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EXPLORING SOCIOECONOMIC PREDICTORS OF THE DEVELOPMENT OF INFANT CONGENITAL HEART DISEASE: A SCOPING REVIEW

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ABSTRACT

Objective: To determine whether socioeconomic status is a predictor for the development of infant congenital heart disease.
Design and Methods: A Scoping Review was conducted using the Joanna Briggs Institute (JBI) guidelines. Multiple databases were searched using a predefined Boolean logic and search criteria. All search results were managed using Zotero – an open- source reference management software. Duplicate results were deleted, and multiple levels of screening were used to remove any articles that did not meet all the inclusion criteria. For the articles that included the reference, study design, study period, the socioeconomic status metrics measured, and the overall findings were extracted and entered in to an Excel Spreadsheet for Analysis. A Narrative Analysis was then performed.
Results: Of the 7156 items that were initially returned by the search, 16 were used in the final analysis. Three different approaches to measuring socioeconomic status emerged namely: personal parental factors; environmental factors; and neighbourhood factors. Regardless of the approach, the selected studies demonstrated an inverse relationship between the parental socioeconomic level and the risk of the neonates and infants having congenital heart disease.
Conclusion: Independent of the method used to determine socioeconomic status, there is an inverse relationship between parental socioeconomic status and the risk of a neonate/infant being diagnosed with CHD.

INTRODUCTION

Congenital Heart Disease (CHD) is a globally significant pathology, with a prevalence ranging from 3.7 to 17.5 cases per 1000 live births, making it the leading cause of neonatal morbidity and mortality. Approximately 30-40% of all congenital disorders worldwide are attributed to CHD [1]. The literature suggests a multifactorial cause of CHD, indicating an interplay between biological and environmental factors. Some identified environmental factors include maternal exposure to drugs and toxins, as well as maternal illnesses and viral infections during pregnancies [2,3].

One potential risk factor contributing to CHD development is disparities in maternal socioeconomic status (MSES). Over the past two decades, social determinants of health, such as social disadvantages and poverty, have been identified as contributors to illness and poor health, persisting even after medical care is provided. These factors disproportionately affect females and minority populations [4]. While there is substantial literature on the relationship between maternal socioeconomic status and CHD risk, there has been little systematic attempt to synthesize the results of these studies.

Hilton and Ware. [1] delved into the clinical intricacies of heart failure in paediatric patients with CHD. The study, published in Circulation Research [1], provides valuable insights into the challenges and complexities associated with heart failure in this vulnerable population. The authors highlight the importance of understanding the clinical manifestations of CHD-related heart failure, setting the stage for exploring how socioeconomic factors may influence the outcomes of infants with CHD.

Davidson and Schaffer. [2] contributed a distinctive perspective by focusing on cyanotic heart disease within the context of paediatric decision-making. Their work, featured in Berman's Paediatric Decision Making [2], explores the decision processes related to this specific subtype of CHD. By emphasizing the clinical decision-making aspects, the article provides a foundation for understanding how socioeconomic factors may intersect with medical decision processes and influence the outcomes of infants with cyanotic heart disease.

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with Gleb [3] offers a historical perspective on the evolving understanding of the causes of congenital heart disease. Published in Circulation Cardiovascular Genetics [3], Gelb's work traces the historical trajectory of CHD research, providing context for contemporary discussions on its aetiology. By examining the historical roots, this article contributes to a nuanced understanding of the complex factors influencing CHD, including those related to socioeconomic status.

Ngwezi, Hornberger, and Osornio-Vargas [4] presented a scoping review focused on the role of socioeconomic status in the development of congenital heart disease. Featured in Advances in Paediatric Research [4], this review consolidates existing knowledge on the topic, providing a comprehensive overview of research findings. By mapping the landscape of socioeconomic factors about CHD, this scoping review sets the stage for a deeper exploration of how these factors serve as predictors for the occurrence and outcomes of infant congenital heart disease.

By critically examining these seminal works collectively, this review aims to lay the groundwork for future research endeavours, promoting a holistic approach to addressing the intricate relationship between social determinants and the health outcomes of neonates/infants with congenital heart disease. This synthesis is imperative in advancing our understanding of CHD and advocating for comprehensive strategies to mitigate its impact on vulnerable paediatric populations.

METHOD

Study Design

A scoping review was conducted using the Joanna Briggs Institute guidelines on articles that were published between 1990 and 2021.

Databases Searched

Pub Med, EBSCO host, HINARI, Web of Science, CINAHL, Cochrane and LILACS

Key Terms

The following BOOLEAN Logic was used Heart Disease* OR Heart Defect* OR Cardiac Disease* OR Cardiac Defect* OR Congenital Heart Defect* AND Neonate* OR Congenital* OR Newborn OR Baby* OR Infant* AND Socioeconomic status* OR Socioeconomic Status OR Social Status OR Social Position* OR Education OR Income or Occupation

Inclusion Criteria

1. Must be published between January st,1990, and December 31st, 2021
2. Must be a full-textpeer-reviewed article
3. The articles must be in English
4. Full text must be available and in English
5. A socioeconomic indicator must be an independent variable
6. The outcome variable must be a congenital heart disease

Method

The following steps were taken to determine which articles to include in this review. Only articles that made the connection between socioeconomic factors and CHD as an outcome variable were included in the review.

1. The Boolean logic was entered into each Database. After each search, all papers were imported into Zotero which is open- source reference management software.
2. Any duplicates that were identified by Zotero were deleted from the collection.
3. A manual review was then conducted, and any duplicates not detected by Zotero were deleted from the collection.
4. Papers were screened at the level of the title and abstract. If the title and abstract did not lend themselves to the research question, it was tagged 'Abstract Reviewed' and 'Excluded' in Zotero.
5. The full text of the remaining articles was reviewed against the inclusion criteria. If all the inclusion criteria were not met, it was tagged as 'Full Text Reviewed' and 'Excluded' in Zotero. If it met all the criteria, it was tagged as 'Include.'
6. The papers that were tagged as 'Include' were then reviewed and the following data was extracted from each article and placed on to a modified version of the JBI data extraction template for scoping reviews: Reference for paper; Description of the sample; Country of study; Research Design used; All applicable statistics; Any important notes made by the authors in the discussion section of the paper.
7. The data was collated into tables and narrative analysis was conducted.

RESULTS

Study Selection

Using the Boolean operators and the restrictions specified in the technique, a search of the databases produced 7156 items. After identifying and eliminating 1348 duplicate articles, and ineligible articles that have no association with the topic which numbered 3378, 2430 articles remained for screening. Of the 2430 items remaining 1557 were removed because the variables of interest were not explored. Of the remaining 873 items 785 were removed because there was no open access to them, or the studies were conducted with the use of animals, or the investigative objectives differed. At the last stage of screening 88 items remained and 46 items were removed because they were articles from magazines, eBooks, reviews, and reports. Another 21 were removed because the variables were not investigated and the final 5 because the mothers had comorbid illnesses. The final number of papers remaining for consideration was 16.

Emerging Themes

All 16 studies pointed to the fact that neonates who were born to parents of relatively low socioeconomic status were more likely to be diagnosed than neonates who were born to parents of relatively high socioeconomic status. Socioeconomic status is a combination of factors that indicates the social capital that is possessed by the persons in the society they live and operate. Maternal neighbourhood, household income, educational attainment, employment, and employment status were all found to be inversely proportional to the risk of delivering a neonate with CHD.

Table 1 Studies Examining Socioeconomic Status and Congenital Heart Disease

Reference Number#	Author	Year	Study Location	Study Design	Study Period	SES Measured	Level of SES Assignment	Findings
5	Kučienė et al	2009	Lithuania	A population-based case-control study included all newborns born in Kaunas city during 1999–2005.	1999-2005	Maternal socioeconomic (age at delivery, education, marital status, occupation) and lifestyle factors (smoking, alcohol consumption	Individual	Adverse maternal socioeconomic conditions and smoking while pregnant amplified the likelihood of congenital heart defects.
6	Kapakasi et al	2021	Uganda	Hospital-based unmatched case-control study		Alcohol use, low birth weight, and paternal socio-economic status	Individual	The findings indicate that maternal febrile illness during pregnancy, parental alcohol consumption, and paternal socioeconomic status are primary risk factors for congenital heart disease (CHD) among children.
7	Borjali et al	2021	Tehran, Iran	A qualitative study conducted with a thematic content analysis	2019	Identifying nonmedical determinants of CHD from the perspective of a mother.	Individual and Neighbourhood	Subthemes such as social contexts, psychological contexts, and cultural and environmental contexts were recorded.
8	Saijo et al	2021	Japan	Prospective cohort study	2011-2014	Maternal psychological distress, education, household income on infant CHD	Individual	The combination of states' risk factors may be a possible predictor.
9	Peyvandi et al	2020	USA, California	Population-based cohort study.	2007-2012	Association of social deprivation and exposure to environmental pollutants	Neighbourhood.	The incidence of live-born CHD cases was associated with an increase in social deprivation and exposure to environmental pollutants.
10	Williams	1999	USA, Michigan	Qualitative study		Considers how health is affected by the complex combination of disparities in race and socioeconomic status.	Neighbourhood	Outlines ethnic and racial inequalities in healthcare and addressed the complex disparities in health due to SES.
11	Fixler et al	1993	USA, Texas	Prevalence study	1971-1984	Prevalence of CHD among different ethnic groups.	Neighbourhood	Prevalence rates of specific cardiac defects differ among the ethnic groups studied pointing to varied environmental backgrounds.

12	Knowles et al	2017	England and Wales	Prevalence study	2005-2010	Prevalence of CHD. Incidence of CHD by ethnicity, age at intervention, antenatal diagnosis, and area deprivation.	Neighbourhood	Varied incidences of CHDs were higher in Black and Asian ethnic groups compared to the White reference population, especially for CHDs with high mortality.
13	Ou et al	2016	China	Population-based case-control study	2004-2013	Multiple maternal environmental exposures, including living in newly renovated rooms, residential proximity to main traffic, paternal smoking, and maternal occupation as a manual worker.	Individual and Neighbourhood	Maternal environmental exposures/ occupation and perinatal disease/ medication were the main risk factors associated with CHDs. Different etiologic factors may be associated with multiple and isolated CHDs
14	Liu et al	2015	China	Multi-ethnic, community-based, cross-sectional study	2010-2012	History of abortion, family history of CHD, consanguinity among 4 ethnic groups.	Identified modifiable risk factors that may contribute to the incidence of CHD among the ethnic groups studied	The overall prevalence of CHD in four ethnic children at 0-18 years in Xinjiang was 16.5%
15	Li et al	2016	Sweden	Prospective nationwide study	2000-2010	Neighbourhood deprivation and incidence of CHD after accounting for family and individual level potential confounders	Neighbourhood	Neighbourhood that are deprived have higher rates of CHD. Results appear to be independent of individual and family level characteristics
16	Miao et al	2021	Canada, Ontario	Population-based retrospective cohort study	2012-2018	Maternal neighbourhood household income, poverty, education level, employment, and unemployment status. Immigration and minority status, population density and the risk of CHD	Neighbourhood and individual	Findings displayed notable social inequity. Lower maternal neighbourhood household income, poverty, lower educational level, and unemployment status had positive associations with CHD.
17	French et al	2019	USA, Chicago	A cross-sectional study of behavioural and socioeconomic correlates of food purchasing patterns	2014-2016	Poor diet associations with lower household income	Individual	Lower quality and less healthy food were purchased by households with lower income compared to higher income households

18	Xie et al	2021	USA, Pennsylvania	Two population-based surveys, and Spearman's rank correlation between the variables were carried out.	2009-2013	Individual- and neighbourhood-level measures of socioeconomic status	Neighbourhood	Neighbourhood and individual-level SES measures were only significantly concordant in urban areas. Neighbourhood measures poorly account for individual SES in rural areas.
19	Flanagan et al	2019	Sweden	Cohort study	1999-2009	Education level, household disposable income, birth country	Low-SES women have disproportionate exposure to pollutants	Results point to environmental injustice, but air quality could be addressed with continued air quality improvement.
20	Singh et al	2003	USA	Census-based area deprivation index was linked to county mortality data	1969-1998	Investigated age, sex, and race-specific gradients in US mortality.	Neighbourhood And individual	Ariel inequalities in mortality widened because of slower mortality in more deprived areas.

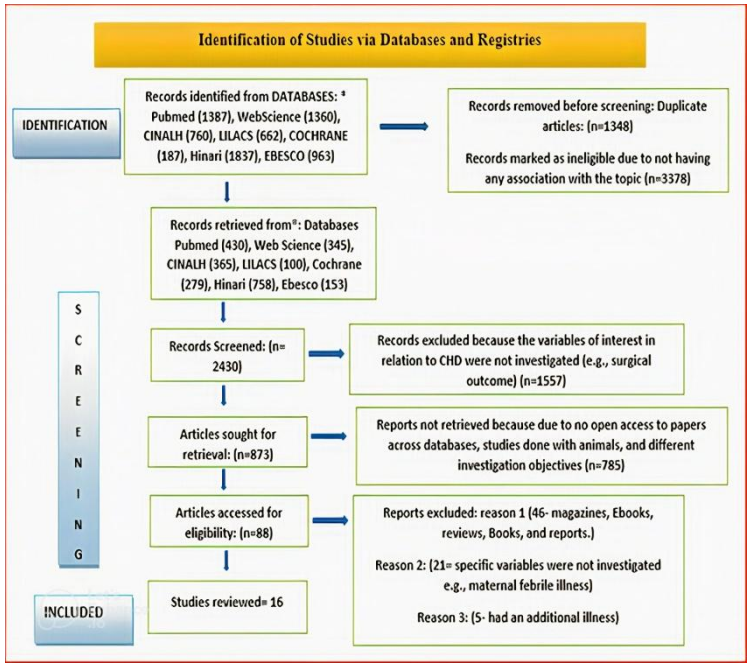

Fig. 1 Algorithm describing the study selection process

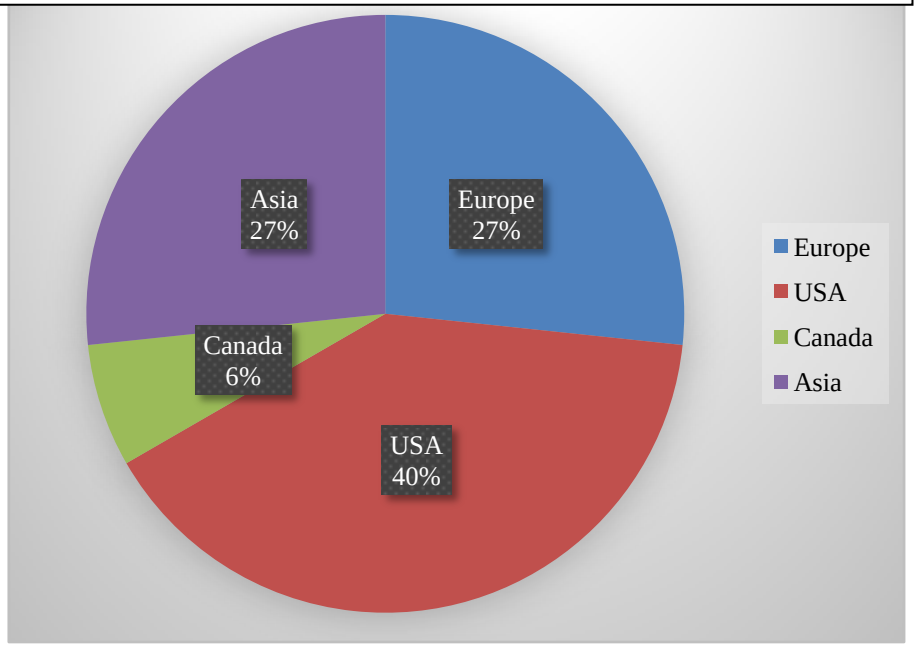

Fig.2 Distribution of selected SES studies and CHD by region

Personal Parental Factors

Three studies examined the relationship between parental socioeconomic status and the risk of having a neonate with CHD and there was agreement that neonates born to parents of relatively lower socioeconomic status were more likely to have CHD than neonates born to parents of relatively higher socioeconomic status. In 2000, authors Kučienė *et al*. [5] investigated the relationship between lifestyle and socioeconomic factors during pregnancy and the risk of developing CHD in Kaunas, Lithuania. The following maternal socioeconomic factors were investigated: education, marital status, occupation, age of delivery and lifestyle factors e.g. alcohol consumption and smoking. These potential CHD risk factors were collected from both case and control mothers via personal interviews. Young mothers (≤19 years) showed an increased risk of 43% of birthing an infant with CHD and single mothers displayed an increased risk of 32% compared to married mothers. These findings could reflect a cumulative effect that results from multiple variables confounding the development of congenital heart disease. [5] These results are comparable to a case-control study conducted in Uganda investigating the relationship between CHD and risk factors relating to the parents. Socioeconomic status was measured using occupation and education level. An adjusted odds ratio showed that primary-level educated mothers carried the highest risk (2.38, 95% CI, 0.88 – 6.46) of birthing children with congenital heart disease [6].This is supported by qualitative research from Iran by Borjali *et al*. [7] , who's findings indicate that childhood poverty, parental unawareness of congenital diseases, inadequate nutrition and healthcare facilities, and limited education, were the most influential factors associated with the occurrence of congenital heart disease in children from their mothers' perspective.

Maternal psychological distress represents another type of variable that relates to socioeconomic status and the development of congenital heart disease [8]. Saijo *et al*. investigated maternal education and household income in the second and third trimesters. In this study, after crude logistic regressions, the only statistically significant association with infant CHD was psychological distress; being 1.39 times more likely (95% CI, 1.03 – 1.870) to result in an infant born with CHD as compared to the control [8].

Environmental Factors

There was agreement among the four studies that attempted to link ethnic disparities with the risk of a neonate having CHD via environmental injustices that exist resulting in persons with lower SES living in more polluted environments. Pollution and hazard exposure may be due to environmental injustice which stems from disparities in ethnicity and socioeconomic status [9,10]. Peyvandi et al. [9] conducted a population-based cohort study that investigated the association between the incidence of CHD and socioeconomic and environmental factors. A database was used to identify births between 2007 to 2012 that included clinical and demographic information on mothers and infants. Kučienė *et al*. [5], Peyvandi *et al* [9] considered the social deprivation index (SDI) and environmental exposures at the neighbourhood level [9]. The findings showed that there was a distinct increase in the incidence of infants being born with CHD when they reside in neighbourhoods with social deprivation and environmental pollutants.[10] In 1993, Fixler *et al*. [11] estimated the prevalence of CHD for Black, White, and Mexican American children born in Dallas County, Texas by a population-based study. It was found that CHD prevalence was higher in white children than in black. Socioeconomic status does not only act as a confounder of differences in race but is a determinant of how race may affect health. [11] Ethnic and socioeconomic deprivation was also highlighted in a study Knowles *et al*. [12]. In this study, the incidence of CHD requiring cardiac intervention among ethnic groups was considered in England and Wales. The findings showed that non-White children were recorded to have CHD at higher percentages when compared to white children. Additionally, 51.4% of Asians, 53% of Blacks, and 44.2% from other ethnic non-White ethnic groups resided in the most deprived areas compared to only 23.2% of white children. The incidence was notably elevated in children of Black and Asian ethnicities. Ou *et al*. [13]. investigated risk factors that may be pertinent in deciphering the aetiology of CHD in a population-based case-control study in Guangdong, Southern China. Its findings underscore a dose-response effect; with increased maternal environmental exposures there is also a significantly increased risk of isolated CHDs. Dangerous chemicals like organic solvents and pesticides had a nearly 9-11-fold increased risk for the development of CHD. While there is evidence of the contribution that maternal exposure has on the development of CHDs, its biological mechanism is still not understood and beckons more research. Additional findings Ou *et al*. [13] showed that socioeconomic factors like household income and maternal education carried an increased risk of 2.27(OR, 95% CI, 1.67, 3.03) and 1.47(OR, 95% CI, 1.12, 3.34) respectively when compared to the control group. These findings are consistent with results from Kučienė *et al*. [5] that studied similar socioeconomic variables [13]. Additionally, in 2015, Liu *et al*. [14] identified modifiable risk factors that may contribute to the incidence of CHD among the ethnic groups studied in China like family history of CHD, and consanguinity.

Neighbourhood/Community Factors

There was agreement among the three studies that examined the relationship between socioeconomic status and the risk of having a neonate with CHD using neighbourhood characteristics. The less desirable the neighbourhood, the higher the risk of having a neonate with CHD Li *et al*. [15] investigated whether there was a significant association between the incidence of CHD and neighbourhood deprivation in Sweden. Neighbourhood deprivation was characterized by summary index calculations. This was based on female and male residents 20 – 64 years old because they were the most socioeconomically active. The findings showed that the odds of CHD increased by 23% when living in a neighbourhood that was highly deprived. The odds of an infant being born in a moderate deprivation neighbourhood was 1.17 (95% CI = 1.01 – 1.35) compared to a neighbourhood with low deprivation [15]. Miao *et al*. [16] studied the variables related to various levels of socioeconomic status in neighbourhoods and the risks of CHD. Notably, infants born in neighbourhoods with lower percentages of minorities and immigrants had a lower risk of CHD than in neighbourhoods with lower percentages. Regardless of the indicator used, the OR concluded that the risk of CHD was most significant in deprived areas. Lower education levels can correlate to lower income and lower-income households may not have access to higher-quality food due to low purchasing capacity [16]. French *et al*. [17] investigated how the quality of household food purchases was

associated with household income. The study was done in Chicago, in the United States from the period of 2014-2016 via a cross-sectional method. Findings indicated that households with low income (compared to the national poverty line within the United States) purchased foods that were less healthy like fruits and vegetables but bought more sugary and empty high-calorie foods compared to higher-income households [17]. In contrast, Xie et al. [18] conducted a population-based study in Pennsylvania which found that outside of urban areas, the correlation between individual and neighbourhood-level socioeconomic status (SES) measures is weak, indicating that neighbourhood-level measures do not sufficiently represent individual SES in rural settings. This may point to a limitation in using neighbourhood SES indicators.

DISCUSSION

One of the major themes that emerged from the results was that there were varying methods of determining socioeconomic status. In this review, three approaches emerged. The first approach that was used to determine socioeconomic status was parental characteristics which included but were not limited to educational level, household income, nature of job and employment status. The second approach was to use environmental factors. Building upon previous theories, it is assumed that environmental quality could be used as a proxy measure for socioeconomic status because of environmental injustices where persons of lower socioeconomic status live in poorer-quality environments. It is also a well-established fact that exposure to pollutants during pregnancy will result in a higher risk of developing congenital pathologies [19]. The third approach was using neighbourhood characteristics such as neighbourhood deprivation, as this is usually an indication of what the parents can afford. The general conclusion however appears to be unchanged no matter the method used for establishing socioeconomic status, that there is an inverse relationship between the socioeconomic status of parents and the risk of having a neonate with CHD [20].

It is noted however that there are some limitations to this study. 15 of the 16 studies were conducted in the Global North which has a very different reality than countries in the Global South. This represents a gap in the data. It was also noted that there were no longitudinal studies in the mix that could compare health outcomes among parents who may have had multiple children under different socioeconomic experiences. Only studies in English were used which may introduce some bias to the findings.

CONCLUSION

The association between lower parental socioeconomic status and an increased risk of congenital heart defects (CHD) in infants underscores the importance of holistic care during pregnancies within marginalized communities[21, 22]. Beyond biological considerations, physicians need to factor in socioeconomic influences, urging a comprehensive approach to prenatal management [23].

However, achieving these goals demands equitable access to comprehensive prenatal screenings, notably including fetal echocardiography and routine obstetric ultrasounds. Governments must prioritize swift measures to ensure universal access to reliable ultrasound services for all expectant mothers. This essential accessibility aligns with informed decision-making throughout pregnancy, enabling proactive strategies for potential postnatal complexities that may arise [24, 25].

Moreover, delving into this correlation warrants expanded research initiatives in emerging economies [26]. These diverse contexts may introduce nuanced realities impacting the relationship between socioeconomic status and CHD prevalence. Thus, dedicating resources to comprehensive studies within these settings is crucial for a deeper understanding and targeted interventions.

Recommendations

1. Implement specialized training programs for healthcare providers working in marginalized areas to heighten awareness of the link between socioeconomic status and CHD risk. This education should emphasize the importance of considering socioeconomic factors alongside biological aspects in managing pregnancies [27].
2. Launch community outreach programs to educate individuals in marginalized populations about the significance of prenatal screenings, including ultrasounds [28, 29]. This involves spreading awareness about their availability, importance, and potential impact on prenatal and postnatal care.
3. Allocate resources and funding for research initiatives focusing on the association between socioeconomic status and CHD in emerging economies [30]. Foster collaborations between local healthcare institutions, researchers, and international organizations to gain comprehensive insights into the multifaceted realities impacting this relationship.
4. Support and encourage longitudinal studies to track the effects of improved access to prenatal screenings, especially ultrasounds, on pregnancy outcomes within marginalized populations [31]. These studies can provide concrete data to further advocate for continued and expanded access to such healthcare services.
5. By implementing these recommendations, it's possible to address the disparities in access to prenatal care and improve pregnancy management [29], thereby reducing the impact of lower parental socioeconomic status on the occurrence and management of congenital heart defects in infants.

References

1. Hinton RB, Ware SM. Heart Failure in Pediatric Patients with Congenital Heart Disease. Circ Res. 2017;120(6):978-994
2. Davidson J, Schaffer MS. Cyanotic heart disease. In: Berman's Pediatric Decision Making. Elsevier Inc.; 2011 p. 537–41.
3. Gelb BD. History of Our Understanding of the Causes of Congenital Heart Disease. Circ Cardiovasc Genet 2015;8(3):529–36
4. Ngwezi DP, Hornberger LK, Osornio-Vargas A. The role of socioeconomic status and the development of congenital heart disease: A scoping review. Adv Pediatr Res. 2018;

5. Kučiene R, Dulskiene V. Maternal socioeconomic and lifestyle factors during pregnancy and the risk of congenital heart defects. Medicina (B Aires). 2009; 45(11):904–9.
6. KahambuKapakasi G, Mawa R, Namuyonga J, Lubega S. Factors Associated with Congenital Heart Diseases among Children in Uganda: A Case-Control Study at Mulago National Referral Hospital (Uganda Heart Institute). Cardiol Cardiovasc Res. 2021; 5(1):1.
7. Borjali M, Amini-Rarani M, Nosratabadi M. Nonmedical Determinants of Congenital Heart Diseases in Children from the Perspective of Mothers: A Qualitative Study in Iran. Cardiol Res Pract. 2021; 2021: 1–10.
8. Saijo Y, Yoshioka E, Sato Y, Azuma H, Tanahashi Y, Ito Y, et al. Maternal psychological distress, education, household income, and congenital heart defects: a prospective cohort study from the Japan environment and children's study. BMC Pregnancy Childbirth. 2021; 21(1):1–10.
9. Peyvandi S, Baer RJ, Chambers CD, Norton ME, Rajagopal S, Ryckman KK, et al. Environmental and socioeconomic factors influence the live-born incidence of congenital heart disease: A population-based study in california. J Am Heart Assoc. 2020; 9(8): 1–11.
10. Williams DR. Race, Socioeconomic Status, and Health The Added Effects of Racism and Discrimination. Ann N Y Acad Sci 896(1):173–88
11. Fixler DE, Pastor P, Sigman E, Eifler CW. Ethnicity and socioeconomic status: Impact on the diagnosis of congenital heart disease. J Am Coll Cardiol [Internet]. 1993; 21(7):1722–6.
12. Knowles RL, Ridout D, Crowe S, Bull C, Wray J, Tregay J, et al. Ethnic and socioeconomic variation in incidence of congenital heart defects. Arch Dis Child. 2017;102(6):496–502
13. Ou Y, Mai J, Zhuang J, Liu X, Wu Y, Gao X, et al. Risk factors of different congenital heart defects in Guangdong, China. Pediatr Res. 2016; 79(4):549–58.
14. Liu F, Yang YN, Xie X, Li XM, Ma X, Fu ZY, et al. Prevalence of congenital heart disease in Xinjiang multi-ethnic region of China. PLoS One 2015 10(8):e0133961
15. Li X, Sundquist J, Hamano T, Zöller B, Sundquist K. Neighbourhood deprivation, individual-level and familial-level socio-demographic factors and risk of congenital heart disease: A nationwide study from Sweden. International journal of behavioral medicine. 2016 Feb; 23: 112-20.
16. Miao Q, Dunn S, Wen SW, Lougheed J, Reszel J, Lavin Venegas C, et al. Neighbourhood maternal socioeconomic status indicators and risk of congenital heart disease. BMC Pregnancy Childbirth. 2021; 21(1)
17. French SA, Tangney CC, Crane MM, Wang Y, Appelhans BM. Nutrition quality of food purchases varies by household income: The SHoPPER study. BMC Public Health. 2019; 19(1):1–8.
18. Xie S, Hubbard RA, Himes BE. Neighborhood-level Measures of Socioeconomic Status are More Correlated with Individual-level Measures in Urban Areas Compared to Less Urban Areas. Ann Epidemiol [Internet]. 2020 Mar 1 [cited 2021 Oct 10]; 43:37. Available from: /pmc/articles/PMC7160852/
19. Flanagan E, Stroh E, Oudin A, Malmqvist E. Connecting Air Pollution Exposure to Socioeconomic Status: A Cross-Sectional Study on Environmental Injustice among Pregnant Women in Scania, Sweden. Int J Environ Res Public Health 2019; 16(24)
20. Singh GK. Area Deprivation and Widening Inequalities in US Mortality, 1969-1998. Am J Public Health. 2003; 93(7):1137–43.
21. Forbess JM, Visconti KJ, Hancock-Friesen C, Howe RC, Bellinger DC, Jonas RA. Neurodevelopmental Outcome After Congenital Heart Surgery: Results From an Institutional Registry. Circulation. 2002 Sep 24;106(12_suppl_1)
22. Dadvand P, Rankin J, Rushton S, Pless-Mulloli T. Association Between Maternal Exposure to Ambient Air Pollution and Congenital Heart Disease: A Register-based Spatiotemporal Analysis. American Journal of Epidemiology [Internet]. 2011 Jan 15 [cited 2021 Jan 5];173(2):171–82. Available from: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3011953/
23. Mitchell SC, Korones SB, Berendes HW. Congenital heart disease in 56,109 births. Incidence and natural history. Circulation [Internet]. 1971 [cited 2021 Feb 15]; 43(3):323–32. Available from: http://ahajournals.org
24. Ramakrishnan S, Khera R, Jain S, Saxena A, Kailash S, Karthikeyan G, et al. Gender differences in the utilisation of surgery for congenital heart disease in India. Heart [Internet]. 2011 Dec 1;97(23):1920–5. Available from: https://heart.bmj.com/content/97/23/1920 .short
25. Ar M, Sadiq M, Hyder Sn, Au Q, Ss A, Ma K, et al. Socioeconomic status and impact of treatment on families of children with congenital heart disease. PubMed. 2011 Jul 1; 21(7):398–402.
26. Clínicas C, Patológicas Y, Congénitas C, Docente DH, Al-Wahda P, Adén Y, et al. Congenital heart diseases in neonatal unit at Al-Wahda Pediatric Teaching Hospital, Aden, Yemen (2012-2013)) [Internet]. Vol. 13, Revista Habanera de CienciasMédicas. 2014 [cited 2021 Feb 15]. Available from: http://scielo.sld.cuNashed LM, O'Neil J. The impact of socioeconomic status and race on the outcomes of congenital heart disease. Current Opinion in Cardiology. 2021 Oct 25; 37(1):86–90.
27. UZARK K, JONES K. Parenting stress and children with heart disease. Journal of Pediatric Health Care. 2003 Jul; 17(4):163–8.
28. Hajat A, Hsia C, O'Neill MS. Socioeconomic Disparities and Air Pollution Exposure: a Global Review. Curr Environ Heal reports [Internet]. 2015 Dec 1 [cited 2021 Nov 10];2(4):440–50. Available from: https://link.springer.com/ article/10.1007/s40572-015-0069-5
29. Nousi D, Christou A. Factors affecting the quality of life in children with congenital heart disease [Internet]. Vol. 4, SCIENCE JOURNAL ® VOLUME. iMedPub; 2010 [cited 2021 Apr 5]. Available from: www.hsj.gr
30. Eslami B, Sundin Ö, Glória Macassa, Hamid Reza Khankeh, Soares J. Gender differences in health conditions and socio-economic status of adults with

congenital heart disease in a developing country. Cardiology in the Young. 2012 Apr 26; 23(2):209–18.
31. Best KE, Vieira R, Glinianaia SV, Rankin J. Socio-economic inequalities in mortality in children with congenital heart disease: A systematic review and meta-analysis. Paediatric and Perinatal Epidemiology. 2019 Jul; 33(4):291–309.

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