

Does Corruption Affect the Reduction in Children's Stunting Rate Caused by Foreign Aid?

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Abstract: Recent empirical evidence has indicated a potential avenue for ameliorating the nutritional status of children in developing nations through focused interventions in the realms of food and agriculture. This research delves into the issue of child stunting prevalence in developing countries, scrutinizing the impact of corruption on the efficacy of such interventions. Utilizing comprehensive data derived from the Organization for Economic Cooperation and Development (OECD) and the World Bank, this study meticulously analyzed evolving trends. Notably, the investigation revealed a diminishing prevalence of child stunting among both genders but the role of total aid emerged as inconsequential in contributing to this positive trend. Furthermore, an intriguing revelation surfaced, indicating that the battle against child malnutrition hinges not solely on the optimized distribution of foreign aid but significantly on the curbing of corruption. The research uncovered a notable improvement in children's nutrition correlated not with the augmentation of foreign aid but with the augmentation of public health expenditures, thereby emphasizing the pivotal role of corruption control. This discernment underscores the imperative need for targeted aid and robust governance mechanisms to effectively combat the formidable challenge of child malnutrition.

Keywords: Poverty, Aid, Child stunting, Corruption, Development economics

1. Introduction

In the realm of global health and development, the persistent issue of child malnutrition, marked notably by stunting, remains a critical concern, particularly in developing countries. Stunting, characterized by impaired growth and development due to chronic malnutrition, has far-reaching consequences for both individual well-being and national development trajectories. Foreign aid has long been a cornerstone in addressing such challenges, with targeted initiatives aiming to alleviate the impacts of malnutrition. However, an underexplored dimension emerges in the form of corruption—a pervasive issue that has the potential to influence the effectiveness of foreign aid interventions.

Globally, efforts to combat child malnutrition have been bolstered by substantial foreign aid contributions. Organizations such as the World Bank and various governmental and non-governmental entities have implemented diverse programs to address the root causes of stunting, encompassing nutrition, healthcare, and socio-economic factors. Despite these concerted efforts, the

reduction in children's stunting rates has displayed variability, prompting a critical examination of the factors influencing the outcomes of foreign aid initiatives.

The primary purpose of this research is to contribute insights into the mechanisms through which corruption may hinder or exacerbate the impact of foreign aid on reducing children's stunting rates. By unravelling these interactions, the study aims to inform policymakers, practitioners, and researchers on the intricacies of designing and implementing effective interventions in the fight against child malnutrition. The significance of this inquiry lies in its potential to refine strategies, enhance accountability, and optimize resource allocation within the context of international development efforts.

This paper proceeds with a comprehensive analysis, drawing on data from the Organization for Economic Cooperation and Development (OECD) and the World Bank. The subsequent sections include a thorough literature review, an exploration of data trends, and a rigorous examination of the impact of corruption on the relationship between foreign aid and children's stunting rates. Through this systematic investigation, the aim is to shed light on a critical nexus that holds implications for global health and development policies.

2. Literature Review

2.1. Child Stunting

Notwithstanding the gradual decrease in the percentage of stunting over the years, the issue of children undernutrition persists as a substantial global public health challenge and a cause for serious concern [1]. The lingering impact of undernutrition on survivors manifests in lasting physical and cognitive impairments, diminished educational attainment, and reduced earning potential [2][3]. Consequently, the diminished cognitive and physical capacities stemming from early malnutrition pose significant obstacles to both productivity and economic progress in affected countries [4].

Stunting, common undernutrition, used to be responsible for about 50% of child deaths globally [5]. The World Health Organization (WHO) reported that in 2020, an estimated 149 million children under the age of five were affected by stunting globally, and it was identified as the underlying cause of 45% of mortality in this vulnerable age group [6]. The prevalence of stunting has demonstrated a steady decrease across all age groups, showing a gradual decline from 32.6% in 2000 to 22.2% in 2017, as reported in the 2018 Global Nutrition Report. Despite this overall positive trend, certain regions, such as the Philippines, still face significant challenges, with an alarming 1 in 3 children under the age of 5 experiencing stunted growth (approximately 3.8 million children). In comparison, the global prevalence stands at 1 in 5 children (approximately 151 million), indicating that the issue persists on a large scale [7]. Actually, prior to the onset of the COVID-19 pandemic, it became increasingly evident that the global community was falling short in its pursuit of Sustainable Development Goal 2, which aims to eradicate hunger and address all forms of malnutrition by the year 2030 [8]. Following the year 2019, the advent of the COVID-19 pandemic posed additional challenges, exacerbating the difficulties in achieving the set goals for reducing stunting by 2025 [9]. Numerous challenges and complexities persisted on this journey towards achieving food security and nutrition for children. Thus, child stunting remains a pressing issue that demands undivided attention and should not be disregarded.

2.2. The Reduction of Child Stunting Rate Caused by Aid

Alesina and Dollar asserted that there are various reasons for countries providing aid to other countries, such as humanitarian reasons, geopolitical and economic interests, development cooperation or even historical ties [10]. In this part, however, what needs to be considered is not the political motivations or strategic considerations behind the aid, but whether the aids are effective or

not, especially in terms of children's stunting rate. Actually, early literature shows that foreign aid has the potential to mitigate child stunting by enhancing health infrastructure, providing nutritious food, clean water, and sanitation, training healthcare workers, and establishing and implementing mother-child nutrition programs, all of which are pivotal components in tackling undernutrition and stunting [11]. Moreover, a recent paper also corroborates that a 10 per cent increase in agricultural aid per capita and food aid led to a reduction of stunting prevalence by 0.5 per cent and 2.1 per cent respectively as evidenced through the application of panel data and ordinary least squares (OLS) analysis [4].

Nevertheless, not all foreign support has a significant impact on all the countries. Many papers argued that the efficiency of aid indeed depends more on policies and related institutions in recipient countries. The aid will only achieve limited success in alleviating poverty in the countries that are poorly performed in bureaucracies. Collier and Dollar discovered that aid has a positive impact on reducing poverty in countries characterized by sound policies and robust institutions, while a limited influence on countries with weaker policies and institutions [12]. A similar conclusion was documented by Easterly, Levine, and Roodma, aid is more likely to be effective when it is provided to countries that have the capacity to absorb and effectively utilize the resources, which is closely related to the quality of governance. Therefore, government issue is noticeable when considering the effect of international aid [13].

2.3. Corruption

When assessing the efficiency of a government, the extent of corruption consistently emerges as an essential indicator that cannot be disregarded. Han and Yan included combating corruption as one of the most important explanatory variables when measuring the level of trust in government competence, which indirectly proves that [14]. Since corruption can, somehow, be a symbol of a government's quality and competence, and the preceding section illuminates the impact of governmental factors on the effectiveness of international aid initiatives, it can be interesting to study how corruption affects the results of aid. Nevertheless, it seems that no paper examined this correlation directly and there is a dearth of quantitative analysis.

However, before analyzing how corruption will affect the effectiveness of foreign support, one thing needs to be noticed is that, whether foreign support will foster the level of corruption. Tawiah and Karungi stated that more foreign aid means less corruption, implying a positive impact of foreign aid on the level of corruption in Africa partly due to aid conditionality, while the opposite result was found showing a positive relationship between aid and corruption by using the Two-Stage Least Squares method (2SLS), but this significance disappeared when using time fixed-effects [15]. They concluded that there was no significant impact of aid on corruption [16]. Another thing is whether aid influences corruption or not. It is understandable for foreign countries and international institutions to decrease their donations if they discover corruption issues after conducting research. Corruption can hinder the achievement of their intended goals. While there is no specific evidence on this matter, the adverse effects of corruption on economic and political stability are well-known. This can potentially disrupt the interests of investors [17].

3. Methodology

The study employs a quantitative research design using secondary data and dynamic model with fixed effects in order to investigate the impacts of corruption on the reduction of the prevalence of child stunting rate. The sample consists of data from 139 developing countries across different regions of the world, covering a time span of nine years (from 2012 to 2020). The countries and time periods have been chosen based on data availability and to provide a comprehensive understanding of the

subject matter across different contexts. The outcome variable is the prevalence of child stunting rate (PS). However, due to the data availability, most countries do not provide specific numbers, so the World Bank chose to use the estimated data on the prevalence of child stunting rate (PSE). Similarly, they estimated the stunting rate for both male (PSM) and female kids (PSF). The main independent variables are the total aid the countries receive (TA) and the control of corruption estimated (CCE). CCE was mentioned as one of the most famous indexes for measuring corruption (Milic et al., 2022). There are other control variables like net national income (NNI), net national income per capita (NNIP), Domestic general government health expenditure (% of GDP) (HE_GDP), Domestic general government health expenditure (% of general government expenditure)(HE_GE). The data for total aid was obtained from the website of OECD while others were from The World Bank.[18][19]

This paper will first make an initial foray into the data will be done via descriptive analysis that uses data visualization analysis. This preliminary step will provide us with a solid understanding of the trends and patterns within the data, laying the groundwork for more advanced forms of analysis. The descriptive analysis will involve a data visualization component that will allow us to comprehend visually the trend of global PSE over the stipulated timeframe. Concurrently, it will graphically illustrate how variables such as the total foreign aid received by a country and the level of corruption control within its administrative system influence stunting rates across genders.

Subsequently, the study will employ correlation analysis and multiple linear regression to quantify the relationships between the dependent variable (children's stunting rates) and the primary independent variables (public sector expenditure and corruption control). The correlation analysis will gauge the strength and direction of the relationships between the variables, while the regression analysis will generate a mathematical model capturing the influence of independent variables on the dependent variable.

While initially considering a model that included year dummy variables to account for potential annual variations, the final model will not include them. This decision is premised on the results from a random slope model constructed during preliminary analysis. The random slope model, a kind of mixed-effect model, allows for the intercept and the slope to vary randomly across different years. After assessing this model, it became apparent that the addition of year dummies was not necessary for the regression analysis. The rationale behind this decision will be explored in detail in a subsequent section.

The next stage of the analysis involves the application of stepwise regression, a form of regression analysis that iteratively selects the predictors to be included in the model. The stepwise process will be utilized in a backward manner, meaning that it starts with a full model and systematically removes the least significant variable at each step. The selection of the final model is guided by the Akaike Information Criterion (AIC), a statistical measure that evaluates the relative quality of models. The model with the smallest AIC value is selected as it is deemed to offer the best balance between goodness of fit and simplicity.

The last phase of the analysis ensures the robustness and reliability of the final model. It involves a thorough diagnostic check of the model, investigating aspects such as residual analysis, autocorrelation tests, and heteroscedasticity tests. The residual analysis will assess the difference between the observed and predicted values, providing insights into the accuracy of the model. Autocorrelation tests will identify if there is any correlation between residuals at different points in time, which might indicate a violation of the independence assumption of the regression model. Heteroscedasticity tests will verify the assumption that the variability of the error term is constant across all levels of the independent variables. Finally, the importance of variables in the model will be evaluated, which can guide policy recommendations and future research.

4. Result

4.1. Trend of Stunting from 2012 to 2020

The graphical depiction of child stunting rates in Figure 1 vividly reflects an overarching downward trend in these rates over the studied period, a pattern that aligns seamlessly with the evidence and discussions presented in the literature review section. This secular decline is a testament to the improvements in child health and nutrition seen globally, affirming the effectiveness of ongoing strategies and interventions aimed at combating stunting in children. However, an intriguing observation emerges when considering the global pandemic's impact, which started sweeping across nations at the end of 2019. Contrary to the widely held expectation that the COVID-19 pandemic would cause a rise in stunting rates due to its disruptive influence on healthcare systems and food security, the data in 2020 shows a continuation of the declining trend. This phenomenon contradicts the prevailing statement about the negative effects of stunting rate reduction, adding a layer of complexity to the understanding of the interplay between global crises and health outcomes.

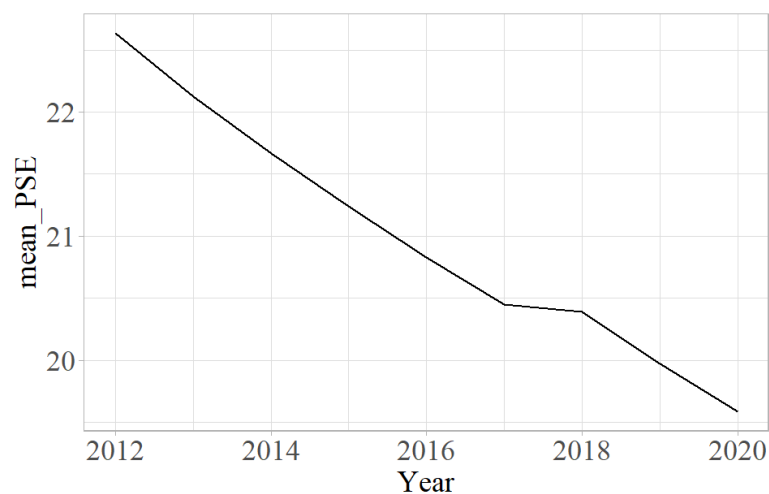


Figure 1: Estimating the prevalence of developmental disorders in children and its relationship with years.

4.2. The Effect of Aid and Corruption on Stunting Rate in Different Gender Groups

Figures 2 and 3 offer visual illustrations of the effects of total aid received and corruption control on the prevalence of stunting rates in different gender groups. The diagrams provide an accessible means of interpreting the correlation between these independent variables and the key critical health outcome under consideration.

From Figure 2, it is evident that the estimated prevalence of stunting rate among children does not vary significantly between different gender groups with the fluctuations in the total amount of foreign aid received. Both male and female children's stunting rates appear to follow a parallel trajectory as the volume of aid changes, suggesting a similar level of responsiveness across genders to this particular form of resource allocation.

Figure 3 echoes this conclusion in the context of corruption control. It reveals a negligible disparity in the stunting rates between male and female children, underscoring the uniform influence of corruption control on health outcomes irrespective of gender. Irrespective of the varying levels of corruption control, both genders seem to display similar patterns in stunting prevalence.

Such a consistent pattern across both genders raises interesting questions about the dynamics of resource allocation, corruption, and health outcomes. It prompts a call for further inquiry into the interaction between these factors and potential nuances that might exist beyond observable consistency. Despite the seemingly equal impact on both genders, more granular research might be needed to uncover any underlying gender-specific issues that are not immediately evident in the aggregate data.

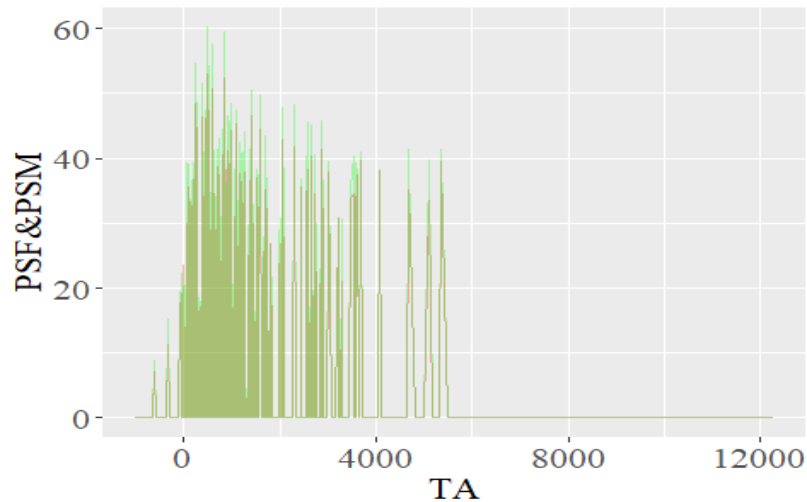


Figure 2: Comparison of the effects of total aid on male and female children stunting rates (the green line represents male and red line represents female)

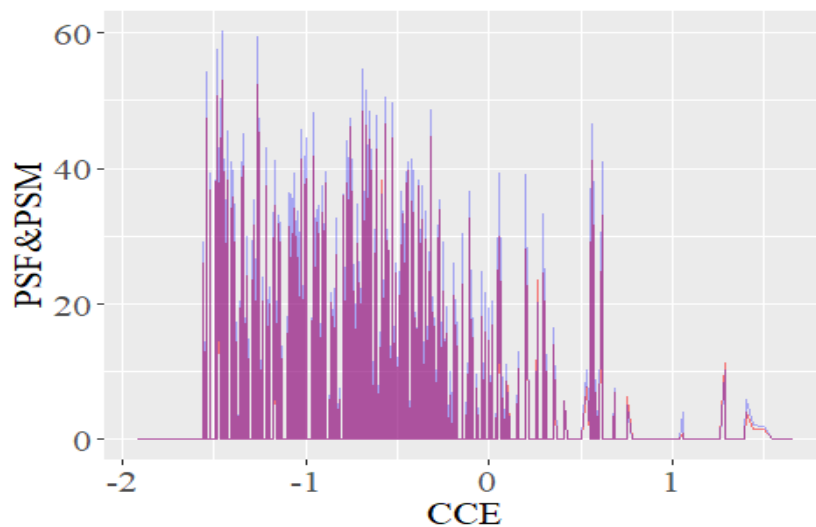


Figure 3: Comparison of the effects of control of corruption on male and female children stunting rates (the blue line represents male and the red line represents female)

4.3. Correlation Test

The results of Pearson's product-moment correlation analysis reveal intriguing relationships between the total amount of foreign aid received, corruption control, and the prevalence of child stunting. On the one hand, a positive correlation of approximately 0.33 is found between the total amount of foreign aid received and the estimated prevalence of child stunting. This positive correlation signifies

that, as the total aid increases, the estimated stunting rate correspondingly rises. Notably, this outcome counters the assertions of earlier studies, proposing an unexpected association between the influx of foreign aid and stunting prevalence. The statistical significance of this relationship is confirmed by a p-value substantially below 0.05. However, it is crucial to underline that this correlation does not presuppose causality; in other words, it does not definitively assert that an increase in foreign aid directly causes an increase in child stunting rates. Further research is needed to unpack the complex dynamics and potential intervening factors in this relationship. Contrastingly, the correlation between corruption control and child stunting rates is approximately -0.465, implying a moderately negative relationship between these variables. This indicates that as corruption control intensifies, thereby reducing corruption levels, the prevalence of stunting diminishes. This finding is intuitive, as more robust corruption control likely leads to better resource allocation, promoting health and nutritional outcomes for children. Once again, the statistical significance of this correlation is affirmed by a p-value substantially lower than 0.05.

Figure 4 visually displays the correlation coefficients between one factor and all the other factors through correlation coefficient graphs. A coefficient greater than 0 indicates a positive correlation, while a coefficient less than 0 indicates a negative correlation. It is noticeable that the relationship between CCE and health expenditure (%GDP) is positively correlated, showing that the higher level of controlling corruption, the higher the money distribution on public health. Meanwhile, it can be seen that higher expenditure on public health may lead to less stunting rate since the correlation coefficient is -0.44. Thus, aid in low-level corruption countries may consequently lead to better results. However, CCE is negatively correlated with foreign support, meaning that less corrupt countries receive less aid.

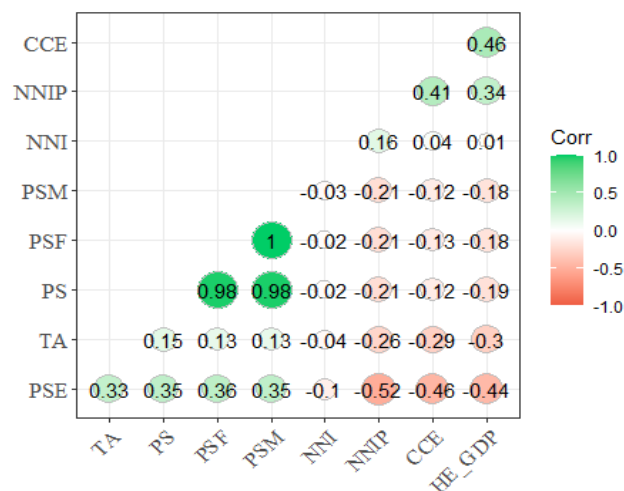


Figure 4: Correlation map

4.4. Linear Regression

Considering that the slopes corresponding to different years may vary, a random slope model was constructed. According to Table 2, the results highlight a remarkable consistency in both intercepts and slopes across different years. This consistency suggests that the relationship between the variables of interest remains stable over time, i.e., the effect of the independent variables on the dependent variable does not significantly change from year to year. Given these findings, the inclusion of year dummy variables – a typical procedure to control for time-specific effects in panel data analysis – appears to be unnecessary in this case. The near uniformity of slopes and intercepts across years

suggests that the data do not exhibit strong time-specific solid variations that need to be controlled for. Therefore, the more parsimonious model without year dummy variables is preferred.

Table 1: Results of random slope model.

YEAR	INTERCEPT	CCE
2012	16.11	-9.481
2013	16.11	-9.473
2014	16.11	-9.465
2015	16.11	-9.464
2016	16.11	-9.4960
2017	16.11	-9.4510
2018	16.11	-9.4467
2019	16.11	-9.4423
2020	16.11	-9.4330

By applying simple and multiple linear regression, a linear model (estimated using OLS) was fitted to predict PSE with CCE and the results are shown in Table 2. It can be seen that the total aid does not affect the stunting rate very much, given 0.004 as the coefficient and a highly significant level. However, control of corruption truly plays a vital role in reducing the stunting rate and its magnitude of the effect was reduced after accounting for other factors like health expenditure and net national income per capita.

Table 2: Results of linear regression.

<i>Dependent variable: PSE</i>				
	(1)	(2)	(3)	(4)
<i>TA</i>	0.004*** (0.0003)		0.004*** (0.001)	0.001*** (0.0003)
<i>NNI</i>				0
<i>NNIP</i>				-0.002*** (0.0001)
<i>CCE</i>		-9.457*** (0.511)	-8.883*** (0.556)	-4.048*** (0.535)
<i>TA:CCE</i>			0.001*** (0.0004)	
<i>HE_GDP</i>				-1.277*** (0.165)
<i>Constant</i>	18.057*** (0.431)	16.114*** (0.428)	14.224*** (0.480)	25.996*** (0.8)
<i>Observations</i>	1,242	1,242	1,242	1,242
<i>R2</i>	0.109	0.216	0.264	0.399
<i>Adjusted R2</i>	0.108	0.215	0.263	0.397
<i>Residual Std. Error</i>	12.674 (df=1240)	11.888 (df=1240)	11.525 (df=1238)	10.425 (df=1236)
<i>F Statistic</i>	151.789*** (df = 1; 1240)	341.894*** (df = 1; 1240)	148.390*** (df = 3; 1238)	164.167*** (df = 5; 1236)
<i>Note:</i>		*p<0.1;	**p<0.05;	***p<0.01

The stepwise regression was also used to optimize the model and found a similar result (Table 3).

Table 3: Results of stepwise regression.

<i>Dependent Variable: PSE</i>	
<i>TA</i>	0.001*** (0.0003)
<i>NNI</i>	0 (0)
<i>NNIP</i>	-0.002*** (0.0001)
<i>CCE</i>	-4.048*** (0.535)
<i>HE_GDP</i>	-1.277*** (0.165)
<i>Constant</i>	25.996*** (0.800)
<i>Observations</i>	1242
<i>R2</i>	0.399
<i>Adjusted R2</i>	0.397
<i>Residual Std. Error</i>	10.425 (df=1236)
<i>F Statistic</i>	164.167*** (df=5; 1236)
<i>Note:</i>	*p<0.1; **p<0.05; ***p<0.01

5. Discussion

The primary aim of this research study was to investigate the extent to which corruption could mitigate the effect of foreign aid on the prevalence of child stunting rates. Over the course of the analysis, it is found that the overall trend in child stunting rates showed a steady decline, even in 2020 when the COVID-19 pandemic had taken hold globally. Moreover, the data clearly highlighted that effective control of corruption resulted in lower child stunting rates. However, contrary to the previous study that shows aid can decrease the stunting rate to a large extent [2], the correlation between total aid and the stunting rate seems to be 0 or even positive. In order to deal with it, the Granger causality approach was tried, thinking that foreign aid might not influence children's malnutrition problem immediately, even under an efficient government. Meanwhile, the values of aid are too large and even have negative numbers, which means that these countries donate to other countries, while this research aims to analyze the effect of receiving aid rather than donation. After

matching the aid with the lag value of PSE for one year and taking the logarithmic value of all positive numbers, the outcome of regression is still positive.

To interpret this result, the bias of causal reverse should be considered. It is not because foreign aid increases children stunting rate, but it is because of the booming children stunting rate that attract more donations. One way to solve this endogeneity problem is to focus on one poor region and use a proper instrumental variable and apply a 2-stage least square.

Furthermore, it is crucial to note that this study used total foreign aid, which encompassing a wide range of categories, as opposed to the specific agricultural and food aid employed in Mary's study [2]. The latter types of aid are designed explicitly to tackle malnutrition issues and may thus have a more direct and immediate impact on child stunting rates. This difference in aid categorization may partly explain the divergent outcomes between this study and Mary's research in 2020. Further investigation into this issue, focusing on specific types of aid, could provide more nuanced insights into the impact of foreign aid on child stunting rates.

6. Conclusion

To sum up, the trend of child prevalence stunting rate in developing countries is gradually diminishing, and this trend affects boys and girls equally. Nevertheless, total aid unexpectedly played an insignificant role in solving children's malnutrition situations. Given that food and agricultural aid essentially decreased stunting [2], it can be inferred that if countries or organizations want to tackle malnutrition problems, the best way is to provide food or agricultural aid rather than fiscal aid or others.

Controlling corruption can genuinely enhance children's nutritional situations, but actually, it works not by improving the distribution of total foreign aid. An uncorrupt government will expand expenditures in public health and that will lift children's nutritional circumstances.

Thus, governments and institutions should focus on providing targeted aid in the form of food and agricultural assistance, as well as invest in public health and anti-corruption measures to effectively combat child malnutrition.

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