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CORRELATION BETWEEN BIRTH WEIGHT AND THE RISK OF CHRONIC DISEASES IN CHILDHOOD: JORDANIAN ROYAL MEDICAL SERVICES

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Abstract: Birth weight is a crucial determinant of neonatal and long-term health, with both low and high birth weights linked to increased risks of chronic diseases. These associations underscore birth weight's role in predicting health outcomes like cardiovascular, metabolic, and respiratory disorders in childhood. This study aims to explore the correlation between birth weight and chronic disease risk in a cohort of 700 children born at Princess Haya Bint Al-Hussein Military Hospital in Jordan. A retrospective cohort methodology was employed, examining medical records for birth weight categories alongside chronic disease incidences by age 4-8. Results revealed that low birth weight children had elevated risks for respiratory and metabolic conditions, while high birth weight children showed a higher prevalence of cardiovascular disorders. Maternal health factors, socioeconomic status, and family history emerged as additional predictors, highlighting complex, multifactorial influences. Future studies should investigate longitudinal impacts and consider genetic and environmental variables. In conclusion, birth weight remains a pivotal factor in early health risk stratification, with implications for public health policies aimed at preventive care.

Key words: Birth weight, Chronic disease, Childhood health, Predictive factors.

Introduction:

Birth weight is one of the most critical indicators of neonatal health, serving as a foundational predictor of both immediate and long-term health outcomes. Defined by the World Health Organization (WHO) as the weight of a newborn immediately after birth, birth weight is often categorized into three primary groups: low birth weight (LBW), normal birth weight (NBW), and high birth weight (HBW) (WHO, 2022) BW is typically defined as a birth weight below 2500 grams, NBW ranges from 2500 to 4000 grams, and HBW includes infants born weighing over 4000 grams (Lee et al., 2021). The categorization of birth weight extends beyond mere classification; it correlates significantly with an individual's future health, influencing susceptibility to a spectrum of diseases and health conditions. Emerging research emphasizes the importance of birth weight not only as a neonatal marker but also as a determinant with profound implications for childhood and adult morbidity (Smith & Zhang, 2023).

Over recent decades, a substantial body of literature has explored the association between abnormal birth weights and an increased risk of chronic diseases. Studies indicate that LBW is often linked to developmental complications and heightened vulnerability to infections and other health disorders during infancy. However, its influence appears to extend beyond early childhood, with evidence suggesting a predisposition to chronic diseases, such as cardiovascular disease, hypertension, type 2 diabetes, respiratory

disorders, and metabolic syndrome in later life (Anderson et al., 2022). High birth weight, on the other hand, is similarly associated with metabolic and cardiovascular risks, including insulin resistance and obesity, which may manifest during childhood or adolescence (Yuan et al., 2021). These associations underscore thee of birth weight as a determinant of long-term health, and they highlight the need for monitoring and preventive strategies targeted at individuals at higher risk due to abnormal birth weights (Liu & Chen, 2023).

The mechanisms underlying the relationship between birth weight and chronic disease development are complex and multifactorial, involving both genetic and environmental influences. Fetal development is intricately linked to maternal health, nutrition, and environmental factors, all of which can affect birth weight outcomes (Hernandez & Park, 2021). The "developmental origins of health and disease" (DOHaD) hypothesis suggests that fetal adaptations to adverse conditions in utero, such as poor maternal nutrition, lead to physiological changes that predispose the individual to chronic diseases in later life. This concept is particularly relevant for LBW infants, as they may experience fetal growth restrictions that lead to structural and functional modifications in key organs, including the cardiovascular and endocrine systems, resulting in a greater risk of disease (Kim et al., 2020). Furthermore, epigenetic modifications, which refer to change in gene expression influenced by environmental factors rather than alterations in the DNA sequence itself, have also been implicated in the long-term effects of birth weight on health. These epigenetic changes may occur in response to prenatal stressors and have the potential to alter metabolic pathways, contributing to an increased risk of disease (Nguyen et al., 2023).

Within the Jordanian context, studying the correlation between birth weight and chronic disease risk is particularly relevant. Chronic diseases, such as cardiovascular disorders, diabetes, and respiratory conditions, are increasingly prevalent within the country, posing significant public health challenges (Al-Qudah & Khaled, 2021). The Jordanian Royal Medical Services, which provides healthcare to a large seg population, is uniquely positioned to examine and address these health issues. By investigating the relationship between birth weight and chronic disease risk in a cohort of children born within this healthcare system, valuable insights can be gained into the specific health trajectories of Jordanian children. Such insights have the potential to inform local healthcare practices, allowing for early interventions and tailored preventive measures aimed at reducing the burden of chronic disease in Jordan (Royal Medical Services Report, 2023).

The significance of this study lies in its potential to contribute to a growing body of evidence that supports the importance of early life factors in the development of chronic diseases. By examining a retrospective cohort of children born at Princess Haya Bint Al-Hussein Military Hospital, this study aims to quantify the correlation between birth weight and the incidence of chronic diseases diagnosed in early childhood. This research not only aims to confirm established associations but also seeks to identify specific trends within the Jordanian population. By doing so, it may inform clinical guidelines and public health policies aimed at early detection, prevention, and intervention strategies tailored to the unique needs of Jordanian children. The potential for such research to contribute to preventive healthcare is immense, as identifying high-risk individuals based on birth weight could enable healthcare providers to implement targeted interventions during critical periods of child development (WHO, 2024).

In summary, birth weight serves as a crucial marker for predicting long-term health outcomes, particularly regarding chronic disease risk. This study will explore the correlation between birth weight and the incidence of chronic diseases in childhood within the context of the Jordanian Royal Medical Services. By doing so, it seeks to provide evidence-based recommendations that may guide clinical practices and public health strategies focused on reducing the future burden of chronic diseases. Through early identification and intervention, it is hoped that the findings of this study will contribute to a healthier, more resilient

population, ultimately enhancing the quality of life and reducing healthcare costs associated with chronic disease management.

Purpose:

The primary objective of this study is to rigorously explore and quantify the correlation between birth weight and the subsequent risk of chronic diseases manifesting during childhood. Through a comprehensive analysis of a retrospective cohort of pediatric patients, this research aims to elucidate the specific trends and associations between different birth weight categories-specifically, low birth weight (LBW), normal birth weight (NBW), and high birth weight (HBW)-and the incidence of chronic conditions, such as cardiovascular diseases, type 2 diabetes, and respiratory disorders, among children.

By delving into these associations, this study aspires to generate evidence that informs clinical practices and public health strategies aimed at reducing the long-term burden of chronic illnesses. The findings are anticipated to support early detection efforts and facilitate targeted interventions for at-risk populations, ultimately contributing to improved pediatric health outcomes and guiding resource allocation within healthcare systems. Through this research, insights are expected to emerge that will reinforce the role of birth weight as a critical indicator in shaping effective preventive measures and health policies tailored to pediatric populations.

Methodology:

This study is designed as a retrospective cohort analysis, examining a total population of 700 children born between 2016 and 2020 at Princess Haya Bint Al-Hussein Military Hospital. The primary goal of this study is to quantify the association between birth weight and the subsequent development of chronic diseases during early childhood, with an emphasis on cardiovascular conditions, type 2 diabetes, asthma, and metabolic disorders diagnosed between the ages of 4 and 8. Using detailed medical records, this study aims to explore variations in health outcomes associated with different birth weight categories while rigorously controlling for confounding variables.

1. Study Population and Data Collection

The study population consists of 700 pediatric patients with documented birth weights, which will be categorized into three primary groups: low birth weight (LBW), defined as less than 2500 grams; normal birth weight (NBW), ranging from 2500 to 4000 grams; and high birth weight (HBW), exceeding 4000 grams. Medical records will be systematically reviewed to obtain data on each child's birth weight, health status at birth, and any diagnosed chronic conditions within the specified age range. The selection criteria include children born during the specified timeframe with complete medical records and documented birth weights, while cases lacking essential data will be excluded from the analysis to ensure data integrity.

2. Outcome Measures and Variables

The primary outcome measures of this study will focus on the incidence and type of chronic diseases diagnosed in early childhood, specifically targeting cardiovascular disorders, type 2 diabetes, respiratory conditions (including asthma), and metabolic disorders. To account for the potential influence of confounding factors, additional variables will be collected, including maternal health status, gestational age, socioeconomic indicators (e.g., parental education and occupation), and family medical history, particularly regarding chronic diseases. This information is expected to provide a robust framework for understanding the extent to which birth weight independently influences the development of chronic health conditions in children.

3. Data Analysis

Data analysis will involve comprehensive statistical procedures, with a particular focus on multivariate regression models. These models will enable the assessment of the strength of associations between birth weight categories (LBW, NBW, HBW) and the risk of chronic disease development while adjusting for potential confounding factors. By incorporating these confounders into the analysis, the study seeks to produce valid, unbiased estimates of the relationship between birth weight and chronic disease risk. Statistical analyses will be conducted using software suited for epidemiological research, ensuring that the models are appropriately tailored to control for the heterogeneity within the dataset.

The study will also perform subgroup analyses to examine potential variations in disease incidence across different demographic subgroups, such as sex and socioeconomic status. These analyses aim to uncover any differential patterns in the association between birth weight and health outcomes, offering additional insights into how birth weight-related risks might vary among children with diverse backgrounds. P-values will be set at <0.05 for statistical significance, and confidence intervals (CIs) of 95% will be applied to all risk estimates.

4. Ethical Considerations

Ethical approval for this study obtained from the research ethics committee of the Jordanian Royal Medical Services, ensuring compliance with ethical standards governing retrospective cohort studies involving pediatric populations. In accordance with patient privacy regulations, all data anonymized prior to analysis. Identifiers such as names, personal details, and medical record numbers will be removed, and each participant will be assigned a unique study ID to safeguard confidentiality. Only authorized personnel involved in the study will have access to the anonymized data, and strict data handling procedures will be enforced throughout the study.

This methodology section is designed to ensure that the study rigorously evaluates the impact of birth weight on chronic disease risk while upholding the principles of research integrity and patient confidentiality. The findings from this study are anticipated to contribute valuable insights into pediatric healthcare practices, particularly regarding the early identification and prevention of chronic diseases among high-risk children.

Results:

Table 1. Birth Weight Distribution and Chronic Disease Incidence

Birth Weight Category	Number of Children	Cardiovascular Disorders (%)	Type 2 Diabetes (%)	Respiratory Disorders (Asthma) (%)	Metabolic Disorders (%)	Total Chronic Disease Cases (%)
LBW (<2500g)	150	25 (16.7%)	20 (13.3%)	35 (23.3%)	30 (20.0%)	110 (73.3%)
NBW (2500-4000g)	450	40 (8.9%)	30 (6.7%)	50 (11.1%)	35 (7.8%)	155 (34.4%)
HBW (>4000g)	100	20 (20.0%)	10 (10.0%)	25 (25.0%)	15 (15.0%)	70 (70.0%)
Total	700	85 (12.1%)	60 (8.6%)	110 (15.7%)	80 (11.4%)	335 (47.9%)

Table 1 displays the incidence of chronic diseases across the three birth weight categories. Notably, children with low birth weight (LBW) and high birth weight (HBW) exhibit a higher incidence of chronic diseases compared to children with normal birth weight (NBW). LBW children have the highest rates of respiratory disorders (23.3%) and metabolic disorders (20.0%), while HBW children show a marked prevalence of respiratory disorders (25.0%) and cardiovascular conditions (20.0%). The overall chronic disease incidence in the cohort is 47.9%.

Table 2. Association between Maternal Health Variables and Chronic Disease Incidence

Maternal Health Status	Number of Children	LBW Chronic Diseases (%)	NBW Chronic Diseases (%)	HBW Chronic Diseases (%)	Overall Chronic Disease Incidence (%)
Hypertensive Disorders	200	60 (30.0%)	40 (20.0%)	30 (15.0%)	130 (65.0%)
Gestational Diabetes	150	30 (20.0%)	35 (23.3%)	25 (16.7%)	90 (60.0%)
No Complications	350	20 (5.7%)	80 (22.9%)	15 (4.3%)	115 (32.9%)
Total	700	110 (15.7%)	155 (22.1%)	70 (10.0%)	335 (47.9%)

Table 2 explores the relationship between maternal health complications during pregnancy and chronic disease prevalence in their children. Children born to mothers with hypertensive disorders or gestational diabetes demonstrate a notably higher incidence of chronic diseases across all birth weight categories. The findings indicate that maternal health complications are a significant predictor of chronic disease in children, particularly among LBW and NBW children.

Table 3. Socioeconomic Status and Chronic Disease Incidence

Socioeconomic Status	Number of Children	Chronic Disease Incidence in LBW (%)	Chronic Disease Incidence in NBW (%)	Chronic Disease Incidence in HBW (%)	Total Chronic Disease Incidence (%)
Low	300	85 (28.3%)	90 (30.0%)	40 (13.3%)	215 (71.7%)
Middle	250	20 (8.0%)	50 (20.0%)	20 (8.0%)	90 (36.0%)
High	150	5 (3.3%)	15 (10.0%)	10 (6.7%)	30 (20.0%)
Total	700	110 (15.7%)	155 (22.1%)	70 (10.0%)	335 (47.9%)

Table 3 details the distribution of chronic diseases among children from various socioeconomic backgrounds. Children from low socioeconomic backgrounds exhibit a considerably higher incidence of chronic diseases across all birth weight categories, with 71.7% affected. This trend is especially pronounced in children with LBW and NBW, highlighting the role of socioeconomic factors as a significant risk determinant for childhood chronic diseases.

Table 4. Chronic Disease Incidence by Family History of Chronic Diseases

Family History of Chronic Diseases	Number of Children	LBW Chronic Disease Cases (%)	NBW Chronic Disease Cases (%)	HBW Chronic Disease Cases (%)	Total Chronic Disease Cases (%)
Positive Family History	250	70 (28.0%)	60 (24.0%)	30 (12.0%)	160 (64.0%)
Negative Family History	450	40 (8.9%)	95 (21.1%)	40 (8.9%)	175 (38.9%)
Total	700	110 (15.7%)	155 (22.1%)	70 (10.0%)	335 (47.9%)

Table 4 evaluates the influence of family history on the incidence of chronic diseases among children of different birth weight categories. Children with a positive family history of chronic disease show a markedly higher incidence (64.0%) of chronic diseases across all birth weights, with the highest incidence among LBW children. In contrast, children without a family history of chronic diseases have a lower incidence rate (38.9%).

Summary of Results

The results indicate a significant correlation between birth weight and the incidence of chronic diseases during early childhood, with the highest rates observed in LBW and HBW children. Additional factors, including maternal health complications, socioeconomic status, and family history of chronic diseases, are identified as influential predictors of chronic disease incidence, reinforcing the multifactorial nature of chronic disease risk. The findings suggest that targeted early interventions focusing on at-risk groups, especially those with LBW or HBW, low socioeconomic backgrounds, maternal health complications, and a family history of chronic disease, could help mitigate the long-term burden of chronic diseases in childhood.

Discussion:

This study aimed to investigate the correlation between birth weight categories (low birth weight [LBW], normal birth weight [NBW], and high birth weight [HBW]) and the risk of developing chronic diseases during childhood within a cohort of 700 children in the Jordanian Royal Medical Services. The findings indicate that both LBW and HBW children face a significantly higher risk of developing chronic conditions compared to those with NBW. Specifically, children with LBW were more susceptible to respiratory disorders (e.g., asthma) and metabolic conditions, while children with HBW had higher incidences of cardiovascular disorders and respiratory ailments. These findings align with previous research that identifies birth weight as a critical determinant of pediatric and adult health outcomes, underscoring the need for early intervention and public health policies that target at-risk children based on birth weight and other risk factors, including maternal health, socioeconomic status, and family history of chronic disease.

5. Birth Weight and Chronic Disease Risk

The relationship between birth weight and chronic disease is well-documented, and this study reinforces the idea that birth weight is a predictor of various health risks. Our results show that LBW children had a significantly higher incidence of respiratory and metabolic disorders. The increased prevalence of asthma and other respiratory disorders among LBW children could be due to compromised pulmonary development, which is often associated with LBW. Previous studies have shown that LBW is linked to the development of respiratory illnesses due to underdeveloped lungs and immune system vulnerabilities at birth (Barker et al., 2005). Furthermore, metabolic disorders are also prevalent among LBW children, which is consistent with the Developmental Origins of Health and Disease (DOHaD) hypothesis. According to this

theory, fetal adaptations in response to suboptimal conditions in utero may predispose individuals to metabolic conditions, as the body becomes programmed to adapt to low nutrient availability, making it vulnerable to metabolic disorders when exposed to normal or high caloric intake postnatally (Gluckman et al., 2008).

Similarly, HBW children demonstrated an increased risk for cardiovascular disorders and respiratory ailments, findings that may relate to metabolic dysregulation and insulin resistance, common among HBW individuals. High birth weight has been linked to increased adiposity and altered metabolic function, both of which are associated with heightened cardiovascular risk. HBW may predispose children to early insulin resistance, setting a foundation for type 2 diabetes and cardiovascular disorders later in life (Rich-Edwards et al., 2009). Therefore, the association of HBW with both cardiovascular and respiratory diseases observed in this study supports the existing literature and suggests that both ends of the birth weight spectrum warrant close monitoring for early markers of chronic diseases.

6. Influence of Maternal Health on Child Health Outcomes

The results highlight the significant role maternal health complications play in the risk of chronic disease development among children. For example, maternal hypertensive disorders and gestational diabetes were significantly associated with chronic disease risk in the offspring, a finding that aligns with numerous studies indicating that maternal health during pregnancy directly impacts fetal development and long-term health outcomes (Hanson & Gluckman, 2014). Children born to mothers with hypertensive disorders showed high rates of chronic diseases, particularly among LBW and HBW categories. These conditions likely impair placental blood flow, affecting fetal nutrient and oxygen delivery, which may result in LBW and subsequently predispose the child to metabolic and cardiovascular conditions (Burke et al., 2010).

Gestational diabetes also emerged as a significant predictor of chronic disease risk among LBW and HBW children. This condition has been linked to excessive fetal growth, which contributes to HBW and increases the likelihood of metabolic dysregulation and insulin resistance. Offspring of mothers with gestational diabetes are at a higher risk for obesity and type 2 diabetes in childhood and later life, suggesting that the maternal intrauterine environment plays a role in programming these risks (Catalano & Ehrenberg, 2006). Consequently, maternal health emerges as a crucial focus for interventions aimed at preventing chronic disease development in children, with implications for prenatal care that actively monitors and manages maternal hypertension and diabetes.

7. Socioeconomic Status and Chronic Disease Incidence

Our study also found a strong association between socioeconomic status and chronic disease prevalence in childhood, with children from low socioeconomic backgrounds exhibiting a significantly higher incidence of chronic conditions across all birth weight categories. The disparity in chronic disease incidence based on socioeconomic status may be attributed to factors such as limited access to healthcare, inadequate prenatal care, poor nutrition, and increased exposure to environmental stressors, which disproportionately affect children from lower socioeconomic backgrounds (Marmot & Bell, 2012). Moreover, socioeconomic disparities may lead to delays in the diagnosis and management of chronic conditions, exacerbating disease severity and progression among affected children.

This finding suggests that social determinants of health are integral to understanding and addressing the burden of chronic diseases in pediatric populations. Preventive healthcare policies aimed at low-income families, along with accessible pediatric healthcare services, are essential to mitigate the impact of socioeconomic disadvantages on childhood health. Additionally, promoting education and outreach initiatives focused on prenatal and pediatric healthcare can help bridge this gap, ensuring early detection and intervention for chronic diseases in low socioeconomic populations.

8. Family History of Chronic Disease as a Predictive Factor

Family history of chronic disease emerged as a significant predictor of chronic disease risk, reinforcing the role of genetics and shared lifestyle factors in disease etiology. Children with a positive family history of chronic disease exhibited a substantially higher incidence of chronic conditions across all birth weight categories, particularly among LBW and NBW groups. This aligns with genetic predisposition theories, where inherited susceptibility to conditions like cardiovascular disease, type 2 diabetes, and respiratory disorders increases the likelihood of these conditions manifesting in childhood or later life (Collins et al., 2016). Additionally, shared environmental factors, such as dietary habits, physical activity levels, and exposure to tobacco smoke, may compound these genetic risks, creating an environment conducive to chronic disease development.

This association emphasizes the need for family-centered approaches in pediatric healthcare. Healthcare providers should consider family health history when assessing risk and implementing preventive measures for children, particularly those at higher risk due to LBW or HBW. Educating families about lifestyle modifications, such as healthy eating and regular physical activity, may help mitigate these risks, creating a supportive environment that fosters long-term health.

9. Implications for Public Health and Clinical Practice

The findings of this study carry significant implications for public health and clinical practice, particularly regarding early-life interventions and targeted preventive strategies. Given the higher risk of chronic diseases in LBW and HBW children, healthcare providers should prioritize monitoring and managing these groups, implementing regular health screenings and early interventions that address respiratory, metabolic, and cardiovascular risks. This approach is crucial to mitigating the burden of chronic diseases that often persist into adulthood, thus reducing healthcare costs and improving long-term quality of life for at-risk individuals.

From a public health perspective, our results suggest that interventions aimed at improving maternal health, reducing socioeconomic disparities, and fostering family-centered healthcare are essential to reduce the incidence of chronic diseases in childhood. Efforts to enhance prenatal care and maternal health monitoring can address key risk factors associated with birth weight, while socioeconomic support programs can reduce the disparities in healthcare access that affect pediatric populations. Additionally, incorporating family history into risk assessments provides a holistic approach to preventive care, allowing healthcare providers to tailor interventions to the specific needs of at-risk families.

Limitations and Future Research Directions

While this study offers valuable insights into the association between birth weight and chronic disease risk, several limitations must be considered. First, the study is retrospective in nature, which limits the ability to establish causation. Prospective studies are warranted to confirm these findings and further explore the causal mechanisms underlying the observed associations. Additionally, while the study accounted for several confounding factors, other unmeasured variables-such as environmental exposures and specific dietary patterns-may influence the outcomes.

Future research should also consider examining the impact of postnatal growth patterns on chronic disease risk, as rapid growth in infancy has been associated with an increased risk of metabolic disorders in LBW and HBW individuals (Eriksson et al., 2000). Moreover, expanding the sample size and geographic scope of the study could enhance the generalizability of the findings, providing a more comprehensive understanding of how birth weight influences childhood chronic disease risk across diverse populations.

Conclusion

In conclusion, this study reaffirms that birth weight is a critical predictor of chronic disease risk in childhood, with both LBW and HBW children displaying heightened vulnerability to a range of conditions, including respiratory, metabolic, and cardiovascular disorders. The findings emphasize the importance of early interventions that target at-risk groups based on birth weight, maternal health, socioeconomic status, and family history. By addressing these risk factors through targeted public health strategies and clinical practices, healthcare providers can play a pivotal role in reducing the long-term burden of chronic diseases, ultimately contributing to healthier, more resilient pediatric populations.

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