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Stunting and Baby's Milk: Evidence from Indonesia

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ABSTRACT

Research Originality: This study uniquely examines the relationship between baby milk consumption and stunting rates in Indonesia using a two-stage least squares (2SLS) approach. It fills a gap in understanding why Indonesian consumers prefer sweetened condensed milk over baby formula, despite the increasing prevalence of stunting, offering new insights into the economic and educational factors influencing milk consumption.

Research Objectives: To investigate the factors that influence baby milk consumption in Indonesia, such as milk prices, education levels, and population size. Also, to assess the impact of baby milk consumption on stunting rates among Indonesian children.

Research Methods: The research uses an econometric approach, specifically two-stage least squares (2SLS) regression, analyzing data from 2005 to 2022.

Empirical Results: The results indicate that baby milk consumption is significantly affected by milk prices, education levels, and population size. Interestingly, the study finds that higher consumption of baby milk is correlated with an increase in stunting rates.

Implications: The findings suggest a need for greater parental awareness regarding the nutritional value of baby milk and potential policy interventions to regulate milk quality. Additionally, the results highlight the importance of educational campaigns to improve milk consumption behaviors and further research on the nutritional content of available baby milk products to address the stunting problem effectively.

Keywords:
stunting; baby nutrition; public health; nutritional interventions

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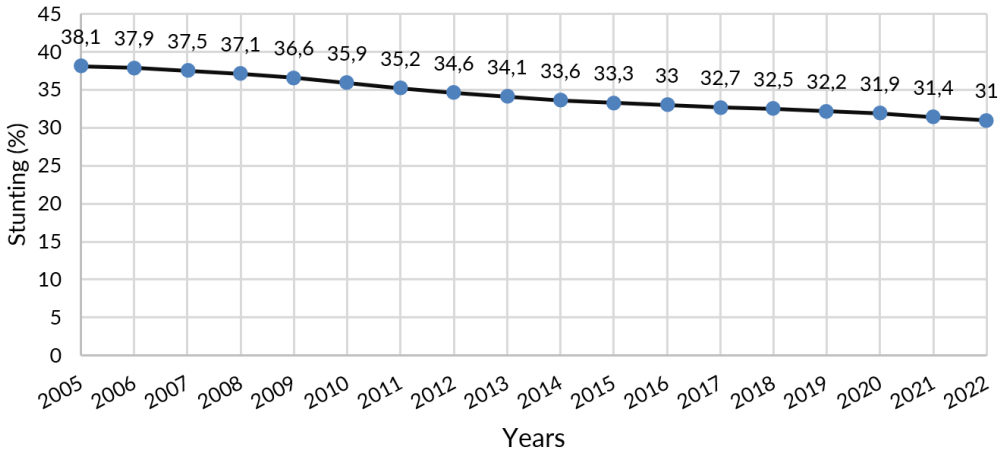
INTRODUCTION

Stunting in children under five is characterized by inadequate height for age, falling below -2 standard deviations from the median of the World Health Organization (WHO) child growth standards (WHO, 2014). This condition has short-term and long-term consequences, including a heightened risk of illness and death in the short-term, while in the long-term stunting could hinder cognitive development and learning abilities, increased susceptibility to infections and non-communicable diseases in later life, and diminished economic productivity (Stewart et al., 2013). The reduction of child stunting is the foremost among the six Global Nutrition Targets set for 2025 by the WHO, and it is a crucial measure in the second Sustainable Development Goal aimed at eradicating hunger (United Nations, 2016). Stunting has been one of the most faced problems in many developing countries, especially in Indonesia. To address this issue, Indonesia's government constructed a plan called "Rancangan Pembangunan Jangka Menengah Nasional 2020 – 2024" (RPJMN) or National Medium-Term Development Plan (Sekretariat Kabinet Republik Indonesia, 2020). But, when referring to data from the World Development Indicators (WDI) (see Figure 1), Indonesia in 2022 recorded the level of stunting by 31% which is still far when compared to the target plan.

Figure 1. Indonesia's Stunting Prevalence (%) (2005 – 2022)



Sources: World Development Indicators (2023)

Overall cause of occurrence stunting can be caused by a lack of nutritional intake and nutrients given for a long time, such as before and after pregnancy (Beal et al., 2018). Knowledge of parenting that is still lacking is also one of the influences of occurrence stunting. Stunting could be tackled by increasing the intake of vitamins, minerals, and protein (Headey et al., 2018). The period between 6 to 24 months is crucial for child development, with the highest incidence of stunting observed during this time. In this phase, children require substantial nutrient intake. However, evidence suggests that the quality and quantity of food consumed by children are often inadequate, particularly following the cessation of exclusive breastfeeding (UNICEF, 2015). Once a baby reaches

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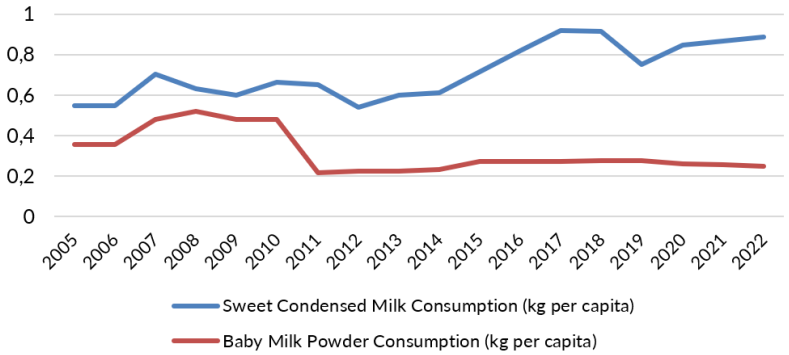
the age of 12 months, breastmilk alone can only meet approximately one-third of the baby's energy requirements (Fikawati et al., 2014). There is also a study that found that toddlers with inadequate protein intake were almost to become stunted compared to children with adequate protein intake (Fikawati et al., 2019, 2021). Therefore, regarding the status of breastfeeding for children, they should eat an adequate amount of animal protein such as eggs, poultry, fish and milk must be eaten as often as possible.

Headey et al. (2018) explained that the consumption of foods sourced from animals has a significant influence on the occurrence of stunting in children. Research has indicated that among various sources of animal protein, milk is one of the most frequently consumed by children daily (Arini et al., 2022). This is because milk is an animal source that contains energy, proteins, amino acids and micronutrients that can stimulate growth compared from other animal-based protein (Haile & Headey, 2023; Semba et al., 2016) in which dairy such as milk is rich in a range of nutrients and hypothesized to improve child growth. Some studies suggest that milk can be beneficial in treating malnutrition (one of many causes of stunting) after birth by improving recovery, nutritional status, and growth (Michaelsen, 2013; Michaelsen et al., 2011), although it may take longer to achieve good nutrition status compared to standard protocols settled by WHO (Fidele et al., 2022). This means milk itself could tackling stunting for children after-birth.

Milk from animal sourced however is not an ideal dietary for children under 2 years because it can causes many digestive problems (Daher et al., 2001). To solve these problems, many companies produce a formulated milk exclusive for baby ranging from 0 – 64 months as a complementary supplementation during a mandatory breastfeeding range (0 – 24 months) up to post breastfeeding (24 – 64 months). However, recently in Indonesia people tend to give their baby more milk products in the form of sweetened condensed milk rather than baby's milk powder for under five children (Juffrie et al., 2020). In fact, sweetened condensed milk is only a complement to the presentation of food or drinks. Not to mention that sweetened condensed milk does not have good nutritional content and mostly contains a lot of sugars. This is evidenced in Figure 2, it can be seen that in the last 17 years the consumption of sweetened condensed milk is higher in Indonesia than the consumption for baby's milk powder.

Figure 2. Consumption of Sweetened Condensed Milk vs. Consumption of Baby Milk Powder



Sources: Central Bureau of Statistics (2023)

In addition to the increased consumption of sweetened condensed milk, the consumption of baby milk powder actually decreased dramatically starting from 2010. Although the term of consumption is general for Indonesia, but this fact proves that many people may still give their toddlers sweetened condensed milk instead of using baby's milk powder. Altough Central Bureau of Statistics indirectly stated that although they also listed baby milk powder as one of several important food ingredients, they also mark sweet condensed milk as one of several important food ingredients which is not good for main consumption due to its lack of nutrients.

Therefore, given the assumption that milk is a crucial factor in preventing stunting, this research addresses the existing gap in the literature by examining the specific factors influencing baby milk consumption in Indonesia and assessing its impact on stunting rates. Previous studies have focused on the benefits of milk consumption and its general impact on child nutrition, but none have explored why Indonesian families often choose sweetened condensed milk over baby milk products, despite the increasing prevalence of stunting. This study offers a novel contribution by using a two-stage least squares (2SLS) regression approach to analyze the effects of baby milk consumption on stunting rates, accounting for unique economic and cultural factors in Indonesia. Specifically, there are two objectives of this research. First, to identify and analyze the key determinants of baby milk consumption, including price, education, and population size; Second, to assess the role of baby milk consumption in reducing stunting among children in Indonesia. These findings are expected to provide critical insights for policymakers and stakeholders aiming to improve child health and nutrition through targeted interventions.

METHODS

The method used in this study is to use econometric techniques two stage least squares (2SLS). Two stage least squares is generally the same as ordinary least squares (OLS) where used in regression analysis extensively, because it is intuitively interesting and mathematically much simpler than the method of maximum likelihood (Gujarati and Porter, 2009). But two stage least squares requires two linear models of a single equation, so it must regress twice.

In measuring milk prices, author use data on the average price of milk powder for toddlers. Then, to measure income we use Indonesia's per capita income data. Furthermore, the population is measured by the number of people in Indonesia. Finally, we measure the level of education by looking at the average length of schooling. The data used are from the period 2005 to 2022, the selection period is based on the availability of the latest data. Table 1 explain about the data summary.

The framework in this study is based on demand theory where demand can be influenced by the price of the goods themselves, then there are non-price factors, namely income and population (Mankiw, 2012). This is reinforced by several previous studies that milk consumption is influenced most significantly by the price of milk itself, per

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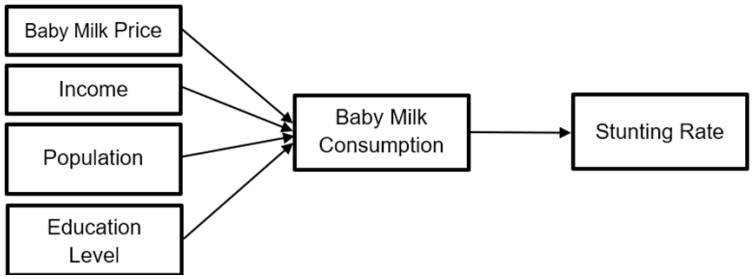
capita income, population and education level (Gulseven, 2018; Handayani et al., 2023; Langi et al., 2024; Tjitrajaya, 2022).

Table 1. Data Summary

No.	Variable Name	Source
1	Indonesian Baby Milk Powder Consumption per Capita per Year (Kg)	Indonesian Central Bureau of Statistics
2	Indonesia's Population Data	World Bank (2023)
3	Stunting Rate in Indonesia	World Development Indicators (2023)
4	Average Price of Baby Milk Powder in Indonesia	Indonesian Central Bureau of Statistics
7	Average Length of School (Years)	Indonesian Central Bureau of Statistics
8	Indonesia's per Capita Income	World Development Indicators (2023)

To achieve the research aims, authors construct a research framework (see Figure 3) to obtain the two stages least squares models.

Figure 3. Research Framework



Source: Authors

According to economic theory, namely demand theory, prices have an important role in influencing demand, especially the demand for baby's milk. An increase in the price of baby's milk will make the demand for baby's milk fall, and conversely if the price of baby's milk falls it will increase the demand for baby's milk, assuming all things are fixed (Mankiw, 2012). In measuring the price, authors use the price of baby's milk itself. Furthermore, income also affects the purchasing power of baby's milk which in this case affects milk consumption. The higher a person's income, the higher the purchasing power of milk so that baby's milk consumption is higher and vice versa. Then there are other factors that affect milk consumption, namely the population, where according to economic theory an increase in population will increase the amount of consumption of daily necessities including milk. Finally, the level of education affects the consumption of milk (Handayani et al., 2023), because high education will affect the choice of consumption in consuming healthy foods and drinks such as giving their children a dense nutrient food like milk.

Thus based on the research framework, 2 linear models were formed related to factors that affect milk consumption, namely:

$$lnBabyMilk_t = \beta_1 + \beta_2 lnY_t + \beta_3 lnPBM_t + \beta_6 lnPop_t + \beta_7 lnSch_t + \varepsilon_t \quad (1)$$

Where, BabyMilk represents the level of consumption of Indonesian baby's milk powder. Then, β_1 is the coefficient of the dependent variable, Y_t is Indonesia's per capita income, PBM is a representation of the average baby's milk price in Indonesia, Pop is the total population of Indonesia, Sch is the average length of schooling, and lastly ε is an error term. Furthermore, to see the relationship between milk consumption and stunting rates in Indonesia, the following model was formed:

$$lnStunting_t = \beta_1 + \beta_2 lnBabyMilk_t + \varepsilon_t \quad (2)$$

Where the Stunting variable represents the stunting rate in Indonesia, β_1 is the coefficient of the dependent variable, BabyMilk is the consumption of Indonesian baby's milk powder and ε_t is an error term. Both models will use variables in the form of natural logarithms so that the interpretation process can easily be done by looking at the elasticity in the relationship of each variables.

RESULTS AND DISCUSSION

Based on the regression results (see Table 2), we found that the significant factors influencing baby milk consumption in Indonesia are baby milk price, the length of schooling, and the size of the Indonesian population. Specifically, baby milk's price has a negative effect on consumption, where a 1% increase in baby milk price could lower baby milk consumption by 1.86%. This highlights the sensitivity of consumers to price changes, suggesting that affordability plays a crucial role in milk purchasing decisions, particularly for low-income families. Also this might be one of the reasons why Indonesia's family choose sweetened condensed milk to feed their babies rather than baby milk itself. In Indonesia, sweetened condensed milk relatively has low price than other type of milks.

On the other hand, there is a positive relationship between the average length of schooling and milk consumption. The results indicate that the higher a person's educational attainment, the more likely they are to invest in baby milk for their children, with a 1% increase in the length of schooling leading to an 8.6% increase in milk consumption. Education appears to play a critical role in shaping awareness of child nutrition and the importance of milk as part of a balanced diet, making it one of the most significant factors influencing baby milk consumption in a positive way.

Furthermore, our findings reveal that population size has a negative relationship with baby milk consumption. Specifically, as Indonesia's population grows, baby milk consumption decreases by 21.6%, an unexpected outcome. This suggests that rising population pressures, particularly in densely populated areas, may limit access to or affordability of baby milk due to strained economic resources. Larger family sizes may also lead parents to prioritize other staple goods, such as rice and eggs, over milk. Additionally, cultural preferences and limited access to quality baby milk products in rural or lower-income areas might exacerbate this trend. The decline in baby milk consumption with increasing population could reflect deeper socio-economic challenges, including income

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inequality and uneven distribution of public health education, which further compound the issue of inadequate milk consumption. Addressing these factors is crucial to ensuring that increased population growth does not continue to negatively impact child nutrition and public health outcomes.

Table 2. Regression Results

Dependent Variable: Baby Milk Consumption		
Independent Variable	**Coefficient**	**Prob.**
Constant	369.5693	0.0000*
Income (lnY)	0.832187	0.7157
Baby Milk Price (lnPBM)	-1.865033	0.0010*
Population (lnPop)	-21.47903	0.0165**
School (lnSch)	8.664887	0.0000*
R-squared = 0.898341		

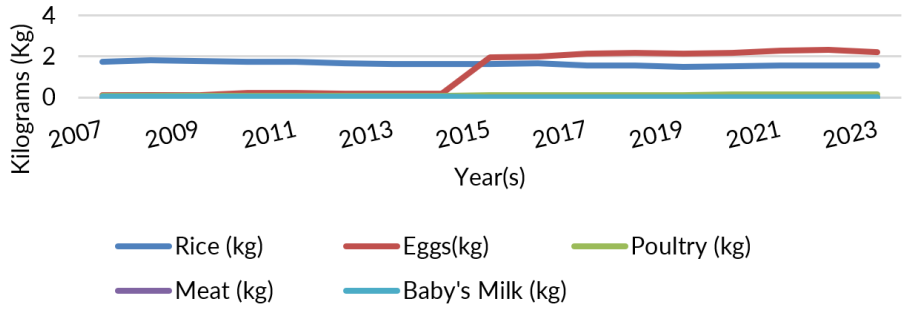
Note:*Significant at α = 1%, ** Significant at α = 5%

In this section, we will try to explain the results of regression that have been processed. Based on our regression results, income is not a significant factor in affecting milk consumption. In fact, according to Firdaus et al, (2024) and Prato (1973) that people's income also plays a significant role in terms of influencing milk consumption. This happens, because in author's opinion that the Indonesian people themselves can actually afford to buy milk, because the price of milk can still be achieved economically. However, Indonesian people still lack awareness in consuming milk especially for their baby. Alwis et al. (2009) mentioned that education is one of the mostet al important factors when talking about milk consumption awareness. Because, someone who has a higher education then he will realize the importance of healthy food choices, where milk will certainly be one of the considerations in him in consumption. Even Gulseven (2018) also found that people whose education level is college, tend to buy milk 2 times higher when compared to people who do not go to college. Therefore, the higher a person's education, the higher his awareness of drinking milk, also being said the higher the education the more his awareness towards to his toddler to give a baby milk instead of sweet condensed milk to replace breast milk feeding.

This level of education in Indonesia also explains the negative correlation between the population and milk consumption. According to demand theory, an increase in population should increase demand for goods/services (Mankiw, 2012). However, population growth in Indonesia actually reduces baby milk consumption. This means that Indonesian people still lack awareness in giving their toddlers a baby milk.

Based on figure 4, if milk in general has been realized for consumption, milk should have become a basic necessity item consumed such as rice and eggs which both has the highest consumption rate in Indonesia. Moreover, the consumption of other nutrition dense foods such as poultry and meat are also low compared to rice and eggs.

Figure 4. Average Per Capita Consumption of Several Important Food Ingredients Per Week



Source: Central Bureau of Statistics (2023)

Important basic goods certainly reflect the preferences of the Indonesian people in consumption, which as the population increases, it certainly increases the amount of demand for these basic goods. However, as already mentioned, the increase in the number of Indonesian population actually reduces national milk consumption due to lack of awareness. This paradox suggests that while population growth traditionally leads to higher demand for staple goods, the relatively low consumption of baby milk indicates a deeper issue. It may reflect cultural preferences, economic constraints, or a lack of trust in the nutritional value of baby milk products. Moreover, widespread misinformation and the affordability of less nutritious alternatives, such as sweetened condensed milk, further compound the issue. Without targeted education and policy efforts to shift consumer behavior and perceptions, the trend of declining baby milk consumption amid population growth could undermine public health initiatives aimed at reducing stunting in Indonesia (Rahn et al., 2017). For example, in Rwanda, government policies and programs have significantly contributed to the growth of the dairy sector, improving nutrition and income for rural households. Programs like "Girinka" have enhanced access to dairy products and improved milk quality and productivity (Habiyaremye et al., 2021). Community-based interventions, including educational interventions, multiple interventions, and changing purchase patterns, also can effectively increase dairy consumption in healthy populations (Nikniaz et al., 2020).

Table 3. Regression Results of Stunting Rate

Dependent Variable: Stunting Rate		
Independent Variable	**Coefficient**	**Prob.**
Constant	2.636894	0.0000*
Baby Milk Consumption (lnBabyMilk)	0.157157	0.0017*
R-squared = 0.471381		

Note: *Significant at α = 1%
Source: Author's calculation result

Based on the regression results (see table 3), milk consumption is significant in influencing stunting rates, but its correlations are positive which means an increase of baby

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milk consumption by 1% could increase stunting rate by 0.15%. This is an abnormal result from the regression. Since there is no other evidence from studies to strengthening this result, author has several arguments. First, this may occur due to the nutritional content formulated in baby milk not meeting the needs of developing toddlers. Further research may be needed to assess the formulation of baby milk powder. Second, this may be an evidence that tackling stunting through the baby's milk alone is not enough therefore a rich nutrient dietary is needed. Many significant factors also plays a role as the determinants of stunting (directly or indirectly) such as the characteristics of the parent and child, parental roles, the child's supervision, and the household's Socio-Economic Status (SES) (Tjitrajaya, 2022). Complementary foods besides milk also needed in order reducing the stunting rates in Indonesia such as foods that contain energy, protein, fat, carbohydrates, zinc, and iron. If those nutrients are not fulfilled it will cause stunting (Abdilahi et al., 2024; Langi et al., 2024; Suratri et al., 2023).

Based on all those results we can state that Indonesian people still lack awareness of drinking milk, of course, people will ignore dairy products in consumption. As a result, they also do not instill awareness of drinking milk to their children from an early age and it could also be that mothers are less aware to drink complementary milk during pregnancy. When the family environment is less aware of consuming protein, especially milk, children under five are affected by stunting. Then, the regression results also explain the lack of inclusion of dairy products in the stunting reduction program which is a government priority in the 2020-2024 National Medium-Term Development Plan (RPJMN).

Lack of milk consumption awareness will certainly interfere with the road plan Sustainable Development Goals (SDGs), where one of the goals is no hunger. According to meta data summary of Indonesia's SDGs indicators, compiled by the Ministry of National Development Planning/Bappenas, stunting including one of the indicators to measure the success of the second goal of the SDGs. In detail, to achieve the second goal of the SDGs is that by 2030 it must eliminate all forms of malnutrition, including by 2025 achieving internationally agreed targets for short and thin children under the age of 5 years, and meeting the nutritional needs of adolescent girls, pregnant and lactating mothers, as well as seniors. In this case stunting is one of the indicators to determine the success of the second goal of the SDGs (United Nations, 2016).

In response to this, the Indonesian government drafted National Medium-Term Development Plan (RPJMN) 2020 – 2024, where one of the plans is to reduce the number stunting up to 14% by 2024. However, in fact, it turns out that in 2022 alone, according to the Central Statistics Agency, Indonesia still recorded numbers (Sekretariat Kabinet Republik Indonesia, 2020) stunting by 24.4%. It can be seen that Indonesia still has 3 more years to close the gap of around 10% in meeting the 2020-2024 RPJMN.

CONCLUSION

In conclusion, this study aimed to investigate the causes of low milk consumption in Indonesia and assess the impact of baby milk consumption on stunting rates among children. The findings indicate that the increasing population in Indonesia negatively impacts milk consumption, revealing a significant gap in public awareness regarding the importance of milk as a staple dietary component. Higher educational attainment was found to positively influence milk consumption, suggesting that individuals with greater awareness of nutritional benefits are more likely to provide milk as a substitute for breast milk. Additionally, while income per capita and baby milk prices do not significantly affect overall consumption, the lack of awareness among the population remains a critical barrier. The study also establishes a significant positive relationship between baby milk consumption and stunting rates, indicating that inadequate nutritional options in the baby milk market contribute to this pressing public health issue.

To address these challenges, targeted awareness campaigns and educational initiatives are essential to enhance milk consumption, particularly among families with young children. Policymakers should leverage social media and community engagement strategies to promote the nutritional benefits of milk and its role in preventing stunting. Effective strategies include community-based interventions, framing policies to emphasize consumer choice, and implementing comprehensive programs, such as those in Rwanda, that enhance access to and quality of dairy products. By prioritizing these recommendations, the government can effectively work towards reducing stunting and improving public health outcomes in alignment with the National Medium-Term Development Plan (RPJMN) 2020 – 2024 and the Sustainable Development Goals (SDGs).

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