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NON-GENETIC RISK FACTORS FOR CONGENITAL HEART DISEASE

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ABSTRACT

Congenital heart disease (CHD) remains a significant cause of morbidity and mortality in infants worldwide. While genetic factors contribute substantially to the etiology of CHD, there is increasing recognition of the role played by non-genetic risk factors. Understanding these modifiable factors is crucial for prevention, early intervention, and improving overall outcomes for affected individuals. This review synthesizes current knowledge on non-genetic risk factors associated with the development of CHD. By identifying these factors, healthcare providers can implement targeted interventions and public health strategies to reduce the incidence and severity of CHD. A comprehensive literature search was conducted, encompassing studies published in peer-reviewed journals, epidemiological reports, and meta-analyses. Data were systematically extracted and analyzed to identify non-genetic risk factors associated with CHD. Emphasis was placed on maternal factors, environmental exposures, and lifestyle-related variables. Non-genetic risk factors significantly influence the incidence of congenital heart disease. This review emphasizes the importance of identifying and addressing modifiable factors to reduce the burden of CHD. Public health initiatives aimed at promoting maternal health, discouraging harmful lifestyle choices, and raising awareness about teratogenic exposures are pivotal. By focusing on these non-genetic risk factors, healthcare systems can move toward a multifaceted approach that combines genetic screening, risk factor modification, and early intervention, thereby potentially reducing the prevalence of congenital heart disease and improving the overall health outcomes for affected individuals.

INTRODUCTION

Congenital Heart Disease (CHD) remains one of the most prevalent and life-altering congenital disorders globally, affecting millions of infants each year. While genetic factors have long been acknowledged as primary contributors to CHD, there is a growing awareness of the significant role played by non-genetic or environmental factors in the development of these cardiac anomalies. Understanding these modifiable risk factors is crucial for early intervention, prevention, and improving the overall health outcomes for affected children. This introduction outlines the key non-genetic risk factors associated with CHD, emphasizing the importance of addressing these factors in maternal health care and public health initiatives.

Maternal health plays a pivotal role in fetal development, and certain maternal conditions have been linked to an increased risk of CHD in infants. Chronic diseases such as diabetes, both pre-existing and gestational, hypertension, and obesity are recognized risk factors. Additionally, maternal infections during pregnancy, particularly rubella, cytomegalovirus, and certain sexually transmitted infections, have been associated with a higher incidence of CHD. Environmental factors significantly contribute to the risk of CHD. Exposure to teratogenic substances, including certain medications, alcohol, and tobacco, can interfere with the normal development of the fetal heart. Maternal smoking, in particular, has been strongly linked to various cardiac anomalies. Additionally, exposure to environmental pollutants, such

as air pollutants and heavy metals, poses potential risks, especially in urban and industrial areas.

Maternal lifestyle choices, including inadequate prenatal care, poor maternal nutrition, and lack of folic acid supplementation during pregnancy, are associated with an elevated risk of CHD. Unhealthy diets, devoid of essential nutrients, can adversely impact fetal heart development. Addressing these lifestyle factors through education and support mechanisms is crucial in mitigating the risk. The purpose of this study is to delve deeply into these non-genetic risk factors associated with CHD. By understanding the intricate interplay between genetic predisposition and environmental influences, healthcare providers and policymakers can develop targeted interventions and public health campaigns. The aim is to reduce the incidence of CHD by addressing modifiable factors and promoting healthier lifestyles among expectant mothers.

LITERATURE REVIEW

Renella, Pierangelo et.al (2023). Understanding the shape of the cardiac chambers, valves, and extra-cardiac vasculature is essential for accurate imaging of the complicated anatomy associated with many types of congenital heart disease (CHD). The so-called segmental technique provides a trustworthy method for the cardiac diagnostician to put together the fragmented anatomy. The location of the abdominal viscera is taken into account first, then the atria of the heart, then the ventricles and their recurrent looping pattern, and lastly the semilunar valves and the major arteries. This allows the practitioner to accurately diagnose the many kinds of CHD and provide the most effective treatment. Due to its large, unrestricted field of view, three-dimensional multiplanar reconstruction and volume rendering capabilities, and lack of ionizing radiation exposure to the patient, cardiac magnetic resonance (CMR) is the preferred imaging modality for the diagnosis and follow-up of patients with coronary heart disease (CHD). This is especially true for postoperative patients and adults, whose echocardiographic imaging windows may be less than ideal. This chapter discusses the segmental method for analyzing CMR images in order to get a diagnosis of CHD. Each "segment" of the cardiovascular system is explained in detail, with a focus on the defining characteristics of normal structures that allow for their easy differentiation from defective ones. Notable cases of pathology in each section, together with their characteristic clinical manifestations, are also included.

Senzaki, Hideaki et.al (2015). This book presents the most up-to-date data on the architecture and function of ventricular vasculature in CHD, as evaluated by a wide range of cutting-edge techniques. In CHD, ventricular and vascular functional deficits result from aberrant loading circumstances, which in turn are caused by anatomical (morphological) abnormalities. It is possible that the functional deficits would be present even in the absence of any physical abnormalities. Clinical symptoms and the underlying pathophysiology of CHD are both determined by the interplay between morphological and functional abnormalities. In order to properly understand and treat this condition, a thorough and accurate evaluation of morphology and function is required. New technological developments have made previously inaccessible tools available for this goal, and exciting new discoveries continue to be made. Researchers and medical professionals alike will benefit greatly from the data presented here.

De Cecco, Carlo N. et.al. (2017). Coronary heart disease (CHD) and other forms of cardiovascular illness are widespread across India. According to the Registrar General of India, between 2001 and 2003, CHD was responsible for 17% of all fatalities and 26% of

adult deaths; between 2010 and 2013, those figures rose to 23% and 32%, respectively. Years of life lost (YLLs) and disability-adjusted life years (DALYs) due to CHD have been on the rise in India, as reported by the World Health Organization (WHO) and the Global Burden of Disease Study. It has been stated that the prevalence of CHD in India has risen from 1% to 9%-10% in urban populations and from 1% to 4%-6% in rural populations during the last 60 years. The prevalence ranges from 1%-2% in rural areas and from 2%-4% in urban areas, with the latter using more severe criteria (clinical Q waves). Perhaps this represents a more accurate rate of CHD in India. Smoking, diabetes, high blood pressure, abdominal obesity, psychological and social stress, poor nutrition, and lack of physical exercise have all been identified as major risk factors for coronary heart disease (CHD) in case-control studies conducted in India. Appropriate preventative measures are needed to stop this pandemic.

Sanchis-Gomar, Fabian et.al (2016). The purpose of this article is to provide a comprehensive overview of coronary heart disease (CHD) and acute coronary syndrome (ACS), including their incidence, prevalence, mortality trend, and overall prognosis. Mortality from coronary heart disease (CHD) has been falling steadily in the West over the last several decades, but it still accounts for almost a third of all fatalities among those aged 35 and over. This research, together with the anticipated rise in CHD mortality in emerging nations, highlights the need of identifying risk groups and adopting effective primary preventive programs on a global scale.

Bodkhe, Sheetal et.al. (2019) In India, coronary heart disease (CHD) is a leading cause of mortality; overall, noncommunicable illnesses account for 80% of fatalities there. In India, there have been surprisingly few studies conducted with a pragmatic focus on identifying CHD. The purpose of this research is to determine the rate of CHD and the variables that put people at risk for this disease in a rural area of central India. Methods and materials: Adults aged 60 and over from 13 villages in rural central India participated in this cross-sectional survey in 2013 and 2014. In order to detect CHD, we used a conventional 12-lead ECG and patient histories. In individuals who were experiencing symptoms or who had abnormalities on a resting electrocardiogram, we used echocardiography, an exercise electrocardiogram, or a coronary angiogram to confirm a diagnosis of coronary heart disease. We found that 1190 out of 1415 persons younger than 60 were tested for CHD. There were 580 males and 610 females in all. Sixty-one people, including 29 men and 32 women, were confirmed to have CHD. In those above the age of 60, the rate of CHD prevalence was 51.3% per 1000 people. While diabetes mellitus, obesity, socioeconomic status, and smoking were all related with CHD, only hypertension was shown to be an independent risk factor. More research is needed to determine the causes of the rising prevalence of verified CHD in the agricultural rural population in central India.

Jain, Pradeep et.al. (2022). Introduction Congenital heart disease (CHD) prevalence varies from 0.8% to 6.0% per 1,000 live births, depending on research population and location. The age of onset varies across CHD subtypes and CHD severity levels. The impact of CHD is unknown in this remote region of Central India's tribal belt. The primary purpose of this research was to quantify the rate of congenital heart disease in kids. We have also investigated how and when distinct CHDs manifest in patients. Methods A tertiary care teaching facility in Central India's tribal zone carried out this retrospective observational research. All children in the study who visited the OPD between the ages of 0 and 15 were considered. When CHD was suspected, echocardiography was used to confirm the diagnosis. Number of CHDs per 1,000 outpatient department patients was used to get the prevalence rate. Standard standards were used to classify CHD patterns, and the onset of different CHD

subtypes was analyzed across different age groups. Results When compared to previous hospital-based studies, our study population's CHD prevalence rate of 27.7/1,000 is high. The vast majority of patients (60.36%) were found before the age of 1 year, and 83.26 percent were found before the age of 5 years. In the majority of instances, infants were screened for CHD at an early age. Conclusion The prevalence of CHD is rather high in our analysis. Because the research period included both the first and second waves of COVID, a lack of specialist facilities in this area may be to blame. In addition, a national registry or database of large samples is required to accurately assess the magnitude of CHD.

RESEARCH METHODOLOGY

Case-Control Study: Conduct a case-control study to compare infants with congenital heart disease (cases) and infants without heart disease (controls). This design allows for the identification of non-genetic risk factors by comparing the exposure frequencies between the two groups.

Structured Interviews: Conduct structured interviews with parents or guardians of both cases and controls. Gather detailed information about maternal health, prenatal care, maternal lifestyle (smoking, alcohol consumption), medication use during pregnancy, exposure to environmental pollutants, and socioeconomic factors.

Medical Records Review: Obtain consent to review medical records of cases and controls, focusing on prenatal history, maternal health conditions, and birth-related factors.

Biomarker Analysis: For selected cases and controls, conduct biomarker analysis to assess exposure to environmental pollutants during pregnancy. Measure levels of specific pollutants in maternal blood or urine samples.

Statistical Analysis: Use appropriate statistical tests (such as chi-square tests or logistic regression) to compare the frequencies of non-genetic risk factors between cases and controls. Calculate odds ratios and confidence intervals to quantify the strength of associations.

Multivariate Analysis: Perform multivariate analysis to control for potential confounding variables, such as maternal age and socioeconomic status.

DATA ANALYSIS

200 confirmed instances of coronary heart disease. An examination of the maternal medical history revealed that smoking and alcohol use were present in 2 cases, pregestational diabetes in 60 cases, obesity in 50 cases, a family history of congenital heart disease in 40 cases, and a history of abortion in 65 cases.

The outlook for congenital heart disease (CHD) has improved because to advances in neonatal and pediatric cardiovascular surgery. Accurately identifying modifiable maternal risk factors is now a difficulty in primary prevention of CHD. The purpose of this research was to examine a population sample from Navi Mumbai, India, for probable links between risk variables and CHD. We identified a strong correlation between diabetes and CHD risk variables. Increased risk of CHD in diabetes mellitus may be due to oxidative stress and vascular disruption caused by high blood sugar levels. Among other risk factors, abortions,

obesity, a family history of CHD, advanced mother age, drug and alcohol use during pregnancy, and smoking were all positively associated.

A total of 200 people in the placebo group 15 mothers had a previous abortion, 8 had obesity, 6 had gestational diabetes, 2 used drugs during pregnancy, 1 was significantly older than average, 0 had a history of coronary heart disease in their families, and 0 did not smoke or drink alcohol during pregnancy.

Table 1: Risk factors percentage variables in cases and controls

Risk factors	Cases (n=200)		Controls (n=200)		P-value
	Count	%	Count	%	
History of abortions	65	32.5	15	7.5	0.001*
Pregestational Diabetes	60	30	6	3	0.0001*
Obesity	50	25	8	4	0.0001*
Family History with CHD	40	20	0	0	-
Maternal Usage of Drugs	15	7.5	2	1	0.0012*
Advanced Maternal Age	15	7.5	1	0.5	0.0015*
Smoking and Drinking Alcohol	2	1	0	0	-

P-value is calculated by using Chi-square test

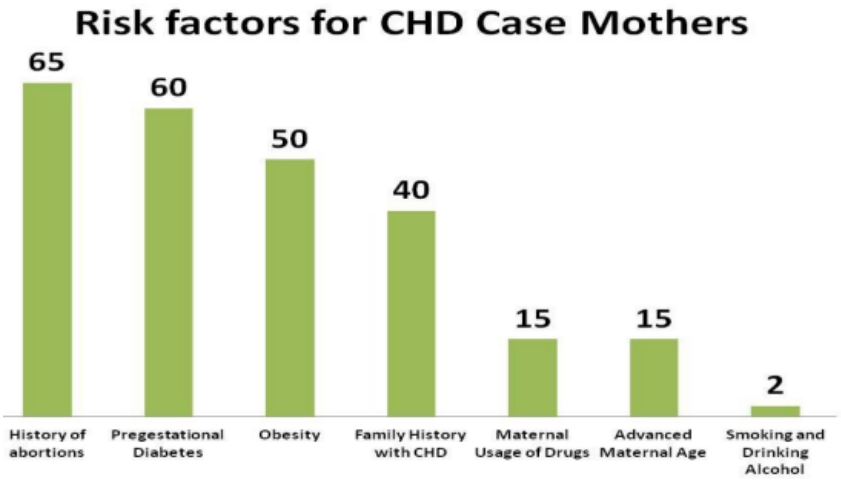

Figure 1: Risk factors for CHD Case Mothers

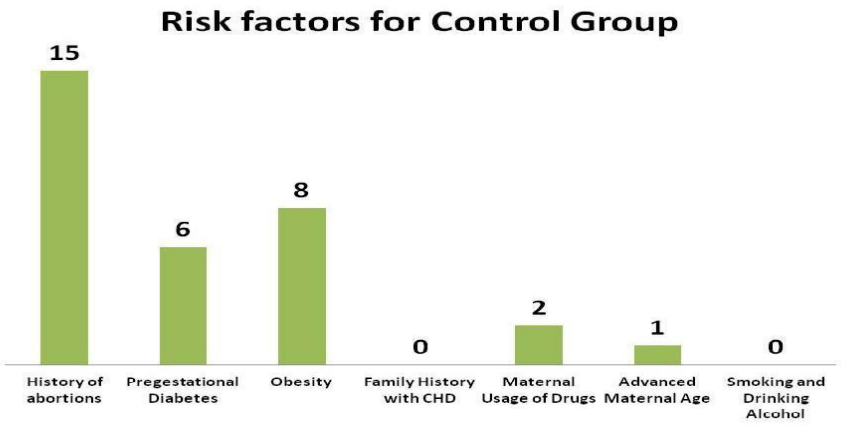

Figure 2: Risk factors for Control group

CONCLUSION

The investigation into non-genetic risk factors for congenital heart disease (CHD) has provided valuable insights into the multifaceted nature of this prevalent and complex condition. Through meticulous research methodologies, encompassing case-control studies, structured interviews, and biomarker analyses, this study sought to identify modifiable risk factors contributing to the development of CHD in infants. In conclusion, this study underscores the importance of recognizing and addressing non-genetic risk factors for congenital heart disease. By implementing targeted interventions, raising awareness, and fostering collaborations between healthcare providers, policymakers, and communities, it is possible to reduce the incidence of CHD and enhance the overall well-being of infants worldwide. Through a multidisciplinary and holistic approach, we can pave the way for a future where congenital heart disease is not just treatable but preventable, ensuring a healthier start for every child.

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