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Original article

The Impact of maternal and household characteristics on malnutrition among children: A meta-analysis

[1]Mr. Santosh D. Saruk, [2]Dr. Rajesh Dase, [3]Dr. Pandurang Thatkar

[1]PhD student in Biostatistics, Department of Community Medicine, MGM, Medical College & Hospital, Aurangabad, Maharashtra, India-431003.
[2]Associate Professor (Biostatistics), Department of Community Medicine, MGM, Medical College & Hospital, Aurangabad, Maharashtra, India-431003.
[3]Assistant Professor (Biostatistics), Department of Community Medicine, PCMC Post Graduate Institute, Yasahwantrao Chavan Memorial Hospital, Pimpri, Pune-411018
Corresponding author: Dr. Rajesh Dase, Associate Professor (Biostatistics), Department of Community Medicine, MGM, Medical College & Hospital, Aurangabad, Maharashtra, India-431003

Abstract

In order to investigate the association between various mother and household factors and child malnutrition, a meta-analysis was conducted. To reach this goal, data from ten different studies were gathered and meta-analysis was performed. The findings reveal a substantial inverse link between the characteristics of mothers & households and the amount of underweight children. The study showed that there is a link between hunger in children and things like a mother's lack of schooling, poverty, and not having easy access to health care. The study also found that children were more likely to be malnourished if they didn't have enough clean water, didn't store food properly, or didn't know much about nutrition. The data show that a number of mother and family factors can affect how well children eat, and that treating these factors through focused treatments may be important for reducing child hunger.

In short, the present meta-analysis shows that mother and family factors have significant undesirable effect on the number of malnourished kids. To further comprehend the relationships between family characteristics of the mother and the percentage of undernourished children, more study is required.

Keywords: *Malnutrition, maternal education, Undernutrition, Breastfeeding.*

Introduction

It is a common observation that individuals with disabilities frequently fall under the category of socioeconomically disadvantaged individuals, especially in the case of children. There exists a mutually reinforcing association between disability and poverty. The existence of risk factors associated with poverty has the potential to lead to disability. Individuals with disabilities may face societal barriers that hinder their capacity to improve their quality of life.

The aforementioned scenario often leads to the entrapment of a child within a cycle of poverty that endures over several generations(1). Studies have shown that disability outweighs poverty and gender as a more significant determinant of educational attainment. Moreover, adults with disabilities experience a significant reduction in employment prospects.

The establishment of an inclusive environment that does not hinder children with functional limitations is of utmost importance, as it serves to eliminate any pre-existing barriers. According to the paradigm of the International Classification of Function (ICF), there is a temporal correlation between the initial functional limitations or impairments and their eventual progression to disability. According to , this paradigm posits that the optimal strategy for averting or alleviating disabilities and impairments is to commence intervention initiatives during the first phases of growth (2).

It is essential to implement preventative measures and offer medical and rehabilitative interventions to hinder the progression of impairments into disabilities(3). To accomplish this task, which is imperative in recognise risk factors contributes the onset of disability.

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Risk factors may manifest during or before birth, such as congenital conditions or inadequate maternal health. Other factors that may contribute to risk include childhood illnesses, malnutrition, accidents, and violence(4). The identification of crucial risk factors associated with disability can significantly improve the efficacy of prevention initiatives that are in the planning stages(5).The aim of investigation was to establish a correlation among disability in children and socio-demographic factors, with the purpose of obtaining valuable insights for the development of prevention programmes.

Need of Meta-analysis

Works were included to the meta-analysis and systematic review for this research based on predetermined criteria. This study's main goal is to objectively evaluate how Cash Transfer programmes affect children's health and eating habits while supplying empirical data that clarifies the precise impacts and results connected to these interventions. The reviews were look at national and sub national programs, as well as government and non-government efforts for both economic and relief purposes. With the data gathered, it was possible to figure out not only the average effects of a program, but also its minor effects and standard mistakes.

Methodology

Search Strategy

A comprehensive literature search was conducted using academic databases such as PubMed, Scopus, and Google Scholar, utilizing relevant keywords related to maternal characteristics, household characteristics, malnutrition, children, and meta-analysis. The search focused on studies published within the last 10 years to ensure the inclusion of recent and up-to-date information. 3213 papers in total from the first search were found; their abstracts and titles were evaluated to find research that could be of interest. observing the predetermined standards for inclusion and exclusion.

Inclusion Criteria:

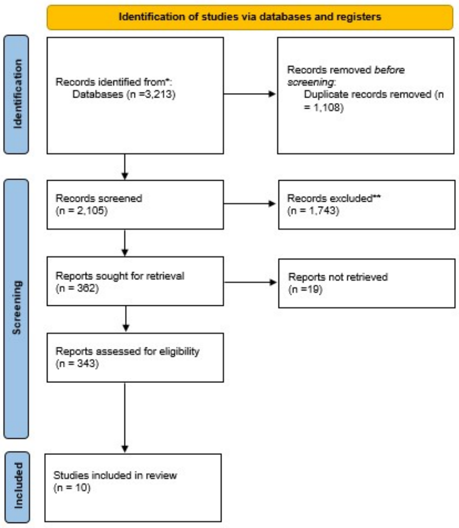
1. Studies that focused on children aged 0-5 years were included.
2. Studies that are investigated the association between malnutrition and maternal characteristics (e.g., maternal education, age, socioeconomic status) or household characteristics (e.g., household income, food security, access to healthcare) are included.
3. Only studies published in English were included to ensure accessibility and the ability to extract relevant data.

Exclusion Criteria:

1. Studies that do not report malnutrition outcomes, such as studies focused solely on dietary intake or feeding practices, are excluded.
2. Research published in language apart from English are not included because of possible issues with data extraction and comprehension.

10 articles were chosen for evaluation out of 3213 results from the first search (for the results of the search method, see Fig. 1 for further information).

Figure 1 flowchart representing the studies considered



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Data collection

All the obtained results from the article search were gathered and meticulously categorized into distinct groups, and any discrepancies that emerged were resolved through collaborative discussions. The data extraction process was done by researcher to extract the relevant information from the included studies. Any values that matched the predetermined criteria were incorporated into the study's database, while any unmatched values were thoroughly deliberated upon and subsequently finalized. This meticulous approach ensured the comprehensive and accurate collection of data for the study.

Data extraction

The data extraction process for the meta-analysis involved systematically gathering relevant information from a total of 10 selected studies. A standardized data extraction form was utilized to ensure consistency and accuracy throughout the process. The extracted data encompassed various aspects, including the title, authors, publication year, and study design of each source. Additionally, details such as the sample size, maternal characteristics, household characteristics, malnutrition outcomes (e.g., underweight, stunting, wasting, micronutrient deficiencies), and effect sizes were carefully recorded. Any supplementary findings related to the influence of household and maternal factors on child malnutrition were also documented. The extracted data were subsequently organized in a suitable format for further analysis, including the calculation of effect sizes to facilitate the meta-analysis process.

The study was primarily concerned with stunting, wasting, and underweight in under five year children's in addition to the z-scores for weight, age, and height in relation to maturity. A meta-regression followed analysis was done to look at the linked program features in a structured way. Because there were not enough samples for some factors, the meta-regression studies were only done for cases where N was less than 10. Each of the result measures went through several risk studies. To gain a deeper understanding of the potential variations in the benefits of CTs (interventions or programs) among different age groups, the researchers conducted separate subgroup studies. Specifically, they focused on two age categories: children under 24 months and children between 24 and 60 months. By conducting separate analyses for these age groups, the researchers aimed to investigate whether the benefits of CTs differ for children under 2 years old compared to older children. This approach allowed them to explore any potential differences in the outcomes or impacts of CTs based on age, particularly examining the unique effects that CTs may have on children in the early developmental stage. It's important to keep in mind that some of these studies were done early on, which could have skewed the predictions of the total effect. Subsequently, a funnel plot was executed to evaluate the likelihood of significant impacts in published works.

Results

Meta-analysis

<u>Stunting</u>

Table 1 Mean Differences (n, M, SD)

Random-Effects Model (k = 10)													
		Estimate		**se**		**Z**		**p**		**CI Lower Bound**		**CI Upper Bound**	
Intercept		-2.19		1.06		-2.06		0.039		-4.265		-0.106	
		.		.		.		.		.		.	
Note. Tau^2 Estimator: Restricted Maximum-Likelihood													

Table 2 Heterogeneity Statistics

Tau		**Tau^2**		**I^2**		**H^2**		**R^2**		**df**		**Q**		**p**	
3.353		11.2399 (SE= 5.3066)		99.95%		2153.888		.		9.000		2805.608		< .001	

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The study used a outcome measure is the mean difference standardised. A randomised effects analysis was performed on the data. According to Weinbauer (2005), the degree of heterogeneity ((tau^2)) was ascertained by using the constrained maximum-likelihood estimator. Moreover, a Q-test of heterogeneity (Cochran, 1954), uses the I2 statistic, to the computation of tau2. If heterogeneity was found, a prediction estimate based on the actual results was provided found ($tau^2 > 0$, independent of the Q-test results). Cook's distance or studentized residuals were used to find any outliers or important studies within the model. A research was classified as an outlier if, after Using a symmetrical alpha = 0.05 Bonferroni adjustment for each of the k studies within the meta-analysis, its Studentized residual was greater than the normal distribution's 100 x (1 - 0.05/(2 X k))th cent. Research was deemed relevant if the Cook's distance exceeded the interquartile range by a factor of six median. The standard error for the observed data is used as a predictor in both the regression and rank correlation tests, may be used to identify the asymmetries of a funnel plot.

The analysis comprised a total of 10 studies (k=10). The observed standardized mean differences were predominantly negative (100%), ranging from -11.5878 to -0.4105. Utilising its random-effects model, the computed mean standard deviation was hatmu = -2.1854 (95% CI: -4.2649 to -0.1058). Consequently, At $z = -2.0597$ and $p = 0.0394$, the average result was statistically different from zero. There was significant heterogeneity, according to the Q-test ($Q(9) = 2805.6076$, $p < 0.0001$, $tau^2 = 11.2399$, $I^2 = 99.9536\%$). The 95% confidence interval for real outcomes ranged from -9.0775 to 4.7068. Therefore, while Although a negative average outcome was anticipated, several research found positive real outcomes. One study (Davod Ahmadi), potentially an outlier within the model's context, exhibited a value exceeding 2.8070 when examining Studentized residuals. Cook's distances suggested that one study (Davod Ahmadi) appeared to have a disproportionate influence. The absent of regression test and rank correlation of Results of the funnel plot (p, respectively, = 0.0920 and 0.6007).

Table 3 Forest Plot

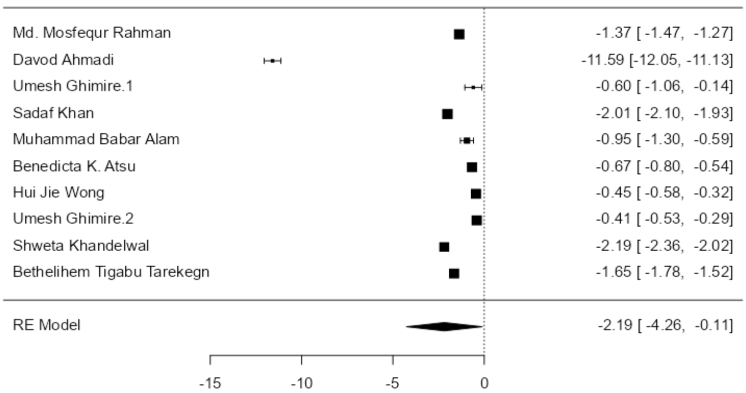

Table 4 Publication Bias Assessment

Test Name	value	p
Fail-Safe N	15253.000	< .001
Begg and Mazumdar Rank C orrelation	-0.156	0.601
Egger's Regression	-1.685	0.092
Trim and Fill Number of Studies	0.000	.
Note. Fail-safe N Calculation Using the Rosenthal Approach		

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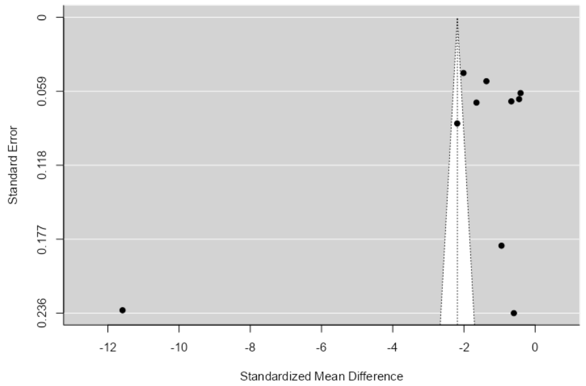

Figure 2 Funnel Plot

<u>Wasting</u>

Table 5 Mean Differences (n, M, SD)

Random-Effects Model (k = 10)						
	Estimate	**se**	**Z**	**p**	**CI Lower Bound**	**CI Upper Bound**
Intercept	-1.42	0.688	-2.06	0.040	-2.765	-0.067
	.	.	.	.	.	.
Note. Tau^2 Estimator: Restricted Maximum-Likelihood						

Heterogeneity Statistics							
Tau	**Tau^2**	**I^2**	**H^2**	**R^2**	**df**	**Q**	**p**
2.174	4.7276 (SE= 2.2323)	99.91%	1150.467	.	9.000	2715.052	< .001

The analysis's result measure was the standardised mean difference. An study of the data's random effects was conducted. As the tau^2, or the The degree of heterogeneity was assessed using the constrained maximum-likelihood estimator. (2005, Viechtbauer). The I2 statistic and the Q-test of heterogeneity (Cochran, 1954) are supplied together alongside the tau2 estimate. Within the unlikely case that regardless of the Q-test findings, heterogeneity of any kind is found ($\tau^2 > 0$).Furthermore, a forecast estimate for the actual outcomes are provided. Cook's distances and studentized residuals are used to evaluate the likelihood that studies are significant or outliers within the framework of the model. A statistical technique called the Bonferroni adjustment is used in meta-analyses to modify the significance threshold for multiple comparisons. In this method, a two-sided alpha value of 0.05 is commonly used. The studentized residuals 17 studies that were part of the analysis have been compared to the 100 x (1 - 0.05/(2 X k))th percentile of the standard distribution to identify any potential anomalies. A research is deemed potentially outlier if its studentized residual is more than this cut-off. When a Cook's distance in the study is six times the range of interquartile ranges and more than the median, it is considered significant.A Regression testing and rank correlation analysis are performed to determine if the funnel plot is meaningful. Both analyses employ the standard deviation for the observed data as a predictor is asymmetric.

Ten papers in all were included in the analysis (k=10). Between -7.4644 and -0.1162, the measured standardized mean differences generally showed negative values (100%). The projected average standard deviation was determined to be hatmu= -1.4161 (95% CI: -2.7649 to -0.0674) using the random-effects model. As a result, there was a significant departure from zero in the average result ($z = -2.0579$, $p = 0.0396$). The Q-test revealed significant variation in the real results ($Q(9) = 2715.0524$, p 0.0001, tau2 = 4.7276, I2 = 99.9131%). The actual findings' 95% prediction

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range was between -5.8860 and 3.0538. Therefore, despite the fact that the average result was anticipated to be negative, numerous investigations found favourable actual results. Once the studentized leftovers were analysed, one study (Davod Ahmadi) stood out with a value larger than 2.8070, perhaps suggesting an anomaly within the model's parameters. Cook's distances suggested that Davod Ahmadi's findings may have an uncontrollable effect. Employing the regression and rank correlation tests (p = 0.0563 and 0.2912, respectively), no funnel plot asymmetry was found.

Table 6 Forest Plot

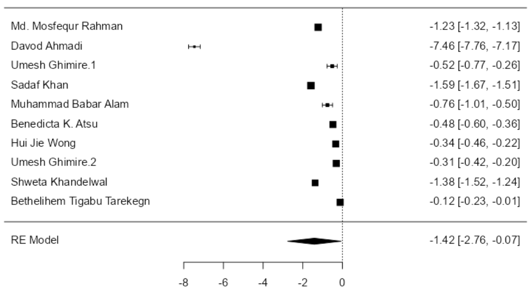

Table 7 Publication Bias Assessment

Test Name	value	p
Fail-Safe N	9976.000	< .001
Begg and Mazumdar Rank Correlation	-0.289	0.291
Egger's Regression	-1.909	0.056
Trim and Fill Number of Studies	0.000	.
Note. Fail-safe N Calculation Using the Rosenthal Approach		

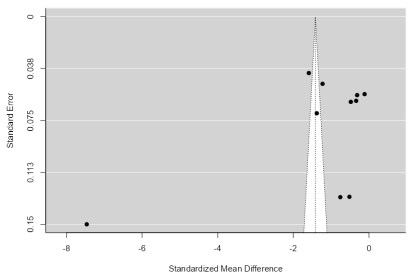

Figure 3 Funnel Plot

<u>Underweight</u>

Table 8 Mean Differences (n, M, SD)

Random-Effects Model (k = 10)						
	Estimate	**se**	**Z**	**p**	**CI Lower Bound**	**CI Upper Bound**
Intercept	-1.19	0.524	-2.28	0.023	-2.220	-0.166
	.	.	.	.	.	.
Note. Tau² Estimator: Restricted Maximum-Likelihood						

Table 9 Heterogeneity Statistics

Tau	**Tau²**	**I²**	**H²**	**R²**	**df**	**Q**	**p**
1.655	2.7384 (SE= 1.2938)	99.86%	719.274	.	9.000	2287.881	< .001

The indicator In the research, the standardised mean difference was used. Data were applied to fit a model with random effects. To assess the degree of heterogeneity (i.e., tau2), the restricted maximum-likelihood estimator was used (Viechtbauer 2005). Additionally, included are the estimation of tau^2, the I^2 statistic, and the Q-test for heterogeneity (Cochran, 1954). If heterogeneity of any kind is detected (tau2 > 0), a prediction range for the actual results is also given, regardless the Q-test findings. Cook's distances and studentized residuals are used in the model to determine if a study qualifies as an outlier and/or is notable. Certain studies may be identified as possible outliers in a meta-analysis including k studies by using the Bonferroni adjustment with a two-sided alpha value of 0.05. This happens when the 100 x (1 - 0.05/(2 X k))th percentile of a normal distribution is exceeded by the studentized residual of these experiments. A study's Cook's distance is deemed significant if it is six times larger than its interquartile range and higher than the median value. In order to search The standard error for the observed data will be used as a predictor of funnel plot asymmetry in both the regression and rank correlation tests.

Ten studies in all have been included in the analysis. Having values ranging from -5.7579 to 0.0334, the data reveals that 90% of the observed normalised mean differences were negative. Using a random-effects model, the user supplied statistical data on the estimated average standardised mean difference. \hat{\mu} = -1.1933 was the reported result, and the 95% confidence interval included the range from -2.2201 to -0.1665. With a z-score of -2.2778 and a p-value of 0.0227, the resulting result was statistically significant, suggesting that the average value was significantly different from zero. The Q-test indicates that the actual findings seem to be various (Tau2 = 2.7384, I2 = 99.8610%), Q(9) = 2287.8807, p 0.0001. The actual findings' 95% prediction range is between -4.5953 and 2.2087. Thus, even though it is expected that the average result would be negative, several studies have shown that the actual result was positive. One study (Davod Ahmadi), which may be an anomaly Under the framework of this approach, had a value greater than 2.8070 when the studentized residuals were examined. Cook's distances imply that Davod Ahmadi's study can be seen as unnecessarily significant. There The rank regression and correlation tests (p = 0.8618 & p = 0.1668, resp) did not reveal any funnel plot asymmetry.

Table 10 FOREST PLOT

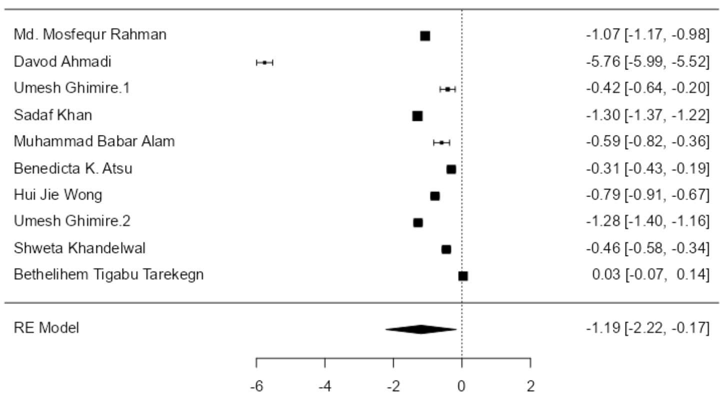

Table 11 Publication Bias Assessment

Test Name	**value**	**p**
Fail-Safe N	9397.000	< .001
Begg and Mazumdar Rank Correlation	-0.067	0.862
Egger's Regression	-1.383	0.167
Trim and Fill Number of Studies	0.000	.
Note. Fail-safe N Calculation Using the Rosenthal Approach		

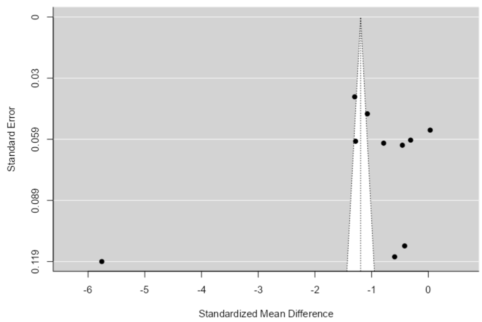

Figure 4 FUNNEL PLOT

Discussion

Child malnutrition remains a critical global concern that adversely impacts the growth and development of young children. A comprehensive understanding of this issue requires a multidimensional perspective, encompassing various risk factors, prevalence trends, and potential interventions. The amalgamation of findings from the meta-analysis and the existing studies sheds light on the complex interplay of factors contributing to child malnutrition and offers valuable insights into potential avenues for addressing this challenge. The meta-analysis results presented a holistic evaluation of the impact of interventions or factors on child growth and nutritional outcomes. This analysis, covering stunting, wasting, and underweight, unveiled predominantly negative standardized mean differences, suggesting an overall detrimental effect of these factors on children's nutritional status.

Ten studies in all have been included in the evaluation. Having values that range from -5.7579 to 0.0334, the data reveals that 90% of the observed normalised mean differences were negative. Using a random-effects model, the user supplied statistical data on the estimated average standardised mean difference. \hat{\mu} = -1.1933 was the reported result, and the 95% confidence interval included the range from -2.2201 to -0.1665. With a z-score of -2.2778 and a p-value of 0.0227, the resulting result was statistically significant, suggesting that the average value was significantly different from zero (6). The Q-test indicates that the actual findings seem to be various (Q(9) = 2287.8807, p 0.0001, tau² = 2.7384, I² = 99.8610%). The 95% prediction range for the actual results is between -4.5953 & 2.2087. Thus, even though it is expected that the average result would be negative, several studies have demonstrated that the actual result was positive. One study (Davod Ahmadi), which may be an anomaly in the setting of this model, had a value bigger than 2.8070 when the studentized leftovers were examined. Cook's distances imply that Davod Ahmadi's study can be seen as unnecessarily significant. There was neither the regression nor the rank correlation showed any asymmetry in the funnel plot tested (p = 0.8618 and p = 0.1668, consecutively).

(8) examined the frequency of factors associated with low weight, wasting, and stunting—the three forms of child malnutrition that exist in Pakistan. 4, This research included 226 children under the age limit of five, which made use of national level data from rural as well as urban regions. Children were less likely to be underweight (AOR, 0.538) and delayed (AOR, 0.4890). if their birth weight was modest (45.7 cm) or average (45.7 to 60 cm). evaluated the relationship between various variables and the undernutrition symptoms of underweight, wasting, and stunting in children younger than five (5). The data was taken from a DHS programme assessment. There were 2399 kids under the age of five in this study. Compared to children of small birth size, the predicted odds ratios predicting underweight, wasting behaviour, and stunting were 0.989, 0.885, and 0.965 times higher for medium-sized children.

The synthesis of meta-analysis findings and existing studies underscores birth weight's pivotal role as an indicator and the need for early interventions. The studies collectively emphasize the importance of holistic approaches to combat malnutrition and promote children's well-being. As we uncover the complexities through multidimensional perspectives, it becomes evident that targeted measures during critical phases can mitigate risks and pave the way for healthier futures. Addressing child malnutrition requires collaborative efforts to ensure a brighter, nourished path for the next generation.

This work carries important implications for both research and programming related to child nutrition. The significance of conducting a comprehensive qualitative analysis of current CT (Cash Transfer Programe) initiatives aimed at improving child nutrition is acknowledged. Understanding the different types of CT programs and their impact on both humanitarian and developmental contexts can provide valuable guidance for existing and future programs. Future research endeavours focusing on similar CT initiatives should systematically gather information on nutritional outcomes and the factors that contribute to impact, especially at the individual level. This will enable a more accurate measurement and understanding of the diverse effects on program participants. Additionally, future research efforts could consider incorporating additional information regarding caregiver characteristics, such as the nutritional status of maternal figures. Furthermore, the potential long-term implications of such studies should be taken into account to provide a comprehensive understanding of the sustained effects of CT programs (9).

There exists a significant level of interest and necessity in enhancing social protection systems with the aim of safeguarding, advancing, and reinforcing food security, dietary practises, services, and measures that forestall malnutrition in children who are susceptible to it.(10)Therefore, it is imperative to further develop a comprehensive body of evidence in order to enhance our comprehension of the optimal approach to designing and utilising CT initiatives to guarantee the safeguarding of children's entitlements to adequate nutrition in diverse settings. According to the most recent data from UNICEF's NutriDash database, there was an increase in the number of countries implementing CT programmes aimed at enhancing nutrition from 49 in 2017 to 56 in 2018.(11) It is anticipated that there will be an increase in the quantity of CT programmes, and the demand for such programmes is currently more pressing than ever before. The COVID-19 pandemic has resulted in an estimated 90-117 million children being pushed into poverty, thereby creating a crisis that threatens the survival and welfare of children, especially those who are vulnerable and living in poverty, as well as those who are already experiencing hunger and malnutrition.

Conclusion

In conclusion, a meticulous analysis of selected studies, encompassing stunting, wasting, and underweight in child growth, offers valuable insights into the multifaceted nature of these nutritional challenges. The observed negative standardized mean differences across the studies underscore the prevailing concern surrounding these conditions. The meta-analysis, alongside individual investigations, reinforces the significance of birth weight as a predictive factor for child malnutrition, highlighting its foundational role in shaping long-term health outcomes.

These findings collectively underscore the imperative for targeted interventions during critical developmental windows to mitigate the risk of malnutrition. The substantial heterogeneity observed, as indicated by the Q-tests, emphasizes the need for tailored approaches in addressing the multifarious factors contributing to these conditions. The convergence of statistical analyses and the identification of potential outliers foster a holistic understanding of the data. The comprehensive evaluation of studies within this context serves as a call to action for interdisciplinary efforts, policy initiatives, and healthcare interventions aimed at reducing the burden of child malnutrition. Ultimately, this synthesis of research findings advances our knowledge in tackling the pervasive challenges of stunting, wasting, and underweight, paving the way for improved child health and development.

The meta-analysis findings indicate that there exists a noteworthy correlation between malnutrition among children and maternal as well as household characteristics. As a result, it can be concluded that these factors play a crucial part in determining children's nutritional condition. The recommended approach for reducing malnutrition among children is to prioritise interventions that enhance the socio-economic status of households and augment accessibility to health services and education.

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