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Evaluating the Impact of Antibiotics on Childhood Immunity: A WASPAS Analysis of Immune System Development and Long-Term Health Effects

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Abstract: *The impact of antibiotics on childhood immunity has been a subject of significant research and ongoing debate in medical science. Antibiotics, while essential for treating bacterial infections and saving lives, have raised concerns regarding their potential influence on the developing immune system of children. This study explores the complex relationship between antibiotic use and immune development, highlighting both beneficial therapeutic effects and unintended negative consequences. The widespread prescription of antibiotics in childhood has contributed to the emergence of antibiotic-resistant bacteria, posing a serious public health challenge. Resistant infections are often harder to treat, resulting in longer illness durations and increased healthcare costs. Childhood represents a critical period for immune system development, during which early exposure to microorganisms helps shape immune responses later in life. Antibiotics can disrupt these natural microbial interactions by altering the composition of the gut microbiota, potentially reducing microbial diversity and affecting immune function. Such disruptions may increase susceptibility to allergies, infections, and immune-related disorders in later stages of life. To assess the impact of antibiotics on childhood immunity, the Weighted Aggregated Sum Product Assessment (WASPAS) method was applied. These multi-criteria decision-making approach assigns weights to relevant factors and aggregates scores to evaluate outcomes effectively. The analysis revealed variations among children, with Child 4 ranking highest in antibiotic impact on immunity, while Child 5 ranked lowest. These findings demonstrate individual differences in immune response and highlight the importance of cautious antibiotic use.*

Keywords: *anti–TNF-a therapy, children, inflammatory bowel disease, prenatal exposure, immune system*

1. INTRODUCTION

It is acknowledged that the micro biota originating from various maternal sources, including the vagina, gastrointestinal tract, and breast milk, can impact the colonization of an infant's system. However, recent findings indicate that these sources might exert an influence before birth, consequently affecting the development of the fetal immune system. The notion of the womb as a sterile environment is currently being challenged. Nevertheless, compelling evidence suggests that the composition of the mother's gut microbiota before childbirth significantly influences the immunity of the newborn. and responses to influenza vaccination. The presence of a healthy micro biome appears to be pivotal in maintaining an effective antibody response, particularly in individuals with limited initial immunity due to micro biome disruption. Furthermore, the utilization of antibiotics leads to heightened levels of inflammatory markers in the bloodstream. The absence of secondary bile acids is linked to the activation of both the inflame some and AP-1/NR4A pathways. A comprehensive exploration highlights numerous ways in which the micro biome influences the immune system. Emerging research underscores the critical role that the microbiome plays in bolstering immunity. Yet, there is limited direct proof in humans. In this study, we administered wide-ranging antibiotics to individuals without any medical issues, both prior to and after they were given the regular flu vaccine. Surprisingly, the levels of antibodies produced remained unchanged even after a substantial 10,000-fold reduction in gut bacteria quantity and a continual decrease in bacterial variety. Nonetheless, a significant reduction was observed in the ability to neutralize H1N1 and the production of binding IgG1 and IgA antibodies in a later trial involving subjects with initially low levels of pre-existing antibodies. Furthermore, administration of antibiotics resulted in divergent metabolic pathways in both investigations. This divergence encompassed a drastic reduction of serum secondary bile acids by a factor of 1,000. This reduction exhibited a robust correlation with the activation of AP-1/NR4A signaling and inflammasomes. Noteworthy shifts consisted of (1) heightened manifestations of inflammation-related indicators, involving heightened AP-1/NR4A expression akin to that observed in older individuals, and heightened activation of dendritic cells. Notably, through the amalgamation of multiomics data, substantial connections between specific bacterial species and metabolic characteristics were unearthed. This underscores the critical role of the micro biome in governing human immune responses [4]. The best accessible method for preventing infectious illnesses is vaccination. Vaccine-induced immune reactions, however, varied greatly across people and between communities in various parts of the world. Thus, it is crucial for human health to understand the causes of this variation. Emerging research indicates that the gut micro biome plays a critical role in regulating immunological responses to vaccination, despite the fact that there are many factors that contribute to intra- and inter population heterogeneity in vaccine responses. The majority of this information comes from studies done on mice, and there is little causal evidence for how the micro biome affects human immunity. The micro biome affects immune responses in humans, but recent research on vaccination in people on broad-spectrum antibiotics has offered causative evidence and mechanistic insights [5]In the therapeutic care of preterm newborns, antibiotic therapy is widely employed. The onset of sepsis brought on by indwelling catheters or by the translocation of gut microorganisms is prevented by antibiotics (38). Additionally, antibiotics are used to treat NEC after it has started or in cases when it shows early symptoms (44, 63). Antibiotics may cause the emergence of resistant strains, and it has been suggested that slow colonization and decreased microbial diversity may predispose to later intestinal disease (15, 32, 63, 70). These are the main causes of concern regarding potential antibiotic side effects. In fact, a prolonged course of systemic antibiotic therapy has been linked to both an increase in the prevalence of NEC and a decrease in bacterial diversity (1, 15, 69). Antibiotics are rarely given orally to preterm newborns, and it is yet unclear how long- and short-term antibiotic treatment may affect gut characteristics. Despite the aforementioned issues, it was found by a systematic assessment of five clinical studies including 456 newborns that oral antibiotics decreased the incidence of NEC in low-birth-weight infants [7]We conducted a survey involving 5379 individuals from nine different countries to gain a better understanding of how patients are involved in the use of antibiotics. While antibiotics are recognized as powerful and effective medicines, there is also a perception that they can weaken the immune system. According to the respondents, most respiratory infections, excluding the common cold, are believed to necessitate antibiotic treatment. Surprisingly, 11% of participants admitted to exaggerating their symptoms when consulting a doctor in order to obtain a prescription for antibiotics. Interestingly, a quarter of the surveyed patients admitted to reserving a portion of their antibiotic course for future use. Among the respondents, 69% claimed to have completed the entire prescribed course of antibiotics, with the United Kingdom showing the highest compliance at 90%, and Thailand the lowest at 53%. Furthermore, 75% of participants insisted that they had faithfully taken all the prescribed daily doses of antibiotics. Antibiotics could be purchased from a chemist without a prescription in every country. This study demonstrates that patients put pressure on their doctors to prescribe antibiotics, which calls for the construction of targeted public education initiatives aimed at better regulating antibiotic use in the community [8]This concept pertains to the possible association between administering antibiotics to children during their early years and a heightened probability of them developing asthma in childhood. The term "heightened probability" denotes the notion that when certain conditions are met, there is an amplified chance of a particular event—such as childhood asthma—taking place. The focus of this inquiry is the utilization of antibiotics during a child's early stages of development. The purpose behind antibiotics is to selectively combat and eliminate harmful bacteria, aiming to treat bacterial infections. However, they might also disrupt the natural balance of microorganisms in the body, including the ones crucial for a robust immune system. Studies suggest that disturbing this microbial harmony, especially during a child's crucial developmental stages, could influence the maturation of the immune system and respiratory well-being, potentially initiating conditions like asthma. Asthma, a chronic respiratory ailment characterized by airway inflammation and constriction, manifests as wheezing, breathlessness, and coughing. Due to the intricate relationship between the immune system and the gut micro biota, alterations in the gut microbiota's makeup, often prompted by early antibiotic utilization, can impact immune system development, potentially increasing vulnerability to inflammatory conditions such as asthma. Multiple studies have explored the link between childhood asthma and antibiotic administration during infancy. Antibiotics might disrupt the natural progression of the immune system, potentially leading to imbalances in immune responses and even triggering allergies, although the exact mechanisms are not fully understood. Furthermore, antibiotic usage might lead to shifts in the composition of the gut microbiota, potentially affecting the body's ability to regulate immune and inflammatory reactions. The term "intestinal microbiota" pertains to communities of microorganisms located in the digestive system that play a crucial role in maintaining the host's health. Our comprehension of how the microbiota functions within the host's response to invasive illnesses will advance with improved insight. To investigate the impact of disrupting the intestinal microbiota on the host's vulnerability to infection, Salmonella enteric a samovar Typhimurium was employed as a model enteric pathogen. The gut microbiota was disturbed through the application of antibiotics. C57BL/6 mice were exposed to streptomycin and vancomycin in their drinking water for two days at levels commonly used in clinical settings. Subsequently, the mice were orally infected with Salmonella enteric samovar Typhimurium. Sib green staining, differential plating, and fluorescent in situ hybridization were used to assess changes in microbiota composition and abundance. Intestinal microbiota composition was influenced by antibiotics in a dose-dependent manner. The chosen antibiotic treatment changed the microbiota's makeup but not the quantity of gut bacteria. Higher mouse susceptibility to Salmonella server Typhimurium intestinal colonization, higher post infection abnormalities in the microbiota, and more severe intestinal disease were all caused by greater reinfection perturbations in the microbiota. These findings highlight the significance of a balanced microbiota in the host's defense against enteric infections by indicating that antibiotic therapy affects the balance of the microbial community and predisposes the host to Salmonella server Typhimurium infection. [10].The specialized macrophages found in a normal colon frequently respond to the gut microbiota in a non-inflammatory manner. However, inflammatory bowel disease (IBD) arises when this balanced response breaks down, even though the exact way intestinal macrophages typically develop their ability to tolerate microbes remains unclear. Compelling epidemiological evidence linking disruption of the gut microbiota due to early-life antibiotic usage to IBD suggests a significant role of the gut microbiota in shaping intestinal immunity. In this study, we illustrate that antibiotic usage heightens the reactivity of intestinal macrophages to bacterial stimulation, leading them to produce higher levels of inflammatory cytokines. Administering antibiotics again to mice previously treated with antibiotics, followed by exposure to their natural microbiota, resulted in a prolonged disturbance in the microbial balance (symbiosis). This disruption triggered a lasting increase in inflammatory immune responses driven by a type of immune cell called macrophages, specifically in the colon. These elevated responses were centered around the inflammatory T helper 1 (TH1) pathway. The mice also became more vulnerable to infections that require different immune responses, such as TH17 and TH2 responses, to combat them. Examples of such infections included bacterial Citrobacter rodentium and helminth Trichuris murids infections. Additionally, this abnormal macrophage activity had a direct impact on the function of T cells, contributing to heightened inflammation. However, when the antibiotic treatment was supplemented with the short-chain fatty acid (SCFA) butyrate, which had decreased following antibiotic therapy, the usual dampened responsiveness of intestinal macrophages was reinstated, and dysfunction in T cell activity was prevented. To promote a different type of activation in macrophages and enhance the process of oxidative phosphorylation, butyrate altered the metabolic patterns of these immune cells. To sum up, the pathways influenced by short-chain fatty acids (SCFAs) and mediated through the gut microbiota play a vital role in upholding the immune equilibrium in the intestines, which relies on the activity of macrophages. The disturbance of this mechanism caused by oral antibiotics, leading to a heightened vulnerability to infections and ongoing dysfunction driven by T cells, underscores the significant repercussions associated with repetitive, wide-ranging use of antibiotics. [11] Women of childbearing age frequently experience inflammatory bowel disease (IBD). The primary objective of medical treatment is to maintain remission in pregnant patients with IBD, as active disease either during conception or pregnancy raises the likelihood of adverse pregnancy results. A growing body of research is endorsing the safety of administering anti-TNF alpha (anti-TNF-a) antibodies such as infliximab (IFX) and adalimumab (ADA) to pregnant individuals with IBD. A recent comprehensive study examined 375 pregnancies in IBD patients exposed to IFX or ADA, generally indicating favorable pregnancy outcomes. The rates of spontaneous abortions, stillbirths, and congenital anomalies were in line with those seen in the general population. Moreover, the percentage of live births among individuals who underwent anti-TNF-a treatment was notably greater than that of the entire US population. Over the initial 30-day postpartum period, no adverse consequences of IFX or ADA medication have been observed in our dataset of 41 pregnancies involving patients with inflammatory bowel disease (IBD) [12]. This passage examines the utilization of antibiotics, their inappropriate application, and the emergence of antibiotic resistance. It underscores the dual impact of antibiotics, crucial for addressing bacterial infections, which can yield both advantageous and unfavorable outcomes. The misuse of medications, including unnecessary prescriptions and incorrect dosing, accelerates the proliferation of bacteria that resist antibiotics. Consequently, these robust strains render antibiotics ineffective, posing a significant health hazard to the general population. The recurrent pattern of incorrect antibiotic utilization, resistance development, and mishandling emphasizes the importance of responsible antibiotic management to preserve the effectiveness of these essential medications in treating illnesses (source: [14] Healthcare workers need to adeptly consider social determinants of health (SDH) when engaging with patients due to the established connections between SDH, health disparities, and racial/ethnic factors. The forthcoming shift in ethnic demographics in the United States will significantly affect the healthcare sector, particularly regarding the need for a more inclusive and culturally attuned workforce. The level to which the diversity within the healthcare workforce can be utilized as a strategy to lessen racial and ethnic disparities in health and healthcare within the United States has been extensively explored in recent times. We examine the existing body of scholarly work on this matter, present a conceptual structure, and point out the upcoming actions in healthcare policy aimed at addressing social determinants of health (SDH), as well as broadening the diversity of the healthcare workforce [15].

2. MATERIALS AND METHODS

Immune response score: An "immune response score" refers to a quantitative assessment or measurement of the effectiveness and strength of an individual's immune system's reaction to a specific stimulus, such as an infection, disease, or vaccination. This score can encompass various parameters, such as the production of antibodies, activation of immune cells, and overall immune system activity. The score provides valuable information about the immune system's capability to defend the body against harmful agents and its potential to mount an appropriate response. It is often used in medical research, clinical trials, and diagnostics to evaluate and compare immune responses among different individuals or groups**.**

side effect score: A "side effect score" typically refers to a numerical or qualitative measure used to assess the potential adverse effects or unintended consequences of a particular action, decision, or intervention. In various contexts, such as medical treatments, environmental policies, or technological developments, a side effect score helps evaluate the possible drawbacks that might arise alongside the desired outcomes. For example, in the context of medication, a side effect score could indicate the likelihood and severity of various negative effects that a drug might have on a patient's health. Similarly, in the realm of software development, a side effect score could measure the unintended consequences or bugs that a software update might introduce. In essence, a side effect score provides a systematic way to weigh the potential drawbacks against the benefits of a specific course of action, allowing for a more informed decision-making process.

Cost-effectiveness: Cost-effectiveness is the measure of how efficiently resources are utilized to achieve a desired outcome or goal. It evaluates the relationship between the costs incurred and the benefits gained from a particular action, project, or investment. A cost-effective approach aims to achieve the maximum outcome for a given set of resources, ensuring that the benefits justify the expenses involved. In other words, it's about finding the most efficient way to achieve a desired result while minimizing unnecessary expenditures.

Environmental Impact: Environmental impact refers to the effects that human activities and natural processes have on the environment. These effects can be positive or negative and encompass a wide range of aspects, such as ecosystems, air quality, water resources, biodiversity, and climate. Human actions, such as industrial processes, agriculture, transportation, and urban development, can lead to changes in the environment that may result in degradation, pollution, or disruption of natural systems. Understanding and assessing the environmental impact of these activities is crucial for making informed decisions that minimize harm to the planet and its inhabitants, while promoting sustainable practices for current and future generations.

Method: The extended WASPAS approach is a brand-new integrated methodology that the researchers present in their work and is based on the WASPAS technique. It may be used to address MCDM problems, including interval type-2 sets of fuzzy values [17]. The time and attendance software issue for the system choice issue for the private hospital is addressed in this research using a combination of the CRITIC and WASPAS approaches. Simple mathematical application steps are required for both techniques. Various parameters for the WASPAS technique result in the identical ranking of the alternatives in this investigation. With different selection issues, the influence of different values may be observed [18]. The present research revisits the notion of rating correctness in the WASPAS tackle and re-derives the essential equations. It has been discovered that derivatives cannot be reliably calculated when the anticipated variation of the WPM is being used. Consequently, a modified equation is suggested, and the outcomes are supported by two examples. For the purpose of to assist practitioners in calculating estimated variances and selecting the perfect parameter, programmers for computers are also supplied [19]. We have created an additional extension of the classic WASPAS system within the MCDM framework. The single-valued neutrosophic collection's conceptual framework is used in the new extension that is being suggested, called WASPAS-SVNS. It has been performed in order to contrast the outcomes of other MCDM techniques. According to the calculations, Vilnius' Garifuna District is the best location for the plant to be built in order to burn non-hazardous garbage. Based on the findings, it can be said that this area is appropriate for the execution of the project to build a waste incinerator plant [20]. Numerous MCDM approaches have been enhanced for IVIFSs as a consequence of rent areas. This research develops a novel WASPAS method-based approach under IVIFSs. The developed technique is based on the IVIFS operators, some modifications to the conventional WASPAS method, and an innovative method for calculating the weights of the decision experts and the criteria. For the purpose to arrive at accurate weights, novel techniques have been suggested to calculate the weights of the choices made by experts and criterion using interval-valued intuitionistic fuzzy data values (entropy, divergence, and similarity measures)[21].To assess the alternatives, a suggested solution technique and a weighting calculation of the criteria established within the parameters of the suggested model were produced[22].Owing to the WASPAS findings, the best means of promoting and pursuing Iran's industrial planning for the future is to take advantage of nanotechnology in both health and healthcare[23].The performance of TSPs is compared in the current study using the intuitively fuzzy weighted aggregate sum evaluation (IF-WASPAS) method. The IF-WASPAS method integrates the "weighted sum (WSM)" and product model (WPM) for processes of decision-making, as well as linguistic uncertainty in MCDM. Furthermore, the objective weights obtained using the similarity measurement method will be added to the personalized weights stated by the professionals in order to determine criterion weights [24]. The station choosing problem for gas stations is examined applying the newly proposed spherical fuzzy AHP-integrated spherical WASPAS method [25]

3. RESULTS AND DISCUSSIONS

TABLE 1. Antibiotics impact on childhood immunities

Child	immune response score	side effect score	Cost-effectiveness	Environmental Impact
1	8.5	2	3	4.5
2	7.2	3.5	3.5	4
3	9	1	2.5	3
4	6.8	4	4	2.5
5	5	2.5	4.5	3.5

Table 1 shows Child 3 has the highest immune response score (9), indicating a stronger immune response compared to the other children. Child 5 has the lowest immune response score (5), suggesting a comparatively weaker immune response. Child 3 has the lowest side effect score (1), implying fewer side effects compared to the other children. Child 4 has the highest side effect score (4), indicating a higher likelihood of experiencing side effects. Child 5's treatment is considered the most cost-effective (score of 4.5), while Child 3's treatment is the least cost-effective (score of 2.5). Child 1 has the highest environmental impact score (4.5), suggesting a relatively larger environmental footprint. Child 4 has the lowest environmental impact score (2.5), indicating a lesser impact on the environment

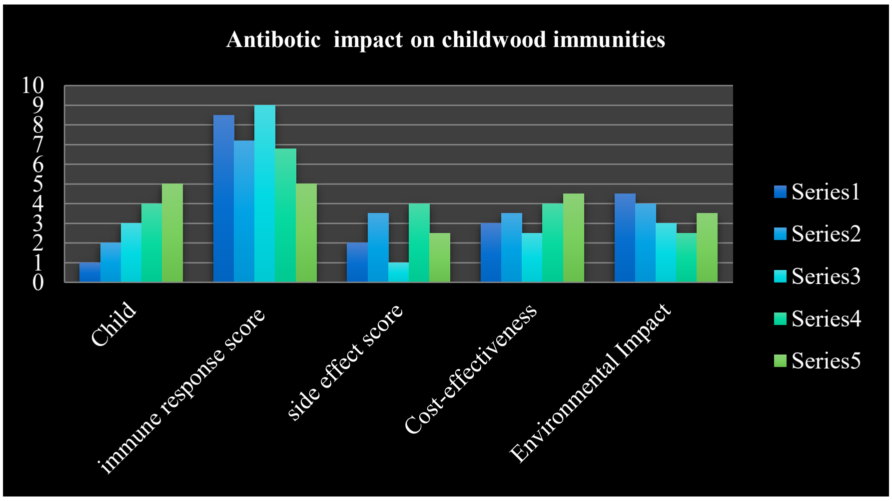

FIGURE 1. Antibiotics impact on childhood immunities

The Impact of Antibiotics on Childhood Immunity" compares five series involving several key factors, including the child's condition, immune response score, side effect score, cost-effectiveness, and environmental impact. Immune response scores are highest across all series, indicating that antibiotics generally provide strong immediate benefits in boosting immunity and fighting infections. Series 3 appears to show the highest immune response, particularly indicating strong short-term efficacy. However, side effect scores are moderate across all series, suggesting that while antibiotics are helpful, they also produce significant negative effects that cannot be ignored. Cost-effectiveness values are fairly balanced, showing that antibiotics are reasonably affordable and accessible, which explains their widespread use in childhood treatment. Environmental impact scores are also moderate, indicating that antibiotic use contributes to environmental concerns such as resistance and pollution, but not at extreme levels. Child-related scores gradually increase across the series, reflecting varying individual responses to antibiotic exposure.

TABLE 2. Performance values

Performance value			
0.94444	0.5	0.83333	0.55556
0.8	0.875	0.71429	0.625
1	0.25	1	0.83333
0.75556	1	0.625	1
0.55556	0.625	0.55556	0.71429

Table 2 The values shown in represent the comparative assessment of five individuals based on four criteria, potentially derived from a multi-criteria evaluation method such as WASPAS. Overall, the results show significant

variation in performance, indicating that the impact of antibiotics on children's immune systems varies from person to person. The third individual exhibits the best overall performance; achieving perfect scores of 1 on two criteria and a high value of 0.83333 on another, suggesting a very strong influence or response in those dimensions. The fourth individual also performs exceptionally well, scoring perfect 1s on two criteria and relatively high values on the remaining criteria, making him/her another top performer. In contrast, the second individual shows moderate to high consistency, particularly with a strong value of 0.875, although slightly lower in other areas. The first individual displays mixed performance; while achieving a very high score of 0.94444, he/she has lower values on some criteria, indicating an inconsistent impact.

TABLE 3. Weight Matrix

Weight			
0.25	0.25	0.25	0.25
0.25	0.25	0.25	0.25
0.25	0.25	0.25	0.25
0.25	0.25	0.25	0.25
0.25	0.25	0.25	0.25

Table 3 shows the weight matrix, indicating that equal importance has been assigned to each of the five subjects and the four evaluation criteria, with each set at 0.25. This uniform distribution signifies that no single factor is considered to have a greater influence than others in assessing the impact of antibiotics on childhood immunity. By assigning equal weights, the analysis assumes that immune response, side effects, cost-effectiveness, and environmental or long-term impact (or similar criteria) contribute equally to overall performance. This approach promotes fairness and balance in the decision-making process, preventing the results from being dominated by a single variable. It also reflects a neutral perspective where all dimensions are considered equally important in understanding the effects of antibiotics.

TABLE 4. Weighted normalized decision matrix by WSM

Weighted normalized decision matrix			
0.23611	0.125	0.20833	0.13889
0.2	0.21875	0.17857	0.15625
0.25	0.0625	0.25	0.20833
0.18889	0.25	0.15625	0.25
0.13889	0.15625	0.13889	0.17857

Table 4 shows the weighted normalized outcome matrix performance values and represents the combined effect of the equivalent criterion weights. Since all criteria are equally weighted at 0.25, the values reflect a balanced influence of immune response, side effects, cost-effectiveness, and overall impact. The third subject shows strong contributions in the first and third criteria, each reaching 0.25, along with a relatively high value of 0.20833 in the fourth criterion, indicating a robust overall performance profile. Similarly, the fourth subject registers the maximum possible weighted scores in the second and fourth criteria, signifying particular strength in those dimensions. The first subject shows moderate to high contributions across all criteria, with its strongest value in the first criterion (0.23611), reflecting good but not dominant performance. The second subject exhibits more consistent results, particularly in the second criterion (0.21875), indicating a balanced influence without extreme highs or lows. In contrast, the fifth subject has low values across most criteria, indicating relatively weak performance.

TABLE 5. Weight Normalized Decision Matrix by WPM

Weighted normalized decision matrix			
0.98581	0.8409	0.95544	0.86334
0.94574	0.96717	0.91932	0.88914
1	0.70711	1	0.95544
0.93232	1	0.88914	1
0.86334	0.88914	0.86334	0.91932

Table 5, the weighted normalized outcome matrix, shows the standardized values reflecting the relative performance of each subject across the four evaluation factors after normalization and weighting. The third subject stands out with perfect scores of 1 in the first and third factors, and a strong value of 0.95544 in the fourth factor, indicating the highest overall influence or performance across the key dimensions. Similarly, the fourth subject achieves perfect scores in the second and fourth factors, highlighting exceptional performance related to those factors, and making it one of the top performers. The second subject exhibits consistently high values across all factors, particularly in the second factor (0.96717), reflecting a balanced and reliable performance without significant weaknesses. The first subject also performs well with values above 0.84 in all categories, indicating a solid overall influence, but slightly lower compared to the top performers. The fifth subject, while showing relatively high normalized values, ranks lowest in the group, indicating a comparatively weaker impact across most factors.

TABLE 6. Preference Score

Preference Score WSM	Preference Score Wpm
0.70833	0.68379
0.75357	0.74767
0.77083	0.6756
0.84514	0.82897
0.6126	0.60926

Table 6 shows the preference scores obtained using the Weighted Sum Model (WSM) and the Weighted Product Model (WPM). These reflect the overall ranking of each subject based on their combined performance across all criteria. Both methods show similar trends, indicating consistency and reliability in the evaluation process. Subject four obtains the highest scores in both WSM (0.84514) and WPM (0.82897), demonstrating the strongest overall impact and placing it at the top rank in this study. This indicates that child 4 experiences the most significant combined effects across all factors related to the impact of antibiotics on the immune system. Three is next with a high WSM score of 0.77083, although its WPM score is slightly lower at 0.6756. This indicates strong performance, but with some variations in proportional impact across the criteria. Subject two also performs well, showing close scores of 0.75357 and 0.74767, reflecting balanced contributions in both additive and multiplicative evaluations. Subject one shows moderate preference values, indicating a reasonable, but not dominant, impact.

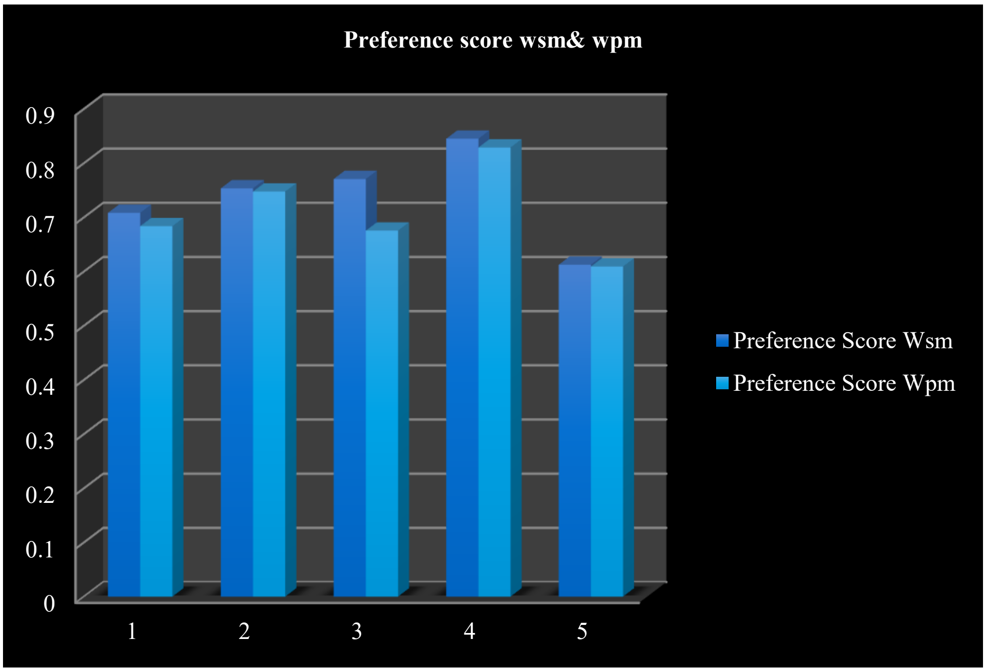

FIGURE 2. preference score

Figure 2 provides a clear comparison of performance across the five subjects using both the Weighted Sum Model (WSM) and the Weighted Product Model (WPM). Both scoring methods follow a similar pattern, indicating strong consistency and reliability in the evaluation process. Subject 4 stands out prominently, showing the highest scores in both WSM and WPM, suggesting that these subject experiences the strongest combined impact across all criteria related to antibiotic effects on childhood immunity. This confirms its top ranking in the analysis.2 and 3 show relatively high preference values, reflecting a moderate to strong overall influence. While Subject 3 has a higher WSM score than Subject 2, its WPM score is slightly lower, indicating some variation in how proportional performance affects the final ranking. Subject 1 shows average performance, indicating a moderate impact when all criteria are considered together.5 records the lowest scores in both models, highlighting it as having the least impact or weakest performance within the group. The chart visually reinforces the numerical results by demonstrating that the impact of antibiotics is not uniform across all children.

TABLE 7. WASPAS Coefficient

child	WASPAS Coefficient
1	0.69606
2	0.75062
3	0.72322
4	0.83705
5	0.61093

Table 7 shows the WASPAS coefficient values. This provides a clear ranking for the five children based on the combined impact of several criteria related to the effect of antibiotics on the children's immune system. Among all the children, Child 4 receives the highest coefficient value of 0.83705, indicating the strongest impact on immune response, side effects, and other evaluated factors. This suggests that antibiotics have a significantly greater combined effect on Child 4 compared to the other children. Child 2 is next with a relatively high value of 0.75062, reflecting a strong, but slightly lower impact. Child 3 follows with a moderate coefficient of 0.72322, showing a balanced response across the evaluation factors. Child 1 records a coefficient of 0.69606, indicating an average level of impact that is neither significantly higher nor lower than others in the group. In contrast, Child 5 has the lowest WASPAS coefficient of 0.61093, suggesting that the overall effect of antibiotics on the immune system is weakest among the children studied.

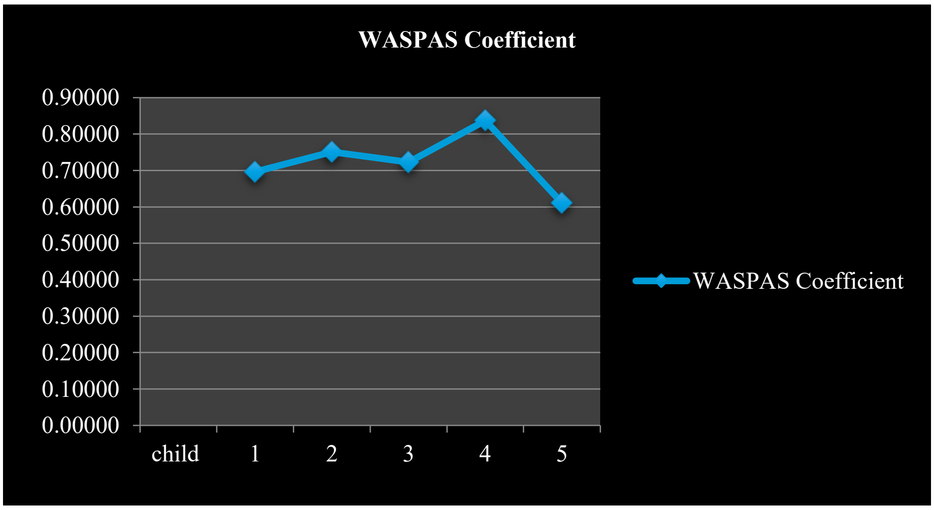

FIGURE 3. WASPAS Coefficient

The WASPAS coefficient line graph illustrates the overall comparative impact of antibiotics on childhood immunity across the five children. This trend shows significant variation, confirming that the effects of antibiotics are not uniform across individuals. Starting with Child 1, the coefficient is moderate, indicating an average level of combined influence from the evaluated criteria. The value then increases for Child 2, signifying a stronger overall impact before slightly decreasing for Child 3, which still maintains a relatively high-performance level. The graph reaches its peak at Child 4, where the WASPAS coefficient is the highest among all subjects. This clearly identifies Child 4 as the most affected or highest-ranked case in terms of antibiotic impact on immunity, reflecting strong combined scores across immune response, side effects, and related factors.

TABLE 8. Rank

Child	RANK
1	4
2	2
3	3
4	1
5	5

Table 8 shows the Based on the WASPAS evaluation, these ranking results clearly summarize the impact of antibiotics on childhood immunity. Child 4 is ranked first, indicating the highest combined impact across all evaluated criteria. This means that, among the five children, Child 4 experienced the strongest overall effects related to immune response, side effects, and other influencing factors. Child 2 is ranked second, showing a high level of impact, but slightly less than Child 4. This suggests that while not as severe as the child ranked first, antibiotics still had a significant impact on Child 2. Child 3 is ranked third, reflecting a moderate level of impact. This indicates a balanced response, where the effects of antibiotics are noticeable but not extreme. Child 1 is ranked fourth, showing a lower overall impact compared to most children in the group, indicating relatively weaker combined effects. Finally, Child 5 is ranked fifth, receiving the lowest rank in this study. This confirms that among the children studied, Child 5 experienced the least impact of antibiotics on its immune system.

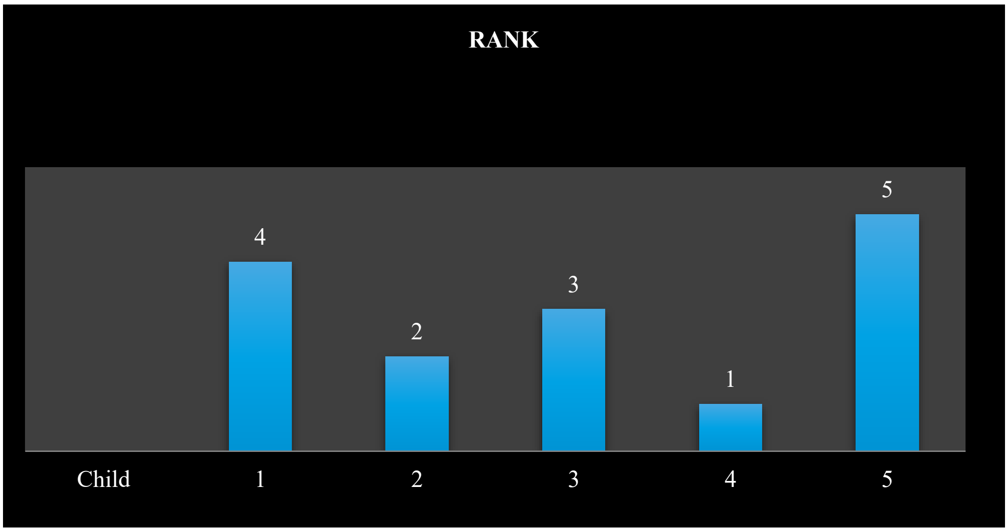

FIGURE 4. Rank for the Antibiotics impact on childhood immunities

The WASPAS analysis in Figure 5 clearly illustrates the relative impact of antibiotics on the immune system of the children. Each bar represents a child, with lower rank values indicating a greater impact. Child 4 stands out with a rank of 1, confirming it as the most affected or best-performing case across all evaluated criteria. This indicates that antibiotics have had the maximum combined impact on this child's immune response, side effects, and related factors. Child 2 is next with a rank of 2, showing the second highest impact, consistent with its strong preference and coefficient values observed earlier. Child 3 is in third place, reflecting a moderate level of impact, where the effects of antibiotics are noticeable but not severe. Child 1 is in fourth place, indicating a relatively low impact compared to the other children. Child 5 is placed fifth, at the lowest position in the chart, illustrating that this child was the least affected by antibiotic exposure within this group. The clear spacing between the bars helps in interpreting the ranking order and visually reinforces the numerical findings. This chart confirms the significant variability in the impact of antibiotics among individuals and emphasizes that Child 4 was the most affected, while Child 5 was the least affected.

4. CONCLUSION

The impact of antibiotics on childhood immunities is a complex and multifaceted topic that has been widely studied by researchers and medical professionals. While antibiotics play a crucial role in treating bacterial infections and saving lives, their use, particularly in early childhood, can have various effects on the development of the immune system. Positive Impact: Antibiotics have significantly improved child health by effectively treating bacterial infections that could otherwise lead to severe complications or even death. They are essential in managing conditions such as bacterial pneumonia, strep throat, urinary tract infections, and more. Disruption of Microbiome: Antibiotics do not differentiate between harmful bacteria causing infections and the beneficial bacteria that make up the body's micro biome. Overuse or inappropriate use of antibiotics can disrupt the balance of the gut microbiome, potentially affecting the development and function of the immune system. Development of Immune System: Exposure to a diverse array of microbes in early childhood is believed to be important for the proper development of the immune system. The disruption of the microbiome through excessive antibiotic use might influence the immune system's ability to differentiate between harmful pathogens and harmless antigens, potentially contributing to allergies, autoimmune disorders, and other immune-related issues. Increased Susceptibility: Some studies suggest that repeated or early antibiotic use in childhood could be associated with an increased susceptibility to certain infections later in life. This might be due to the disruption of the microbiome and alterations in the immune system's response. Antibiotic Resistance: Overuse of antibiotics, not only in children but across all age groups, contributes to the development of antibiotic-resistant bacteria. This poses a significant public health threat, as infections caused by these resistant bacteria can be much more difficult to treat and may lead to worse outcomes. Individual Variation.

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