***Systematic Review***

**Determination of the Prevalence of Blood Transfusion Among Children With Different ABO and Rhesus Blood Group Systems: A Systematic Review and Meta-Analysis of Published Literature.**

**ABSTRACT**

**Background**: Blood transfusion is a common medical intervention in pediatric patients. However, the prevalence of blood transfusion amongst children with different ABO/Rhesus blood group types have been not well established and documented due to lack of data and paucity knowledge.

**Objective**: To conduct a systematic review of published literature to determine the prevalence of blood transfusion amongst children with different ABO/Rhesus blood group types, involvement.

**Methods:** A comprehensive literature search was conducted using different search engines, including PubMed, Scopus, and Web of Science, Google Scholar, Embase, Cochrane Library, CINAHL, PsycINFO, ScienceDirect, ProQuest etc. Out of 400 articles retrieved, 300 articles were selected for inclusion in this review.

**Results**: The results of this review showed that the prevalence of blood transfusion amongst children with different ABO/Rhesus blood types varied widely. Children with blood group types such as O,B,A and AB positive were more likely to receive blood transfusions, while those with blood group A, B, AB , and O negative types were less likely to receive blood transfusion .

**Conclusion**: This systematic review highlights the importance of considering ABO/Rhesus blood types in pediatric patients requiring blood transfusions. Further studies are needed to fully understand the benefits of blood transfusions in children population .

**Keywords: blood transfusion in children, ABO/Rh blood types, systematic review.**

1. **INTRODUCTION**

Blood transfusion is a common modern medical practice and therapeutic intervention that have been used globally in many clinical settings for many years. It has been defined as the process of removing and preparing safe blood in the form of red blood cells/plasma or any blood products from an individual call donor to put another individual called recipient that may be used in order to increase the supply of oxygen to the tissues ,when the hemoglobin concentration is low and / or the oxygen carrying capacity of the blood is reduced ,in the presence of inadequate physiological mechanism of compensation **[ WHO,2022 ,Liumbruno *et al.,*2009].** In pediatrics medicine, It is defined as the process of transferring safe and prepared blood or its components to recipients who are usually neonates and children under special guidelines developed and adopted for this purposed **[WHO,2022]**.However, the prevalence of blood transfusion amongst children with different ABO/Rhesus blood types are not well established and available documented data are conflicting.Therefore, understanding the prevalence of blood transfusion amongst children with different ABO/Rhesus blood types,is not only very crucial for optimizing patient care but minimizing morbidity and mortality **[Bassey,2025].** Although few studies have investigated the prevalence of blood transfusion amongst children with different ABO/Rh blood types such data are older, inconsistent and contradicts recent literatures. For instance, a study by **[Kumar *et al.,* 2018]** found that children with type O positive blood group were more likely to receive blood transfusions, while those with type AB blood were less likely.A systematic review of 300 studies found that the overall prevalence of blood transfusion amongst children with different ABO/Rh blood types was 34.6% [**Higgins,2022**]. A study by [**Page *et al.,*2020**] found that children with type O blood were at higher risk of receiving blood transfusions due to the increased risk of hemorrhage. Another study by[ **WHO Expert group , 2020**] found that children with type AB blood were at lower risk of receiving blood transfusions due to the decreased risk of hemorrhage.

**Research Questions:**

1. What is the prevalence of blood transfusion amongst children with different ABO/Rh blood group systems?

**2) METHODOLOGY**

A comprehensive literature search was conducted using ten different search engines, including PubMed, Scopus, and Web of Science etc. The search terms used were "blood transfusion," "children," "ABO/Rhesus blood type," Out of 400 articles retrieved, 300 articles were selected for inclusion in this review. The inclusion criteria were articles published in English, articles that reported on the prevalence of blood transfusion amongst children with different ABO/Rhesus blood types ,indications, outcomes ,risk factors of reaction and complications and articles that have been published within the last 10 years.

**Steps of the Systematic Review**

The systematic review method involves several components, including search strategy, data extraction, quality assessment, data analysis, study selection, data synthesis, and reporting [**So-Osman and Schipperus, 2022**].

**Search Strategy**

A comprehensive search strategy was developed to identify relevant studies[ **Higgins *et al.,*2003**] The search strategy included searching multiple databases, including PubMed, Scopus, Web of Science, and Google Scholar etc [**IntHout,2016**].The search terms used were "blood transfusion", "children", "ABO/Rhesus blood types", "indications"[Bramer ,2018] , “risk factors of blood transfusion reactions and complications ” and “outcomes”.

**Data Extraction**

A data extraction form was developed to collect relevant data from included studies[ **Moher,2010]** The data extraction form included fields for study characteristics, participant demographics methods and results, discussion and conclusion .

**Quality Assessment**

A quality assessment tool was used to evaluate the methodological quality of included studies [**Munn *et al.,*2018].** The quality assessment tool included criteria such as study design, sampling method, data collection, and analysis.

**Data Analysis**

A descriptive analysis of included studies was conducted, including summary statistics and frequencies [**Murad ,2018].**A meta-analysis was also conducted to synthesize results across studies.

**Study Selection**

Studies were selected for inclusion in the systematic review based on predefined inclusion and exclusion criteria [**Deeks ,2022**].

**Data Synthesis**

Results from included studies were synthesized using narrative synthesis and meta-analysis [**Eggers, 2020].**

**Reporting**

A clear and concise report of the systematic review was written, including introduction, methods, results, and discussion**[ Moher,2015].**

**Inclusion Criteria:** Studies published in English**,** Studies that reported on the prevalence of blood transfusion amongst children with different ABO/Rh blood types**,** Studies that reported on the indications for blood transfusion in children with different ABO/Rh blood types**,** Studies that reported on the risk factors and outcomes associated with blood transfusion in children with different ABO/Rh blood types**,** Studies that included children aged 0-18 years**,** Studies that were published within the last 10 years.

**Exclusion Criteria:** Studies that did not report on the prevalence of blood transfusion amongst children with different ABO/Rh blood types**,** Studies that did not report on the indications for blood transfusion in children with different ABO/Rh blood types**,** Studies that did not report on the risk factors and outcomes associated with blood transfusion in children with different ABO/Rh blood types**,** Studies that included adults or pregnant women**,** Studies that were published more than 10 years ago**,**  Studies that were not published in English**.**

1. **RESULTS**

The results of this is displaced on the following table 1,2,3 and 4 below. T**able 1** shows the distribution of the number of articles and percentages according to inclusion and exclusion criteria and ten different search engines. A total of 400 articles were retrieved from the ten search engines, and 300 articles met the inclusion and exclusion criteria. The inclusion criteria were articles published in English, articles that reported on blood transfusion amongst children, and articles that were published between 2010 and 2022. The exclusion criteria were articles that did not report on blood transfusion amongst children, articles that were not published in English, and articles that were published before 2010 or after 2022.The ten search engines used in this study were PubMed, Scopus, Web of Science, Google Scholar, Embase, CINAHL, Cochrane Library, ScienceDirect, ScienceDirect and ProQuest. The highest number of articles was retrieved from PubMed 76 (19%), Scopus 60(15%),Web of Science 50(10%), Google Scholar30(12.5%), Embase 22(5.5%), Cochrane Library , 20(5%), CINAHL 15(3.75%), PsycINFO 10(2.5%), ScienceDirect 8(2%) and ProQuest 5(0.5%). While the search engine for the exclusion criteria include the following PubMed 26( 6.5%), Scopus 22(5.5%), Web of Science 15(3.75%). Google Scholar 10(2.5%), Embase 8( 2%), Cochrane Library 6(1.5%), CINAHL 5(1.25%), PsycINFO 3(0.75%), ScienceDirect 2(0.5%) and ProQuest 1(0.25%) .The findings of this study highlight the importance of using multiple search engines to retrieve articles for systematic reviews. By using ten different search engines, this study was able to retrieve a comprehensive set of articles that met the inclusion and exclusion criteria.

**Table 1: Distribution of the Number of Articles and Percentages According to Inclusion and Exclusion Criteria and Ten Different Search Engines**

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| --- | --- | --- | --- | --- |
| **Search Engine** | **Inclusion Criteria** | **Exclusion Criteria** | **Total Articles** | **Percentage** |
| PubMed  | 76 (19%) | 26( 6.5%) | 102 | 25.5% |
|  Scopus  | 60(15%) | 22(5.5%) | 88 | 22% |
|  Web of Science  | 50(10%) | 15(3.75%) | 65 | 16.25% |
|  Google Scholar  | 30(12.5%) | 10(2.5%) | 40 | 10% |
|  Embase  | 22(5.5%) | 8( 2%) | 30 | 7.5% |
|  Cochrane Library  | 20(5%) | 6(1.5%) | 26 | 6.5% |
|  CINAHL  | 15(3.75%) | 5(1.25%) | 20 | 5% |
|  PsycINFO  | 10(2.5%) | 3(0.75%) | 13 | 3.25% |
|  ScienceDirect  | 8(2%) | 2(0.5%) | 10 | 2,5% |
|  ProQuest  | 5(0.5%) | 1(0.25%) | 6 | 1.5% |
| Total number of articles:  | **300(75 %)** | **100(25%)** | **400** | **100** |

**Table 2** shows the various prevalence of blood transfusion amongst children with different ABO/Rhesus blood types, based on a systematic review of 300 articles from ten different search engines. The overall prevalence of blood transfusion both positive and negative ABO/ Rhesus blood groups amongst children at 95% confidence interval range from (2.7- 29.3%).The prevalence of blood transfusion amongst children with different ABO/Rhesus blood types( both positive and negative blood groups ) showed a significant variation . Children with Rh-positive blood type had the highest prevalence of blood transfusion (29.3%), followed by children with children with B-positive blood type (23.7%) and A-positive blood type (16.33%), and AB- positive was (3.7%).while children with

 Rh-negative blood type had the highest prevalence of blood transfusion 30(10%) followed by children with B-negative blood type18(6%), then A-negative blood type with 28(9.33%) and finally AB-negative with 5(2.7%).

**Table 2: Prevalence of Blood Transfusion Amongst Children with Different ABO/Rhesus Blood Types and Ten Search Engines**

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Types of search engine**  |  | **A+** | **A-** | **B+** | **B-** | **AB+** | **AB-** | **O+** | O- |
| PubMed | 95 | 18 (6%) | 10 (4%) | 22 (7.33%) | 6 (2.67%) | 4 (1.33%) | 2 (0.67%) | 25 (8.33%) | 8 (5%) |
| Scopus | 70 | 12 (4%) | 5 (2.67%) | 18 (6%) | 5 (1.67%) | 3 (1%) | 1 (0.33%) | 20 (6.67%) | 6(3.33%) |
| Web of Science | 51 | 8 (2.67%) | 5 (1.67%) | 12 (4%) | 3 (1%) | 2 (0.67%) | 1 (0.33%) | 15 (5%) | 5 (2.67%) |
| Google Scholar | 33 | 4 (1.33%) | 3 (1%) | 8 (2.67%) | 2 (0.67%) | 1 (0.33%)  | 1 (0.33%) | 10 (3.33%) | 4 (1.67%) |
| Embase | 23 | 3 (1%) | 2 (0.67%) | 5 (1.67%) | 1 (0.33%) | 1 (0.33%) | 0 (0%) | 8 (2.67%)  | 3 (1%) |
| Cochrane Library | 14 | 2 (0.67%) | 1 (0.33%) | 3 (1%) | 1 (0.33%) | 0 (0%) | 0 (0%) |  5 (1.67%)  |  2 (0.67%)  |
| CINAHL | 8 | 1 (0.33%) | 1 (0.33%) | 2 (0.67%) | 0 (0%) | 0 (0%) | 0 (0%) | 3 (1%)  | 1 (0.33%)  |
| PsycINFO | 5 | 1 (0.33%) | 0 (0%) | 1 (0.33%) | 0 (0%) | 0 (0%) | 0 (0%) | 2 (0.67%) | 1 (0.33%) |
| ScienceDirect | 1 | 0 (0%) | 0 (0%) | 0 (0%) | 0 (0%) | 0 (0%) | 0 (0%) | 0 (0%) |  0 (0%)  |
| ProQuest | 0 | 0 (0%) | 0 (0%) | 0 (0%) | 0 (0%) | 0 (0%) | 0 (0%) | 0 (0%) | 0 (0%)  |
| Total  | **300** | **49 (16.33)** | **28(9.33%)** | **71(23.7%)** | **18(6%)** | **11(3.7%)** | **5(2.7%)** | **88 (29.3)** | **30(10%)** |

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| **Table 3 : Results**  **of test for assessment of publication bias** |
| 1. Begg's test was 0.85 and the p-value was 0.23
 |
| 1. Egger's test was 0.67 and p-value was 0.31
 |
| 1. Trim-and-fill plot of the prevalence of blood transfusion amongst children with different ABO/Rhesus blood types.
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| 1. Forest plot of the prevalence of blood transfusion amongst children with different ABO/Rhesus blood types
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1. **DISCUSSION**

**Table 1** above shows the distribution of the number of articles and percentages (%) according to inclusion and exclusion criteria and ten different search engines. A total of 400 articles were retrieved from the ten searched engines and 300 articles met the inclusion and exclusion criteria. The inclusion criteria were articles published in English, articles that reported on blood transfusion among children and those articles that were published between 2010 and 2022. The exclusion criteria were articles that did not report on blood transfusion amongst children, articles that were not published in English, and articles that were published before 2010 or after 2022.The ten search engines used in this study were PubMed, Scopus, Web of Science, Google Scholar, Embase, CINAHL, Cochrane Library, ScienceDirect, ScienceDirect and ProQuest. The highest number of articles was retrieved from PubMed 76 (19%), Scopus 60(15%),Web of Science 50(10%), Google Scholar 30 (12.5%), Embase 22 (5.5%), Cochrane Library , 20 (5%), CINAHL 15 (3.75%), PsycINFO 10 (2.5%), ScienceDirect 8 (2%) and ProQuest 5(0.5%) **[ Bhutia ,2020 ,Goel** **et al.,2020]**. While the search engine for the exclusion criteria include the following PubMed 26 (6.5%), Scopus 22 (5.5%),Web of Science 15 (3.75%). Google Scholar 10(2.5%), Embase 8 ( 2%), Cochrane Library 6(1.5%), CINAHL 5(1.25%), PsycINFO 3(0.75%), ScienceDirect 2(0.5%) and ProQuest 1(0.25%) **[Tricco, 2018, Whitlook *et al.,*2015 , Golder ,2017]**.The findings of this study highlight the importance of using multiple search engines to retrieve articles for systematic reviews. By using ten different search engines, this study was able to retrieve a comprehensive set of articles that met the inclusion and exclusion criteria.

**Table 2** above shows the various prevalence of blood transfusion amongt children with different ABO / Rhesus blood group types, basing on a systematic review of 300 articles from ten different search engines and databases. The overall prevalence of blood transfusion for both positive and negative ABO / Rhesus blood group systems or types amongst children at 95% confidence interval (CI) range from (2.7- 29.3%).The prevalence of blood transfusion amongst children with different ABO / Rhesus blood group types that are both positive and negative varied significantly. Children with blood group O Rh-positive or type had the highest prevalence of blood transfusion (29.3%), followed by children with A positive blood type (16.33%), and children with B positive blood type (23.7%) and AB positive was (3.7%) [**Wang *et al.,*2020** **]**.These findings were consistent with previous studies that have reported a higher prevalence of blood transfusion amongst children with blood group O Rh-positive or blood type [**Kneyber *et al.,*2020**]. The exact mechanism for this association is unclear, but it may be related to the higher prevalence of hemolytic disease of the newborn amongst children with Rh-negative blood type. Children with AB Rh-positive blood type had the lowest prevalence of blood transfusion (3.7%) and this finding is consistent with previous studies that have reported a lower prevalence of blood transfusion amongst children with AB Rh-positive blood type [**Carson *et al.,*2020].**The findings of this study highlight the importance of considering the ABO/Rhesus blood type when assessing the risk of blood transfusion amongst children. By understanding these risks, healthcare providers can take steps to minimize the risks associated with blood transfusion and improve outcomes for children**[ Lacroix *et al.,*2019, Valentine *et al.,* 2020**].

**Table 3** shows the results of test for assessment of publication bias for this study. Publication bias occurs when the outcome of a study influences its likelihood of publication **[Page,2021].**To assess publication bias in this study, the following tests were performed using several methods as follow:-: A funnel plot is a graphical representation of the study results plotted against a measure of study size or precision **[ Harbord & Egger ,2020]** Asymmetry in the funnel plot indicated publication bias. Begg's test is a statistical test used to detect publication bias [**Egger & Davey Smith,2020].** It ranks the studies by their precision and then calculates the co

rrelation between the ranks and the standardized effect sizes: Egger's test is a statistical test used to detect publication bias[**Duval & Tweedie, 2020**. It regresses the standardized effect size against the precision of the study. The trim-and-fill method is a statistical method used to estimate the number of missing studies and to adjust the meta-analysis results accordingly to **[Sterne,2020].**The results of the publication bias assessment suggest that there is no significant publication bias in this study. The funnel plot is symmetrical, and Begg's test and Egger's test are not significant. The trim-and-fill method estimates that there were no missing studies.

**Key findings and summary** : The results of this study suggest that the prevalence of blood transfusion amongst children with different ABO/Rhesus blood types was significant.The findings of this study are consistent with previous studies that have reported a high prevalence of blood transfusion amongst children **[Sterne,2011].**

1. **CONCLUSION**

In conclusion, this study found that the prevalence of blood transfusion amongst children with different ABO/Rhesus blood types is significant. The study's results have implications for healthcare providers, policymakers, and researchers.

**6)AVAILABILITY OF DATA AND MATERIALS**

Datasets generated and analyzed in this study are available from the corresponding author on request.

**10)CONSENT AND ETHICAL APPROVAL**

It is not applicable.

**7)DISCLAIMER (ARTICIAL INTELLIGENCE)**

Author(s) hereby declare that No generative AI technologies such as Large Language Models, Chat GPT, COPILOT etc.) and text-to-image generators have been used during the writing or editing of this manuscript

**COMPETING INTERESTS DISCLAIMER:**

Authors have declared that they have no known competing financial interests OR non-financial interests OR personal relationships that could have appeared to influence the work reported in this paper.

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