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## Model of stunting determinants: A systematic review<sup>☆</sup>



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### KEYWORDS

Stunting;  
Malnutrition;  
Growth disorder;  
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### Abstract 30

**Objective:** This study aimed to determine the factors associated with stunting base on modeling inferential analysis.

**Methods:** This systematic review was conducted using the 2015 Preferred Reporting Items for Systematic reviews and Meta-Analysis (PRISMA) guidelines. The computerized bibliographic databases searched were Scopus, PubMed, and Google Scholar. The included studies were rated using eight quality-appraisal criteria derived from the Strengthening the Reporting of Observational studies in Epidemiology (STROBE) checklist: sample size, sampling methodology, response rate, outcome measures, statistical analyses, control for confounding, study limitation, and ethical consideration. As many as 12 of 5690 articles met our inclusion criteria for review.

**Results:** The most consistent factors associated with childhood stunting were: low mother's education, increasing child's age, male sex, poor household, prolonged breastfeeding duration, low birth weight, mother's age (<20 years), drinking water source (unimproved), low mother's BMI (<18.5), diarrhoeal episode, low father's education and residence (rural).

**Conclusion:** The factors that predispose a child to stunting are multifactors. Various factors causing stunting on children can be avoided through a holistic multi-strategy community-based approach.

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### Introduction

The first 1000 days of life called as opportunity window is recognized as the most important period to prevent stunting. In this period, stunting can occur after conception and is associated with many factors; socio-economic status, food intake, infection, maternal nutritional status, infectious diseases, micronutrient and environmental

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deficiencies.<sup>1</sup> Stunted children usually belongs to disadvantaged socio-economic population with the likelihood of poor performance at school, have low adulthood income and contribute to the transmission of intergenerational poverty and inequality or income gaps.<sup>2</sup> Globally in 2018, 21.9% or 149 million children under 5 years old suffered from stunting. Thus, it needs to be reduced to reach the target SDGs 2030.<sup>3</sup>

It is important to prevent or control stunting, since those who are suffered will be more susceptible to disease and tend to develop degenerative diseases and growth failure before the age of 12 months which affects stature in adulthood. In addition, it affects the children's intelligence level.<sup>4</sup> Therefore, it is very important to study stunting determinants based on this systematic review so that appropriate interventions can be done.

## Methods

### Search strategy

This systematic literature review was conducted using the 2015 Preferred Reporting Items for Systematic reviews and Meta-Analysis (PRISMA) guidelines.<sup>5</sup> It was used to comprehensively search peer-reviewed articles from five computerized bibliographic databases: Scopus, PubMed and Google Scholar. The search cover 15 worldwide research published between 2012 and 2019. The articles retrieved from each database were imported to Mendeley Library. For additional relevant publications that might have been missed, we searched the bibliographical references of all retrieved articles that met the inclusion criteria, complemented by citation tracking using Google Scholar. The following keywords combination was used in the search:

- (Chronic Malnutr\* OR malnourish\* OR undernourish\* OR stunt\*)
- (Child\* OR under-five\* OR preschool\*OR paediatr\* OR infan\* or bab\*)
- (Risk Factor\* OR determinant\* OR correlate\* OR cause\*)
- (Model\* analysis\*)

### Inclusion and exclusion

The data inclusion criteria included are those which (a) focused on children under-five years old; (b) analyzed factors associated with child malnutrition (stunting); (c) were published between 2012 and 2019; (d) were analyzed using multivariate regression model, multilevel analysis model, (qualitative studies, case study, books, policy briefs or thesis were excluded); (e) were published in peer-reviewed journal (non-peer reviewed research, review or commentaries were excluded); (f) were written in English.

### Data extraction

Articles identified were exported to Mendeley Library and duplicates were removed. The first author (MT) screened the articles' titles and abstracts. In the final screening phase, MT read the full text of the remaining articles and retained studies that met the inclusion/exclusion criteria. All data extraction and appraisals of retrieved studies were

independently reviewed by MT and RA and all disagreements between the two reviewers were resolved through discussion and consensus. The selected studies were recorded including; author, publication year, publication country, number of children, children's age, quality assessment score and stunting determinant (Table 1).

## Quality assessment

Strengthening the reporting of observational studies in Epidemiology (STROBE) checklist<sup>6</sup> was used to assess the studies reviewed. After the initial assessment based on the 22 STROBE items, the items were further collapsed into 8 quality-appraisal criteria; sample size, sampling methodology, responses rate, outcome measures, statistical analysis, study limitation, ethical consideration and control for confounding (Table 1). The sum of points awarded represented the overall quality score of the study. Studies' quality were rated as poor (score  $\leq 3$ ); medium (4–6); and high ( $\geq 7$ ).

## Results

A total of 5690 articles were retrieved from the three databases. After the removal of duplicates, 4440 articles were remained. The title screening resulted in removing 4338 articles. Furthermore, abstract screening led to the exclusion of other 53 articles. At last, 8 articles were obtained after the full-text screening, added by 3 articles through manual search of the bibliographic references of the retained articles, giving a total of 11 studies (Fig. 1).

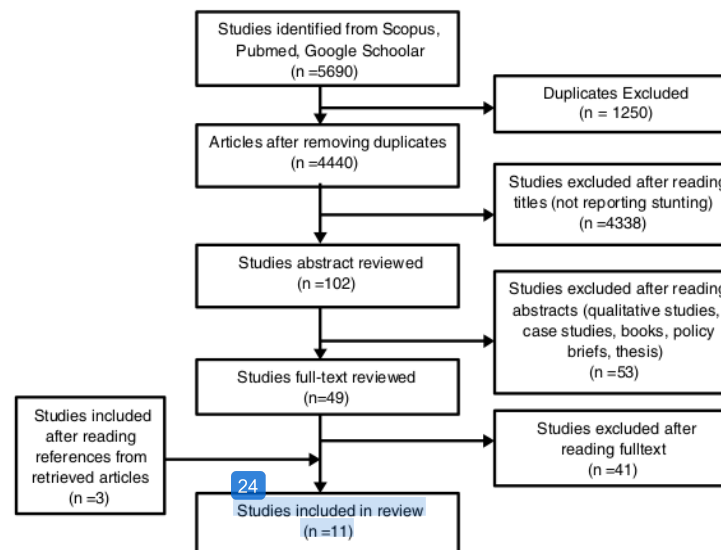
Table 1 shows the studies' summary; 6 in Africa, 5 in Asia, and 1 in America. Sample sizes ranged from 404 to 48,656 participants and all study were rated as high quality ( $\geq 7$ ). Through multiple regression and multilevel analysis, the most consistent determinants of stunting obtained were: low mother's education, increasing child's age, male's sex, poor household, prolonged breastfeeding duration, low birth weight, mother's age (<20 years), drinking water source (unimproved), low mother's BMI (<18.5), diarrhoeal episode, low father's education and residence (rural).

## Discussion

Our study showed that the prevalence of stunting is low mother's education. Low mother's education is an indirect cause of stunting.<sup>18</sup> Stunting occurs with increasing child's age, which is higher among the age groups of 12–23 months, 36–47 months, and 48–59 months and lowers in the age group 0–11 months which is consistent with previous studies.<sup>19</sup> The prevalence of stunting also occurs mostly in male. Similarly, the prevalence of stunting was higher among boys than girls.<sup>20</sup> Another determinant is a poor household, poorest households are more likely to suffer from food and nutritional insecurity due to lack of resources, low education levels, and nutritional health information, and poor health-care access and utilization.<sup>21</sup> The children born less than 2.5 kg possess a higher risk of stunting in early childhood. Stunting prevalence was also significantly higher among low birth weight babies (weight <2.5 kg) than babies with normal birth weight.<sup>20</sup>

Table 1 Summary of selected studies and finding of stunting determinants.

Analysis model	Author, year, country	Sample	Assessment quality (0–8)	Finding (stunting determinants)
Multiple logistic regression	Abuya et al. 2012 Kenya <sup>6</sup>	5,156 children aged 0–42 months <sup>4</sup>	High (7)	Children's birth weight and gender, marital status, parity, pregnancy intentions, health seeking behavior; and socio-economic status. <sup>13</sup>
Multivariate logistic regression	Victor M. Aguayo et al. 2015 Buthan <sup>8</sup>	2,085 children aged 0–23 months <sup>4</sup>	High (7)	Age and boys, Eastern/Western children, the mothers did not receive antenatal care and children were not fed complementary foods at 6–8 months. <sup>12</sup>
Multivariate logistic regression	Victor M. Aguayo et al. 2016 India <sup>9</sup>	2,561 children aged 0–23 months	High (7)	Low birth weight, 6–23 months old who were not fed a minimum number of times/day and lower consumption of eggs, short mothers (<145 cm) and poor sanitation households. <sup>5</sup>
Multiple logistic regression	Chirande et al. 2015 Tanzania <sup>10</sup>	7,324 children aged 0–59 months	High (7)	Mothers with no schooling, male children, low birth weight and unsafe drinking water sources. <sup>27</sup>
Regression logistic multivariate	Martinez et al. 2018 Argentina <sup>11</sup>	48,656 newborns alive	High (7)	Maternal age, education, BMI, parity, diabetes, hypertension, preeclampsia, tuberculosis, prematurity, and congenital malformations.
Multivariate logistic regression	Shinsugi et al. 2015 Kenya <sup>12</sup>	404 children	High (8)	Household food insecurity, feeding tea/porridge with milk, raising animals, low socio-economic status. <sup>8</sup>
Multiple logistic regression	Torlesse et al. 2016 Indonesia <sup>13</sup>	1,366 children	High (7)	Untreated drinking water, household using unimproved latrine, male, older child age, lower wealth quintile, no antenatal care in a health facility, and mother's participation in household food making decisions.
Multilevel multivariate logistic regression	Adekanmbi, Kayode, and Uthman 2013 Kenya <sup>14</sup>	28,647 children aged 0–59 months	High (8)	Male, age above 11 months, multiple birth, low birth weight, low maternal education, low maternal BMI, poor mother's health-seeking behavior, poverty and short birth interval and child residing in community with high illiteracy rate and NorthWest and NorthEast regions of the country. <sup>5</sup>
Multilevel logistic regression	Pantay Geburu et al. 2019 Ethiopia <sup>15</sup>	8,855 children under-five and 640 community groups <sup>4</sup>	High (7)	Age above 12 months, male, small size of the child at birth, poor households, low maternal education, multiple birth, children from communities of Amhara, Tigray, and Benishangul and children from Muslim, Orthodox and other traditional religion.
Multilevel multivariable logistic regression	Haile et al. 2016 Ethiopia <sup>16</sup>	9,893 children aged 0–59 months	High (7)	Short birth interval, being male and a male-headed household, children with severe anemia, the mothers do not have formal education, the fathers not have formal education, the mothers have normal BMI. <sup>13</sup>
Multilevel analysis and two sequential	Titaley et al. 2019 Indonesia <sup>17</sup>	24,657 children aged 0–24 months	High (7)	Households with three or more children under five, households with five to seven household members, children whose mothers during pregnancy attended less than four antenatal care services, boys, children aged 12–23 months, and low birth weight.



**Figure 1** Flow chart for study based on PRISMA 2015 guidelines.<sup>5</sup>

Similar to <sup>18</sup> study result, maternal undernutrition puts the child at greater risk for low birth weight, preterm birth, and small-for-gestational-age (SGA), which results in increased risk for undernutrition later in childhood.<sup>22</sup> Similarly, adolescent pregnancy has been shown to be associated with low birth weight and stunting in early childhood.<sup>9</sup> The prevalence of stunting is a household source of drinking-water (unsafe); type of latrine (unimproved). Similarly, children suffering from diarrhea episodes within the last 3 months were more likely to be stunted.<sup>20</sup> The residence (rural) found many stunted toddlers, low maternal education and low socio-economic class which limit mothers' utilization of available resources to improve their own nutritional status and that their families were also commoner in rural communities. These may explain the high prevalence of child undernutrition in our rural communities.<sup>23</sup>

## Conclusions

Various factors causing stunting are: low mother's education, increasing child's age, male's sex, poor household, prolonged breastfeeding duration, low birth weight, mother's age (<20 years), drinking water source (unimproved), low mother's BMI (<18.5), diarrhoeal episode, low father's education and residence (rural). A holistic multi-strategy community-based approach is needed based on the factors causing stunting. The weakness of this research is that no evidence database analysis. Therefore, further research to confirm the stunting determinant using the database on the laboratory and community is recommended.

## Acknowledgments

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## Conflict of interest

The authors declare no conflict of interest.

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