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GLOBAL PREVALENCE AND CHARACTERISTICS OF CONGENITAL HEART DISEASE IN CHILDREN: AN UPDATED SYSTEMATIC REVIEW AND META-ANALYSIS (2018-2025)

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Abstract:

Background: Congenital Heart Disease (CHD) is the most common major congenital anomaly, accounting for one-third of all serious birth defects. Despite therapeutic advances, it remains a leading cause of mortality and disability in children under five. Reported global prevalence remains highly variable, often influenced more by diagnostic infrastructure than biological factors.

Objective: This systematic review and meta-analysis aim to provide a contemporary global estimate of CHD birth prevalence and evaluate how methodological and regional factors influence reported rates.

Methods: Following PRISMA and MOOSE guidelines, we searched PubMed, Embase, Scopus, WOS, and Science Direct for observational studies published between January 2018 and August 2025. We included 37 studies encompassing 24,559,331 participants. Primary outcomes included birth prevalence per 1,000 live births. Due to extreme heterogeneity (I^2 = 100%), data were synthesized using random-effects models, meta-regression, and sample-size weighted medians.

Results of the meta-analysis, encompassing 37 articles and a total sample size of 24,559,331 participants, yielded an overall pooled CHD prevalence of 21.9 per 1,000 births (95% CI: 11.0–43.1). The random-effects model confirmed this estimate was statistically significant ($p < 0.0001$), though it was accompanied by extreme heterogeneity (I^2 = 100%) and an exceptionally wide 95% prediction interval ranging from 0.4 to 572.6 per 1,000 births. Univariate meta-regression identified sample size as a primary moderator, explaining 34.1% of the observed heterogeneity. Further analysis revealed significant disparities based on

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study methodology: hospital-based studies reported a pooled prevalence of 36.8 per 1,000 compared to 8.8 per 1,000 in population-based registries, while studies utilizing echocardiography for diagnosis showed a prevalence of 34.1 per 1,000 versus 8.6 per 1,000 for clinical examinations. Regionally, the Eastern Mediterranean and Europe exhibited the highest pooled rates at 43.8 and 27.4 per 1,000, respectively. Despite these high raw estimates, sensitivity analysis and the removal of extreme outliers such as Hashim 2020 and Haberkern 2024 resulted in a stable, sample-size weighted median of 6.7 per 1,000 births, suggesting a more robust indicator of true baseline prevalence.

Conclusion: The high reported prevalence of 21.9 per 1,000 reflects a detection paradox where improved diagnostic sensitivity (specifically echocardiography) captures more mild lesions, rather than a biological surge. Reported rates are heavily mediated by study setting and diagnostic infrastructure. Standardized, population-based registry reporting is essential to bridge regional gaps and accurately inform global health policy.

Key Words: Congenital Heart Disease (CHD); Birth Prevalence; Meta-Analysis; Epidemiology; Echocardiography; Pediatric Cardiology.

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