

Is the household food security the nucleus determinant for the prevalence of stunting in Purworejo Regency?

Oki Wijaya^{1,4,*}, Deni Aditya Susanto^{2,4}, Yekti Satriyandari^{3,4} and Anisah Binti Kasim⁵

¹ Department of Agribusiness, Faculty of Agriculture, University of Muhammadiyah Yogyakarta, Indonesia

² Department of Economics, Faculty of Economics and Business, Universitas Muhammadiyah Surakarta, Indonesia

³ Department of Midwifery, Faculty of Health Science, Universitas Aisyiyah Yogyakarta, Indonesia

⁴ Creavill Indonesia, Bantul, D.I. Yogyakarta, Indonesia

⁵ Universiti Teknikal Malaysia Melaka, Jalan Hang Tuah Jaya, 76100 Durian Tunggal, Melaka, Malaysia

Abstract. This study aims to analyze household food security as the core determinant of stunting and Purworejo Regency of Central Java Province as a case study. Methodologically, this study used multiple binary regression models. This study analyzed 250 samples selected randomly tiered (multi-stage random sampling). The equation used is stunting as a dependent variable and an independent variable (dummy) in the form of household food security and control variables (parental marriage age, use of contraceptives, gestation, parity, early breastfeeding initiation, exclusive breastfeeding, pollution status, and distance of health facilities). As a result, household food security is proven to be a core determinant of stunting in Purworejo District. Household food security has a significant effect on the -0.679 (α 0.001) coefficient on stunting. This means that houses that have food security have the opportunity to reduce the risk and prevent stunting by 67.9% than those that do not. As a control variable, the use of contraceptives, parity, early initiation of breastfeeding, and exclusive breastfeeding had a significant negative effect on stunting while pollution status had a significant positive effect. This model has been able to explain the research phenomenon by 58.2% (adjusted R-square 0.582).

1 Introduction

1.1 Background

Food needs are attached to people's lives as basic needs that must be met. Therefore, the fulfillment of minimum food for the community is pursued in various mechanisms, both natural and artificial [1]. In the context of food fulfillment, the success of quality human resource development, namely human resources who have physical, mental, and intelligent health is determined by the fulfillment of food as the basic needs of each individual [2]. Furthermore, the definition of food security is a condition when everyone at all times has physical, social, and economic access to diverse, safe and nutritious food sufficiency to meet their needs according to their tastes for productive and healthy lives [3]. A country cannot

*Corresponding author: okiwijaya@umy.ac.id

Regency, and Salatiga City. The stunting prevalence of Purworejo Regency was 15.7% in 2021. Compared to other urban areas, Surakarta City (20.4%), Semarang City (21.3%), and Tegal City (23.9%), Purworejo Regency has a fairly low stunting prevalence [16]. This is allegedly based on the performance of health sector policies that are right on target so as to reduce the prevalence of *stunting* to a minimum.

Food security and pattern factors are the first and main factors analyzed considering pregnancy, birth, and 1000 first days of life (FDL) rely on household food pattern conditions. This household food pattern utilizes, diversifies, safety, quality, adequacy of components, and other supporting nutrients [2]. Household characteristics are thought to have a significant effect on food patterns, food availability, and food access characterized by the household's ability of a certain income level (*marginal propensity to consume*) [17]. Not only economic status but social status of households such as women's leadership in the household, employment status of housewives, education level, access to information, and health services [17].

2 Literature Review

2.1 Household Food Security

Household food security theory is an approach used to analyze and understand food consumption patterns within households [18]. This concept is based on the assumption that decisions in choosing and consuming food are not only influenced by individual factors, but also influenced by the dynamics and characteristics of the household itself [19]. Household food patterns include various aspects, such as the type of food consumed, the amount, frequency of consumption, how to cook, as well as eating preferences and habits. Factors that influence household food patterns include economic, social, cultural, religious, and food availability factors [20].

Household food security theory aims to understand and analyze food consumption patterns in hopes of providing insight into existing eating habits within households [21]. This information is important in food policy planning, health promotion, and nutrition program development. By studying household food patterns, we can identify eating preferences and habits that have the potential to have a positive or negative impact on the health and nutrition of family members [22]. Thus, we can design appropriate intervention strategies to promote a healthy and balanced diet within the household.

Household food security is the ability of a household to obtain sufficient, safe, nutritious, and viable food physically, economically, and socially [18]. This concept involves access to adequate food, stability of food supply, and utilization of healthy and nutritious food. Household food security includes the following.

1. **Food Access:** this concept emphasizes the importance of households having adequate physical and economic access to food. Physical access means the availability of food in the household area, such as the existence of an adequate market. Meanwhile, economic access refers to the ability of households to buy food at affordable prices. [23]
2. **Food Supply Stability:** food supply stability refers to the sustainability of food supply over time. This concept includes aspects such as food security, price stability, and resilience to climate change and natural disasters. Stability of food supply is important so that households do not experience hunger or food shortages in the future. [24]
3. **Utilization of Healthy and Nutritious Food:** this concept emphasizes the importance of households to utilize food optimally to meet nutritional and health needs. This involves activities such as diversification of food consumption, proper food processing, and a balanced diet. [19]
4. **Social Security:** household food security is also related to social aspects. These include issues such as gender equality, community participation in food-related decision-

making, and social protection for vulnerable groups such as children and the elderly. [25]

5. Resource Management: this theory underscores the importance of sustainable management of food-related natural resources, such as agricultural land, water, and biodiversity. Good resource management will ensure long-term food availability. [26]

2.2 Determinants of stunting

Stunting is a condition of failure to thrive in the first 1,000 FDL in children under five years old caused by chronic malnutrition [27]. The condition of failure to thrive is caused by repeated infections, lack of nutritional intake, and the influence of parenting (especially mothers) that is not optimal in the 1,000 FDL [28]. The stunting is influenced by socioeconomic and environmental factors, is also an indicator of the health of children who are chronically malnourished. Children who are stunted are children with nutritional status indicators "under" height/age equal to or less than -2 standard deviations below the standard average of normal children [27, 29].

The most effective treatment of short toddlers is carried out at 1000 FDL, namely in children aged 0-30 months, pregnant women, and nursing mothers, because stunting occurs from fetus to two-year-old. This period is referred to as the "golden period" and the "critical period" or "*window of opportunity*" [30]. Stunting is a nutritional problem in Indonesia that must be solved jointly by all elements of society. The factors causing chronic stunting in children in Indonesia are directly due to public health status and low nutritional intake [31]. The causes of stunting problems directly focus on nutritional problems, which are related to infant and child feeding (parenting), factors related to the social environment, access to health for prevention, food security factors, especially access to nutritious food (food), and access to environmental health [32], and also contained in "*The Conceptual Framework of the Determinants of Child Undernutrition*" [29] and "*The Underlying Drivers of Malnutrition*" [33].

In the determinant analysis, children in families with low economic levels are more at risk of stunting because of their low nutritional fulfillment ability, which will increase the risk of malnutrition [2]. While, low family income can increase 3.93 times the risk of toddlers with greater stunting [17].

Low levels of parental education are also thought to increase the risk of malnutrition in children. A high level of education will improve the economic status of households, this is closely related to the acquisition of jobs and greater income so that it will increase the purchasing power of better household needs [34]. The level of parental education will also affect parents' knowledge related to nutrition and parenting patterns, where improper parenting will increase the risk of stunting. The level of parental education at the primary level will reduce the risk factors for toddlers with stunting by 3% compared to uneducated parents.

The number of family members in the household also affects the incidence of *stunting* in children. Based on research by Fikadu et al in 2014 in Africa reported that the risk factors for children with *stunting* will be higher in families with more than five members in one house, compared to families of two to four people. This is associated with the ability to fulfill inadequate nutrition to a larger number of family members and is also directly proportional to the level of education and economic status of the family [35]. A shorter period of exclusive breastfeeding and inadequate complementary feeding also contribute to the fulfillment of inadequate nutrition for more family members.

Environmental factors have a close impact on the development of toddlers, especially from the epidemiological side, namely the potential spread of environmental diseases. Environmental sanitation and hygiene factors, for example, have an influence on the health of pregnant women and child development, because children under 2 years old are susceptible to various infections and diseases [36]. According to WHO and UNICEF, sanitation is divided into two criteria, namely *improved* and *unimproved*. Categorized as *improved* if the

use of sewage facilities is personal, latrine toilet types and fecal landfills in the form of septic tanks or wastewater disposal facilities.

Policies and regulations issued by the government related to efforts to overcome malnutrition are then followed up and interpreted into a series of programs and activities carried out by each relevant ministry/institution in accordance with their main tasks and functions as a form of government intervention [37]. Government interventions are grouped into sensitive interventions and specific interventions. Specific nutrition interventions are carried out by the Ministry of Health through Community Health Centers and Integrated Service Posts [32]. Nutrition-sensitive interventions are carried out by other sectors outside health, such as the Ministry of National Planning and Development, and Ministry of Agriculture.

3 Methodology

This study used a descriptive quantitative approach. This approach seeks to reveal phenomena more measurably and systematically. The main objective of this study is to explain the determinants of household resilience and the effect of home food security on the incidence of household stunting. This influence analysis is also called statistical inference.

3.1 Data and Variables Definition

Table 1. Variables of research

Notation	Variables	Measure
Stunting		
Stu_i	Toddler Stunting Status	$-1(st. dev(\frac{height}{age}))$
Household Food Security Variables		
HFS_i	Household Food Security	This is a dummy variable measured by calorie adequacy for each family member of 2200 calories per day. Strong HFS (enough calories) is worth 1 and weak HFS (less calories) is worth 0 [48].
Stunting Determinant		
PMA_i	Parent's Marriage Age	This is a dummy variable, the marriageable age of < 19 years old is 0 and ≥ 19 years is 1
CnU_i	Contraceptives Usage	This is a dummy variable of contraceptive use (1 to use, 0 otherwise)
Ges_i	Gestation	This is a dummy variable of maternal age when pregnant is grouped at risk pregnant women at <17 years or >36 years 0 and pregnant women of productive age are not at risk worth 1
Par_i	Parity	This is a variable birth distance of sample toddlers if < 3 years is 0 and ≥ 3 years is 1
EIB_i	Early Initiation of Breastfeeding	This is a dummy variable for maternal success in performing EIB on toddler samples that mothers succeed EIB is worth 1 and otherwise are worth 0
ExB_i	Exclusive Breastfeeding	This is a dummy variable toddler getting exclusive breastfeeding for 6 months without any additional food (1 yes, 0 otherwise)(Syeda, Agho, Wilson, Maheshwari, &; Raza, 2021)
Pos_i	Pollution Status	This is a dummy variable of the existence of smokers in the household, that there is a smoker worth 1 and otherwise is worth 0
DHF_i	Distance to Health Facilities	This is a dummy variable distance (kilometers) between households and nearby health facilities, that if a distance of < 2 km is worth 1 and ≥ 2 km is worth 0

The unit of analysis in this study is households identified with ownership of proof of administration of family cards. This research was conducted in Purworejo Regency, Central Java Province, Indonesia. A sample of 250 household units out of a total population of 17,251 [38]. The sample was selected using a multi-stage random sampling method. This sampling technique is carried out sequentially at the subdistrict, village, and hamlet levels. This is done to ensure that the data obtained meets the rules of randomization in statistical inference methods [39]. In a series of stages of analysis, the variables analyzed in this study are described as Table 1.

3.2 Analysis Method and Hypotheses

The descriptive quantitative approach in this study is described in more detail in this section. This study used multiple binary regression analysis methods to examine the risk probability of the effect of household food security and the determinants of stunting-on-stunting status of toddlers [40]. This method consists of constructing equations of several variables to prove influence relationships in the statistical mechanisms of inference.

$$Stu_i = \sigma - Y_1 HFS_i - Y_2 PMA_i - Y_3 CnU_i - Y_4 Ges_i - Y_5 Par_i - Y_6 EIB_i - Y_7 ExB_i + Y_8 PoS_i - Y_9 DHF_i + \epsilon \quad (1)$$

By explanation, i is the symbol of the cross section variable, is a constant, is σ , $Y_1; Y_2; Y_3; Y_4; Y_5; Y_6; Y_7; Y_8; Y_9$ a coefficient, and is the error standard of the stunting determinant equation ϵ .

Table 2. Hypotheses of Stunting Determinant

Dependent Variables	Independent Variables	Hypothesis	Requirements
Stu_i	HFS_i	Negative	$Y_1 =$ negative; Sig. < 0.05
	PMA_i	Negative	$Y_2 =$ negative; Sig. < 0.05
	CnU_i	Negative	$Y_3 =$ negative; Sig. < 0.05
	Ges_i	Negative	$Y_4 =$ negative; Sig. < 0.05
	Par_i	Negative	$Y_5 =$ negative; Sig. < 0.05
	EIB_i	Negative	$Y_6 =$ negative; Sig. < 0.05
	ExB_i	Negative	$Y_7 =$ negative; Sig. < 0.05
	PoS_i	Positive	$Y_8 =$ positive; sig. < 0.05
	DHF_i	Negative	$Y_9 =$ negative; Sig. < 0.05

4 Result and Discussion

The determinants of stunting consist of various vectors (collections of variables), such as household vectors, individual toddlers, environment, policy interventions, health services [1]. Nevertheless, nutrition is thought to have a major role in reducing the risk and preventing stunting in toddlers. These nutrients are obtained based on the mechanism of consumption carried out by households, namely food intake in mothers and toddlers themselves [41]. Household food security is one measure in determining household nutrient consumption. Next, household food security ensures other derivative impacts such as child health, parental productivity as workers, and sustainable livelihoods. In relation to stunting, household resilience is thought to be a core determinant of stunting events suffered by toddlers. Food security in the form of food ability, availability, access, and utilization is the core determinant that causes stunting toddlers from before pregnancy, during pregnancy, childbirth, babies, to toddlers (1000 FDL) [42].

In this study, multiple binary regression have been tested for classical assumptions including tests of normality, heteroscedasticity, multicollinearity, and autocorrelation. This is to ensure that the processed data produces a robust equation function. Meanwhile, data that

has an ordinal original value does not require instrument tests such as data validity and reliability tests. [43]

4.1 Determinant of Stunting

The determinants of stunting consist of various vectors (collections of variables) including individual toddlers, households, environment, policy interventions, and health facilities. In this study, the main goal is to prove that suspected family food security is the core determinant of stunting in toddlers. Therefore, the status of other variables is considered as a control variable as an optimizer of the equation to get close to reality.

Table 3. Result of Multiple Binary Regression on Stunting Determinant

Variables	Sig.	Coefficients	Conclusions	Hypotheses Test
HFS_i	0.001	-0.679	Negative Affect	Accepted
PMA_i	0.146	-0.002	Not Affect	Rejected
CnU_i	0,038	-0.506	Negative Affect	Accepted
Ges_i	0,419	-0.761	Not Affect	Rejected
Par_i	0,035	-0.448	Negative Affect	Accepted
EIB_i	0,012	-0.083	Negative Affect	Accepted
ExB_i	0,020	-0.607	Negative Affect	Accepted
PoS_i	0,050	0.318	Positive Affect	Accepted
DHF_i	0,055	-0.822	Not Affect	Rejected
Sig. ANOVA		0.002		
Adjusted R-Square		0.582		

Dependent Variables: Stunting

The equation of determinants of stunting proved to be the right model with sig values. ANOVA 0.002 ($< \alpha$ 0.05). This indicates that the selection of variable combinations has adequately represented the phenomenon of determinants of stunting in the unit of analysis. Meanwhile, in terminology, this simultaneous significance indicates that the combination of independent variables has a significant effect simultaneously on the dependent variable of stunting. Next, the equation has been able to explain the phenomenon of stunting by 58.2% (adjusted R-square). In other words, the combination of variables has accommodated the determinants of stunting by 58.2% while the rest is influenced by other variables outside the model.

Household food security (HFS_i) has a significant negative effect on stunting. This is indicated by a significant 0.001 ($< \alpha$ 0.05) with a coefficient value of -0.679. Household food security is ensured to be the core determinant of stunting by referring to the value of GIS. 0.001 and the probability of its coefficient when compared to other variables. This value means that households that have strong food security have the potential (opportunity) to reduce the risk and prevent stunting in toddlers by 67.9%. Household food security becomes a core determinant in line with the basic theory of stunting as failure to thrive in toddlers during 1000 FDL due to long-term chronic malnutrition and malnutrition [44-47]. Then, this definition is translated as household performance in providing adequate nutritional intake as the minimum calorie threshold of 2000 kcal per capita per day [48]. Household food security ensures that every family member has access to sufficient food. However, household food security has quite complex determinants such as economic status issues (poverty), food prices, food access, consumption culture, and parental education [4].

Variables CnU_i (Contraceptive Usage) have a significant negative effect on stunting. Sig value. 0.038 ($< \alpha$ 0.05) and a coefficient of -0.506 confirm the conclusion that the accepted hypothesis of contraceptive usage has a significant negative effect on stunting. Households that use contraceptives have a 50.6% better probability of preventing and reducing the risk of stunting than households that do not use contraceptives. Although initially, the use of

contraceptives was an instrument of public health policy to control the population, along with it the benefits of contraceptive use transformed in the prevention of stunting toddlers [49]. The use of contraceptives has the main purpose of regulating birth spacing and controlling pregnancy. This means that the distance and number of births in the household can be well managed. The number of children and proportional birth spacing support households to optimize food, nutrition, and toddler growth and development [50]. This was also confirmed by the variables Par_i (parity) identified as having a significant ($\text{sig. } 0.035 < \alpha$) negative (coefficient -0.448) on stunting. This proves that parity (birth spacing) > 3 years can reduce the risk and prevent stunting in toddlers with a probability of 44.8% than in households that have toddlers with a parity of < 3 years. The two variables, the use of contraceptives and parity, are variables that are interconnected in a causal framework [51, 52].

Next, the variable of early breastfeeding initiation (EIB_i) was shown to have a significant negative effect on stunting. Early initiation of breastfeeding can prevent and reduce the risk of stunting 8.3% (coefficient -0.083) better than those who do not. In addition to the colostrum content in the first breast milk, early initiation of breastfeeding increases the sustainability and success of exclusive breastfeeding for toddlers [53]. Early initiation of breastfeeding stimulates the release of milk and trains the baby to breastfeed so that it pumps milk naturally [54]. This is in line with the exclusion breast milk variable (ExB_i) which has a negative significant effect ($0.020 < \alpha$) (coefficient -0.607). The success of early breastfeeding initiation promotes the success of exclusive breastfeeding [55]. Exclusive breastfeeding is the process of breastfeeding a baby for 6 months without any additional food intake [56]. This process can reduce the risk of stunting with a 60.7% probability than those who do not exclusively breastfeed. Early initiation of breastfeeding and exclusive breastfeeding plays a role in forming antibodies, strengthening the digestive system, and optimizing growth in the first 6 months of birth [56]. This will prevent stunting in toddlers. In fact, in the long run, toddlers who get early initiation of breastfeeding and exclusive breastfeeding are able to optimize food absorption and metabolism so that food patterns can optimally support growth [54, 55, 57].

Finally, this study also proves that pollution status is one of the factors causing stunting in toddlers. The presence of smokers increases the risk of stunting by 31.8% (coefficient 0.318) than in households without smokers. This is based on the growth and development of toddlers not only by the intake of food nutrients, but also the quality of oxygen-providing air [34, 58]. Toddlers exposed to secondhand smoke pollution can experience respiratory infections. In the long run, these risks causing stunting toddlers due to decreased organ function to cause death [36].

4.2 Discussion: Household Food Security as Nucleus Determinant for the Prevalence of Stunting

The previous section has proven that family food security is a core determinant of stunting. It is evidenced by the highest significance and coefficient among other control variables. Household food security has broad dimensions, not only limited to food nutrition. However, household food security also concerns access, availability, purchasing power (economic status), food utilization and patterns [59]. Thus, household food security is a core determinant of stunting to ensure healthy ladder growth is sustainable in the long term.

Behind the household food security indicator, there are various other factors that influence it such as purchasing power, socio-cultural conditions, education, external and macroeconomic factors [60]. Therefore, household food security is a variable that can represent various other indicators behind it. However, this study limits the analysis to proving food security as a core determinant of stunting prevalence. Family food security has the most complex transmission in reducing the risk of stunting in toddlers. Stunting as a condition of failure to thrive (short) depends on the metabolism of toddlers supported by food

consumption since the mother before pregnancy, during pregnancy, childbirth, and toddlers grow 10 FDL [61].

First, household food security means the availability of sufficient and varied amounts of food. Foods rich in nutrients such as protein, iron, vitamin A, and vitamin C are essential for a child's growth and development [63]. With food security, families can meet children's nutritional needs optimally, reduce the risk of nutritional deficiencies, and prevent stunting [46]. This is related to food availability both at the household and regional levels in macro terms. Sufficient regional food supplies help households in meeting food needs [3].

Second, adequate food supply needs to be supported by access to food which is one of the indicators in building household food security. Good household food security ensures access to affordable quality food (distance and price) [63]. This food access is related to the sustainability of household consumption so that it can continue to reduce the risk of stunting [51]. The calorie standard of 2000 kcal per capita must be maintained under various conditions so that access to food is very important. In the policy context, food access at the household scale is part of the agricultural trade and food distribution system [3]. Therefore, the existence of food marketing channels close to households is important to build.

Third, another sub-section of household food security is household consumption patterns. The food consumption pattern in question is a pattern of consumption of healthy, nutritious, safe, and balanced food [6, 63]. Households will have good food security if they eat a diverse diet such as vegetables, fruits, whole grains, and animal and vegetable proteins. In addition, the food provided also meets safe and healthy indicators. With a good diet, toddlers will get the nutrients needed for optimal growth and reduce the risk of stunting [64].

Finally, the education factor to support household food security, especially in the practice of providing and feeding appropriately to toddlers and families. Knowledge of proper nutrition and good feeding practices can help in putting together a balanced menu and ensuring that the child gets the right amount of food [65]. Proper feeding regularly and accompanied by hygiene practices can also reduce the risk of infections that can affect a child's growth. Poor households are synonymous with low levels of education and other social problems so that the inability to mix, combine, and process food ingredients worsens health conditions in children [60, 63].

5 Conclusion and Recommendation

5.1 Conclusion

Stunting is a problem faced by all countries in the world, especially developing countries. The determinants of stunting found in this study were contraceptive use, parity rate, early breastfeeding initiation, exclusive breastfeeding, and air pollution status. Sequentially, the first 4 variables negatively affect stunting, while the last air pollution status has a positive effect on stunting. The use of contraceptives, parity rates, early initiation of breastfeeding, and exclusive breastfeeding have the potential to prevent and reduce the risk of stunting in toddlers. Meanwhile, pollution status has the opportunity to cause stunting, especially if exposed to pregnant women, breastfeeding mothers, and toddlers.

In addition to the control variable dominated by health factors, the core definition of stunting is household food security which is evident from the significance and value of the highest beta coefficient. Household food security is a major and fundamental factor in the incidence of stunting in toddlers. It is based on the source of food intake from parents before and during pregnancy, childbirth, and toddler growth and development in the household. Low household food security risks increasing the risk of stunting in toddlers since they are in the womb due to insufficient nutrition in mothers. In addition, food security has several aspects such as food availability which is determined by household income and local agricultural production. In addition, affordable household food access both distance and price. Consumption patterns are also a subsection in household food security for food optimization.

5.2 Recommendation

Household food security as a core determinant of stunting needs to be viewed as a significant finding in public policy design. Government policy interventions must be able to provide and sustain the sustainability of minimum basic food fulfillment. Therefore, some government policy recommendations can be designed as follows.

- a. Food assistance for poor and vulnerable households to obtain a minimum standard of 2000 kcal per capita in households. This requires the government to carefully calculate poverty levels and unmet household food needs.
- b. Development of the agricultural sector and guarantee of regional food supply.
- c. Improvement and expansion of the food trade system that is affordable both distance and price for all levels of household income.
- d. Socialization and education of household food patterns to provide nutritious, healthy, safe, and balanced food.

References

1. Bridgman, G., and Fintel, D. *Economics and Human Biology*, **44** 101076 (2022)
2. Ayelign, A., & Zerfu, T. *Heliyon Journal*, **7** e06733 (2021)
3. Mary, S., Shaw, K., Colen, L., & Paloma, S. G. *World Development*, **130** 104951 (2020)
4. Kassy et al, W. C. *Journal of Health Care of Poor and Underserved*, **32**: 565-581. (2021)
5. Rodriguez-Cruz, L., Alvarez-Berrios, N., & Niles, M. *Environmental Research Letters*, **17** 044057 (2022).
6. Hayat et al, N. *Sustainability*, **14** 7086 (2022).
7. Cameron et al, L. *Economics and Human Biology*, **40** 100944 (2021)
8. Argaw et al, D. *International Journal of Africa Nursing Sciences*, **17** 100451 (2022)
9. Bulkis et al, S. *IOP Conf. Series: Earth and Environmental Science* , **807** 032078 (2021)
10. Mary et al, S. *World Development*, **130** 104951 (2020)
11. Widyaningsih et al, V. *Rural and Remote Health*, **22** 1 (2022)
12. Mengistu, D., Degaga, D., & Tsehay, A. *Agriculture and Food Security*, **10** 7 (2021)
13. Pusat Penelitian DPR RI. *Diversifikasi Pangan Lokal dalam Mengantisipasi Krisis Pangan Global*, Jakarta, Pusat Penelitian Badan Keahlian DPR RI, (2022)
14. Basri et al, H. *Gac Sanit*, **35** S2 483-486 (2021)
15. Pusat Ketersediaan dan Kerawanan Pangan Kementerian Pertanian. *Indeks Ketahanan Pangan 2021*, Jakarta, Pusat Ketersediaan dan Kerawanan Pangan Kementerian Pertanian, (2022)
16. Ministry of Health. *Indonesia's Health Profile in 2020*. Jakarta, Ministry of Health, (2021).
17. Wendt et al, A. *SSM - Population Health*, **15** 100888 (2021)
18. Bahiru, A., Senapathy, M., & Bojago, E. *Journal of Agriculture and Food Research*, **11** 100461 (2023)
19. Rono, P. K., Rahman, S. M., Amin, M. D., & Badruddoza, S. *Current Development in Nutrition*, **7** 100005 (2023)
20. Woleba, G., Tadiwos, T., Bojago, E., & Marisennayya, S. *Journal of Agriculture and Food Research*, **12** 100597 (2023)
21. Feyisa, B. W., Haji, J., & Mirzabaev, A. *Journal of Agriculture and Food Research*, **12** 100556 (2023)
22. Kolog, J. D., Asem, F. E., & Mensah-Bonsu, A. *Scientific African*, **19** e01579 (2023)

23. Mutea, E., Rist, S., & Jacobi, J. MDPI Sustainability, **12** 1751 (2020)
24. Liang, Y., & Zhong, T. International Journal of Disaster Risk Reduction, **85** 103490 (2023)
25. Karim, K. M., & Tasnim, T. Heliyon, **8** e09368 (2022)
26. Yovo, K., & Gnedeka, K. T. Scientific African, **20** e01685 (2023)
27. WHO. *Reducing stunting in children: equity considerations for achieving the Global Nutrition Targets 2025*, Geneva, World Health Organization (2018)
28. WHO. *Childhood Stunting: Challenges and Opportunity*, Geneva: WHO (2013)
29. UNICEF. *Child stunting, hidden hunger and human capital in South Asia: Implications for sustainable development post 2015*, New York: UNICEF (2016)
30. Waghmare, H., Chauhan, S., & Sharma, S. K. *Prevalence and determinants of nutritional status among women and children in Pakistan*, BMC Public Health, **22** 766 (2022)
31. Bappenas. *Health Budget Surgery*, Jakarta, Directorate of Public Health and Nutrition, Ministry of National Development Planning / Bappenas (2020)
32. TNP2K. *National strategy to accelerate stunting prevention for the 2018-2024 period*, Jakarta, National Team for the Acceleration of Poverty Reduction (2018)
33. McGovern, M. E., Krishna, A., Aguayo, V. M., & Subramanian, S. International Journal of Epidemiology, 1-21 (2017)
34. Cao, S., Xie, M., & Jia, C. Environmental Technology & Innovation, **27** 102521 (2022)
35. McKelvie-Sebileau et al, P. International Journal of Environmental Research and Public Health, **19** 4936 (2022)
36. Fregonese et al, F. Communicable Diseases Journal, **71** 356-363 (2017)
37. Freeman et al, T. SSM-Quantitative Research in Health, - (2022)
38. Purworejo County Public Health Office. *Data of Toddlers Aged 24-36 Months Population*, Purworejo County, Purworejo County Public Health Office (2022)
39. Collis, J., & Hussey, R. *Business Research: A Practical Guide fo Undergraduate & Postgraduate Student*. London: Sffron House (2014)
40. Cameron, A. C., & Trivedi, P. K. *Microeconometrics: Methods and Applications*, New York, Cambridge University Press (2005)
41. M'Kaibi, F. K., Steyn, N. P., Ochola, S. A., & Plessis, L. D. Food Science & Nutrition, **5** 2 243-257 (2017)
42. Fahmida, U., Pramesthi, I. L., Kusuma, S., Wurjandaru, G., & Izwardy, D. Current Development in Nutrition, **18** 76 (2022)
43. Wooldridge, J. *Econometric Analysis of Cross Section and Panel Data*, New York, MIT (2010)
44. Correa, E. M., Gallo, C. d., Antunes, J. L., & Jaime, P. C. Jornal de Pediatria, **99** 2 120-126 (2023)
45. Argaw et al, D. International Journal of Africa Nursing Sciences, **17** 100451 (2022)
46. Berti, C., & Vecchia, A. L. Journal de Pediatria, **99** 2 99-100 (2023)
47. Castro-Bedrinana, J., Chirinos-Peinado, D., & Cruz-Calderon, D. D. Public Health in Practice, **2** 100112 (2021)
48. Hargrove, J. L. The Journal of Nutrition, **136** 12 (2006)
49. Stifani, B. M., Madden, T., Micks, E., Moayed, G., Tarleton, J., & Benson, L. S. Contraception, **113** 1-12 (2022)
50. Mulu, N., Mohammed, B., Woldie, H., & Shitu, K. *Nutrition Journal*, **94** 111532 (2022)

51. Botfield et al, J. R. *Women and Birth*, **35** e439-e445 (2022)
52. Quamme, S. H., & Iversen, P. O. *Clinical Nutrition Open Science*, **42** 49-61 (2022)
53. Cetthakrikul et al, N. *BMC Pediatrics*, **18** 395 (2018)
54. Muldiasman, K., & Laksmningsih, E. *Journal of Health Research*, **32** 5 334-341 (2018)
55. Hadi et al, H. *Nutrients*, **13** 4264 (2021)
56. Ekholuenetale, M., Okonji, O. C., Nzopotam, C. I., & Barrow, A. *BMC Pediatrics*, **22** 333 (2022)
57. Syeda, B., Agho, K., Wilson, L., Maheshwari, G. K., & Raza, M. Q. **8** 10-17 (2021)
58. Budge, S., Parker, A., & Hutching, P. T. *Nutrition Reviews*, **77** 4 240-253 (2021)
59. Drammeh, W., Hamid, N. A., & Rohana, A. J. *Current Research in Nutrition and Food Science*, **07** 3 610-623 (2019)
60. Omachi, B., Onselen, A., & Kolanisi, U. *Nutrients*, **14** 4112 (2022)
61. Gassara et al, G. *Nutrients*, **15** 573 (2023)
62. Gassara, G., & Chen, J. *Nutrients*, **13** 4401 (2021)
63. Wang, D., & Li, L. *Applied Geography*, **145** 102752 (2022)
64. Mekonnen et al, D. *Agricultural and Food Economics*, **9** 16 (2021)
65. Kusumawardani, H., & Ashar, H. *The 3rd International Conference on Agricultural Postharvest Handling and Processing* (pp. 1-6), Jakarta, IOP Publishing (2022)
66. Daines et al, C. *European Journal of Public Health*, **30** 5 (2020)