karachi, Pakistan

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ABSTRACT

Background: The study aimed to assess the frequency and impact of attention-deficit hyperactivity disorder (ADHD) on behavior, social-emotional development, intelligence, and overall quality of life among school-aged children with congenital heart diseases (CHD).

Methodology:

A descriptive cross-sectional study was undertaken at the National Institute of Cardiovascular Diseases (NICVD) between July 2021 to August 2021. A total of 100 CHD patients aged 6 to 18 were assessed using the non-probability purposive sampling technique. The data was collected using a questionnaire comprising SNAP-IV 26 Scale that is a screening tool for ADHD. The collected data was entered and analyzed by using Statistical Package for Social Sciences (SPSS) v 24.0. The statistical analysis was carried out with a confidence interval set at 95% and no p-value was determined as a threshold of statistical significance, owing to the qualitative nature of the data.

Result: The study comprises n=100 CHD patients, aged 6 to 18 with the mean age ± standard deviation of 11.18 ± 3.914, and males and females stratifiable into 56% and 44% respectively. The ADHD screening identified n=22 (22%) subjects as highly suspected of having ADHD with no statistically significant gender difference (n=10 females vs. n=12 males). The study revealed Ventricular Septal Defect (VSD) to be the most common (28%) congenital heart defect across the in-patient and out-patient settings. VSD is followed by Atrial Septal Defect (ASD) at 24%, Tetralogy of Fallot (TOF) at 22%, Atrioventricular Septal Defect (AVSD) at 19%, and Aortic Stenosis (AS) in 7% of the patients. Out of the 25% facing comorbidities, hypertension dominated the subset of 23%.

Conclusion: This study suggests that children with CHD are at an increased risk of developing ADHD, the hyperactive and the combined subtype in particular, compared to the healthy population. About 22 percent of the subjects manifested a typical clinical picture of an ADHD patient with mostly living a 'somewhat difficult' life.

Keywords: Children, Congenital Heart Disease, CHD, Attention-Deficit Hyperactivity Disorder, ADHD, Ventricular Septal Defect, VSD, Atrial Septal Defect, ASD

INTRODUCTION

Congenital heart diseases (CHD) refer to a broad array of simple to complex developmental anomalies involving the structural and functional defects of the heart walls, chambers, and/or great vessels. In Pakistan, the most common cardiac lesions include atrial septal defect (ASD), ventricular septal defect (VSD), aortic stenosis (AS), atrioventricular septal defect (AVSD), cardiomyopathies, and tetralogy of Fallot (TOF) among a few others. [1]

Congenital heart disease is the most frequently diagnosed type of all congenital disorders, afflicting between 0.8 and 1.2 percent of live births worldwide [1], out of which only 15 percent of the recorded cases can be traced etiologically. [2] An upsurge in CHD numbers can be associated with countries that have higher fertility rates, financial constraints, and educational deficits. This equation has been backed up by numerous research and databases provided by Global Burden of Disease 2017 that reveal South Asia and Africa have significantly higher incidence and mortality rates than other developed economies. Approximately 6 to 10 percent of newborn mortality is attributable to congenital heart disease, with an additional 20 to 40 percent attributable to malformations.[3]

It is challenging to determine the actual and authentic prevalence of these congenital cardiac abnormalities in the rural segment-dominated Pakistani population, as 80 percent of rural childbirths are performed at home by traditional birth attendants (TBA). [4] However, the only local study to ever generate an incidence report of Pakistan calculated it to be 4/1000 live births.[5] It is also attributable to the fact that they typically arise prenatally which tends to go unnoticed due to the ignorance of pregnant women, and lack of the proper utilization of antenatal care, and screening procedures. [6]

Numerous studies have been carried out to assess the neurocognitive implications of congenital heart disease in children up to adolescence. As per neuroimaging and psychological evaluations, the surveys suggest that cardiac anomalies can precipitate impaired neurocognitive function. It is marked by changes in multiple areas, including diminished brain power, an increased risk of seizure or stroke, and an altered level of consciousness (ALOC), [7], or diminishing IQ as a result of chronic or prolonged hypoxia and cyanotic lesions. However, our point of focus in this study is the outcome of attention-deficit/hyperactivity disorder (ADHD) as a late complication in CHD patients. CHD greatly hikes the risk of developing ADHD by three to four times as compared to the normal population, making it one of the most frequently observed complications. Generally, the probability of developing neurological morbidity in the CHD population is low owing to a dramatic expansion in the cardiopulmonary bypass (CPB) circuit and extensively practiced neuroprotective techniques in both intraoperative and critical care settings. However, due to limitations in therapeutic resources for CHD management and data collection in a developing country like Pakistan, its statistical analysis demands rigorous research to conclude the association between CHD and neurological outcomes.

Improved quality of medical and surgical care has certainly lowered the mortality and morbidity in congenital heart disease patients to some extent. Yet the patients can develop neurocognitive and psychiatric morbidities.[8] The purpose of this study is to find the prevalence of attention-deficit/hyperactivity disorder in NICVD among children and adolescents with congenital heart disease. It is significant to highlight the treatable cognitive problems because it hinders the quality of life that mostly goes unnoticed. Children and adolescents with attention deficit/hyperactivity disorder develop concentration difficulties which affect their school performance while also impacting their long-term mental health status concomitantly. Recognizing ADHD

at the earliest age in patients would be much beneficial in the management of the patients to improve their quality of life.

MATERIALS AND METHODS

A descriptive cross-sectional study was undertaken at the National Institute of Cardiovascular Diseases (NICVD) between July 2021 to August 2021 after the approval from the Institutional Review Board. The sampling technique was non-probability purposive sampling. The data was collected through a Questionnaire that used SNAP-IV 26 Scale.

The study was conducted on 100 patients of CHD identified at the pediatric OPD and ward of NICVD as they were assessed for ADHD using a Questionnaire and SNAP-IV 26 Scale. The inclusion criteria were age 6 to 18 years from both genders. Exclusion criteria were patients under 6 and beyond 18 years with an unconfirmed diagnosis of congenital heart disease or a known case of acquired heart disease.

All ethical measures were undertaken for data collection and documentation. Informed consent was sought from all the participants and confidentiality of their identities is maintained.

Procedure: A structured questionnaire was administered to obtain detailed information through interviewing the parents/guardian. The socio-demographic characteristics along with the medical & surgical history were extracted. SNAP-IV 26 scale was used to assess the patients for Attention Deficit/Hyperactivity Disorder as it screened for nine symptoms of ADHD hyperactive-impulsive type, nine symptoms of ADHD inattentive type, and eight symptoms of oppositional defiant disorder. The BMI kg/m^2 of the patients was also assessed.

The analysis of data was performed using SPSS version 24.0. Mean standard deviation was then determined and calculated for descriptive statistics, while categorical variables were represented as frequency and percentages. Cross tabulations were done for corresponding variables in terms of their percentages. The statistical analysis was done with 95% confidence interval with no p value determined as threshold of statistical significance owing to the qualitative nature of the data.

RESULTS

Out of 100 subjects of congenital heart diseases that were analyzed aged 6 to 18, approximately 59% fell under the threshold of 12 years. The mean age ± standard deviation turned out to be 11.18 ± 3.914 (Table-I).

Table 1: Socio-demographics of CHD population (n=100)

Characteristics	Percentage	Mean ± SD
Age groups (in years)		11.18 ± 3.914
< 12 years	59%	
≥ 12 years	41%	
Gender		-
Male	56%	
Female	44%	
Residence		-
Rural	57%	
Urban	43%	
Ethnicity/ Cast		-
Balochi	14%	
Punjabi	15%	
Pushtoon	12%	
Sindhi	33%	
Urdu Speaking	26%	

The study population stratification based on the CHD type reveals that VSD is the most prevalent condition (28%) across the in-patient and out-patient settings, followed by ASD with 24%, and TOF with 22%. ASD and VSD were frequently reported in combination; they existed concurrently in a total of 19 patients. The subset of AS makes 7% of the CHD population included in our study, standing as the least common defect out of all.

Our survey encompassed the medical and surgical history of every subject involved. Upon the measurement of comorbidity, limited to a certain list of conditions (Table-II), 75% of the patients were ascertained to be free of other associated ailments. However, hypertension bore a share of about 23% to the comorbidity burden in our remaining population. Our study reveals that more than half of the patients experienced frequent episodes of angina. In the surgical domain, 40% of the patients had a history of surgical intervention, with most surgeries accounting for TOF followed by AVSD, 13% and 10% respectively. (Table-III)

Table 2: Distribution of comorbidities among the participants

Comorbids	Congenital Heart Diseases					
	AS	ASD	VSD	TOF	VSD	Total
Diabetes	0	1	0	0	0	1
Hyperlipidemia	0	0	0	1	0	1
Hypertension	3	6	6	4	4	23
None	4	17	13	17	24	75
Total	7	24	19	22	28	100

Table 3: Frequency distribution of CHD patients that underwent corrective cardiac surgeries

	Congenital Heart Diseases					
History of Cardiac Surgery	AS	ASD	AVSD	TOF	VSD	Total
	4	16	9	9	22	60
Yes	3	8	10	13	6	40
Total	7	24	19	22	28	100

Children with CHD are relatively more susceptible to neurodevelopmental deficits such as ADHD as opposed to a healthy population. A deeper evaluation of the study participants through the SNAP-IV 26 scale allowed us to screen the patients for the presence of ADHD. The results indicated that 22% of the children aligned with the idea of inattentiveness, impulsivity, emotional dysregulation, or distractibility. The data suggests no significant association amid the presence of ADHD with the type of CHD it exists with; there is almost an equal predilection of every cardiac defect towards the development of ADHD. While ADHD can be stratified into an impulsive/hyperactive type, inattentive/distractible type, and the combined type; each half of the patients determined with ADHD (22%) could be correlated with the hyperactive (50%) and the combined subtype (50%).

The SNAP-IV 26 scale incorporated a quick question into assessing the quality of life of each subject with and without ADHD. The subjects with positive ADHD diagnosis were mostly reported with their lives becoming 'somewhat difficult'.

10% female patients and 12% male patients were diagnosed with ADHD.

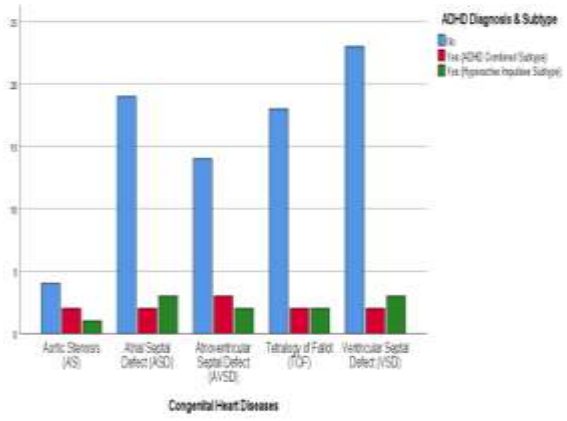

Figure 1: Distribution of ADHD diagnosis and subtypes among CHD patients (%)

The distribution of ADHD among different types of CHD is given in Figure 1. ADHD was further categorized into ADHD centered type (red) and Hyperactive impulsive subtype (green). It was found that the lowest rates of ADHD were found in patients

with AS while highest rate was found in patients with ASD, AVSD, and VSD.

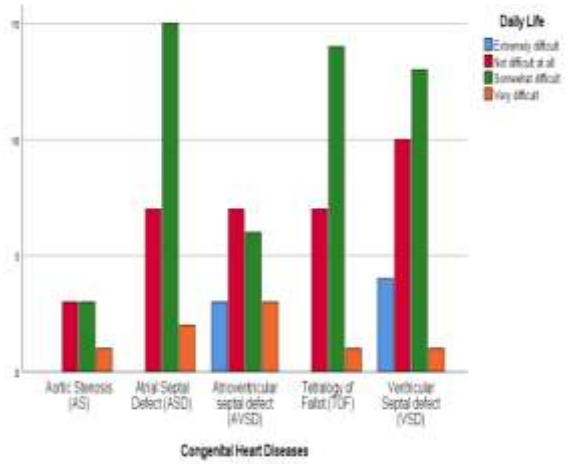

Figure 2: Quality of life of CHD patients due to ADHD (%)

Figure 2 revealed that patients with ADHD had poor quality of life with majority describing their lives as somewhat difficult while few of the patients also claimed very difficult lives due to their condition.

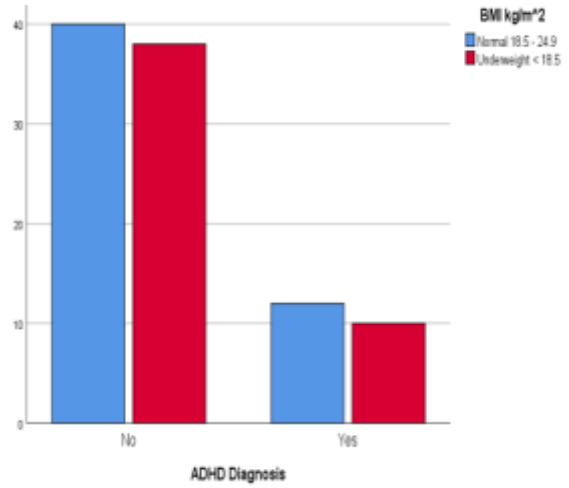

Figure 3: Distribution of BMI with ADHD (%)

It was found that 11% of the patients with ADHD had normal BMI while 10% were underweight (BMI < 18.5%) (Figure 3).

DISCUSSION

The global prevalence of ADHD in children and adolescents is estimated to be 5.29% [18]. Behavioral changes (36–40%), major depressive episodes (18%), anxiety (26%), and learning deficits (30%) [19] are all frequently reported with ADHD thereby impacting their quality of life.

Individuals with cardiac anomalies can particularly be afflicted with neurocognitive deficits. Regardless of the likelihood to develop other genetic comorbidities or neurological complications, our study focuses on determining the overall frequency of ADHD in the CHD population. Our study suggests a strikingly high rate of 22% in contrast to 3% recorded among the general population of school-age children in Pakistan [20]. Various other studies reinforce this equation that the CHD population is at an increased risk of acquiring neurocognitive complications [9] with statistics showing that ADHD is more common in CHD children of age 4 to 17 years at 5.1% than in children without CHD at 2.1%. The affected mental capacity in ADHD is largely attributable to chronic hypoxia and resultant cyanotic lesions due to cardiac problems like septal defects. A large proportion of children with CHD suffer from ADHD that tends to affect their lives and hinder their daily activities or social interaction. Our findings agree with present data on mental health disorders in children with congenital heart disease [9, 10] as well as with studies that support the increased prevalence of depression, anxiety, and ADHD in adolescents with ventricular congenital heart disease. [8] Other studies indicate that 29% of children aged 7 to 15 years undergoing corrective cardiac surgeries manifested ADHD symptomatology within a year of operation. [17] Our study incorporated the use of the SNAP-IV 26 scale to interview our CHD subject and their parents to calculate ADHD scores that make our study distinctive from others that were based on self-report surveys to evaluate neurological complications. [9]

In terms of cardiac anomalies, 57% belonged to rural areas that agree with the current data on CHD prevalence in rural areas of Pakistan. [4] Our study shows a slightly higher prevalence of CHD among males (56%) in Pakistan consistent with another study [5] that also stated approximately a similar figure of 56.3%. However, another study at a global level [1] proved an equal prevalence of CHD among females and males across the span of 1990-2017. Furthermore, our findings indicate that VSD at 28% and ASD at 24% are the frequently occurring congenital cardiac defects in Pakistan, comparable with a study conducted at tertiary care cardiac hospital of Karachi [5] recording VSD in 21.5% of the population followed by ASD present in 9.3% participating population. CHD is one of the leading causes of death among infants because of low birth weight. [11, 16] Fortunately, various studies have shown a significant decrease in mortality over the years due to major improvements in the areas of anesthesia, surgery, and pediatric care. [1, 14, 15]. However, with improvements in surgery and increased survival of the CHD population to adulthood [15], most of the CHD population tends to experience ADHD, which has a great impact on their lives and often goes unnoticed. Children with CHD already suffer from multiple hospital visits and surgeries; ADHD becomes an added burden to their lives that deteriorates their mental health and makes their lives 'somewhat difficult' to lead, as per our survey.

Our study has the limitation of being a single-center study with small sample size. Pakistan being a developing country with an upsurging population is still subjected to strict COVID-19

restrictions. The limited-time allocation per patient for interaction and data collection kept us from exploring various other aspects of ADHD symptomatology.

CONCLUSION

Our study initially concludes that among multiple congenital heart diseases, Ventricular Septal Defect is the most common. Along with this, the study also reveals that due to limited basic medical health care and lack of healthy nutrition and other obscure reasons, the incidence of congenital heart diseases is greater in rural regions and thus higher incidence of ADHD and hyperactivity symptoms. After thorough research and working on our agenda, our study concludes that children with congenital heart diseases are at increased risk of developing ADHD symptoms of both, hyperactive and the combined subtype. 22 percent of our subjects had a typical clinical ADHD presentation and are living a `somehow difficult' life.

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